MATH CONCURRENT SUPPORT



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Math Concurrent Support

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CHAPTER OVERVIEW

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1.1: Prelude to Knowing Yourself as a Learner



Figure 1.1.1: *The School of Athens* by Raphael, a fresco in the Vatican, is thought to depict many of the greatest figures in Greek philosophy, including Plato and Aristotle as well as Nicomachus and Averroes. (Credit: Wikimedia Commons / Public Domain)

Student Survey

How do you feel about your learning abilities? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning “least like me” and 4 meaning “most like me.” These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We’ll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. Learning for me is easy. I don’t even have to think about it.
2. I have a preferred learning style.
3. If I can't learn something right away, I have difficulty staying with it.
4. I think my teachers are the most significant aspect of my learning.

You can also take the Chapter 2 survey anonymously online.

STUDENT PROFILE

“When I came to college, I was a great STEM student. I knew the best ways to study for understanding the complexity of cellular mechanisms, but I had no idea how to study for classes where I would need to draw upon political theory or even how to memorize vocabulary words for language classes. Since I am now a humanities student studying Russian, I learned the hard way that you cannot study for every class the same way.

“For my first Russian vocabulary quiz, I studied almost 14 hours because I could not remember the words no matter how hard I tried. I was studying the Russian textbook the same way that I would study for a Chemistry or Biology class: to simply read the chapter or vocabulary list over and over again. I knew that I could not afford to be this time-inefficient for the entire semester, so I asked my professor for some tips on how to study for her class. Now, I start studying three days before each quiz by making flash cards the first day, studying the words from Russian to English the second day, and then studying the words from English to Russian by writing them down the third day. This new method is not one that works well for every class, but that’s the beauty of it! I am a better learner because I have found ways to use a more diverse range of studying tactics.”

— Gabby Kennedy, Baylor University

About This Chapter

In this chapter you will learn about the art of learning itself, as well as how to employ strategies that enable you to learn more efficiently.

After reading this chapter, you should be able to do the following:

- Discover the different types of learning and your learning practices.
- Make informed and effective learning choices in regards to personal engagement and motivation.
- Identify and apply the learning benefits of a growth mindset.
- Evaluate and make informed decisions about learning styles and learning skills.
- Recognize how personality type models influence learning and utilize that knowledge to improve your own learning.
- Identify the impact of outside circumstances on personal learning experiences and develop strategies to compensate for them.
- Recognize the presence of the “hidden curriculum” and how to navigate it.

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1.2: The Power to Learn

Questions to consider

- What actually happens to me when I learn something?
- Am I aware of different types of learning?
- Do I approach studying or practicing differently depending on the desired outcome?

Welcome to one of the most empowering chapters in this book! While each chapter focuses on showing you clear paths to success as a student, this one deals specifically with what is at the core of being a student: the act of learning.

We humans have been obsessed with how we learn and understand things since ancient times. Because of this, some of our earliest recorded philosophies have tried to explain how we take in information about the world around us, how we acquire new knowledge, and even how we can be certain what we learn is correct. This obsession has produced a large number of theories, ideas, and research into how we learn. There is a great deal of information out there on the subject—some of it is very good, and some of it, while well intentioned, has been a bit misguided.

Because of this obsession with learning, over the centuries, people have continually come up with new ideas about how we acquire knowledge. The result has been that commonly held “facts” about education have been known to change frequently. Often, what was once thought to be the newest, greatest discovery about learning was debunked later on. One well-known example of this is that of corporal punishment. For most of the time formal education has existed in our society, educators truly believed that beating students when they made a mistake actually helped them learn faster. Thankfully, *birching* (striking someone with a rod made from a birch tree) has fallen out of favor in education circles, and our institutions of learning have adopted different approaches. In this chapter, not only will you learn about current learning theories that are backed by neuroscience (something we did not have back in the days of birching), but you will also learn other learning theories that did not turn out to be as effective or as thoroughly researched as once thought. That does not mean those ideas about learning are useless. Instead, in these cases you find ways to separate the valuable parts from the myths to make good learning choices.

> ***"Research has shown that one of the most influential aids in learning is an understanding about learning itself."***

What Is the Nature of Learning?

To begin with, it is important to recognize that learning is work. Sometimes it is easy and sometimes it is difficult, but there is always work involved. For many years people made the error of assuming that learning was a passive activity that involved little more than just absorbing information. Learning was thought to be a lot like copying and pasting words in a document; the student’s mind was blank and ready for an instructor to teach them facts that they could quickly take in. As it turns out, learning is much more than that. In fact, at its most rudimentary level, it is an actual process that physically changes our brains. Even something as simple as learning the meaning of a new word requires the physical alteration of neurons and the creation of new paths to receptors. These new electrochemical pathways are formed and strengthened as we utilize, practice, or remember what we have learned. If the new skill or knowledge is used in conjunction with other things we have already learned, completely different sections of the brain, our nerves, or our muscles may be tied in as a part of the process. A good example of this would be studying a painting or drawing that depicts a scene from a story or play you are already familiar with. Adding additional connections, memories, and mental associations to things you already know something about expands your knowledge and understanding in a way that cannot be reversed. In essence, it can be said that every time we learn something new we are no longer the same.

In addition to the physical transformation that takes place during learning, there are also a number of other factors that can influence how easy or how difficult learning something can be. While most people would assume that the ease or difficulty would really depend on what is being learned, there are actually several other factors that play a greater role.

In fact, research has shown that one of the most influential factors in learning is a clear understanding about learning itself. This is not to say that you need to become neuroscientists in order to do well in school, but instead, knowing a thing or two about learning and how we learn in general can have strong, positive results for your own learning. This is called *metacognition* (i.e., thinking about thinking).

Some of the benefits to how we learn can be broken down into different areas such as

- attitude and motivation toward learning,
- types of learning,
- methods of learning, and
- your own preferences for learning.

In this chapter you will explore these different areas to better understand how they may influence your own learning, as well as how to make conscious decisions about your own learning process to maximize positive outcomes.

All Learning Is Not the Same

The first, fundamental point to understand about learning is that there are several types of learning. Different kinds of knowledge are learned in different ways. Each of these different types of learning can require different processes that may take place in completely different parts of our brain.

For example, simple memorization is a form of learning that does not always require deeper understanding. Children often learn this way when they memorize poems or verses they recite. An interesting example of this can be found in the music industry, where there have been several hit songs sung in English by vocalists who do not speak English. In these cases, the singers did not truly understand what they were singing, but instead they were taught to memorize the sounds of the words in the proper order.



Figure 1.2.2 Learning has many levels and forms. For example, collaborative learning and showing your work require different skills and produce different results than reading or notetaking on your own. (Credit: StartUpStockPhotos / Pexels)

Memorizing sounds is a very different type of learning than, say, acquiring a deep understanding of Einstein's general theory of relativity.

Notice in the comparative examples of music and physics that the different levels of learning are being defined by what they allow you to know or do. When classifying learning in this way, people usually agree on six different levels of learning. In this next section we will take a detailed look at each of these.

In the table below, the cells in the left column each contain one of the main levels of learning, categorized by what the learning allows you to do. To the right of each category are the "skill acquired" and a set of real-world examples of what those skills might be as applied to a specific topic. This set of categories is called Bloom's Taxonomy, and it is often used as a guide for educators when they are determining what students should learn within a course.

Table 2.1

Category of Learning	Skill acquired	Example 1: Musical ability	Example 2: Historical information on Charles the Bald

Category of Learning	Skill acquired	Example 1: Musical ability	Example 2: Historical information on Charles the Bald
Create	Produce new or original work	Compose a piece of music	Write a paper on Charles that draws a new conclusion about his reign
Evaluate	Justify or support an idea or decision	Make critical decisions about the notes that make up a melody—what works, what doesn't, and why	Make arguments that support the idea that Charles was a good ruler
Analyze	Draw connections	Play the specific notes that are found in the key of A	Compare and contrast the historical differences between the reign of Charles and his grandfather, Charlemagne
Apply	Use information in new ways	Use knowledge to play several notes that sound good together	Use the information to write a historical account on the reign of Charles
Understand/ Comprehend	Explain ideas or concepts	Understand the relationship between the musical notes and how to play each on a musical instrument	Explain the historical events that enabled Charles to become Emperor
Remember	Recall facts and basic concepts	Memorize notes on a musical scale	Recall that Charles the Bald was Holy Roman Emperor from 875–877 CE

A review of the above table shows that actions in the left column (or what you will be able to do with the new knowledge) has a direct influence over what needs to be learned and can even dictate the type of learning approach that is best. For example, *remembering* requires a type of learning that allows the person basic memorization. In the case of Charles the Bald and his reign, it is simply a matter of committing the dates to memory. When it comes to *understanding and comprehension*, being able to explain how Charles came to power requires not only the ability to recall several events, but also for the learner to be able to understand the cause and effect of those events and how they worked together to make Charles emperor. Another example would be the ability to *analyze*. In this particular instance the information learned would not only be about Charles, but also about other rulers, such as Charlemagne. The information would have to be of such a depth that the learner could compare the events and facts about each ruler.

When you engage in any learning activity, take the time to understand what you will do with the knowledge once you have attained it. This can help a great deal when it comes to making decisions on how to go about it. Using flashcards to help memorize angles does not really help you solve problems using geometry formulas. Instead, practicing problem-solving with the actual formulas is a much better approach. The key is to make certain the learning activity fits your needs.

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1.3: The Motivated Learner

Questions to consider

- How do different types of motivation affect my learning?
- What is resilience and grit?
- How can I apply the Uses and Gratification Theory to make decisions about my learning?
- How do I prevent negative bias from hindering learning?

In this section, you will continue to increase your ability as an informed learner. Here you will explore how much of an influence motivation has on learning, as well as how to use motivation to purposefully take an active role in any learning activity. Rather than passively attempting to absorb new information, you will learn how to make conscious decisions about the methods of learning you will use (based on what you intend to do with the information), how you will select and use learning materials that are appropriate for your needs, and how persistent you will be in the learning activity.

There are three main motivation concepts that have been found to directly relate to learning. Each of these has been proven to mean the difference between success and failure. You will find that each of these is a strong tool that will enable you to engage with learning material in a way that not only suits your needs, but also gives you ownership over your own learning processes.

Resilience and Grit

While much of this chapter will cover very specific aspects about the act of learning, in this section, we will present different information that may at first seem unrelated. Some people would consider it more of a personal outlook than a learning practice, and yet it has a significant influence on the ability to learn.

What we are talking about here is called grit or resilience. Grit can be defined as personal perseverance toward a task or goal. In learning, it can be thought of as a trait that drives a person to keep trying until they succeed. It is not tied to talent or ability, but is simply a tendency to not give up until something is finished or accomplished.



Figure 1.3.3 U.S. Army veteran and captain of the U.S. Invictus team, Will Reynolds, races to the finish line. (Credit: DoD News / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

> ***The study showed that grit and perseverance were better predictors of academic success and achievement than talent or IQ.***

This personality trait was defined as “grit” by the psychologist Angela Duckworth.[1] In a 2007 study Duckworth and colleagues found that individuals with high grit were able to maintain motivation in learning tasks despite failures. The study examined a cross section of learning environments, such as GPA scores in Ivy League universities, dropout rates at West Point, rankings in the National Spelling Bee, and general educational attainment for adults. What the results showed was that grit and perseverance were better predictors of academic success and achievement than talent or IQ.

Applying Grit

The concept of grit is an easy one to dismiss as something taken for granted. In our culture, we have a number of sayings and aphorisms that capture the essence of grit: “If at first you do not succeed, try, try again,” or the famous quote by Thomas Edison:

"Genius is one percent inspiration, ninety-nine percent perspiration."

The problem is we all understand the concept, but actually applying it takes work. If the task we are trying to complete is a difficult one, it can take a lot of work.

The first step in applying grit is to adopt an attitude that looks directly to the end goal as the only acceptable outcome. With this attitude comes an acceptance that you may not succeed on the first attempt—or the nineteenth attempt. Failed attempts are viewed as merely part of the process and seen as a very useful way to gain knowledge that moves you toward success. An example of this would be studying for an exam. In your first attempt at studying you simply reread the chapters of your textbook covered in the exam. You find that while this reinforces some of the knowledge you have gained, it does not ensure you have all the information you will need to do well on the test. You know that if you simply read the chapters yet again, there is no guarantee you are going to be any more successful. You determine that you need to find a different approach. In other words, your first attempt was not a complete failure, but it did not achieve the end goal, so you try again with a different method.

On your second try, you copy down all of the main points onto a piece of paper using the section headlines from the chapters. After a short break you come back to your list and write down a summary of what you know about each item on your list. This accomplishes two things: first, you are able to immediately spot areas where you need to learn more, and second, you can check your summaries against the text to make certain what you know is correct and adequate. In this example, while you may not have yet achieved complete success, you will have learned what you need to do next.

In true grit fashion, for your next try, you study those items on your list where you found you needed a bit more information, and then you go through your list again. This time you are able to write down summaries of all the important points, and you are confident you have the knowledge you need to do well on the exam. After this, you still do not stop, but instead you change your approach to use other methods that keep what you have learned fresh in your mind.

Keeping Grit in Mind: Grit to GRIT

The concept of grit has been taken beyond the original studies of successful learning. While the concept of grit as a personality trait was originally recognized as something positive in all areas of activity, encouraging grit became very popular in education circles as a way to help students become more successful. In fact, many of those that were first introduced to grit through education have begun applying it to business, professional development, and their personal lives. Using a grit approach and working until the goal is achieved has been found to be very effective in not only academics, but in many other areas.[2]

The *New York Times* best-selling author Paul G. Stoltz has taken grit and turned it into an acronym (GRIT) to help people remember and use the attributes of a grit mindset.[3] His acronym is Growth, Resilience, Instinct, and Tenacity. Each of these elements is explained in the table below.

Table 2.2 The GRIT acronym as outlined by Paul G. Stoltz

Growth	Your propensity to seek and consider new ideas, additional alternatives, different approaches, and fresh perspectives
Resilience	Your capacity to respond constructively and ideally make use of all kinds of adversity
Instinct	Your gut-level capacity to pursue the right goals in the best and smartest ways
Tenacity	The degree to which you persist, commit to, stick with, and go after whatever you choose to achieve

There is one other thing to keep in mind when it comes to applying grit (or GRIT) to college success. The same sort of persevering approach can not only be used for individual learning activities, but can be applied to your entire degree. An attitude of tenacity and "sticking with it" until you reach the desired results works just as well for graduation as it does for studying for an exam.

How Do You Get Grit?

A quick Internet search will reveal that there are a large number of articles out there on grit and how to get it. While these sources may vary in their lists, most cover about five basic ideas that all touch upon concepts emphasized by Duckworth. What follows is a brief introduction to each. Note that each thing listed here begins with a verb. In other words, it is an activity for you to do and keep doing in order to build grit.

1. Pursue what interests you.

Personal interest is a great motivator! People tend to have more grit when pursuing things that they have developed an interest in.

2. Practice until you can do it, and then keep practicing.

The idea of practicing has been applied to every skill in human experience. The reason everyone seems to be so fixated with practice is because it is effective and there is no “grittier” activity.

3. Find a purpose in what you do.

Purpose is truly the driver for anything we pursue. If you have a strong purpose in any activity, you have reason to persist at it. Think in terms of end goals and why doing something is worth it. Purpose answers the question of “Why should I accomplish this?”

4. Have hope in what you are doing.

Have hope in what you are doing and in how it will make things different for you or others. While this is somewhat related to purpose, it should be viewed as a separate and positive overall outlook in regard to what you are trying to achieve. Hope gives value to purpose. If purpose is the goal, hope is why the goal is worth attaining at all.

5. Surround yourself with gritty people.

Persistence and tenacity tend to rub off on others, and the opposite does as well. As social creatures we often adopt the behaviors we find in the groups we hang out with. If you are surrounded by people that quit early, before achieving their goals, you may find it acceptable to give up early as well. On the other hand, if your peers are all achievers with grit, you will tend to exhibit grit yourself.

Application

Get a Grit Partner

It is an unfortunate statistic that far too many students who begin college never complete their degree. Over the years a tremendous amount of research has gone into why some students succeed while others do not. After reading about grit, you will probably not be surprised to learn that the research has shown it to not only be a major contributor of learning but to be one of the strongest factors contributing to student graduation.

While that may seem obvious since, by definition, grit is a tendency to keep going until you reach your goal, there was something very significant that turned up in the details of a study conducted by American College Testing (also known as ACT). ACT is a nonprofit organization that administers the college admissions test by the same name, and they have been looking at over 50 years of student persistence data to figure out why some students complete college while others do not. What they have found is that the probability a student will stay in college is tied directly to social connections.[4] In other words, students that found someone they connected with and that provided a sense of accountability dramatically increased their grit. It did not matter if the person was another student, an instructor, or someone else. What did matter is that they felt a strong motivation to keep working, even when their college experience was at its most difficult. It has been surmised that from a psychological perspective, the extra grit comes from not wanting to disappoint the person they have connected with. Regardless of the reason, the data show that having a grit partner is one of the most effective ways to statistically increase your chances of graduation.

A grit partner does not have to be a formal relationship. Your partner can simply be a classmate—someone that you can talk with. It can be an instructor you admire or someone else that you establish a connection with. It can even be a family member who will encourage you—someone you do not want to disappoint. What you are looking for is someone who will help motivate you, either by their example or by their willingness to give you a pep talk when you need it. The key is that it is someone you respect and who will encourage you to do well in school.

Right now, think about someone who could be your grit partner. Keep in mind that you may not have the same grit partner throughout your entire college experience. You may begin with another classmate but later find that a school staff member steps into the role. Later, as you near graduation, you may find that your favorite instructor motivates you more to do well in school than anyone else. Regardless, the importance of finding the social connection that helps your grit is important.

Uses and Gratification Theory and Learning

In the middle of the last century, experts held some odd beliefs that we might find exceptionally strange in our present age. For example, many scholars were convinced that not only was learning a passive activity, but that mass media such as movies, television, and newspapers held significant control over us as individuals. The thinking at that time was that we were helpless to think for ourselves or make choices about learning or the media we consumed. The idea was that we just simply ingested information fed to us and we were almost completely manipulated by it.

What changed this way of thinking was a significant study on audience motivations for watching different political television programs.[5] The study found that not only did people make decisions about what information they consumed, but they also had preferences in content and how it was delivered. In other words, people were active in their choices about information. What is more important is that the research began to show that our own needs, goals, and personal opinions are bigger drivers for our choices in information than anything else. This gave rise to what became known as the Uses and Gratification Theory (UGT).

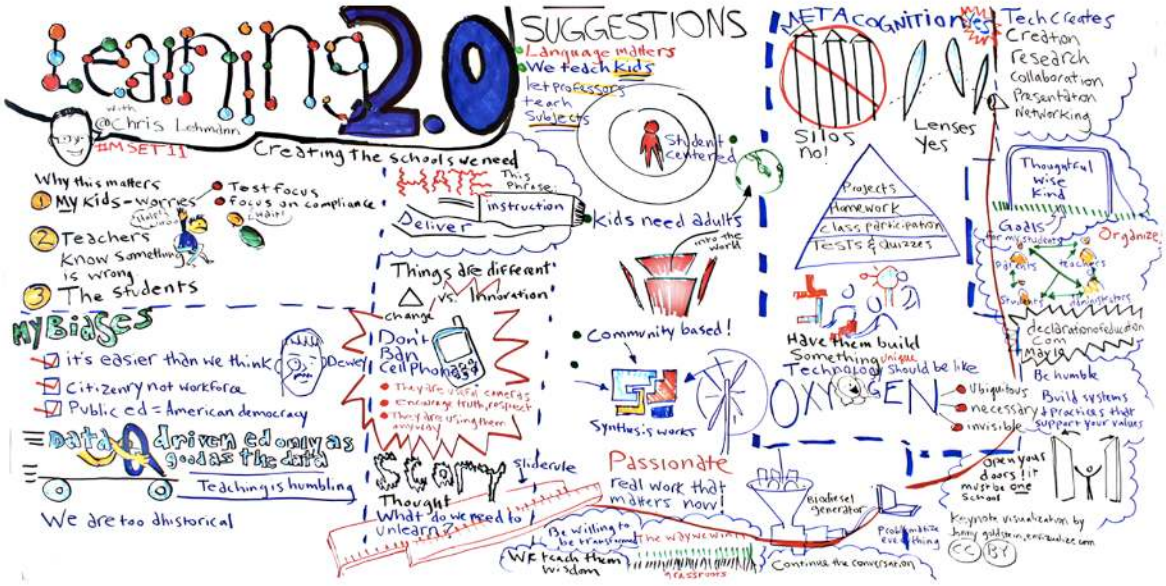


Figure 2.4 Concept maps, or idea clusters, are used to gather and connect ideas. The exercise of creating, recreating, and improving them can be an excellent way to build and internalize a deeper knowledge of subjects. (Credit: Johnny Goldstien / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

At first, personal choices about television programs might seem a strange topic for a chapter on learning, but if you think about it, learning at its simplest is the consumption of information to meet a specific need. You choose to learn something so you can attain certain goals. This makes education and UGT a natural fit.

Applying UGT to education is a *learner-centered* approach that focuses on helping you take control of how and what you learn. Not only that, but it gives you a framework as an informed learner and allows you to choose information and learning activities with the end results in mind. The next section examines UGT a little more closely and shows how it can be directly applied to learning.

The Uses and Gratification Model

The Uses and Gratification model is how people are thought to react according to UGT. It considers individual behavior and motivation as the primary driver for media consumption. In education this means that the needs of the learner are what determine the interaction with learning content such as textbooks, lectures, and other information sources. Since any educational program is essentially content and delivery (the same as with any media), the Uses and Gratification model can be applied to meet student needs, student satisfaction, and student academic success. This is something that is not recognized in many other learning theories since they begin with the premise that it is learning content and how it is delivered that influences the learner more than the learner's own wants and expectations.

The main assumption of the Uses and Gratification model is that media consumers will seek out and return to specific media sources based on a personal need. For learners this is exceptionally useful since it gives an insight and the ability to positively influence their own motivations, expectations, and the perceived value of their education.



Figure 2.5 The Uses and Gratification model indicates that people will actively seek out and integrate specific media into their lives. (Credit: Garry Knight / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

If you understand the key concepts of the Uses and Gratification model, you can make informed decisions about your own learning: how you learn, which materials you use to learn, and what motivates you to learn. An illustration of this was found in the example given in the previous section on grit. There, a series of exam study activities were presented—first reading the appropriate chapters, then making a list of chapter concepts and reviewing what was known, then returning to learn the information needed to fill the gaps. Each activity was chosen by the learner based on how well it fit their needs to help reach the goal of doing well on an exam.

Here we should offer a brief word of caution about being wary when choosing materials and media. There is a great deal of misleading and inaccurate information presented via the Internet and social media. Making informed decisions about your learning and the material you consume includes checking sources and avoiding information that is not credible.

> ***"We are able to consciously make learning choices based on our own identified needs and what we hope to gain by that learning."***

In his book *Key Themes in Media Theory*,[6] Dan Laughey presents the UGT model according to its original authors as a single sentence that divides each area of influence into the following concerns:

1. Social and psychological origins of …
2. needs, which generate …
3. expectations of …
4. the mass media or other sources, which lead to …
5. differential patterns of media exposure, resulting in …
6. needs gratification and …
7. other unintended consequences.

Taken as a list or a single sentence, this can be a bit overwhelming to digest. There are many things being said at the same time, and they may not all be immediately clear. To better understand what each of the “areas of concern” are and how they can impact learning, each has been separated and explained in the table below.

Table 2.3

Area of Concern	What it means for you	How it applies to learning	Real-world example

Area of Concern	What it means for you	How it applies to learning	Real-world example
1. Social and psychological origins of …	Your motivations, not only as a student but as a person, and both the social and psychological factors that influence you	This can be everything from the original motivation behind enrolling in school in the first place, down to more specific goals like why you want to learn to write and communicate well.	A drive to be self-supporting and to take on a productive role in society.
2. needs, which generate …	Better job, increased income, satisfying career, prestige	This can include the area of study you select and the school you choose to attend.	Pursuing a degree to seek a career in a field you enjoy.
3. expectations of …	Expectation and perception (preconceived and continuing) of educational material	What you expect to learn to fulfill goals and meet needs.	Understanding what you need to accomplish the smaller goals. An example would be “study for an exam.”
4. the mass media or other sources, which lead to…	The content and learning activities of the program	Selection of content aimed at fulfilling needs. Results are student satisfaction, perceived value, and continued enrollment.	Choosing which learning activities to use (e.g., texts, watch videos, research alternative content, etc.).
5. differential patterns of media exposure, resulting in …	Frequency and level of participation	How you engage with learning activities and how often. Results are student satisfaction and perceived value, and continued enrollment.	When, how often, and how much time you spend in learning activities.
6. needs gratification and …	Better job, increased income, satisfying career, prestige, more immediate goals like pass an exam, earn a good grade, etc.	Needs fulfillment and completion of goals.	Learning activities that meet your learning needs, including fulfillment of your original goals.
7. other unintended consequences.	Increased skills and knowledge, entertainment, social involvement and networking	Causes positive loop-back into 4, 5, and 6, reinforcing those positive outcomes.	Things you learn beyond your initial goals.

What to Do with UGT

On the surface, UGT may seem overly complex, but this is due to its attempt to capture everything that influences how and why we take in information. At this point in your understanding, the main thing to focus on is the bigger idea that our motivations, our end goals, and our expectations are what drive us to learn. If we are aware of these motivations, we can use them to make influential decisions about what we learn and how we learn.

One of the things that will become apparent as you continue reading this chapter and doing the included activities is that all of it fits within the UGT model. Everything about learning styles, your own attitude about learning, how you prefer to learn, and what you get out of it are covered in UGT. Being familiar with it gives you a way to identify and apply everything else you will learn about learning. As you continue in this chapter, rather than looking at each topic as a stand-alone idea, think about where each fits in the Uses and Gratification model. Does it influence your motivations, or does it help you make decisions about the way you learn? This way UGT can provide a way for you to see the value and how to apply everything you learn from this point forward and for every learning experience along the way.

If you were going to define how UGT applies to learning with a few quick statements, it would look something like this:

UGT asks:

- What is it that motivates you to learn something?
- What need does it fulfill?
- What do you expect to have happen with certain learning activities?
- How can you choose the right learning activities to better ensure you meet your needs and expectations?
- What other things might result from your choices?

Analysis Question

Take a moment to think about your own choices when it comes to consuming media. Are there certain sources you prefer? Why? What needs or gratifications do those particular sources fulfill in a way that others do not? Now, use the same process to analyze your current college experience. Are there certain classes or activities you like more than others? Why? Do any of your reasons have to do with the needs or gratifications the classes or learning activities fulfill?

After you have answered those questions, you can always step beyond mere analysis and determine what you could change to make the classes or activities you enjoy less better fulfill your needs.

Combating Negative Bias

In addition to being a motivated learner through the use of grit and UGT, there is a third natural psychological tendency you should be aware of. It is a tendency that you should guard against. Ignoring the fact that it exists can not only adversely affect learning, but it can set up roadblocks that may prevent you from achieving many goals. This tendency is called *negative bias.*

Negative bias is the psychological trait of focusing on the negative aspects of a situation rather than the positive. An example of this in a learning environment would be earning a 95 percent score on an assignment but obsessing over the 5 percent of the points that were missed. Another example would be worrying and thinking negative thoughts about yourself over a handful of courses where you did not do as well as in others—so much so that you begin to doubt your abilities altogether.



Figure 1.3.6 Some level of worry and concern is natural, but an overwhelming amount of negative thoughts about yourself, including doubt in your abilities and place in school, can impede your learning and stifle your success. You can develop strategies to recognize and overcome these feelings. (Credit: Inzmam Kahn / Pexels)

Unfortunately, this is a human tendency that can often overwhelm a student. As a pure survival mechanism it does have its usefulness in that it reminds us to be wary of behaviors that can result in undesirable outcomes. Imagine that as a child playing outside, you have seen dozens if not hundreds of bees over the years. But once, out of all those other times, you were stung by a single bee. Now, every time you see a bee you recall the sting, and you now have a negative bias toward bees in general. Whenever possible you avoid bees altogether.

It is easy to see how this psychological system could be beneficial in those types of situations, but it can be a hindrance in learning since a large part of the learning process often involves failure on early attempts. Recognizing this is a key to overcoming negative bias. Another way to combat negative bias is to purposefully focus on successes and to acknowledge earlier attempts that fail as just a part of the learning.

What follows are a few methods for overcoming negative bias and negative self-talk. Each focuses on being aware of any negative attitude or emphasizing the positive aspects in a situation.

- **Be aware of any negative bias.** Keep an eye out for any time you find yourself focusing on some negative aspect, whether toward your own abilities or on some specific situation. Whenever you recognize that you are exhibiting a negative bias toward

something, stop and look for the positive parts of the experience. Think back to what you have learned about grit, how any lack of success is only temporary, and what you have learned that gets you closer to your goal.

- **Focus on the positive before you begin.** While reversing the impact of negative bias on your learning is helpful, it can be even more useful to prevent it in the first place. One way to do this is to look for the positives before you begin a task. An example of this would be receiving early feedback for an assignment you are working on. To accomplish this, you can often ask your instructor or one of your classmates to look over your work and provide some informal comments. If the feedback is positive then you know you are on the right track. That is useful information. If the feedback seems to indicate that you need to make a number of corrections and adjustments, then that is even more valuable information, and you can use it to greatly improve the assignment for a much better final grade. In either case, accurate feedback is what you really want most, and both outcomes are positive for you.
- **Keep a gratitude and accomplishment journal.** Again, the tendency to recall and overemphasize the negative instances while ignoring or forgetting about the positive outcomes is the nature of negative bias. Sometimes we need a little help remembering the positives, and we can prompt our memories by keeping a journal. Just as in a diary, the idea is to keep a flowing record of the positive things that happen, the lessons you learned from instances that were “less than successful,” and all accomplishments you make toward learning. In your journal you can write or paste anything that you appreciated or that has positive outcomes. Whenever you are not feeling up to a challenge or when negative bias is starting to wear on you, you can look over your journal to remind yourself of previous accomplishments in the face of adversity.

Analysis Question

Building the Foundation

In this section you read about three major factors that contribute to your motivation as a learner: grit and perseverance, your own motivations for learning (UGT), and the pitfalls of negative bias. Now it is time to do a little self-analysis and reflection.

Which of these three areas do you feel strongest in? Are you a person that naturally has grit, or do you better understand your own motivations for learning (using UGT)? Do you struggle with negativity bias, or is it something that you rarely have to deal with?

Determine in which of these areas you are strongest, and think about what things make you so strong. Is it a positive attitude (you always see the glass as half full as opposed to half empty), or do you know exactly why you are in college and exactly what you expect to learn?

After you have analyzed your strongest area, then do the same for the two weaker ones. What makes you susceptible to challenges in these areas? Do you have a difficult time sticking with things or possibly focus too much on the negative? Look back at the sections on your two weakest areas, and put together a plan for overcoming them. For each one, choose a behavior you intend to change and think of some way you will change it.

Footnotes

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1.4: It's All in the Mindset

Questions to consider

- What is a growth mindset, and how does it affect my learning?
- What are performance goals versus learning goals?

In the previous sections of this chapter you have focused on a number of concepts and models about learning. One of the things they all have in common is that they utilize different approaches to education by presenting new ways to think about learning. In each of these, the common element has been a better understanding of yourself as a learner and how to apply what you know about yourself to your own learning experience. If you were to distill all that you have learned in this chapter so far down to a single factor, it would be about using your mindset to your best advantage. In this next section, you will examine how all of this works in a broader sense by learning about the significance of certain mindsets and how they can hinder or promote your own learning efforts.



Figure 1.4.7: Many fields of study and work create intersections of growth and fixed mindset. People may feel great ability to grow and learn in some areas, like art and communication, but feel more limited in others, such as planning and financials. Recognizing these intersections will help you approach new topics and tasks. (Credit: mentatdgt / Pexels)

Performance vs. Learning Goals

As you have discovered in this chapter, much of our ability to learn is governed by our motivations and goals. What has not yet been covered in detail has been how sometimes hidden goals or mindsets can impact the learning process. In truth, we all have goals that we might not be fully aware of, or if we are aware of them, we might not understand how they help or restrict our ability to learn. An illustration of this can be seen in a comparison of a student that has *performance*-based goals with a student that has *learning*-based goals.

If you are a student with strict performance goals, your primary psychological concern might be to appear intelligent to others. At first, this might not seem to be a bad thing for college, but it can truly limit your ability to move forward in your own learning. Instead, you would tend to play it safe without even realizing it. For example, a student who is strictly performance-goal-oriented will often only says things in a classroom discussion when they think it will make them look knowledgeable to the instructor or their classmates. For example, a performance-oriented student might ask a question that she knows is beyond the topic being covered (e.g., asking about the economics of Japanese whaling while discussing the book *Moby Dick* in an American literature course). Rarely will they ask a question in class because they actually do not understand a concept. Instead they will ask questions that make them look intelligent to others or in an effort to “stump the teacher.” When they do finally ask an honest question, it may be because they are more afraid that their lack of understanding will result in a poor performance on an exam rather than simply wanting to learn.

If you are a student who is driven by learning goals, your interactions in classroom discussions are usually quite different. You see the opportunity to share ideas and ask questions as a way to gain knowledge quickly. In a classroom discussion you can ask for

clarification immediately if you don't quite understand what is being discussed. If you are a person guided by learning goals, you are less worried about what others think since you are there to learn and you see that as the most important goal.

Another example where the difference between the two mindsets is clear can be found in assignments and other coursework. If you are a student who is more concerned about performance, you may avoid work that is challenging. You will take the "easy A" route by relying on what you already know. You will not step out of your comfort zone because your psychological goals are based on approval of your performance instead of being motivated by learning.

This is very different from a student with a learning-based psychology. If you are a student who is motivated by learning goals, you may actively seek challenging assignments, and you will put a great deal of effort into using the assignment to expand on what you already know. While getting a good grade is important to you, what is even more important is the learning itself.

If you find that you sometimes lean toward performance-based goals, do not feel discouraged. Many of the best students tend to initially focus on performance until they begin to see the ways it can restrict their learning. The key to switching to learning-based goals is often simply a matter of first recognizing the difference and seeing how making a change can positively impact your own learning.

What follows in this section is a more in-depth look at the difference between performance- and learning-based goals. This is followed by an exercise that will give you the opportunity to identify, analyze, and determine a positive course of action in a situation where you believe you could improve in this area.

WHAT STUDENTS SAY

1. In the past, did you feel like you had control over your own learning?
    a. No. Someone has always dictated how and what I learned.
    b. Yes. I always look for ways to take control of what and how I learned.
    c. I am uncertain. I never thought about it before.
2. Have you ever heard of learning styles or do you know your own learning style?
    a. No. I have never heard of learning styles.
    b. Yes. I have heard of learning styles and know my own.
    c. Yes. I have heard of learning styles, but I don't think they're accurate or relate to me.
3. Which factors other than intelligence do you think have the greatest influence on learning?
    a. Motivation
    b. Perseverance
    c. Understanding how I learn
    d. Good teachers and support

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

In the past, did you feel like you had control over your own learning?

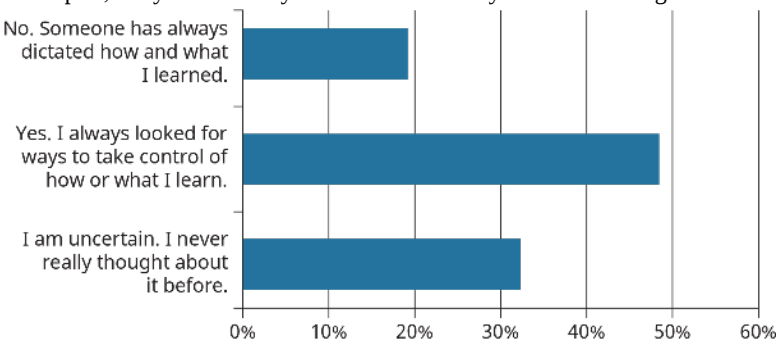


Figure 1.4.8

Have you ever heard of learning styles or do you know your own learning style?

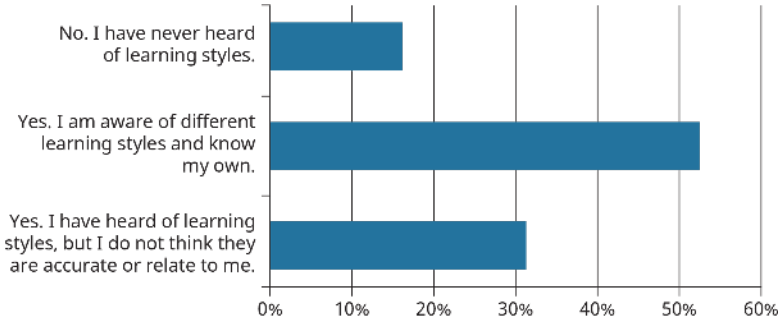


Figure 1.4.9

Which factors other than intelligence do you think have the greatest influence on learning?

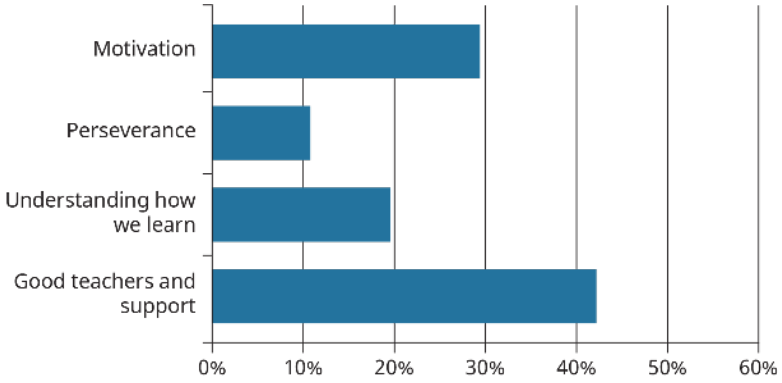


Figure 1.4.10

Fixed vs. Growth Mindset

The research-based model of these two mindsets and their influence on learning was presented in 1988 by Carol Dweck.[7] In Dr. Dweck's work, she determined that a student's perception about their own learning accompanied by a broader goal of learning had a significant influence on their ability to overcome challenges and grow in knowledge and ability. This has become known as the Fixed vs. Growth Mindset model. In this model, the *performance*-goal-oriented student is represented by the *fixed* mindset, while the *learning*-goal-oriented student is represented by the *growth* mindset.

In the following graphic, based on Dr. Dweck's research, you can see how many of the components associated with learning are impacted by these two mindsets.

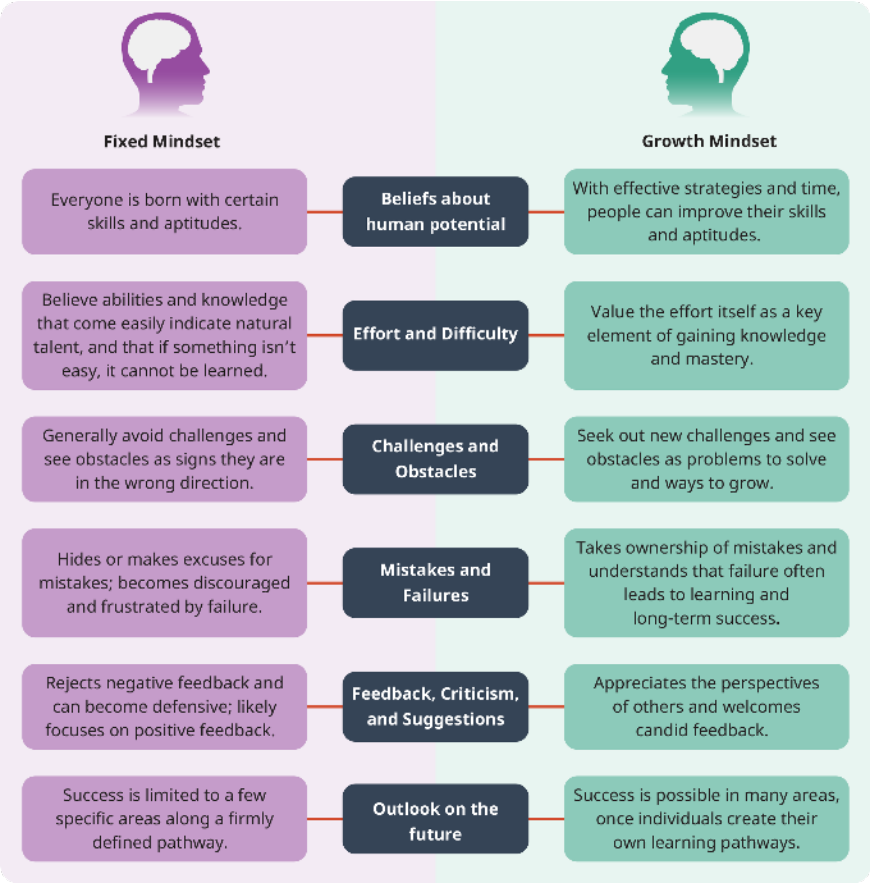


Figure 1.4.11: The differences between fixed and growth mindset are clear when aligned to key elements of learning and personality. (Credit: Based on work by Dr. Carol Dweck)

The Growth Mindset and Lessons About Failing

Something you may have noticed is that a growth mindset would tend to give a learner grit and persistence. If you had learning as your major goal, you would normally keep trying to attain that goal even if it took you multiple attempts. Not only that, but if you learned a little bit more with each try you would see each attempt as a success, even if you had not achieved complete mastery of whatever it was you were working to learn.

With that in mind, it should come as no surprise that Dr. Dweck found that those people who believed their abilities could change through learning (growth vs. a fixed mindset) readily accepted learning challenges and persisted despite early failures.

Improving Your Ability to Learn

As strange as it may seem, research into fixed vs. growth mindsets has shown that if you believe you can learn something new, you greatly improve your ability to learn. At first, this may seem like the sort of feel-good advice we often encounter in social media posts or quotes that are intended to inspire or motivate us (e.g., *believe in yourself!*), but in looking at the differences outlined between a fixed and a growth mindset, you can see how each part of the growth mindset path would increase your probability of success when it came to learning.

ACTIVITY

Very few people have a strict fixed or growth mindset all of the time. Often we tend to lean one way or another in certain situations. For example, a person trying to improve their ability in a sport they enjoy may exhibit all of the growth mindset traits and characteristics, but they find themselves blocked in a fixed mindset when they try to learn something in another area like computer programming or arithmetic.

In this exercise, do a little self-analysis and think of some areas where you may find yourself hindered by a fixed mindset. Using the outline presented below, in the far right column, write down how you can change your own behavior for each of the parts of the learning process. What will you do to move from a fixed to a growth mindset? For example, say you were trying to

learn to play a musical instrument. In the *Challenges* row, you might pursue a growth path by trying to play increasingly more difficult songs rather than sticking to the easy ones you have already mastered. In the *Criticism* row, you might take someone's comment about a weakness in timing as a motivation for you to practice with a metronome. For *Success of others* you could take inspiration from a famous musician that is considered a master and study their techniques.

Whatever it is that you decide you want to use for your analysis, apply each of the Growth characteristics to determine a course of action to improve.

Table 2.4

Parts of the learning process	Growth characteristic	What will you do to adopt a growth mindset?
Challenges	Embraces challenges	
Obstacles	Persists despite setbacks	
Effort	Sees effort as a path to success	
Criticism	Learns from criticism	
Success of Others	Finds learning and inspiration in the success of others	

Footnotes

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1.5: Learning Preferences

Questions to consider

- What are learning styles, and do they really work?
- How do I take advantage of learning styles in a way that works for me?
- How can I combine learning styles for better outcomes?
- What opportunities and resources are available for students with disabilities?

Several decades ago, a new way of thinking about learning became very prominent in education. It was based on the concept that each person has a preferred way to learn. It was thought that these preferences had to do with each person's natural tendencies toward one of their senses. The idea was that learning might be easier if a student sought out content that was specifically oriented to their favored sense. For example, it was thought that a student who preferred to learn visually would respond better to pictures and diagrams.

Over the years there were many variations on the basic idea, but one of the most popular theories was known as the VAK model. VAK was an acronym for the three types of learning, each linked to one of the basic senses thought to be used by students: visual, aural, and kinesthetic. What follows is an outline of each of these and the preferred method.

- **Visual:** The student prefers pictures, images, and the graphic display of information to learn. An example would be looking at an illustration that showed how to do something.
- **Aural:** The student prefers sound as a way to learn. Examples would be listening to a lecture or a podcast.
- **Kinesthetic:** The student prefers using their body, hands, and sense of touch. An example would be doing something physical, such as examining an object rather than reading about it or looking at an illustration.

The Truth about Learning Styles

In many ways these ideas about learning styles made some sense. Because of this, educators encouraged students to find out about their own learning styles. They developed tests and other techniques to help students determine which particular sense they preferred to use for learning, and in some cases learning materials were produced in multiple ways that focused on each of the different senses. That way, each individual learner could participate in learning activities that were tailored to their specific preferences.

While it initially seemed that dividing everyone by learning styles provided a leap forward in education, continued research began to show that the fixation on this new model might not have been as effective as it was once thought. In fact, in some cases, the way learning styles were actually being used created roadblocks to learning. This was because the popularization of this new idea brought on a rush to use learning styles in ways that failed to take into account several important aspects that are listed below:

- A person does not always prefer the same learning style all the time or for each situation. For example, some learners might enjoy lectures during the day but prefer reading in the evenings. Or they may prefer looking at diagrams when learning about mechanics but prefer reading for history topics.
- There are more preferences involved in learning than just the three that became popular. These other preferences can become nearly impossible to make use of within certain styles. For example, some prefer to learn in a more social environment that includes interaction with other learners. Reading can be difficult or restrictive as a group effort. Recognized learning styles beyond the original three include: **social** (preferring to learn as a part of group activity), **solitary** (preferring to learn alone or using self-study), or **logical** (preferring to use logic, reasoning, etc.).
- Students that thought they were limited to a single preferred learning style found themselves convinced that they could not do as well with content that was presented in a way that differed from their style.[8] For example, a student that had identified as a visual learner might feel they were at a significant disadvantage when listening to a lecture. Sometimes they even believed they had an even greater impairment that prevented them from learning that way at all.
- Some forms of learning are extremely difficult in activities delivered in one style or another. Subjects like computer programming would be almost impossible to learn using an aural learning style. And, while it is possible to read about a subject such as how to swing a bat or how to do a medical procedure, actually applying that knowledge in a learning environment is difficult if the subject is something that requires a physical skill.

Knowing and Taking Advantage of Learning Styles in a Way That Works for You

The problem with relying on learning styles comes from thinking that just one defines your needs. Coupling what you know about learning styles with what you know about UGT can make a difference in your own learning. Rather than being constrained by a single learning style, or limiting your activities to a certain kind of media, you may choose media that best fit your needs for what you are trying to learn at a particular time.

Following are a couple of ways you might combine your learning style preference with a given learning situation:

- You are trying to learn how to build something but find the written instructions confusing so you watch a video online that shows someone building the same thing.
- You have a long commute on the bus but reading while riding makes you dizzy. You choose an aural solution by listening to pre-recorded podcasts or a mobile device that reads your texts out loud.

These examples show that by recognizing and understanding what different learning styles have to offer, you can use the techniques that are best suited for you and that work best under the circumstances of the moment. You may also find yourself using two learning styles at the same time - as when you watch a live demonstration or video in which a person shows you how to do something while verbally explaining what you are being shown. This helps to reinforce the learning as it utilizes different aspects of your thinking. Using learning styles in an informed way can improve both the speed and the quality of your learning.

Get Connected

Finding content related to a subject or topic can be relatively easy, but you must use caution and rely on reputable sources. Relatively little of the material on the Web provides a way to ensure accuracy or balance.

Below are descriptions of common informational sites with varying degrees of reliability:

- Khan Academy: This site is full of useful tutorials and videos on a wide range of subjects.
- Wikipedia: Wikipedia is often frowned upon in some academic circles, because review of its content takes place *after* publication, potentially resulting in inaccurate or misleading information being available. But Wikipedia can provide a brief overview of a topic, and its lists of references is often quite extensive. You probably shouldn't rely Wikipedia as your only source, but it can be useful.
- Government website:. Most items that governments administer are referenced on informational websites. In the United States, these include educational statistics, economic data, health information, and many other topics.

When choosing alternate content, it is imperative to compare it to the content that is being provided to you as a part of your course. If the alternate content does not line up, you should view it with a healthy skepticism. In those cases, it is always a good idea to share the content with your instructor and ask their opinion.

Activity

In this activity you will try an experiment by combining learning styles to see if it is something that works for you. The experiment will test the example of combining reading/writing and aural learning styles for better memorization.

To begin, you will start with a short segment of numbers. You will read the numbers only one time without saying them aloud. When you are finished, wait 10 seconds and try to remember the numbers in sequence by writing them down.

67914528

After you have finished you will repeat the experiment with a new set of numbers, but this time you will read them aloud, wait 10 seconds, and then see how easy they are to remember. During this part of the experiment you are free to say the numbers in any way you like. For example, the number 8734 could be read as eight-seven-three-four, eighty-seven thirty-four, or any combination you would like.

10387264

Did you find that there was a difference in your ability to memorize a short sequence of numbers for 10 seconds? Even if you were able to remember both, was the example that combined learning styles easier? What about if you had to wait for a full minute before attempting to rewrite the numbers? Would that make a difference?

What about Students with Disabilities?

Students with disabilities are sometimes the most informed when it comes to making decisions about their own learning. They should understand that it is in their best interest to take ownership of their own approach to education, especially when it comes to leveraging resources and opportunities. In this section, you will learn about the laws that regulate education for students with disabilities as well as look at some resources that are available to them.

Just like anyone else, under the law, qualified students with disabilities are entitled to the same education colleges and universities provide to students without disabilities. Even though a particular disability may make attending college more difficult, awareness on the part of the government, learning institutions, and the students themselves has brought about a great deal of change over the years. Now, students with disabilities find that they have available appropriate student services, campus accessibility, and academic resources that can make school attendance and academic success possible.

Due to this increased support and advocacy, colleges have seen an increase of students with disabilities. According to the National Center for Education Statistics, in 2012, 11.1 percent of the total undergraduate population in the United States was made up of people with disabilities.[9]

The Legal Rights of Students with Disabilities

Section 504 of the Rehabilitation Act of 1973 protects students "with a physical or mental impairment which substantially limits one or more major life activities."[10] Learning definitely falls within the definition of major life activities.

In addition to Section 504, another set of laws that greatly help learners with disabilities is the Americans with Disabilities Act of 1990 (also known as ADA). Both of these acts have been driving forces in making certain that students with disabilities have equal access to higher education, and they have been instrumental in helping educators looking for new ways and resources to provide services that do just that.

What follows is a list of services that schools commonly provide to help students with disabilities. These are often referred to as *ADA accommodations* and are named after the American with Disabilities Act:

- Recordings of class lectures or lecture transcription by in-class note takers
- Text readers or other technologies that can deliver content in another format
- Test or assessment accommodations
- Interpreter services and Braille transcriptions
- Physical access accommodations
- Accommodations of time and due dates

Most colleges will have policies and staff that are designated to help arrange for these types of accommodations. They are often found within the Department of Student Services or in related departments within your college campus. If you are a student with disabilities protected under these acts, it is in your best interest to contact the person responsible for ADA accommodations at your school. Even if you decide that you do not need accommodations, it is a good idea to find out about any services and policies the school has in place.

Organizations

In addition to the accommodations that schools commonly provide, there are also a number of national and local organizations that can provide assistance and advice when it comes to being a student with a disability. If you fit into this category, it is recommended that you make contact with one or more of these organizations in order to find out how they can help. These can be tremendously beneficial resources that offer everything from information and support to simple social connections that can make pursuing a formal education easier.

Footnotes

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1.6: Personality Types and Learning

Questions to consider

- Is there any connection between personality types and learning?
- Can the Myers-Briggs test be used to identify personality traits and learning styles?
- Is there a real correlation between personality styles and learning?
- What is the impact on learning with work that you enjoy?

Much like learning styles, there have been a number of theories surrounding the idea that different personality types may prefer different kinds of learning. Again, this builds on the original learning style concept that people may have a single preference toward how they learn, and then adds to it that certain personality traits may determine which learning style a person prefers.

Since it has already been determined that learning styles are more effective when selected for the subject being learned rather than the sensory preference of the learner, it might seem foolish to revisit another learning style theory. But, in this case, understanding how personality traits and learning styles are categorized can be useful in making decisions and choices for your own learning activities. In other words, we won't dismiss the theory out of hand without first seeing if there is anything useful in it.

One part of this theory that can be useful is the identification of personality traits that affect your motivation, emotions, and interests toward learning. You have already read a great deal about how these internal characteristics can influence your learning. What knowing about personality traits and learning can do for you is to help you be aware and informed about how these affect you so you can deal with them directly.

Myers-Briggs: Identifying Personality Traits and Styles

The Myers-Briggs system is one of the most popular personality tests, and it is relatively well known. It has seen a great deal of use in the business world with testing seminars and presentations on group dynamics. In fact, it is so popular that you may already be familiar with it and may have taken a test yourself to find out which of the 16 personality types you most favor.

The basic concept of Myers-Briggs is that there are four main traits. These traits are represented by two opposites, seen in the table below.

Table 2.5

Extroverted (E)	vs.	Introverted (I)
Intuition (N)	vs.	Sensing (S)
Feeling (F)	vs.	Thinking (T)
Judging (J)	vs.	Perceiving (P)

It is thought that people generally exhibit one trait or the other in each of these categories, or that they fall along a spectrum between the two opposites. For example, an individual might exhibit both Feeling and Thinking personality traits, but they will favor one more than the other.

Also note that with each of these traits there is a letter in parentheses. The letter is used to represent the specific traits when they are combined to define a personality type (e.g., Extrovert is E and Introvert is I, Intuition is N, etc.). To better understand these, each is briefly explained.

Extroverted (E) vs. Introverted (I): In the Myers-Briggs system, the traits of Extroverted and Introverted are somewhat different from the more common interpretations of the two words. The definition is more about an individual's attitude, interests, and motivation. The extrovert is primarily motivated by the outside world and social interaction, while the introvert is often more motivated by things that are internal to them—things like their own interests.

Intuition (N) vs. Sensing (S): This personality trait is classified as a preference toward one way of perceiving or another. It is concerned with how people tend to arrive at conclusions. A person on the intuitive end of the spectrum often perceives things in broader categories. A part of their process for "knowing things" is internal and is often described as *having a hunch* or *a gut feeling*. This is opposed to the preferred method of a sensing person, who often looks to direct observation as a means of perception. They prefer to arrive at a conclusion by details and facts, or by testing something with their senses.

Feeling (F) vs. Thinking (T): This trait is considered a decision-making process over the information gathered through the perception (N versus S). People that find themselves more on the Feeling end of the spectrum tend to respond based on their feelings and empathy. Examples of this would be conclusions about what is good versus bad or right versus wrong based on how they feel things should be. The Thinking person, on the other hand, arrives at opinions based on reason and logic. For them, feeling has little to do with it.

Judging (J) vs. Perceiving (P): This category can be thought of as a personal preference for using either the Feeling versus Thinking (decision-making) or the Intuition versus Sensing (perceiving) when forming opinions about the outside world. A person that leans toward the Judging side of the spectrum approaches things in a structured way—usually using Sensing and Thinking traits. The Perceiving person often thinks of structure as somewhat inhibiting. They tend to make more use of Intuition and Feeling in their approach to life.

The Impact of Personality Styles on Learning

To find out their own personality traits and learning styles, a person takes an approved Myers-Briggs test, which consists of a series of questions that help pinpoint their preferences. These preferences are then arranged in order to build a profile using each of the four categories.

For example, a person that answered questions in a way that favored Extroverted tendencies along with a preference toward Sensing, Thinking, and Judging would be designated as ESTJ personality type. Another person that tended more toward answers that aligned with Intuitive traits than Sensing traits would fall into the ENTJ category.

Table 2.6 Personality Types

ESTJ	ISTJ	ENTJ	INTJ
ESTP	ISTP	ENTP	INTP
ESFJ	ISFJ	ENFJ	INFJ
ESFP	ISFP	ENFP	INFP

As with other learning style models, Myers-Briggs has received a good deal of criticism based on the artificial restrictions and impairments it tends to suggest. Additionally, the claim that each person has a permanent and unwavering preference towards personality traits and learning styles has not turned out to be as concrete as it was once thought. This has been demonstrated by people taking tests like the Myers-Briggs a few weeks apart and getting different results based on their personal preferences at that time.

What this means is that, just as with the VAK and other learning style models, you should not constrain your own learning activities based on a predetermined model. Neither should you think of yourself as being limited to one set of preferences. Instead, different types of learning and different preferences can better fit your needs at different times. This and how to best apply the idea of personality types influencing learning styles is explained in the next section.

How to Use Personality Type Learning Styles

To recap, personality tests such as the Myers-Briggs can provide a great deal of insight into personal choices toward learning. Unfortunately, many people interpret them as being something that defines them as both a person and a learner. They tell themselves things like “I am an ESTJ, so I am only at my best when I learn a certain way” or “I rely on intuition, so a science course is not for me!” They limit themselves instead of understanding that while they may have particular preferences under a given situation, all of the different categories are open to them and can be put to good use.

What is important to know is that these sorts of models can serve you better as a way to think about learning. They can help you make decisions about how you will go about learning in a way that best suits your needs and goals for that particular task. As an example of how to do this, what follows are several different approaches to learning about the play *Julius Caesar* by William Shakespeare. In each case, Myers-Briggs categories are used to define what sort of activities would help you meet your desired learning goals.

- Your assignment is to read *Julius Caesar* as a work of English literature. Your learning goal is not just to read the play, but to be able to compare it to other, more modern works of literature. To do that, it would be beneficial to use a more *introverted* approach so that you can think about the influences that may have affected each author. You might also want to focus on a

thinking learning style when examining and comparing the use of words and language in the 17th-century piece to more modern writing styles.

- Your use of learning style approaches would be very different if you were assigned to actually perform a scene from *Julius Caesar* as a part of a class. In this case, it would be better for you to rely on an *extroverted* attitude since you will be more concerned with audience reaction than your own inner thoughts about the work. And since one of your goals would be to create a believable character for the audience, you would want to base decisions on the gestures you might make during the performance through *feeling* so that you have empathy with the character and are convincing in your portrayal.
- A third, completely different assignment, such as examining the play *Julius Caesar* as a political commentary on English society during the reign of Queen Elizabeth, would have very different goals and therefore should be approached using different learning styles. In this example, you might want to begin by using a *sensing* approach to gather facts about what was happening politically in that time period and then switch to *intuition* for insight into the motivations of Shakespeare and the attitudes of his audience in England at that time.

As you can see in the examples above, the choices about each of the different approaches can be entirely dictated by what you will be doing with the learning. Because of this, being aware of the personality type learning styles you have available to you can make a tremendous difference in both how you go about it and your success.

Analysis Question

To find out more about personality types and learning styles, you can take an online personality test to experience it yourself. Several companies charge for this service, but there are a few that offer tests online for free. Click here for one such free online personality test.

Again, keep in mind that your results can change under different circumstances, but doing it for the first time will give you a place to start.

Afterwards you can click here to read more about the connections between personality and learning styles. There you can look up the results from your personality test and see how much you think it aligns with your learning style preferences. Again, this exercise is not to determine your ultimate learning style, but it is to give you a deeper understanding of what is behind the concept of connecting personality types to learning.

The Impact of Work You Enjoy

For a final word on personality types and learning styles, there is no denying that there are going to be different approaches you enjoy more than others. While you do have the ability to use each of the different approaches to meet the goals of your learning activities, some will come more easily for you in certain situations and some will be more pleasurable. As most people do, you will probably find that your work is actually better when you are doing things you like to do. Because of this, it is to your advantage to recognize your preferred methods of learning and to make use of them whenever possible. As discussed elsewhere in this book, in college you will often have opportunities to make decisions about the assignments you complete. In many instances, your instructor may allow for some creativity in what you do and in the finished product. When those opportunities arise, you have everything to gain by taking a path that will allow you to employ preferences you enjoy most. An example of this might be an assignment that requires you to give a presentation on a novel you read for class. In such a case, you might have the freedom to focus your presentation on something that interests you more and better aligns with how you like to learn. It might be more enjoyable for you to present a study on each of the characters in the book and how they relate to each other, or you might be more interested in doing a presentation on the historical accuracy of the book and the background research the author put into writing it.

Whatever the case, discuss your ideas with your instructor to make certain they will both meet the criteria of the assignment and fulfill the learning goals of the activity. There is a great potential for benefit in talking with your instructors when you have ideas about how you can personalize assignments or explore areas of the subject that interest you. In fact, it is a great practice to ask your instructors for guidance and recommendations and, above all, to demonstrate to them that you are taking a direct interest in your own learning. There is never any downside to talking with your instructors about your learning.

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1.7: Applying What You Know about Learning

Questions to consider

- How can I apply what I now know to learning?
- How can I make decisions about my own learning?
- Will doing so be different from what I have experienced before?

Another useful part of being an informed learner is recognizing that as a college student you will have many choices when it comes to learning. Looking back at the Uses and Gratification model, you'll discover that your motivations as well as your choices in how you interact with learning activities can make a significant difference in not only what you learn, but how you learn. By being aware of a few learning theories, students can take initiative and tailor their own learning so that it best benefits them and meets their main needs.

Student Profile

"My seating choice significantly affects my learning. Sitting at a desk where the professor's voice can be heard clearly helps me better understand the subject; and ensuring I have a clear view helps me take notes. Therefore, sitting in the front of the classroom should be a "go to" strategy while attending college. It will keep you focused and attentive throughout the lecture. Also, sitting towards the front of the classroom limits the tendency to be on check my phone."

—Luis Angel Ochoa, Westchester Community College

Making Decisions about Your Own Learning

As a learner, the kinds of materials, study activities, and assignments that work best for you will derive from your own experiences and needs (needs that are both short-term as well as those that fulfill long-term goals). In order to make your learning better suited to meet these needs, you can use the knowledge you have gained about UGT and other learning theories to make decisions concerning your own learning. These decisions can include personal choices in learning materials, how and when you study, and most importantly, taking ownership of your learning activities as an active participant and decision maker. In fact, one of the main principles emphasized in this chapter is that students not only benefit from being involved in planning their instruction, but learners also gain by continually evaluating the actual success of that instruction. In other words: *Does this work for me? Am I learning what I need to by doing it this way?*

While it may not always be possible to control every component of your learning over an entire degree program, you can take every opportunity to influence learning activities so they work to your best advantage. What follows are several examples of how this can be done by making decisions about your learning activities based on what you have already learned in this chapter.

Make Mistakes Safe

Create an environment for yourself where mistakes are safe and mistakes are expected as just another part of learning. This practice ties back to the principles you learned in the section on grit and persistence. The key is to allow yourself the opportunity to make mistakes and learn from them *before* they become a part of your grades. You can do this by creating your own learning activities that you design to do just that. An example of this might be taking practice quizzes on your own, outside of the more formal course activities. The quizzes could be something you find in your textbook, something you find online, or something that you develop with a partner. In the latter case you would arrange with a classmate for each of you to produce a quiz and then exchange them. That particular exercise would serve double learning duty, since to create a good quiz you would need to learn the main concepts of the subject, and answering the questions on your partner's quiz might help you identify areas where you need more knowledge.

The main idea with this sort of practice is that you are creating a safe environment where you can make mistakes and learn from them before those mistakes can negatively impact your success in the course. Better to make mistakes on a practice run than on any kind of assignment or exam that can heavily influence your final grade in a course.

Make Everything Problem Centered

When working through a learning activity, the practical act of problem-solving is a good strategy. Problem-solving, as an approach, can give a learning activity more meaning and motivation for you, as a learner. Whenever possible it is to your advantage to turn an assignment or learning task into a problem you are trying to solve or something you are trying to accomplish.

In essence, you do this by deciding on some purpose for the assignment (other than just completing the assignment itself). An example of this would be taking the classic college term paper and writing it in a way that solves a problem you are already interested in.

Typically, many students treat a term paper as a collection of requirements that must be fulfilled—the paper must be on a certain topic; it should include an introduction section, a body, a closing, and a bibliography; it should be so many pages long, etc. With this approach, the student is simply completing a checklist of attributes and components dictated by the instructor, but other than that, there is no reason for the paper to exist.

Instead, writing it to solve a problem gives the paper purpose and meaning. For example, if you were to write a paper with the purpose of informing the reader about a topic they knew little about, that purpose would influence not only how you wrote the paper but would also help you make decisions on what information to include. It would also influence how you would structure information in the paper so that the reader might best learn what you were teaching them. Another example would be to write a paper to persuade the reader about a certain opinion or way of looking at things. In other words, your paper now has a purpose rather than just reporting facts on the subject. Obviously, you would still meet the format requirements of the paper, such as number of pages and inclusion of a bibliography, but now you do that in a way that helps to solve your problem.

Make It Occupation Related

Much like making assignments problem centered, you will also do well when your learning activities have meaning for your profession or major area of study. This can take the form of simply understanding how the things you are learning are important to your occupation, or it can include the decision to do assignments in a way that can be directly applied to your career. If an exercise seems pointless and possibly unrelated to your long-term goals, you will be much less motivated by the learning activity.

An example of understanding how a specific school topic impacts your occupation future would be that of a nursing student in an algebra course. At first, algebra might seem unrelated to the field of nursing, but if the nursing student recognizes that drug dosage calculations are critical to patient safety and that algebra can help them in that area, there is a much stronger motivation to learn the subject.

In the case of making a decision to apply assignments directly to your field, you can look for ways to use learning activities to build upon other areas or emulate tasks that would be required in your profession. Examples of this might be a communication student giving a presentation in a speech course on how the Internet has changed corporate advertising strategies, or an accounting student doing statistics research for an environmental studies course. Whenever possible, it is even better to use assignments to produce things that are much like what you will be doing in your chosen career. An example of this would be a graphic design student taking the opportunity to create an infographic or other supporting visual elements as a part of an assignment for another course. In cases where this is possible, it is always best to discuss your ideas with your instructor to make certain what you intend will still meet the requirements of the assignment.

Managing Your Time

One of the most common traits of college students is the constraint on their time. As adults, we do not always have the luxury of attending school without other demands on our time. Because of this, we must become efficient with our use of time, and it is important that we maximize our learning activities to be most effective. In fact, time management is so important that there is an entire chapter in this text dedicated to it. When you can, refer to that chapter to learn more about time management concepts and techniques that can be very useful.

Instructors as Learning Partners

In K-12 education, the instructor often has the dual role of both teacher and authority figure for students. Children come to expect their teachers to tell them what to do, how to do it, and when to do it. College learners, on the other hand, seem to work better when they begin to think of their instructors as respected experts that are partners in their education. The change in the relationship for you as a learner accomplishes several things: it gives you ownership and decision-making ability in your own learning, and it enables you to personalize your learning experience to best fit your own needs. For the instructor, it gives them the opportunity to help you meet your own needs and expectations in a rich experience, rather than focusing all of their time on trying to get information to you.

The way to develop learning partnerships is through direct communication with your instructors. If there is something you do not understand or need to know more about, go directly to them. When you have ideas about how you can personalize assignments or explore areas of the subject that interest you or better fit your needs, ask them about it. Ask your instructors for guidance and

recommendations, and above all, demonstrate to them that you are taking a direct interest in your own learning. Most instructors are thrilled when they encounter students that want to take ownership of their own learning, and they will gladly become a resourceful guide for you.

Application

Applying What You Know about Learning to What You Are Doing: In this activity, you will work with an upcoming assignment from one of your courses—preferably something you might be dreading or are at least less than enthusiastic about working on. You will see if there is anything you can apply to the assignment from what you know about learning that might make it more interesting.

In the table below are several attributes that college students generally prefer in their learning activities, listed in the far left column. As you think about your assignment, consider whether or not it already possesses the attribute. If it does, go on to the next row. If it does not, see if there is some way you can approach the assignment so that it does follow preferred learning attributes; write that down in the last column, to the far right.

Table 2.7

Does it …?	Yes	No	What you can do to turn the assignment into something that is better suited to you as a learner?
Does it allow you to make decisions about your own learning?			In essence, you are doing this right now. You are making decisions on how you can make your assignment more effective for you.
Does it allow you to make mistakes without adversely affecting your grade?			Hints: *Are there ways for you to practice? Can you create a series of drafts for the assignment and get feedback?*
Is it centered on solving a problem?			Hint: *Can you turn the assignment into something that solves a problem? An example would be making a presentation that actually educated others rather than just covered what you may have learned.*
Is it related to your chosen occupation in any way?			Hint: *Can you turn the assignment into something you might actually do as a part of your profession or make it about your profession? Examples might be creating an informative poster for the workplace or writing a paper on new trends in your profession.*

Does it …?	Yes	No	What you can do to turn the assignment into something that is better suited to you as a learner?
Does it allow you to manage the time you work on it?			*More than likely the answer here will be "yes," but you can plan how you will do it. For more information on this, see the chapter on time management.*
Does it allow interaction with your instructor as a learning partner?			Hint: *Talking to your instructor about the ideas you have for making this assignment more personalized accomplishes this exact thing.*

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1.8: The Hidden Curriculum

Questions to consider

- What is the hidden or invisible curriculum?
- How can I work within the hidden curriculum to prevent negative results?

The *hidden curriculum* is a phrase used to cover a wide variety of circumstances at school that can influence learning and affect your experience. Sometimes called the invisible curriculum, it varies by institution and can be thought of as a set of unwritten rules or expectations.

Situation: According to your syllabus, your history professor is lecturing on the chapter that covers the stock market crash of 1929 on Tuesday of next week.

Sounds pretty straightforward and common. Your professor lectures on a topic and you will be there to hear it. However, there are some unwritten rules, or hidden curriculum, that are not likely to be communicated. Can you guess what they may be?

- What is an unwritten rule about what you should be doing before attending class?
- What is an unwritten rule about what you should be doing in class?
- What is an unwritten rule about what you should be doing after class?
- What is an unwritten rule if you are not able to attend that class?

Some of your answers could have included the following:

Table 2.8

Before class:	*read the assigned chapter, take notes, record any questions you have about the reading*
During class:	*take detailed notes, ask critical thinking or clarifying questions, avoid distractions, bring your book and your reading notes*
After class:	*reorganize your notes in relation to your other notes, start the studying process by testing yourself on the material, make an appointment with your professor if you are not clear on a concept*
Absent:	*communicate with the professor, get notes from a classmate, make sure you did not miss anything important in your notes*

The expectations before, during, and after class, as well as what you should do if you miss class, are often unspoken because many professors assume you already know and do these things or because they feel you should figure them out on your own. Nonetheless, some students struggle at first because they don't know about these habits, behaviors, and strategies. But once they learn them, they are able to meet them with ease.

While the previous example may seem obvious once they've been pointed out, most instances of the invisible curriculum are complex and require a bit of critical thinking to uncover. What follows are some common but often overlooked examples of this invisible curriculum.

One example of a hidden curriculum could be found in the beliefs of your professor. Some professors may refuse to reveal their personal beliefs to avoid your writing toward their bias rather than presenting a cogent argument of your own. Other professors may be outspoken about their beliefs to force you to consider and possibly defend your own position. As a result, you may be influenced by those opinions which can then influence your learning, but not as an official part of your study.

Other examples of how this hidden curriculum might not always be so easily identified can be found in classroom arrangements or even scheduling. To better understand this, imagine two different classes on the exact same subject and taught by the same instructor. One class is held in a large lecture hall and has over 100 students in it, while the other meets in a small classroom and has fewer than 20 students. In the smaller class, there is time for all of the students to participate in discussions as a learning activity, and they receive the benefit of being able to talk about their ideas and the lessons through direct interaction with each other and the professor. In the larger class, there is simply not enough time for all 100 students to each discuss their thoughts. On the flip side, most professors who teach lecture classes use technology to give them constant feedback on how well students understand a

given subject. If the data suggests more time should be spent, these professors discover this in real time and can adapt the class accordingly.

Another instance where class circumstances might heavily influence student learning could be found in the class schedule. If the class was scheduled to meet on Mondays and Wednesdays and the due date for assignments was always on Monday, those students would benefit from having the weekend to finalize their work before handing it in. If the class met on a different day, students might not have as much free time just before handing in the assignment. The obvious solution would be better planning and time management to complete assignments in advance of due dates, but nonetheless, conditions caused by scheduling may still impact student learning.

Working Within the Hidden Curriculum

The first step in dealing with the hidden curriculum is to recognize it and understand how it can influence your learning. After any specific situation has been identified, the next step is to figure out how to work around the circumstances to either take advantage of any benefits or to remove any roadblocks.

To illustrate this, here are some possible solutions to the situations given as examples earlier in this section:

Prevailing Opinions—Simply put, you are going to encounter instructors and learning activities that you sometimes agree with and sometimes do not. The key is to learn from them regardless. In either case, take ownership of your learning and even make an effort to learn about other perspectives, even if it is only for your own education on the matter. There is no better time to expose yourself to other opinions and philosophies than in college. In fact, many would say that this is a significant part of the college experience. With a growth mindset, it is easy to view everything as a learning opportunity.

Classroom Circumstances—These kinds of circumstances often require a more structured approach to turn the situation to your advantage, but they also usually have the most obvious solutions. In the example of the large class, you might find yourself limited in the ability to participate in classroom discussions because of so many other students. The way around that would be to speak to several classmates and create your own discussion group. You could set up a time to meet, or you could take a different route by using technology such as an online discussion board, a Skype session, or even a group text. Several of the technologically based solutions might even be better than an in-class discussion since you do not all have to be present at the same time. The discussion can be something that occurs all week long, giving everyone the time to think through their ideas and responses.

Again, the main point is to first spot those things in the hidden curriculum that might put your learning at a disadvantage and devise a solution that either reduces the negative impact or even becomes a learning advantage.

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1.9: Summary

The purpose of this chapter is to help make you a motivated learner and empower you to make informed choices about your own learning. Throughout the chapter, you were introduced to ideas, research, and popular models on learning and given examples of how to use each of these as an effective part of your own learning experience.

Most importantly, you were able to explore how things like motivation, grit, and mindset are the most influential aspects of successful learning.

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1.10: Career Connection

Watch this TEDx video on learning styles and the importance of critical thinking. After you have watched the video, consider some of the reflective points below.

The concept of personalized learning styles has been popular for almost half a century. Given the information presented in this video, why do you think people are attracted to the idea of personal learning styles even though evidence shows they do not actually exist?

If you were going to devise an experiment to prove or disprove the idea of personalized learning styles, what would you do?

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1.11: Rethinking

Recall the four statements that you evaluated at the beginning of this chapter (see below). Have you changed your mind about any of them, or do you intend to work on changing any of them? If you answered no to either or both, why do you feel no change is needed?

1. Learning for me is easy. I don’t even have to think about it.
2. I have a preferred learning style.
3. If I can't learn something right away, I have difficulty staying with it.
4. I think my teachers are the most significant aspect of my learning.

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1.12: Where do you go from here?

Learning about how we learn allows us to make informed decisions about our own learning activities. This chapter covered a number of concepts, and more than likely a few may have sparked a deeper interest in you. Hopefully these will be things you will choose to explore further. If you would like to learn more, choose from any of the topics covered in this chapter or from those in the list below.

1. More details about the growth mindset
2. Additional strategies for overcoming negative bias
3. The influence of grit as a personal trait
4. Uses and Gratification model as a structure for understanding our daily decisions

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1.13: Collaborative Student Learning- The Art of Study Groups

By nature, talking over course material promotes active learning. Some students shy away from studying with other people, because often study sessions deteriorate into “gripe” sessions about the course or certain members of the group do not contribute to the understanding of information. However, these distractions can be avoided with some study group “ground rules” that develop a habit for effective group work. Students who develop strong team working relation- ships with other students in their classes often report more motivation toward studying, less stress related to the course with this support system, and a better understanding of the material (University of Illinois–Chicago, 2008).



There are several types of study groups. Some groups simply get together prior to exams to go over the material. While this exercise can be helpful, typically these are not the type of study groups that actually promote long-term learning and social support. The most effective types of study groups tend to meet regularly—weekly or every couple of weeks—to work on homework problems, compare lecture notes, discuss current assigned readings, and create cram cards or other study tools that will aid later group review for an exam.

Activity 5-5:

Conduct a Post-Test Analysis for one of your exams by answering and reflecting on these relevant questions. It is best if you can complete this analysis prior to receiving your grade for the exam, but if you have already received a grade try to think about how you felt about the test before getting it back.

1. What grade do you think you made on this exam? (circle one)
   A B C D
2. How much time did you spend preparing for this exam?
   1. None
   2. 1/2 hour or less
   3. about an hour

4. about 2 hours
5. between 2 – 4 hours
6. between 4 – 6 hours
7. more than 6 hours

3. Approximately what percentage of the assigned reading did you read?
    1. Zero
    2. 100%
    3. Other (write in the approximate percentage)_____
4. What parts of the textbook did you use as you were preparing for the exam? (mark all that apply)
    1. Chapter headings
    2. Exercises
    3. Key points
    4. Follow-up activities
    5. Tables/graphs/photographs
    6. Chapter questions
5. Did you use your notes for the test?
    1. Yes
    2. No, I do not have any notes
    3. I have notes, but I did not review them before the test
    4. I borrowed notes from someone else and reviewed them
6. Did you review the handouts given in class before the test?
    1. Yes
    2. No, I do not have any handouts
    3. I have handouts, but I did not review them before the test
    4. I borrowed the handouts from someone else and reviewed them

Before the test did you:

- Read through each portion of the test when you got it? YES NO
- Set a time budget to pace yourself? YES NO

7. The objective portion of the test was:

For the Multiple Choice:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

For the True/False:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

For the Matching:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

8. The short answer portion of the test was:
    1. easy to complete
    2. too difficult
    3. reasonably challenging, but I feel confident about my ability to answer the questions
9. The essay portion of the test was:
    1. easy to complete

2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

10. Did you study with other people? (mark all that apply)
    1. No
    2. Yes, one other person
    3. Yes, more than one other person at the same time
    4. Yes, I attended a Supplemental Instruction (SI) test review or a test review offered by the instructor or graduate assistant
11. If you studied with others, rate how effective the study sessions were on a scale of 1-10.
    (1= not at all effective in helping me review and understand the material, to 10 = highly effective in helping me review and understand the material)
12. What study techniques did you use to study for this exam? (mark all that apply)
    1. I consolidated my notes with my textbook notes
    2. I re-read the book chapters
    3. I re-read my class notes
    4. I made up questions and tried to answer them and then reviewed what I did not know
    5. I reviewed exams from an authorized test file
    6. Other explain what you did below

_____

_____

_____

1. Reflection Once you have received your grade, compare that with what you initially guessed you would receive. Consider some of these questions:
    1. What types of questions did you tend to miss more? What were the topics of content? Do you now understand the correct answer? Do you see any patterns in the types of mistakes thatyou may have made? Did you tend to second guess yourself and change a correct answer to an incorrect answer?
    2. Do you see any patterns in where the test items tended to come from? Mostly from the readings? Mostly from class notes? An even mix between the readings and notes? More from the notes, but some from the readings? From places you would not have thought of like thegraphs, photographs, or tables?
    3. Was there certain content that you were not as strong in answering correctly? What do you need to do to make sure you understand this material? Do you need to talk with your professor to better understand this material?
    4. Based on the answers to some of the questions throughout this assessment, what are you going to do differently next time? Be specific.

_____

_____

_____

_____

_____

Getting a strong start with a group of committed students at the beginning of the class is tremendously important. A group with mixed levels of academic expertise can be a very effective group as long as the members are committed to working with the group. Stronger students can benefit from teaching students who may be struggling with the material, while struggling students learn study strategies as well as the material the group is reviewing. Consider “Tips for Effective Study Groups” as you move forward with developing study groups.

Tips for Effective Study Groups

- Establish a study group with 2–4 other committed students in your class. Exchange contact information with those participants. You may begin a conversation with students who attend class regularly, take notes, sit toward the front, and appear to pay attention in class. You may ask the professor to help you identify other committed students that you can recruit.
- Set a regular time and place to meet.

- Meet in a public place like the library, empty classroom, residence hall study room, cafeteria, etc.
- At the first session, decide on the rules that your group will agree to adhere to in order to promote teamwork and accountability. For instance, some groups determine that if a member does not prepare for a session that they cannot stay to learn from the others. Some groups set a routine in which they study for 50 minutes and then spend ten minutes “blowing off steam” and problem solving (with a timekeeper keeping it limited to ten minutes).
- Set study goals for each session regarding what material you want to cover or what activities you want to perform as a group.
- Establish a “monitor” for a given session to watch the time, record notes for the group, and make sure that everyone is participating. This duty can be rotated throughout the group and may even become obsolete once a strong working team has been established.
- Make sure that everyone participates actively. Take turns presenting sections of lecture notes or readings, take turns taking a group through the solution of a problem, take turns asking each other questions and having others answer them, etc.
- Share study tools developed, summaries of topics, visual organizers, etc.
- Write down any questions that one or two group members can approach the professor or graduate assistant for help and then share with the group at the next session or via e-mail.
- At the end of the study session, establish what material you are going to focus on so that everyone in the group can prepare for the next session.

Adapted from Dembo & Seli (2008) and University of Illinois–Chicago (2008).

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CHAPTER OVERVIEW

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2.1: Prelude to Thinking



Figure 2.1.1: Games like basketball require many types and levels of thinking. Players and coaches must analyze their opponents' offense and defense, solve problems related to opposing players' skills and their own team's weaknesses, and constantly create through split-second decision making. (Credit: San Francisco Foghorn / Flickr / Attribution 2.0 Generic (CC BY 2.0))

Student Survey

How do you feel about the ways you think? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning "least like me" and 4 meaning "most like me." These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. I understand how to approach problem-solving.
2. I have creative potential.
3. I often think about how I'm learning
4. I know how to find and evaluate valid information.

You can also take the Chapter 7 Survey anonymously online.

STUDENT PROFILE

"I never considered myself a problem solver. I was more creative. I wrote music and fiction, and saw myself in a musical theater career. Two years of college and two majors later, I had moved into a related pathway: entertainment management. I was thrilled to find something that suited my passions and gave me a great shot at a number of jobs. But I hadn't counted on the business and math courses I needed to take. Solving these types of problems wasn't in my skill set. I didn't have the background, and kept missing half the ideas. I started going to the academic success center and office hours, and managed to keep my grades in the passing range. But I wasn't excelling and couldn't stay ahead. It was a struggle.

"During a study session, a success counselor noticed that I was approaching a problem all wrong. She helped me for the next hour -- not working on the problem itself, but on how I was thinking about it and others like it. She asked me about the information I knew, how I put it together, and so on. She taught me a progression of steps to analyze the components, get the data I needed, ignore the unimportant information, and run the numbers. Then she had me watch a TED talk with some more information.

"I realized that it wasn't my prior knowledge that was holding me back. It was the way I was thinking about the work. I started asking my professors more about how to approach the courses -- how to think about them. I didn't start getting A's right away, but I did get better results, and even felt more creative as I started to try new things."

About This Chapter

In this chapter, you'll be introduced to different ways of thinking about the way you think. By the time you complete this chapter, you should be able to do the following:

- Describe *thinking* as a process and the reasons it is important.
- Discuss the importance of *creative thinking* and ways of generating original ideas.
- Define *analytical thinking*, its component parts, and outcomes.
- Articulate the process and importance of *critical thinking*.
- Describe the best approaches to *problem-solving*.
- Define *metacognition* and describe ways to become thoughtful about your thinking.
- Define *information literacy* for college students.

Whether we admit it or not or even consider it or not, we cannot stop thinking. We think during intense work situations, while we're playing games, when we eat, as we watch a movie, even during meditation that purports to empty the mind of all thought. Skilled and practiced yogis may be able to get into a state that resembles non-thinking, but most of us keep thinking all the time. Perhaps as you read these lines, you doubt their accuracy suggesting that you don't really think when you're just relaxing with friends. But you do. You may think about the other people in the group and what you do or do not know about them. You may wonder what you'll eat for your next meal. Your mind may flit to question whether you locked the door on the way out. Or you may debate internally whether you'll finish on time the assignment due for one of your classes. Now, you may not act on any of those random thoughts during this relaxing time, but you *are* nonetheless thinking. As you begin this exploration of thinking, consider all the ways we turn to technology to assist with our thinking and how thinking impacts and defines various careers.

When you consider the word *thinking*, does your mind drift toward:

a. School
b. Work
c. Relationships
d. Free time

Reflect on your answer, and write one or two sentences on why you associate this idea with thinking.

In this chapter, we'll look more closely at several distinct types of thinking including creative, analytical, and critical thinking, all of which come into play for problem-solving. We'll also explore the multitude of resources available relative to understanding and enhancing your thinking skills, all of which constitutes metacognition, the practice of thinking about your thinking.

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2.2: What Thinking Means

Thinking is one of those hard-to-pinpoint aspects of life we typically don't analyze much—like breathing or walking or sleeping. We constantly think, and becoming more attuned to how we think and what we do when we encounter new ideas is an excellent habit to pursue.

> ***"If you're going to do anything as much as you think, you might just as well learn about it and hone this skill."***

You may have read quotes or inspirational slogans that claim *you are what you think.* What does that mean? Can you *think* yourself into a good mood? Can you *think* you have a million dollars in your pocket? Does that mean you are the next music sensation if you often sing at parties? Not necessarily, but consider Jose, for instance. He isn't a rock and roll star, but Jose spends a lot of his leisure time thinking about music, analyzing performances, memorizing his favorite musicians' characteristics, buying fan clothing, and even designing a creative means to explain his excitement for music to his friends through a homemade video. Jose certainly could allow his fascination to seep into other aspects of his life. Do you have a hobby or interest you spend a lot of time thinking about?

Many people go to great lengths to attend a concert by a favorite music star. They think creatively about how to save enough money for tickets; they think analytically about scheduling their other obligations to have time off work to attend or how to make up work in their college classes. This much planning involves a great deal of thinking, and not all about music. In the example about Jose, thinking directs the actions of the person doing the thinking. So, in fact, what we think *does* influence who we are and how we act. We have many resources available to be more effective thinkers, and learning about these resources gives us options.

GET CONNECTED

Apps and search engines literally bring thinking to our fingertips. Consider how often you visit Google. The use of this familiar site has become so commonplace as to render the proper name of the company into a verb—*to google* a topic. Basic calculators or word-processing software programs are other simple examples of technology we often use without recognizing them as thinking aids.

While apps, software programs, thinking games, and thought exercises may help you stretch your brain, don't let their simplicity fool you into thinking that cultivating an inquisitive, thoughtful mind is easy or automatic. Thinking is as complex as it is necessary for our success in life. Some tools you may find useful are applications that provide challenges using mind puzzles are Peak and Elevate. These training apps offer brain training that varies from quick matching memory games to more sophisticated thought-processing speed scenarios. You can even use a straightforward tool like a flashcard app, such as Chegg Prep, to create your own thinking games -- using word associations or pictures to help you connect topics and build your skills.

A familiar element of the thinking apps is a progression tracker to help thinkers improve their focus and memory as well as to learn and practice math and verbal skills over time. Researchers are still investigating the correlation between thought-invoking game playing and the decrease in mental agility, memory, and cognitive vitality. Early studies have produced numerous findings, including a long-term investigation of the onset of Alzheimer's disease conducted with nuns; you can look up the *Nun Study* to learn more, or go to this article.

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2.3: Types of Thinking

Learning Objectives

1. Understand that there are different types of thinking.
2. Identify how each type of thinking contributes to learning.

So what are the various types of thinking skills, and what kind things are we doing when we apply them? In the 1950s, Benjamin Bloom developed a classification of thinking skills that is still helpful today; it is known as Bloom's taxonomy. He lists six types of thinking skills, ranked in order of complexity: knowledge, comprehension, application, analysis, synthesis, and evaluation. Figure 3.2 outlines each skill and what is involved in that type of thinking, as updated by Lorin Anderson and David Krothwohl.

Thinking Still	What It Involves
1. Remembering and Recalling	Retrieving or repeating information or ideas from memory. This is the first and most basic thinking skill you develop (starting as a toddler with learning numbers, letters, and colors).
2. Understanding	Interpreting, constructing meaning, inferring, or explaining material from written, spoken, or graphic sources. Reading is the most common understanding skill; these skills are developed starting with early education.
3. Applying	Using learned material or implementing material in new situations. This skill is commonly used starting in middle school (in some cases earlier).
4. Analyzing	Breaking material or concepts into key elements and determining how the parts relate to one another or to an overall structure or purpose. Mental actions included in this skill are examining, contrasting or differentiating, separating, categorizing, experimenting, and deducing. You most likely started developing this skill in high school (particularly in science courses) and will continue to practice it in college.
5. Evaluating	Assessing, making judgments, and drawing conclusions from ideas, information, or data. Critiquing the value and usefulness of material. This skill encompasses most of what is commonly referred to as critical thinking; this skill will be called on frequently during your college years and beyond. Critical thinking is the first focus of this chapter.
6. Creating	Putting parts together or reorganizing them in a new way, form, or product. This process is the most difficult mental function. This skill will make you stand out in college and is in very high demand in the workforce. Creative thinking is the second focus of this chapter.

All of these thinking skills are important for college work (and life in the "real world," too). You've likely had a great deal of experience with the lower-level thinking skills (yellow section). The midlevel skills are skills you will get a lot of practice with in college, and you may be well on your way to mastering them already. The higher-level thinking skills (red section) are the most demanding, and you will need to invest focused effort to develop them.

? Exercise : Thought Inventory

Think about Figure 3.2. Are you using all six thinking skills? Reflect on your schoolwork in the past three weeks and identify specific examples where you used each of the thinking skills. Use the comment column to write notes about the skills that are

second nature to you and those you would like to develop further.

Skill Set	How You Used It in the Past Three Weeks	Comments
Remembering and Recalling		
Understanding		
Applying		
Analyzing		
Evaluating		
Creating		

Look at the lists of things you actually did in each case. Notice that there are certain verbs that apply to each skill set. When you see those verbs as a prompt in an assignment or an exam, you will know what kind of thinking the instructor expects from you. Table 3.1 “Thinking Verbs” lists some of the most common verbs associated with each thinking skill.

Table 3.1 Thinking Verbs

Skill Set	Verbs
1. Remembering and Recalling	Bookmark, count, describe, draw, enumerate, find, google, identify, label, list, match, name, quote, recall, recite, search, select, sequence, tell, write
2. Understanding	Blog, conclude, describe, discuss, explain, generalize, identify, illustrate, interpret, paraphrase, predict, report, restate, review, summarize, tell, tweet
3. Applying	Apply, articulate, change, chart, choose, collect, compute, control, demonstrate, determine, do, download, dramatize, imitate, implement, interview, install (as in software), participate, prepare, produce, provide, report, role-play, run (software), select, share, show, solve, transfer, use
4. Analyzing	Analyze, break down, characterize, classify, compare, contrast, debate, deduce, diagram, differentiate, discriminate, distinguish, examine, infer, link, outline, relate, research, reverse-engineer, separate, subdivide, tag
5. Evaluating	Appraise, argue, assess, beta test, choose, collaborate, compare, contrast, conclude, critique, criticize, decide, defend, “friend/de-friend,” evaluate, judge, justify, network, post, predict, prioritize, prove, rank, rate, review, select, support
6. Creating	Adapt, animate, blog, combine, compose, construct, create, design, develop, devise, film, formulate, integrate, invent, make, model, modify, organize, perform, plan, podcast, produce, program, propose, rearrange, remix, revise, rewrite, structure

Throughout this book, we give tips that will help you develop your thinking skills. You have read about the learning cycle and the importance of *applying* your knowledge. You will learn tips for *remembering* information from your notes and classes. Preparing for class requires you to *analyze* what you know and what you need to learn. The sections on listening and reading will help you develop your *understanding* skills. Look for those tips and practice them.

In this chapter, we will focus on critical thinking (evaluating) and creative thinking. They deserve specific focus because they are likely to be the skills you have least practice with. These are the skills most helpful for success in college and in “real life.”

Creative thinking will help you come up with possible solutions for problems and new ideas. Critical thinking will help you decide which of those ideas have most merit and deserve to be implemented.

Key Takeaways

- We use different types of thinking skills to address different requirements, and these skills are classified in Bloom's taxonomy.
- You have been using many thinking skills since childhood.
- Two very important thinking skills you will need to develop for success in college and in life are critical (or evaluative) thinking and creative thinking.

Exercise

List three verbs that are associated with application skills.

_____

_____

_____

Exercise

What is another name for "evaluation" thinking skills?

_____

Exercise

What thinking skills are associated with each of the following?

1. Compose and design: _____
2. Tweet and describe: _____
3. Break down and discriminate: _____
4. Rank and beta test: _____
5. Enumerate and google: _____

References

Anderson, L. W., and David R. Krathwohl, eds., *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives* (Boston, MA: Allyn & Bacon, 2001).

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2.4: Creative Thinking

Questions to consider:

- How can you go about generating original ideas?
- What is the best way to approach working with unconventional ideas?

Has anyone ever told you that you have a flair for the creative? If so, celebrate! That's a good personality trait to nurture. Creativity is needed in all occupations and during all stages of life. Learning to be more in tune with your own version of creativity can help you think more clearly, resolve problems, and appreciate setbacks. You're creative if you repurpose old furniture into a new function. You're also creative if you invent a new cookie recipe for a friend who has a nut allergy. And you're using creativity if you can explain complex biological concepts to your classmates in your lab class. Creativity pops up everywhere. When creative thinking comes into play, you'll be looking for both original and unconventional ideas, and learning to recognize those ideas improves your thinking skills all around.

Would you learn more about the French Revolution by eating foods popular in that era? What if you were to stop using your phone for all non-emergency communication to understand how news flowed in the early 20th century? These examples present creative ways to approach learning the experiences of a specific time in history. When actors want to learn about a character they'll be playing, they often engage in method acting to immerse themselves in the role. They may maintain a different accent or wear only clothes their character would wear even when they are not at rehearsals, all so they can feel what it was like for their character. Think of ways you may be able to apply method acting to your learning experiences.

WHAT STUDENTS SAY

1. Which type of thinking do you think is most important for your academic studies?
    a. Creative thinking
    b. Analytical thinking
    c. Critical thinking
2. In which area do you have the most difficulty being creative?
    a. Writing
    b. In-class discussions/activities
    c. Personal life
    d. Problem-solving
    e. Finding resources/help
3. In which course areas or activities do you make the most use of problem-solving skills?
    a. Math or quantitative classes
    b. Computer or technical classes
    c. Social science classes
    d. Real-life situations

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

Which type of thinking do you think is most important for your academic studies?

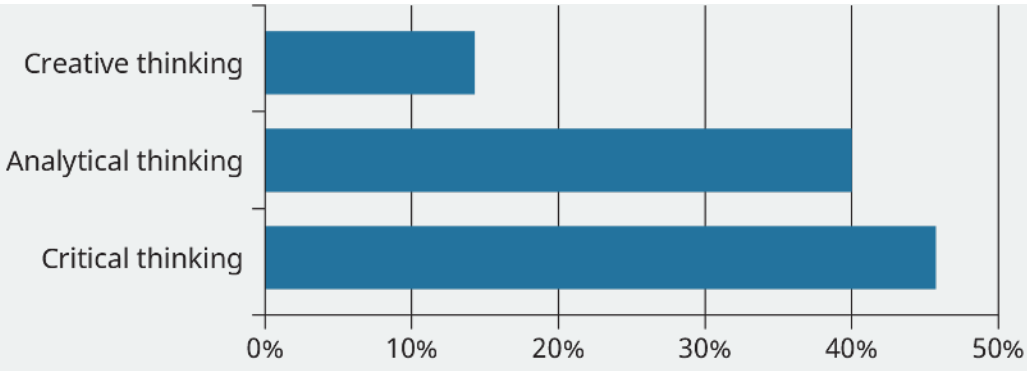


Figure 2.4.2

In which area do you have the most difficulty being creative?

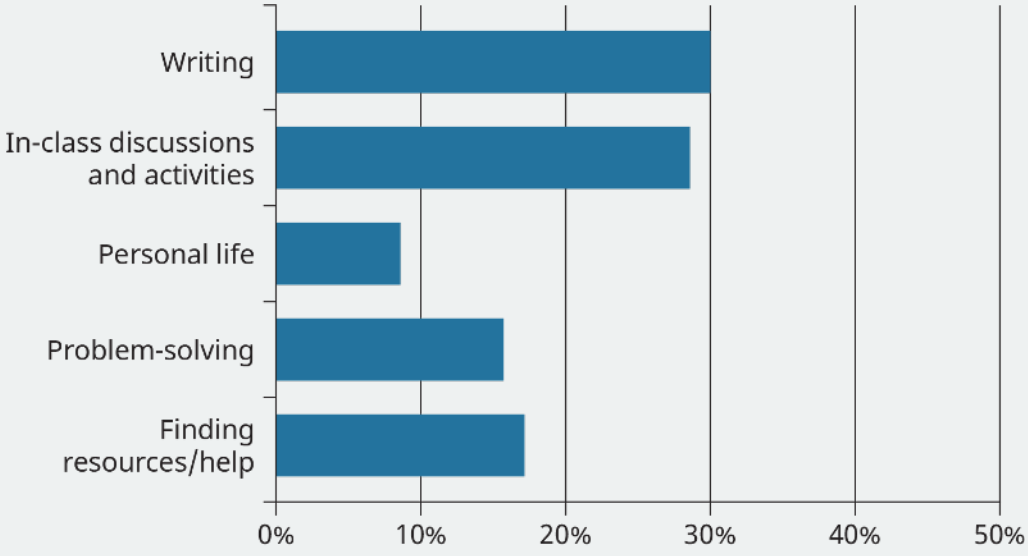


Figure 2.4.3

In which course areas or activities do you make the most use of problem-solving skills?

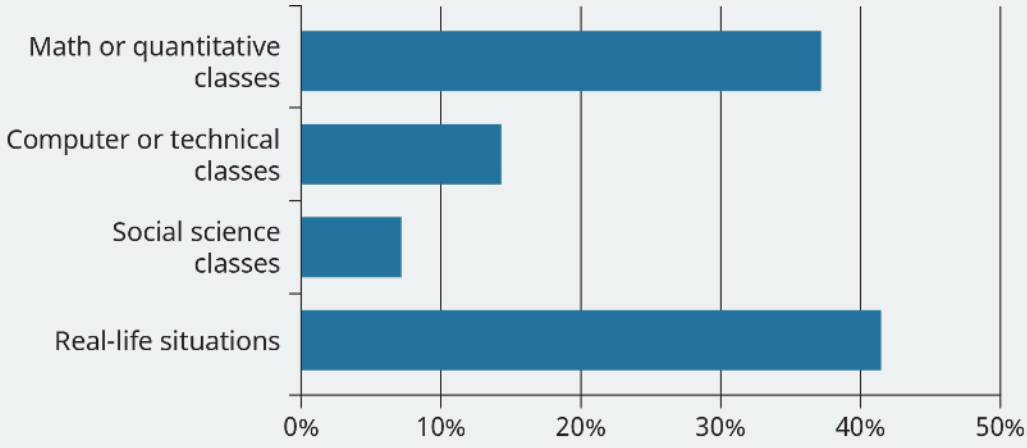


Figure 2.4.4

ANALYSIS QUESTION

In what ways could thinking creatively help you be a better student? Write a one-paragraph reflection on that aspect and how you could realistically go about being more creative.

ANALYSIS QUESTION

Some people say creativity is the realm of children. Can you think of how a child's curiosity and willingness to explore may help you understand a college discipline that is unfamiliar to you now? Write a one-paragraph reflection on how you could use curiosity toward one of your most difficult courses in college.

Creativity doesn't always present itself in the guise of a chart-topping musical hit or other artistic expression. We need creative solutions throughout the workplace—whether board room, emergency room, or classroom. It was no fluke that the 2001 revised Bloom's cognitive taxonomy, originally developed in 1948, placed a new word at the apex—*create*. That is the highest level of thinking skills. As noted in previous chapters, we do all need to use and develop the lower thinking skills that include remembering, applying, and analyzing, but true intelligence and successful thinking move beyond these levels to invention.

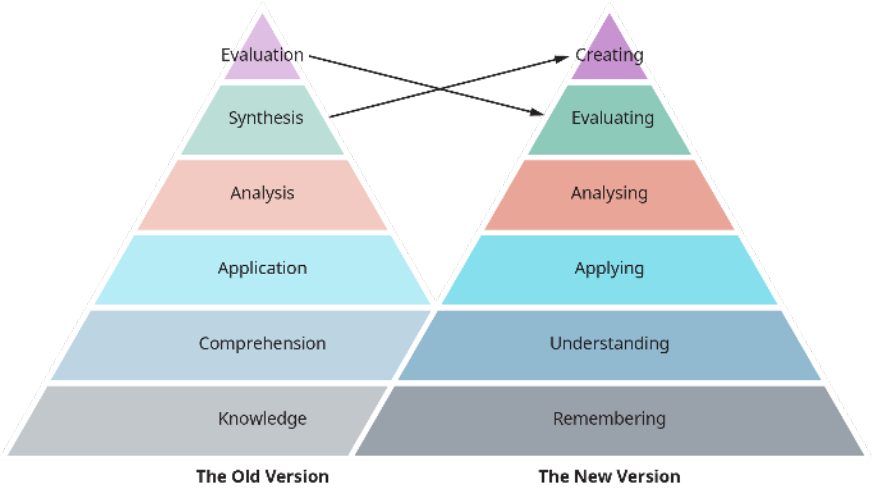


Figure 2.4.5 Bloom's Taxonomy is an important learning theory used by psychologists, cognitive scientists, and educators to demonstrate levels of thinking. Many assessments and lessons you've seen during your schooling have likely been arranged with Bloom's in mind. Researchers recently revised it to place creativity -- invention -- as the highest level.

Regurgitating the minute details of *Goldilocks* or *Beowulf* demonstrates far less comprehension than fashioning an original ending that turns the tables or developing a board game from the story. Author Gregory Maguire used the base plot of L. Frank Baum's 1900 book *The Wonderful Wizard of Oz* and the 1939 movie *The Wizard of Oz* to create the smash-hit 2003 Broadway musical *Wicked* that tells the story from the perspective of the Wicked Witch of the West, making her a sympathetic character. This creative approach calls for far more critical and creative thinking than memorizing facts.

> ***"Creating new out of old or new out of nothing is how we ended up with manned space flight, cell phones, the Constitution, and rap music."***

Continuing to support creativity in whatever form it takes will be how we cure cancer, establish peace, and manipulate the time-space continuum. Don't shortchange your own creativity.

Generating Original Ideas

Nineteenth-century American writer and humorist Mark Twain may have been partially correct when he said:

> *There is no such thing as a new idea. It is impossible. We simply take a lot of old ideas and put them into a sort of mental kaleidoscope. We give them a turn and they make new and curious combinations. We keep on turning and making new combinations indefinitely; but they are the same old pieces of colored glass that have been in use through all the ages.*
>
> *(Mark Twain's Own Autobiography by Mark Twain)*



Figure 2.4.6 You may feel like you cannot come up with new ideas, but even the process of combining and recombining familiar concepts and approaches is a creative act. A kaleidoscope creates a nearly infinite number of new images by repositioning the same pieces of glass.

It is certainly a pretty metaphor of idea generation, but even if old ideas are reworked to create new solutions to existing problems or we embellish a current thought to include new ways of living or working, that renewal is the epitome of the creative process.

It's common to think of creativity as something used mostly by traditional artists—people who paint, draw, or sculpt. Indeed, artists are creative, but think of other fields in which people think just a little differently to approach situations in their discipline. The famous heart surgeon Dr. Denton Cooley didn't have an exact model when he first implanted an artificial heart. Chemist Stephanie Kwoleck discovered life-saving Kevlar when she continued work on a substance that would usually be thrown away. Early US astronauts owed their ability to orbit and return to Earth based on creative uses of mathematics by people like Karen Johnson. Inventor and actress Hedy Lamarr used diagrams of fish and birds to help aviation pioneer Howard Hughes produce faster airplanes. Indeed, biomimicry, an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies, is now a huge field of study. This list could go on and on.



Figure 2.4.7: Denton Cooley (Credit: Texas Children's Hospital / Public Domain), Stephanie Kwolek (Credit: Chemical Heritage Foundation / Attribution 3.0), Karen Johnson (Credit: NASA / Public Domain), and Hedy Lamarr (Credit: MGM / Public Domain). These individuals employed extensive creativity in the fields of science and math, leading to significant discoveries and accomplishments.

ACTIVITY

Work with two or three classmates to determine a product or service you could develop. Think of a situation in your life where a new way of doing something or a not-yet-invented process or device would make your life easier, more convenient, or more purposeful. And this is not limited to the creation of something big. Just looking at something you see all the time with a different lens/perspective is also creative, and we can all do that. What adaptation would you need to make? Let your imagination go wild—driverless cars, wireless communication . . . oh wait, already here. Keep thinking! Each member of your

group should write a paragraph that describes the product/service, what you would need to create it, and how it will be received by others. Read each other's paragraphs and discuss the merits of the ideas.

You may actually be very good at coming up with original creative ideas. Some people naturally seem to think more creatively than others, but we all have the capacity to create and devise. Do you enjoy rearranging furniture or organizing your closet? If you already think "I could make that so much better!" as you walk through shops or events, you're on the right track. Do you tinker with wood, paper, yarn, or dirt? Are you a doodler? One way to enhance your creativity is to track your ideas. You can keep a running list on your phone, jot down ideas on index cards you can later sort into categories, or keep ideas flowing in a paper journal. Some creative people design storyboards to visualize goals or projects using pictures from magazines or online for creative inspiration. Play around with ways to keep up with ideas you may be able to incorporate in some various aspects of your life.

Since the 1980s, Roger von Oech, the president of Creative Think, a California consulting firm, has been encouraging employees in corporations, educational institutions, and government agencies to think more creatively. His pithy stories, examples, scenarios, and challenges present either a barrier to creative thinking that needs to be overcome or an example of how to harness seemingly unproductive ideas. Sometimes creative ideas do not initially seem viable or productive compared to a known process or product, but talking out ideas with others and considering new approaches without fear of ridicule or censure can help individuals and groups think beyond the status quo. Von Oech's discussion starters recommend that thinkers *Avoid Arrogance, Fight for It, Get Rid of Excuses,* and *Listen to That Hunch.* You may be interested in looking these up on the Creative Think website. If you do, you may find some of von Oech's ideas a little out of the ordinary, but great ideas sometimes are, and thinking about them in a different way may be the spark you need to come up with your own version of an idea that will prove effective for you. Stay open to different approaches even if you aren't immediately comfortable with the ideas.

Another creative thinking group you may be interested in investigating is koozai.com, a digital marketing consulting firm based in the United Kingdom with clients worldwide. You may not be in need of help with digital marketing, but the koozai.com website is worth a look to see how creativity can highlight excellent customer service, detail award-winning services, and inject a sense of fun and vitality into a service that may not seem very exciting on the surface, namely helping companies optimize their web presence for increased exposure and profits. The team is a creative mix of engineers, designers, and analysts who use data-based evidence to find the right fit for their clients in a relaxed and productive environment. The actual nuts-and-bolts work involved in web marketing involves a great deal of tedious coding and specialized web design often performed by software engineers working alone, but you don't get a sense of bored, isolated office workers when you peruse the koozai.com site.

Working with Unconventional Ideas

Working with unconventional ideas can produce anxiety because the ideas are unfamiliar and the results of implementing these ideas could be unpredictable. People may not immediately accept your nontraditional ideas. Some may never accept them. If your original creation were to require individuals to give up their current cell phones, you can imagine the resistance. Even if the new idea is an improvement in communication, some people would hesitate.

To work in this possibly uncomfortable realm, you have to remain open-minded, focus on your organizational skills, and learn to communicate your ideas well. If a coworker at a café where you work suggests serving breakfast in addition to the already-served lunch and dinner, keeping an open mind means thinking through the benefits of this new plan (e.g., potential new customers, increased profits) instead of merely focusing on the possible drawbacks (e.g., possible scheduling problems, added start-up costs, loss of lunch business). Implementing this plan would mean a new structure for buying, workers' schedules and pay, and advertising, so you would have to organize all of these component areas. And finally, you would need to communicate your ideas on how to make this new plan work not only to the staff who will work the new shift, but also to the public who frequent your café and the others you want to encourage to try your new hours.

"Because we've always done it that way" is not a valid reason to not try a new approach. It may very well be that the old process is a very good way to do things, but it also may just be that the old, comfortable routine is not as effective and efficient as a new process could be.

Can you think of any routine task you do now that you've never questioned, such as doing laundry, studying for exams, spending downtime, or preparing food? Consider how you came to learn this routine. Are you following a pattern your parents set for you growing up? Do you ask friends how they perform these tasks and follow their example? How well do these routines work for you? Think of at least one different way you could approach one of these tasks. Would it be a good idea to change the way you do it?

How would that benefit you? If not, why is the best approach to keep doing this thing the way you have always done it? Reflect on your thinking behind this routine. How could creative thinking help you identify and assess all of your options?

Another element of working with unconventional ideas is to pay attention to how you organize your thoughts. Organizing includes establishing a clear goal to accomplish, outlining the steps toward that goal, and monitoring progress with specific deadlines. You may be able to add flexibility to this plan since creativity deals in the unknown and that may take longer than you initially expected, but an organized map of your thinking and where you hope to take it can move creative projects forward.

For example, what if you were asked to build a shed for a project or as part of your job? You would need a plan of some sort. It wouldn't be prudent to run to the hardware store and just buy various supplies you see on the spur of the moment. Rather, you would organize your thoughts around this project and determine some specific goals about the size of the shed, its ultimate location and use, the type of materials that would best serve your purposes, and how long the project will take so you can budget time and money toward the accomplishment of the goal. Do you need a building permit in your area for this sort of home improvement project? Will you or others need to sacrifice something (yard space, time, money, a special view) for you to build this shed? Do you have time to complete all the steps? Do you have the skills to put the shed together, or can you learn how to do it? How much are you willing to spend on this? Without an organized plan, you may end up with a good idea, some random supplies, and an incomplete building project that wastes both time and money and does not meet your initial expectations.



Figure 2.4.8 Thinking through a plan isn't just for school. Household activities and projects require forethought and strategic thinking. (Credit: TWP, Inc. / Flickr / Attribution 2.0 Generic (CC BY 2.0))

In addition to the need to remain open-minded and organized, creative thinking calls for a dissemination plan. Unconventional ideas typically don't get off the ground without the creator of the ideas communicating those thoughts to others. Do you set yourself up to be in the company of other creative thinkers? It's not a bad idea. Creativity is somewhat contagious. You may not think you have a creative way to approach a situation, but if you were to bounce ideas off like-minded friends and also friends who would offer a completely different way of looking at something, you may discover that indeed you do have some good ideas ready to come to fruition. This creative brainstorming doesn't just happen though. You need to set aside specific times to work with others to flesh out ideas and think through obstacles. And then you'll need some more time alone for the ideas to gel. Sometimes the creative answers to problems come to you at odd moments once you have laid the groundwork—be ready to capture the ideas in some form of note when your lightbulb goes off.

Creative thinking isn't just helpful in solving problems. You may want to enhance an otherwise good plan to make it fantastic and memorable, which is when you can bring in creative thinking. If you want to surprise your best friend with a special birthday celebration but are low on funds, you could think of creative ways to make this event one to remember. You could take in a free museum night or window shop at the mall or make a photo collage from pictures on your phone that bring back great memories.

Table 7.1 Creative processes should include a plan that considers the goals of the project and provides opportunities for brainstorming and feedback. The steps in this table may not work for everyone, but you can use them to think about what is needed in a process of your own. See the student resources for a blank version you can adapt.

Creative Process Applied to a Sample Campus Activity

Creative Process Applied to a Sample Campus Activity	
Creative Process Step	**Description and Notes**
Problem to Solve or Item/Work to Create	**Create a new logo for our Commuter Student Association**
Requirements and Needs	• Will be used on Insta/Twitter, merch, print • Must incorporate school colors but be readable in grayscale • Must be understandable at large and small sizes (computer/phone)
Parameters and Limitations	• Cannot look like other logos on campus • Cannot use photos-illustration only • Timeline: 7 weeks (in time for next year's college catalog) • Budget: $450
Inspiration and Ideas	• Look at Commuter Association logos from other colleges. • Look at city and state transit logos. • Go to library to look at our school's old yearbooks.
Resources/Knowledge	• Graphic design • Copyright info (consult student govt) • Market research
Dissemination and Brainstorming	• Create a survey for all our commuters • Launch a contest for ideas and submissions? • Share drafts with advisor for approval. • Talk to graphic design club?
Implementation Plan	• Samples needed in 3 weeks. From there: • 1 week for survey feedback • 1 week for improvement • 1 week for additional feedback on final candidates • 1 week for finalization and approval
Reflection and Revision	• Ask all new club members in Fall for feedback. • Consider improving logo during Spring semester next year.

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2.5: Analytical Thinking

Questions to consider:

- How can you best establish component parts in thinking?
- How can you use analysis to improve efficiency?

Thinking helps in many situations, as we've discussed throughout this chapter. When we work out a problem or situation systematically, breaking the whole into its component parts for separate analysis, to come to a solution or a variety of possible solutions, we call that *analytical thinking*. Characteristics of analytical thinking include setting up the parts, using information literacy, and verifying the validity of any sources you reference. While the phrase *analytical thinking* may sound daunting, we actually do this sort of thinking in our everyday lives when we brainstorm, budget, detect patterns, plan, compare, work puzzles, and make decisions based on multiple sources of information. Think of all the thinking that goes into the logistics of a dinner-and-a-movie date—where to eat, what to watch, who to invite, what to wear, popcorn or candy—when choices and decisions are rapid-fire, but we do it relatively successfully all the time.

Employers specifically look for candidates with analytical skills because they need to know employees can use clear and logical thinking to resolve conflicts that cause work to slow down or may even put the company in jeopardy of not complying with state or national requirements. If everything always went smoothly on the shop floor or in the office, we wouldn't need front-line managers, but everything doesn't always go according to plan or company policy. Your ability to think analytically could be the difference between getting a good job and being passed over by others who prove they are stronger thinkers. A mechanic who takes each car apart piece by piece to see what might be wrong instead of investigating the entire car, gathering customer information, assessing the symptoms, and focusing on a narrow set of possible problems is not an effective member of the team. Some career fields even have set, formulaic analyses that professionals in those fields need to know how to conduct and understand, such as a cost analysis, a statistical analysis, or a return on investment (ROI) analysis. You can learn more about these in Chapters 4 and 12.

ACTIVITY

Generate a list of at least two courses you are taking now that you think would routinely practice analytical thinking. Now, think of the profession you are interested in joining. How could the deliberate use of analytical thinking processes be beneficial for that career field? What are you currently learning about in your courses that apply directly to your chosen career path? Think of at least two ways analytical thinking would be used in the career field you are pursuing.

Establishing Component Parts

Component parts refer to the separate elements of a situation or problem. It might include the people involved, the locations of the people, the weather, market fluctuations, or any number of other characteristics of the situation you're examining. If you don't identify all parts of a problem, you run the risk of ignoring a critical element when you offer the solution. For example, if you have a scheduling problem at home and seem to never see your loved ones, the first step in thinking through this problem analytically would be to decide what is contributing to this unfavorable result. To begin, you may examine the family members' individual work, school, and personal schedules, and then create a group calendar to determine if pockets of time exist that are not taken by outside commitments. Perhaps rather than reading your homework assignments at the college library, you could plan to one day a week read with other members of your family who are doing quiet work. You may also need to determine how time is spent to better understand the family's use of time, perhaps using categories such as work/school, recreation, exercise, sleep, and meals. Once you sort the categories for all the family members, you may see blocks of time spent that would lend themselves to combining with other categories—if you and your significant other both exercise three times a week for an hour each time but at separate locations, one possible solution may be to work out together. You could alternate locations if both people have favorite places to run, or you could compromise and decide on one location for both of you—one week at the park, one week at the campus rec center. This may not ultimately be the solution, but after establishing the component parts and thinking analytically, you have provided at least one viable solution.

What if you look at the situation and decide you have too many component parts? Consider, for instance, how Amazon delivers packages every day. That's a lot of items going to and from seemingly countless locations within a relatively short time—sometimes within just one day. An organization such as Amazon must use a great deal of thinking and organizing to deliver goods and services.



Figure 2.5.9 Warehouse designers must think through complex problems and allow for a range of package sizes and shapes -- even ones they haven't yet seen -- to work within their systems. (Credit: Scott Lewis / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

One way to maintain clear thinking with so many parts is hyper organization. Proper labeling (for Amazon to ship it uses the foundation of our mailing system, unique ZIP codes that each address must contain to be delivered) as well as a strong sense of categorization (fulfillment warehouses, customer return warehouses, grocery item warehouses, etc.) are necessary for Amazon to do business. If you were faced with a major research paper your freshman composition professor expects to be polished by the end of the semester, where do you start? What are the component parts of a high-quality research paper? What tasks do you need to finish and how quickly to accomplish the overall goals? A partial list might include generating ideas, selecting a topic, researching, reviewing the available literature, outlining, drafting, and reviewing. What if you encounter setbacks in any of the steps? Do you have a contingency plan? In the construction industry, engineers called this *float*, and they deliberately build in extra time and money in case problems arise on the project. This allows them to avoid getting off schedule, for instance if a severe storm makes access to the worksite impossible.



Figure 2.5.10 Construction planners and engineers allow for a range of contingencies and conditions they cannot control, such as weather, supply problems, safety adjustments, and so on. (Credit: Metropolitan Transportation Authority of New York / Flickr / Attribution Generic 2.0 (CC-BY 2.0))

Forging a Revolution

While most problems require a variety of thinking types, analytical thinking is arguably required in solving all. There was a time when manufacturing was completed by a few people who moved around a workspace to complete their projects. As companies grew, this became more and more inefficient, leading to the need for automation. Henry Ford, the early-20th-century American auto inventor, used analytical thinking to revolutionize the way companies increase production by inventing the assembly line. He perceived the problem in his own factory. When the demand for cars increased but his workers continued their work at the same

pace, he analyzed their process to create something more efficient in the assembly line. This invention allowed one person to perform the same role over and over before sending the car chassis to another person who also performed the same role over and over as the evolving car moved down a sort of conveyor-belt system. The workers on Ford's assembly lines still had to think and make sure that the task for which they were responsible was properly constructed, free of defects, and ready to move to the next station; they just did this thinking about their one area of expertise. Instead of various skilled workers wasting time and energy moving themselves and their tools around the factory from one incomplete car to the next, possibly getting in the way of each other's work, the cars came to the workers. Ford vastly improved production rates and decreased manufacturing time by thinking about this then-new way of doing things.

In the 1960s, companies did not have a fast, reliable, and cost-effective way to deliver urgent documents or packages to each other. The standard mail system was slow but inexpensive, and the only alternative was a private courier, which, while faster, was prohibitively expensive. That's when Frederick W. Smith came up with the idea of a national, overnight delivery service as a part of an assignment in his undergraduate economics class at Yale University. As the story goes, Smith received only an average grade because evidently his professor wasn't all that impressed with the concept, but after analyzing the problems with the current system, thinking through his original ideas more fully, and refining his business plan, Smith launched FedEx, the largest, now global, overnight delivery service in the world.[1] This isn't a parable about ignoring your professors, but a testimony to thinking through ideas others may not initially support or even understand; thinking can create change and always has. As with Ford's assembly line and Smith's overnight delivery service, any service we now use and any problem we may still face provides thinkers with opportunities to generate solutions and viable options for improvement. Your thinking may result in a new personal service, a cure for cancer, or a revolutionary way to deliver water to developing countries.

Footnotes

- 1 "Online Extra: Fred Smith on the BIrth of FedEx." Bloomberg Business Week. 2004. Retrieved 1/28/20. https://www.bloomberg.com/news/artic...birth-of-fedex

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2.6: Critical Thinking

Questions to consider:

- How can determining the situation help you think critically?
- How do you present informed, unbiased thinking?
- What is the difference between factual arguments and opinions?

Critical thinking has become a buzz phrase in education and corporate environments in recent years. The definitions vary slightly, but most agree that thinking critically includes some form of judgement that thinkers generate after careful analysis of the perspectives, opinions, or experimental results present for a particular problem or situation. Before you wonder if you're even capable of critical thinking, consider that you think critically every day. When you grab an unwashed T-shirt off the top of the pile on the floor of your bedroom to wear into class but then suddenly remember that you may see the person of your dreams on that route, you may change into something a bit less disheveled. That's thinking critically—you used data (the memory that your potential soul mate walks the same route you use on that day on campus) to change a sartorial decision (dirty shirt for clean shirt), and you will validate your thinking if and when you do have a successful encounter with said soul mate.

Likewise, when you decide to make your lunch rather than just grabbing a bag of chips, you're thinking critically. You have to plan ahead, buy the food, possibly prepare it, arrange to and carry the lunch with you, and you may have various reasons for doing that —making healthier eating choices, saving money for an upcoming trip, or wanting more quiet time to unwind instead of waiting in a crowded lunch line. You are constantly weighing options, consulting data, gathering opinions, making choices, and then evaluating those decisions, which is a general definition of critical thinking.

Consider the following situations and how each one demands your thinking attention. Which do you find most demanding of critical thinking? Why?

1. Participating in competitive athletic events
2. Watching competitive athletic events
3. Reading a novel for pleasure
4. Reading a textbook passage in science

Critical thinking forces you to determine the actual situation under question and to determine your thoughts and actions around that situation.

Determining the Problem

One component to keep in mind to guide your critical thinking is to determine the situation. What problem are you solving? When problems become complex and multifaceted, it is easy to be distracted by the simple parts that may not need as much thinking to resolve but also may not contribute as much to the ultimate problem resolution. What aspect of the situation truly needs your attention and your critical thinking?

Imagine you're planning a fantasy vacation as a group assignment in a class you're taking where each person is allowed only $200. The group doles out specific preliminary tasks to each member to decide where to go, what sort of trip to take, and how to keep costs low, all in the name of a fun fantasy vacation. In this scenario, whose plan demonstrates the most effective critical thinking?

a. DeRhonda creates an elaborate invitation for a dinner party she'll coordinate at an exclusive mountain cabin.
b. Patrick researches cruises, cabin rentals, and staycation options, considering costs for various trip lengths.
c. Rodrigio puts down a deposit for a private dining room for 25 at an expensive local restaurant for a date six weeks from the end of the semester.

Write out what each person's thinking reflects about their expectations for this trip and why their actions may or may not help the group at this stage of the planning.

Critical thinking differs according to the subject you're thinking about, and as such it can be difficult to pin down any sort of formula to make sure you are doing a good job of thinking critically in all situations. While you may need to adapt this list of critical thinking components, you can get started if you do the following:

- Question everything
- Conduct legitimate research
- Limit your assumptions

- Recognize your own biases
- Gather and weigh all options

Additionally, you must recognize that changes will occur and may alter your conclusions now and in the future. You may eventually have to revisit an issue you effectively resolved previously and adapt to changing conditions. Knowing when to do that is another example of critical thinking. Informed flexibility, or knowing that parts of the plan may need to change and how those changes can work into the overall goal, is also a recognized element of thinking critically.

For example, early in the 20th century, many people considered cigarette smoking a relaxing social pastime that didn't have many negative consequences. Some people may still consider smoking a way to relax; however, years of medical research have proven with mounting evidence that smoking causes cancer and exacerbates numerous other medical conditions. Researchers asked questions about the impact of smoking on people's overall health, conducted regulated experiments, tracked smokers' reactions, and concluded that smoking did impact health. Over time, attitudes, evidence, and opinions change, and as a critical thinker, you must continue to research, synthesize newly discovered evidence, and adapt to that new information.



Figure 2.6.11: Information, attitudes, laws, and acceptance of smoking changed dramatically over time. More recently, vaping and related practices have rekindled debates and launched new research into safety. (Credit: Satish Krishnamurthy / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Defending against Bias

Once you have all your information gathered and you have checked your sources for currency and validity, you need to direct your attention to how you're going to present your now well-informed analysis. Be careful on this step to recognize your own possible biases. Facts are verifiable; opinions are beliefs without supporting evidence. Stating an opinion is just that. You could say "Blue is the best color," and that's your opinion. If you were to conduct research and find evidence to support this claim, you could say, "Researchers at Oxford University recognize that the use of blue paint in mental hospitals reduces heart rates by 25% and contributes to fewer angry outbursts from patients." This would be an informed analysis with credible evidence to support the claim.

Not everyone will accept your analysis, which can be frustrating. Most people resist change and have firm beliefs on both important issues and less significant preferences. With all the competing information surfacing online, on the news, and in general conversation, you can understand how confusing it can be to make any decisions. Look at all the reliable, valid sources that claim different approaches to be the *best* diet for healthy living: ketogenic, low-carb, vegan, vegetarian, high fat, raw foods, paleo, Mediterranean, etc. All you can do in this sort of situation is conduct your own serious research, check your sources, and write clearly and concisely to provide your analysis of the information for consideration. You cannot force others to accept your stance, but you can show your evidence in support of your thinking, being as persuasive as possible without lapsing into your own personal biases. Then the rest is up to the person reading or viewing your analysis.

Factual Arguments vs. Opinions

Thinking and constructing analyses based on your thinking will bring you in contact with a great deal of information. Some of that information will be factual, and some will not be. You need to be able to distinguish between facts and opinions so you know how

to support your arguments. Begin with basic definitions:

- **Fact:** a statement that is true and backed up with evidence; facts can be verified through observation or research
- **Opinion:** a statement someone holds to be true without supporting evidence; opinions express beliefs, assumptions, perceptions, or judgements

Of course, the tricky part is that most people do not label statements as fact and opinion, so you need to be aware and recognize the difference as you go about honing your critical thinking skills.

You probably have heard the old saying "Everyone is entitled to their own opinions," which may be true, but conversely, not everyone is entitled to their own facts. Facts are true for everyone, not just those who want to believe in them. For example, *mice are animals* is a fact; *mice make the best pets* is an opinion.

ACTIVITY

Determine if the following statements are facts or opinions based on just the information provided here, referring to the basic definitions above. Some people consider scientific findings to be opinions even when they are convincingly backed by reputable evidence and experimentation. However, remember the definition of *fact*—verifiable by research or observation. Think about what other research you may have to conduct to make an informed decision.

- Oregon is a state in the United States. (How would this be proven?)
- Beef is made from cattle. (See current legislation concerning vegetarian "burgers.")
- Increased street lighting decreases criminal behavior. (What information would you need to validate this claim?)
- In 1952, Elizabeth became Queen of England. (What documents could validate this?)
- Oatmeal tastes plain. (What factors might play into this claim?)
- Acne is an embarrassing skin condition. (Who might verify this claim?)
- Kindergarten decreases student dropout rates. (Think of different interest groups that may take sides on this issue.)
- Carbohydrates promote weight gain. (Can you determine if this is a valid statement?)
- Cell phones cause brain tumors. (What research considers this claim?)
- Immigration is good for the US economy. (What research would help you make an informed decision on this topic?)

Many people become very attached to their opinions, even stating them as facts despite the lack of verifiable evidence. Think about political campaigns, sporting rivalries, musical preferences, and religious or philosophical beliefs. When you are reading, writing, and thinking critically, you must be on the lookout for sophisticated opinions others may present as factual information. While it's possible to be polite when questioning another person's opinions when engaging in intellectual debate, thinking critically requires that you do conduct this questioning.

For instance, someone may say or write that a particular political party should move its offices to different cities every year—that's an opinion regardless of whether you side with one party or the other. If, on the other hand, the same person said that one political party is headquartered in a specific city, that is a fact you can verify. You could find sources that can validate or discredit the statement. Even if the city the person lists as the party headquarters is incorrect, the statement itself is still a fact—just an erroneous one. If you use biased and opinionated information or even incorrect facts as your evidence to support your factual arguments, then you have not validated your sources or checked your facts well enough. At this point, you would need to keep researching.

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2.7: It's Critical

Learning Objectives

1. Understand what critical thinking is and why it's important.
2. Identify logical pitfalls.
3. Discover assumptions and biases.
4. Practice problem solving and decision making.
5. Know the power of questions.
6. Evaluate information (on and off the Internet).

Americans Have Access to…

- 1 million *new* books each year
- 5,500 magazines
- 10,500 radio stations
- 65,000 iPhone apps
- 1,000,000,000,000 Web pages

In today's environment, it is not so critical to "know" a great deal of information. The list above indicates how much information we can easily access. In fact, the abundance of information might be the greater challenge. Your success will depend on what you can do with the information, not just on what you know. How we filter and use that abundance of data is the reason critical thinking has become so important today.

Critical thinking is the ability to discover the value of an idea, a set of beliefs, a claim, or an argument. It requires you to use logic and reasoning to evaluate evidence or information to make a decision or reach a conclusion. Critical thinking is

- a foundation for effective communication,
- the principal skill used in effective decision making,
- at the core of creating new knowledge,
- a way to uncover bias and prejudices.

Critical thinking is a part of everyday life, too. Decisions you make can have a lasting impact on your life, and these decisions benefit from critical thinking. Did you ever decide to quit smoking or to lose weight? Were you successful? How did you decide to attend the college you are in? Was that the right choice for you? In any of these cases, could you have made a better decision if you had better or more information?

The Critical Thinking Process

The critical thinking process is really nothing more than asking the right questions to understand a problem or issue and then gathering the data you need to complete the decision or take sides on an issue.

What is the problem or issue I am considering really about? Understanding this is key to successful critical thinking. What is the objective? A position? A decision? Are you deciding what candidate in an election will do a better overall job, or are you looking to strengthen the political support for a particular cause? Are you really against a recommendation from your dad, or are you using the issue to establish your independence?

Do you understand the terms related to the issue? Are you in agreement with the proponent's definitions? For example, if you are evaluating a quotation on the health-care system for use in a paper, your objective might be to decide to use the quotation or not, but before you can make that decision you need to understand what the writer is really saying. If a term like "family" is used, for example, does it mean direct relations or extended family?

What are my options? What are choices that are available to you (if you are making a decision), or what are the "sides" (in the case of a position) you might choose to agree with? What are their differences? What are the likely consequences of each option? In making a decision, it might be helpful to ask yourself, "What is the worst thing that might happen in each scenario?" Examining different points of view is very important; there may be dozens of alternative viewpoints to a particular issue—and the validity of each can change depending on circumstances. A position that is popular or politically correct today may not have been a year ago,

and there is no guarantee it will be right in the future. Likewise, a solution to a personal problem that was successful for your roommate may not apply to you. Remember also that sometimes the best option might be a combination of the options you identify initially.

What do I know about each option? First, make sure you have all the information about each option. Do you have all the information to support each of your likely options? What is still missing? Where can you get the information you need? Keep an open mind and don't dismiss supporting information on any position before you evaluate it carefully.

How good is my information? Now it's time to evaluate the quality of the support of each option or point of view. Evaluate the strengths and the weaknesses of each piece of supporting evidence. Are all the relevant facts presented? Are some facts presented in misleading ways? Are enough examples presented to support the premise? Consider the source of the supporting information. Who is the expert presenting the facts? That "expert" may have a vested interest in the position. Consider that bias, more for understanding the point of view than for rejecting it. Consider your own opinions (especially when working with emotional issues); are your emotional ties to a point of view getting in your way of clear thinking (your own biases)? If you really like a particular car model, are you giving the financial implications of buying that car a fair consideration? Are there any errors or fallacies in your logic? (See Table 3.2 "Fallacies and How to Avoid Them".)

Fallacies are defects in logic that weaken arguments. You should learn to identify them in your own thinking so you can strengthen your positions, as well as in the arguments of others when evaluating their strength.

Table 3.2 Fallacies and How to Avoid Them

Fallacy	Description	Examples	How to Avoid It in Your Own Thinking
Generalizations	Making assumptions about a whole group of people based on an inadequate sample.	Engineering students are nerds. My economics class is boring, and my friend says her economic class is boring, too—therefore all economics classes are boring.	What kind of sample are you using? Is it large enough to support the conclusions? You may want to increase your sample size or draw a more modest conclusion by using the word "some" or "many."
False Cause	Drawing improper conclusions through sequencing. If A comes before B, then A causes B.	I studied biology last term, and this term I'm taking organic chem, which is very confusing. Biology makes chemistry confusing.	When making causal statements, be sure you can explain the process through which A causes B beyond their mere sequence.
Personalizations	Also known by their Latin names (*ad hominem*, or "against the man," and *tu quoque*, or "you too"). Inserting personalities inappropriately into an argument. Common in political arguments.	*Against the man:* I won't support Senator Smith's education bill. He's had a mistress and marital problems.	Focus on the merits and supporting data of an argument, not on the personality or behavior of the people making the arguments.
Everyone Does It	Also known by its Latin name (*ad populum*, or "against many"). Justifying an issue based solely on the number of people involved.	*You too:* A parent explains the evidence of the risks of binge drinking. The child rejects the arguments, saying, "When you were my age, you drank too." It's healthy to drink only soda; millions of American kids do.	The popular position is not always the right one. Be wary of arguments that rely exclusively on one set of numbers.

Fallacy	Description	Examples	How to Avoid It in Your Own Thinking
Appealing to Authority	Using an endorsement from someone as a primary reason for supporting a point of view.	We should oppose higher taxes; Curt Schilling does. Pitcher Curt Schilling may be a credible authority on baseball, but is he an authority on taxes?	Quoting authorities is a valuable tool to build an argument; make sure the authorities you quote are truly subject matter experts on the issue you are discussing.
Weak Analogy	Using irrelevant similarities in two objects to draw a conclusion.	Cars and motorcycles are both driven at high speeds on the highway. Car drivers aren't required to wear helmets, so motorcycle riders shouldn't have to either.	You can draw an analogy between just about any two objects or ideas. If you are using an analogy, make sure you identify the properties relevant to the argument you are making and see if both share those properties. (In the example, the motorcycle does not provide protection to the rider, but the car does. Equating the two vehicles based on traveling speed is not relevant to the argument.)
False Dichotomy	Setting up a situation in which it looks like there are only two possible options. If one option is discredited, the other must be accepted.	The classic example here is "America, love it or leave it."	Examine your own thinking. Are there really only two options? Look for the third option. If you were asked to develop a compromise between the two positions, what would it look like? What would its strengths and weaknesses be?

You will need to use critical thinking throughout your college years and beyond. Here are some common critical thinking situations and the kinds of questions you should ask to apply critical thinking. Note that critical thinking is central to themes covered in detail throughout this book.

- **Personal choices.** Examples include "What should I major in?" and "Should I buy a new car?" What do you know about each of your options? What is the quality of that information? Where can you get more (reliable) information? How do those options relate to your financial and emotional needs? What are the pros and cons of each option? Are you open to the points of view of others who may be involved? (See Chapter 11 "Taking Control of Your Finances" and Chapter 12 "Taking Control of Your Future".)
- **Reading, listening, note taking, and studying.** What are the core messages of the instructor or author? Why are they important? How do these messages relate to one another or differ? (This is covered in much more detail in Chapter 4 "Listening, Taking Notes, and Remembering" and Chapter 5 "Reading to Learn".)
- **Research papers.** What evidence do you need to support your thesis? What sources are available for that evidence? Are they reliable sources? Are there any fallacies in your argument? (This is covered in more detail in Chapter 8 "Writing for Classes".)
- **Essay questions on exams.** What is the professor really asking you to do? What do you know about the question? What is your personal belief about the question? What are the beliefs or biases of the professor or quoted authors? What are the arguments against your point of view? What are the most important pieces of evidence you should offer to support your answer? (This covered in more detail in Chapter 6 "Preparing for and Taking Tests".)

Tips for Critical Thinking

- Consider all points of view; seriously consider more than two (look for grey areas).
- Keep an open mind.
- Answer three questions about your supporting data:
  1. Is it enough support?
  2. Is it the right support?
  3. Is it credible?
- Look for evidence that contradicts your point of view. Pretend to disagree with the position you are supporting. What parts of your argument are weak? Do you have the supporting facts to overcome that evidence?
- Create a set of criteria you will use to evaluate the strength of information you want to use to support your argument. Ask questions like these:
  - What is the source of this information?
  - Is the author well respected in the field?
  - When was this information developed? Is that important? Why?
  - Does the author or publisher have an agenda for publishing the information? How does that agenda affect the credibility of the information?
- Create a table on which you list your main points, then for each one, list the evidence you have to support it. This method will help you visually identify where you have weak evidence and what points actually lack evidence.
- Be willing to admit that you lack information to support a point of view or make a decision. Ask questions or do some focused research to get what you still need.
- Make sure that your assumptions and points of view are supported by facts, not opinions.
- Learn what types of fallacies you use habitually, and then be on the lookout for them. Writers will often rely on certain types of arguments as a matter of habit. Review some of your old papers to identify which fallacies you need to avoid.
- Question your characterizations of others. Are those authorities truly competent in the area you are considering? Are you attacking the opponents of your point of view rather than attacking their arguments?
- Be careful of broad generalizations. Claims that use absolute words like “all,” “none,” “always,” “never,” “no one,” and “everyone” require much more proof than claims that use words like “most,” “some,” “often,” “rarely,” “sometimes,” and so on.

Where Did That Come From?

One of the most consistent uses for critical thinking in your college work is in considering the value of research material and deciding how to use it. The Internet gives you access to an almost unlimited amount of data, and you must choose what to use carefully. Following are some guidelines.

1. Look at the URL, the Web address. It can give you important information about the reliability and intentions of the site. Start with the page publisher. Have you heard of this source before? If so, would you consider it a reliable source for the kind of material you are about to read? Now consider the domain type in the URL, which follows the period after the publisher: “.com” and “.biz” are used by commercial enterprises, “.org” is normally used by nonprofit organizations, and “.edu” is reserved for educational institutions. None of these is necessarily bad or good, but they may give you a sense behind the motivation for publishing this material. Are you dealing with a company or the Web site of an individual—and how might that affect the quality of the information on that site?
2. What can you learn from poking around with navigation tabs or buttons, and what do they tell you about the objective of the Web site? Look for a tab labeled “About Us” or “Biography.”
3. Consider what others are saying about the site. Does the author offer references, reviews, or quotations about the material? What do they say? Check the blogosphere to see what other people think of the author or Web site.
4. Trust your own impressions about the material. Is the information consistent with what you already know?
5. Ask yourself why the Web site was written. (To inform? To provide data or facts? To sell something? To promote a cause? To parody?)

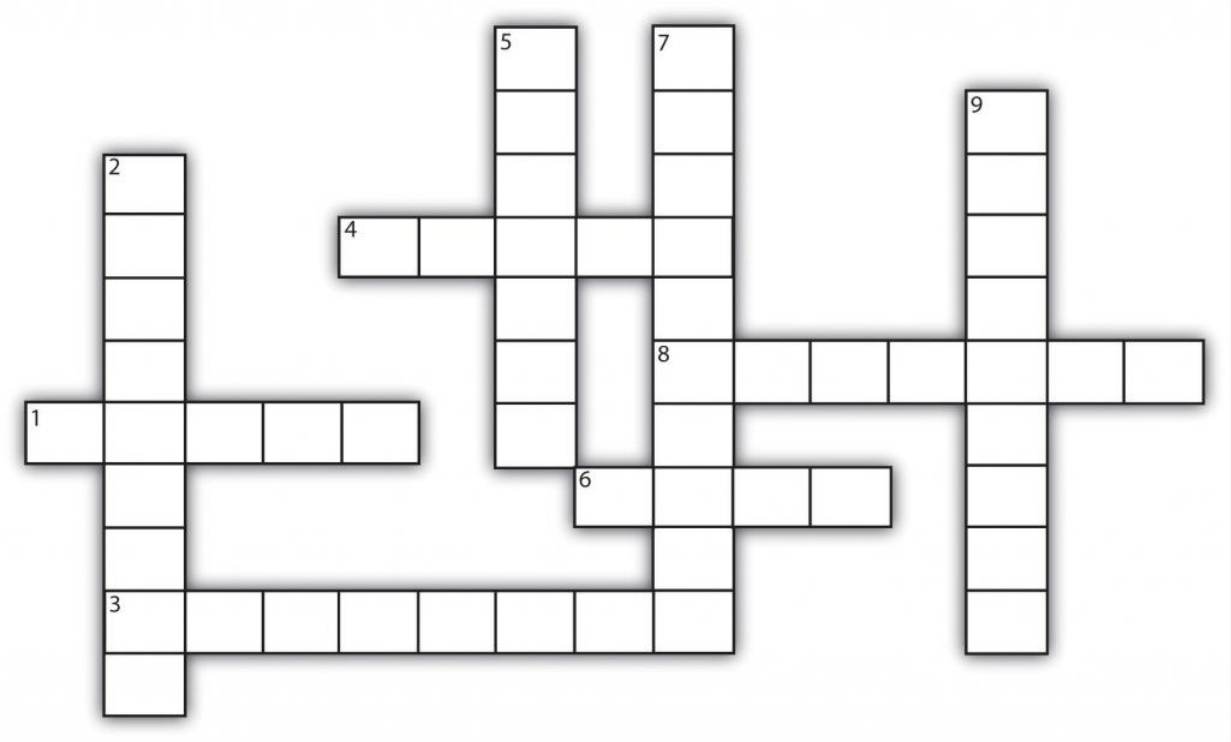
Based on what you learned, ask yourself if the information from this Web site is reliable for your needs. These steps are covered in more detail in Chapter 5 “Reading to Learn”.

Key Takeaways

- Critical thinking is evaluating the strength of your arguments, data, and information.
- Three questions to ask about the support for an argument or position:
  1. Is it enough support?
  2. Is it the right support?
  3. Is it credible?
- Weaknesses in arguments are most commonly logical fallacies. Recognizing them will help evaluate the strength of an argument effectively.

? Checkpoint Exercises

Figure 3.3 Crossword: Full of Fallacies



Across	Down
1. Fallacy is an error in _____.	2. Appealing to _____
3. Also known as the “you too” fallacy	5. Ad _____; everybody does it
4. False _____; a fallacy based on the order of events	7. To draw conclusions based on a small sample
6. A tendency or inclination which prevents fair consideration of a point of view	9. False _____; a fallacy on forced choice between only two options
8. Weak _____; irrelevant comparison	

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2.8: Searching for “Aha”

Learning Objectives

1. Use creative thinking: the competitive advantage in the twenty-first century.
2. Understand the difference between creative thinking and free-form thinking.
3. Practice guidelines for creating ideas.
4. Use rules and directions to create effectively.
5. Understand group creativity: how to conduct effective brainstorming.

America still has the right stuff to thrive. We still have the most creative, diverse, innovative culture and open society—in a world where the ability to imagine and generate new ideas with speed and to implement them through global collaboration is the most important competitive advantage.

Thomas Friedman

Let’s face it: many jobs are subject to outsourcing. The more menial or mechanical the job, the greater the likelihood that there will be someone overseas ready to do the job for a lot less pay. But generating new ideas, fostering innovation, and developing processes or plans to implement them are something that cannot be easily farmed out, and these are strengths of the American collegiate education. Businesses want problem solvers, not just doers. Developing your creative thinking skills will position you for lifelong success in whatever career you choose.

Creative thinking is the ability to look at things from a new perspective, to come up with fresh solutions to problems. It is a deliberate process that allows you to think in ways that improve the likelihood of generating new ideas or thoughts.

Let’s start by killing a couple of myths:

- **Creativity is an inherited skill.** Creativity is not something people are born with but is a skill that is developed over time with consistent practice. It can be argued that people you think were “born” creative because their parents were creative, too, are creative simply because they have been practicing creative thinking since childhood, stimulated by their parents’ questions and discussions.
- **Creativity is free-form thinking.** While you may want to free yourself from all preconceived notions, there is a recognizable structure to creative thinking. Rules and requirements do not limit creative thinking—they provide the scaffolding on which truly creative solutions can be built. Free-form thinking often lacks direction or an objective; creative thinking is aimed at producing a defined outcome or solution.

Creative thinking involves coming up with new or original ideas; it is the process of seeing the same things others see but seeing them differently. You use skills such as examining associations and relationships, flexibility, elaboration, modification, imagery, and metaphorical thinking. In the process, you will stimulate your curiosity, come up with new approaches to things, and have fun!

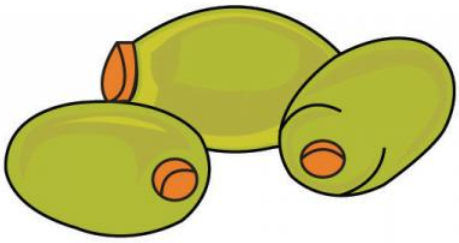
Tips for Creative Thinking

- **Feed your curiosity.** Read. Read books, newspapers, magazines, blogs—anything at any time. When surfing the Web, follow links just to see where they will take you. Go to the theatre or movies. Attend lectures. Creative people make a habit of gathering information, because they never know when they might put it to good use. Creativity is often as much about rearranging known ideas as it is about creating a completely new concept. The more “known ideas” you have been exposed to, the more options you’ll have for combining them into new concepts.
- **Develop your flexibility** by looking for a second right answer. Throughout school we have been conditioned to come up with the right answer; the reality is that there is often more than one “right” answer. Examine all the possibilities. Look at the items in Figure 3.4. Which is different from all the others?

Figure 3.4



a. Apple



b. Olives



c. Board



d. Clams

If you chose C, you're right; you can't eat a board. Maybe you chose D; that's right, too—clams are the only animal on the chart. B is right, as it's the only item you can make oil from, and A can also be right; it's the only red item.

Each option can be right depending on your point of view. Life is full of multiple answers, and if we go along with only the first most obvious answer, we are in danger of losing the context for our ideas. The value of an idea can only be determined by comparing it with another. Multiple ideas will also help you generate new approaches by combining elements from a variety of "right" answers. In fact, the greatest danger to creative thinking is to have only one idea. Always ask yourself, "What's the *other* right answer?"

- **Combine old ideas in new ways.** When King C. Gillette registered his patent for the safety razor, he built on the idea of disposable bottle caps, but his venture didn't become profitable until he toyed with a watch spring and came up with the idea of how to manufacture inexpensive (therefore disposable) blades. Bottle caps and watch springs are far from men's grooming materials, but Gillette's genius was in combining those existing but unlikely ideas. Train yourself to think "out of the box." Ask yourself questions like, "What is the most ridiculous solution I can come up with for this problem?" or "If I were transported by a time machine back to the 1930s, how would I solve this problem?" You may enjoy watching competitive design, cooking, or fashion shows (*Top Chef*, *Chopped*, *Project Runway*, etc.); they are great examples of combining old ideas to make new, functional ones.
- **Think metaphorically.** Metaphors are useful to describe complex ideas; they are also useful in making problems more familiar and in stimulating possible solutions. For example, if you were a partner in a company about to take on outside investors, you might use the pie metaphor to clarify your options (a smaller slice of a bigger pie versus a larger slice of a smaller pie). If an

organization you are a part of is lacking direction, you may search for a “steady hand at the tiller,” communicating quickly that you want a consistent, nonreactionary, calm leader. Based on that ship-steering metaphor, it will be easier to see which of your potential leaders you might want to support. Your ability to work comfortably with metaphors takes practice. When faced with a problem, take time to think about metaphors to describe it, and the desired solution. Observe how metaphors are used throughout communication and think about why those metaphors are effective. Have you ever noticed that the financial business uses water-based metaphors (cash *flow*, *frozen* assets, *liquidity*) and that meteorologists use war terms (*fronts*, wind *force*, storm *surge*)? What kinds of metaphors are used in your area of study?

- **Ask.** A creative thinker always questions the way things are: Why are we doing things this way? What were the objectives of this process and the assumptions made when we developed the process? Are they still valid? What if we changed certain aspects? What if our circumstances changed? Would we need to change the process? How? Get in the habit of asking questions—lots of questions.

Key Takeaways

- Creative thinking is a requirement for success.
- Creative thinking is a deliberate process that can be learned and practiced.
- Creative thinking involves, but is not limited to, curiosity, flexibility, looking for the second right answer, combining things in new ways, thinking metaphorically, and questioning the way things are.

? Checkpoint Exercises

1. **Feed your curiosity.** List five things you will do in the next month that you have never done before (go to the ballet, visit a local museum, try Moroccan food, or watch a foreign movie). Expand your comfort “envelope.” Put them on your calendar.
    1. _____
    2. _____
    3. _____
    4. _____
    5. _____
2. **How many ways can you use it?** Think of as many uses for the following common items as possible. Can you name more than ten?

Peanut Butter (PBJ counts as one, regardless of the flavor of jelly)	**Paper Clips**	Honors Level: **Pen Caps**

Peanut Butter (PBJ counts as one, regardless of the flavor of jelly)	**Paper Clips**	Honors Level: **Pen Caps**

- **A metaphor for life.** In the movie *Forrest Gump*, Forrest states, "Life was like a box of chocolates; you never know what you're gonna get." Write your own metaphor for life and share it with your classmates.

  _____

- **He has eyes in the back of his head.** What if we really had eyes in the backs of our heads? How would life be different? What would be affected? Would we walk backward? Would we get dizzy if we spun in circles? Would it be easy to put mascara on the back eyes? Generate your own questions and answers; let the creative juices flow!

  _____

  _____

  _____

  _____

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2.9: Problem-Solving

Questions to consider:

- How can determining the best approach to solve a problem help you generate solutions?
- Why do thinkers create multiple solutions to problems?

When we're solving a problem, whether at work, school, or home, we are being asked to perform multiple, often complex, tasks. The most effective problem-solving approach includes some variation of the following steps:

- Determine the issue(s)
- Recognize other perspectives
- Think of multiple possible results
- Research and evaluate the possibilities
- Select the best result(s)
- Communicate your findings
- Establish logical action items based on your analysis

Determining the best approach to any given problem and generating more than one possible solution to the problem constitutes the complicated process of problem-solving. People who are good at these skills are highly marketable because many jobs consist of a series of problems that need to be solved for production, services, goods, and sales to continue smoothly. Think about what happens when a worker at your favorite coffee shop slips on a wet spot behind the counter, dropping several drinks she just prepared. One problem is the employee may be hurt, in need of attention, and probably embarrassed; another problem is that several customers do not have the drinks they were waiting for; and another problem is that stopping production of drinks (to care for the hurt worker, to clean up her spilled drinks, to make new drinks) causes the line at the cash register to back up. A good manager has to juggle all of these elements to resolve the situation as quickly and efficiently as possible. That resolution and return to standard operations doesn't happen without a great deal of thinking: prioritizing needs, shifting other workers off one station onto another temporarily, and dealing with all the people involved, from the injured worker to the impatient patrons.

Determining the Best Approach

Faced with a problem-solving opportunity, you must assess the skills you will need to create solutions. Problem-solving can involve many different types of thinking. You may have to call on your creative, analytical, or critical thinking skills—or more frequently, a combination of several different types of thinking—to solve a problem satisfactorily. When you approach a situation, how can you decide what is the best type of thinking to employ? Sometimes the answer is obvious; if you are working a scientific challenge, you likely will use analytical thinking; if you are a design student considering the atmosphere of a home, you may need to tap into creative thinking skills; and if you are an early childhood education major outlining the logistics involved in establishing a summer day camp for children, you may need a combination of critical, analytical, and creative thinking to solve this challenge.

ACTIVITY

What sort of thinking do you imagine initially helped in the following scenarios? How would the other types of thinking come into resolving these problems?

1. Mission Control reacting to the Apollo 13 emergency
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking
2. Automakers coordinating the switch from fuel-based to electric cars
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking
3. The construction of the New York subway system
    a. Analytical thinking
    b. Creative thinking
    c. Critical thinking

> Write a one- to two-sentence rationale for why you chose the answers you did on the above survey.

Generating Multiple Solutions

Why do you think it is important to provide multiple solutions when you're going through the steps to solve problems? Typically, you'll end up only using one solution at a time, so why expend the extra energy to create alternatives? If you planned a wonderful trip to Europe and had all the sites you want to see planned out and reservations made, you would think that your problem-solving and organizational skills had quite a workout. But what if when you arrived, the country you're visiting is enmeshed in a public transportation strike experts predict will last several weeks if not longer? A back-up plan would have helped you contemplate alternatives you could substitute for the original plans. You certainly cannot predict every possible contingency—sick children, weather delays, economic downfalls—but you can be prepared for unexpected issues to come up and adapt more easily if you plan for multiple solutions.

Write out at least two possible solutions to these dilemmas:

- Your significant other wants a birthday present—you have no cash.
- You have three exams scheduled on a day when you also need to work.
- Your car needs new tires, an oil change, and gas—you have no cash. (Is there a trend here?)
- You have to pass a running test for your physical education class, but you're out of shape.

Providing more than one solution to a problem gives people options. You may not need several options, but having more than one solution will allow you to feel more in control and part of the problem-solving process.

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2.10: Problem Solving and Decision Making

Learning Objectives

1. Learn to understand the problem.
2. Learn to combine creative thinking and critical thinking to solve problems.
3. Practice problem solving in a group.

Much of your college and professional life will be spent solving problems; some will be complex, such as deciding on a career, and require time and effort to come up with a solution. Others will be small, such as deciding what to eat for lunch, and will allow you to make a quick decision based entirely on your own experience. But, in either case, when coming up with the solution and deciding what to do, follow the same basic steps.

- **Define the problem.** Use your analytical skills. What is the real issue? Why is it a problem? What are the root causes? What kinds of outcomes or actions do you expect to generate to solve the problem? What are some of the key characteristics that will make a good choice: Timing? Resources? Availability of tools and materials? For more complex problems, it helps to actually write out the problem and the answers to these questions. Can you clarify your understanding of the problem by using metaphors to illustrate the issue?
- **Narrow the problem.** Many problems are made up of a series of smaller problems, each requiring its own solution. Can you break the problem into different facets? What aspects of the current issue are "noise" that should not be considered in the problem solution? (Use critical thinking to separate facts from opinion in this step.)
- **Generate possible solutions.** List all your options. Use your creative thinking skills in this phase. Did you come up with the second "right" answer, and the third or the fourth? Can any of these answers be combined into a stronger solution? What past or existing solutions can be adapted or combined to solve this problem?

Group Think: Effective Brainstorming

Brainstorming is a process of generating ideas for solutions in a group. This method is very effective because ideas from one person will trigger additional ideas from another. The following guidelines make for an effective brainstorming session:

- Decide who should moderate the session. That person may participate, but his main role is to keep the discussion flowing.
- Define the problem to be discussed and the time you will allow to consider it.
- Write all ideas down on a board or flip chart for all participants to see.
- Encourage everyone to speak.
- Do not allow criticism of ideas. *All* ideas are good during a brainstorm. Suspend disbelief until after the session. Remember a wildly impossible idea may trigger a creative and feasible solution to a problem.

- **Choose the best solution.** Use your critical thinking skills to select the most likely choices. List the pros and cons for each of your selections. How do these lists compare with the requirements you identified when you defined the problem? If you still can't decide between options, you may want to seek further input from your brainstorming team.

Decisions, Decisions

You will be called on to make many decisions in your life. Some will be personal, like what to major in, or whether or not to get married. Other times you will be making decisions on behalf of others at work or for a volunteer organization. Occasionally you will be asked for your opinion or experience for decisions others are making. To be effective in all of these circumstances, it is helpful to understand some principles about decision making.

First, define who is responsible for solving the problem or making the decision. In an organization, this may be someone above or below you on the organization chart but is usually the person who will be responsible for implementing the solution. Deciding on an academic major should be your decision, because *you* will have to follow the course of study. Deciding on the boundaries of a sales territory would most likely be the sales manager who supervises the territories, because he or she will be responsible for producing the results with the combined territories. Once you define who is responsible for making the decision, everyone else will fall into one of two roles: giving input, or in rare cases, approving the decision.

Understanding the role of input is very important for good decisions. Input is sought or given due to experience or expertise, but it is up to the decision maker to weigh the input and decide whether and how to use it. Input should be fact based, or if offering an opinion, it should be clearly stated as such. Finally, once input is given, the person giving the input must support the other's decision, whether or not the input is actually used.

Consider a team working on a project for a science course. The team assigns you the responsibility of analyzing and presenting a large set of complex data. Others on the team will set up the experiment to demonstrate the hypothesis, prepare the class presentation, and write the paper summarizing the results. As you face the data, you go to the team to seek input about the level of detail on the data you should consider for your analysis. The person doing the experiment setup thinks you should be very detailed, because then it will be easy to compare experiment results with the data. However, the person preparing the class presentation wants only high-level data to be considered because that will make for a clearer presentation. If there is not a clear understanding of the decision-making process, each of you may think the decision is yours to make because it influences the output of your work; there will be conflict and frustration on the team. If the decision maker is clearly defined upfront, however, and the input is thoughtfully given and considered, a good decision can be made (perhaps a creative compromise?) and the team can get behind the decision and work together to complete the project.

Finally, there is the approval role in decisions. This is very common in business decisions but often occurs in college work as well (the professor needs to approve the theme of the team project, for example). Approval decisions are usually based on availability of resources, legality, history, or policy.

Key Takeaways

- Effective problem solving involves critical and creative thinking.
- The four steps to effective problem solving are the following:
  1. Define the problem
  2. Narrow the problem
  3. Generate solutions
  4. Choose the solution
- Brainstorming is a good method for generating creative solutions.
- Understanding the difference between the roles of deciding and providing input makes for better decisions.

? Checkpoint Exercises

1. Gather a group of three or four friends and conduct three short brainstorming sessions (ten minutes each) to generate ideas for alternate uses for peanut butter, paper clips, and pen caps. Compare the results of the group with your own ideas. Be sure to follow the brainstorming guidelines. Did you generate more ideas in the group? Did the quality of the ideas improve? Were the group ideas more innovative? Which was more fun? Write your conclusions here.

   _____

   _____

   _____

   _____

   _____

2. Using the steps outlined earlier for problem solving, write a plan for the following problem: You are in your second year of studies in computer animation at Jefferson Community College. You and your wife both work, and you would like to start a family in the next year or two. You want to become a video game designer and can benefit from more advanced work in programming. Should you go on to complete a four-year degree?
   1. Define the problem: What is the core issue? What are the related issues? Are there any requirements to a successful solution? Can you come up with a metaphor to describe the issue?

      _____

      _____

2. Narrow the problem: Can you break down the problem into smaller manageable pieces? What would they be?

3. Generate solutions: What are at least two “right” answers to each of the problem pieces?

4. Choose the right approach: What do you already know about each solution? What do you still need to know? How can you get the information you need? Make a list of pros and cons for each solution.

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2.11: Metacognition

Questions to consider:

- How can you become more aware of your own thinking?
- What is the benefit of thinkers using their thoughts deliberately?

For many of us, it was in kindergarten or first grade when our teacher asked our class to “put on our thinking caps.” That may partially have been a clever way for a harried teacher to get young scholars to calm down and focus, but the idea is an apt depiction of how we think. Depending on the situation, we may have to don several very different caps to do our best thinking. Knowing which cap to wear in which situation so we are most prepared, effective, and efficient becomes the work of a lifetime. When you can handle more than one complex thought at a time or when you need to direct all your focus on one crucial task is highly individual. Some people study well with music on in the background while others need absolute silence and see any noise as a distraction. Many chefs delight in creating dinners for hundreds of people in a chaotic kitchen but don’t care for making a meal for two at home.

When an individual thinks about how he or she thinks, this practice is called *metacognition*. Developmental psychiatrist John Flavell coined the term metacognition and divided the theory into three processes of planning, tracking, and assessing your own understanding.[2]

> ***“Becoming aware of your thought processes and using this awareness deliberately is a sign of mature thinking.”***

For example, you may be reading a difficult passage in a textbook on chemistry and recognize that you are not fully understanding the meaning of the section you just read or its connection to the rest of the chapter. Students use metacognition when they practice self-awareness and self-assessment. You are the best judge of how well you know a topic or a skill. In college especially, thinking about your thinking is crucial so you know what you don't know and how to fix this problem, i.e., what you need to study, how you need to organize your calendar, and so on.

If you stop and recognize this challenge with the aim of improving your comprehension, you are practicing metacognition. You may decide to highlight difficult terms to look up, write a summary of each paragraph in as few sentences as you can, or join a peer study group to work on your comprehension. If you know you retain material better if you hear it, you may read out loud or watch video tutorials covering the material. These are all examples of thinking about how you think and adapting your behavior based on this metacognition. Likewise, if you periodically assess your progress toward a goal, such as when you check your grades in a course every few weeks during a long semester so you know how well you are doing, this too is metacognition.

Beyond just being a good idea, thinking about your own thinking process allows you to reap great benefits from becoming more aware of and deliberate with your thoughts. If you know how you react in a specific thinking or learning situation, you have a better chance to improve how well you think or to change your thoughts altogether by tuning into your reaction and your thinking. You can plan how to move forward because you recognize that the way you think about a task or idea makes a difference in what you do with that thought. The famous Greek philosopher Socrates allegedly said, “The unexamined life isn’t worth living.” Examine your thoughts and be aware of them.

Becoming Aware of Your Thinking

Just as elite athletes watch game footage and work with coaches to improve specific aspects of their athletic performance, students can improve their mindset and performance reliant upon their thinking by starting to be aware of what they think. If a baseball pitcher recognizes that the curveball that once was so successful in producing strikeouts has not worked as well recently, the pitcher may break down every step of the physical movement required for the once-successful pitch. He and his coaches may notice a slight difference they can remedy during practice to improve the pitch.



Figure 2.11.12 Baseball pitchers and coaches analyze every component of their motion using video and other technology. (Credit: West Point, The US Military Academy / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Likewise, if Shamika, for instance, wants to be more generally optimistic and not dwell on negative thoughts, she may ask her friends to mention every time she adds a negative post on social media. Shamika may go even further by stopping herself when she says something that is not in line with her new, optimistic mindset. She could jot down the instance in a journal and capture her feelings at the time so that later she could analyze or think through why she was negative at that time. If you procrastinate on assignments, you may ask a friend to be your accountability buddy to help keep you on track. Thinking about how to focus on the positive, in Shamika's case, or avoid procrastination doesn't magically change the situation. It does, however, allow the owner of the thought to contemplate alternatives instead of becoming frustrated or mindlessly continuing to sabotage sincere goals. Think now of a personal example of a habit you may want to change, such as smoking, or an attribute such as patience or perseverance you may want to improve in yourself. Can you determine what steps you may need to undertake to change this habit or to develop a stronger awareness of the need to change?

Using Thought Deliberately

If you need to plan, track, and assess your understanding to engage in metacognition, what strategies do you need to employ? Students can use metacognition strategies before, during, and after reading, lectures, assignments, and group work.

Planning

Students can plan and get ready to learn by asking questions such as:

- What am I supposed to learn in this situation?
- What do I already know that might help me learn this information?
- How should I start to get the most out of this situation?
- What should I be looking for and anticipating as I read or study or listen?

As part of this planning stage, students may want to jot down the answers to some of the questions they considered while preparing to study. If the task is a writing assignment, prewriting is particularly helpful just to get your ideas down on paper. You may want to start an outline of ideas you think you may encounter in the upcoming session; it probably won't be complete until you learn more, but it can be a place to start.

Tracking

Students can keep up with their learning or track their progress by asking themselves:

- How am I doing so far?
- What information is important in each section?
- Should I slow down my pace to understand the difficult parts more fully?
- What information should I review now or mark for later review?

In this part of metacognition, students may want to step away from a reading selection and write a summary paragraph on what the passage was about without looking at the text. Another way to track your learning progress is to review lecture or lab notes within a

few hours of the initial note-taking session. This allows you to have a fresh memory of the information and fill in gaps you may need to research more fully.

Assessing

Students can assess their learning by asking themselves:

- How well do I understand this material?
- What else can I do to understand the information better?
- Is there any element of the task I don't get yet?
- What do I need to do now to understand the information more fully?
- How can I adjust how I study (or read or listen or perform) to get better results moving forward?

Looking back at how you did on assignments, tests, and reading selections isn't just a means to getting a better grade the next time, even if that does sometimes happen as a result of this sort of reflection. If you rework the math problems you missed on a quiz and figure out what went wrong the first time, you will understand that mathematical concept better than if you ignore the opportunity to learn from your errors. Learning is not a linear process; you will bring knowledge from other parts of your life and from your reading to understand something new in your academic or personal learning for the rest of your life. Using these planning, tracking, and assessing strategies will help you progress as a learner in all subjects.

Have you ever been in a situation where a series of events transpired that on reflection you wish you had handled differently? For instance, what if you were tired after a long day at work or school and snapped at your roommates over an insignificant problem and that heated exchange ruined your weekend plans? You'd been anticipating a fun outing with a large group, but now several people don't want to go because of the increased tension. Afterwards, you come up with several other ways you wish you had acted—you might have explained how tired you were, ignored the irritation, or even asked if you could continue your discussion of the problem at another time when you were less tired. You could call that wish metacognition after the fact. How much more effective could you be in general if instead of *reacting* to events and then contemplating better alternatives later, you were able to do the thinking *proactively* before the situation arises? Just the act of pausing to think through the potential consequences is a good first step to accomplishing the goal of using metacognition to reduce negative results. Can you think of a situation in which you reacted to events around you with less than ideal results? How about a time when you thought through a situation beforehand and reaped the benefits of this proactive approach?

Let's look at two seemingly ordinary examples of this concept. Think about your reaction and the eventual long- and short-term results of you walking into your math class on Tuesday afternoon to recall only then that you have a major closed-book exam that class session. You look around to see nervous classmates reading notecards or working practice problems. You choose to stay and take the exam wholly unprepared. You end up with a low D on the exam and now must contemplate the consequences of that result.



Figure 2.11.13 Self-awareness and self-assessment are critical in preparing for tests. (Credit: Magharebia / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Scoring such a low exam grade may not be the end of the world, certainly, but you may not maintain the GPA you had hoped to post, you may need to repeat the course, or you may get further behind in this subject because you didn't master the skills on this test. This is quite a bit of awareness about your thinking. Now you need to decide what actions to take as a result of your self-

awareness thinking. Contemplating this negative consequence may lead you to make an appointment with your instructor to discuss your situation, which is always a good idea. Could you take an alternate exam to replace this atypical low score? Even if the answer is no, you have still made a connection and shown your instructor that you are seriously thinking about your coursework.

Now consider the opposite scenario. What if you had entered your exam schedule onto your calendar beforehand and devised a viable plan to be prepared? You likely would have prepared in advance of exam days, studied the required materials, worked through similar problems, and come to the exam session more prepared than you did in the first example. Because you know you need a set amount of time to prepare for exams, you would have blocked that time on your calendar, possibly changing your work schedule for the week, declining social invitations, and otherwise altering your daily routine to accommodate this significant event. Consider how much better your results would be with this amount of preparation and how this would improve your overall performance in the course. You can take advantage of thinking about consequences before they happen so you can employ specific strategies to improve your learning.

Footnotes

- 2 Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), The nature of intelligence (pp. 231–236). Hillsdale, NJ: Erlbaum

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2.12: Information Literacy

Questions to consider:

- How do you go about verifying source validity, and why is this important?
- How do you use resources to improve your thinking?
- Where do you go to find print and online resources?

What type of system best helps you to manage your resources?

When conducting any type of thinking, you need to have a firm grasp on *information literacy*, or knowing how to access the sources you may need. Practicing good information literacy skills involves more than simply using a search engine such as Google, although that could be a starting point. You also engage in creative thinking (i.e., generating topics to research), analytical thinking (i.e., reading and examining the parts of sources), and critical thinking (i.e., evaluating sources for accuracy, authority, etc.). Then there is synthesis that is used when incorporating multiple sources into a research project. Information literacy utilizes all of the necessary thinking skills. If you saw the name of a person on the cover of a magazine, for instance, you might assume the person did something important to merit the attention. If you were to google the person's name, you would instantly need to use context clues to determine if the information your search produced is actually about your person and not someone else with the same or a similar name, whether the information is accurate, and if it is current. If it is not, you would need to continue your research with other sources.

Verifying Source Validity

The American Library Association defines information literacy as a set of skills that allow you to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information."[3] We need information almost all the time, and with practice, you'll become more and more efficient at knowing where to look for answers on certain topics. As information is increasingly available in multiple formats, not only in print and online versions but also through audio and visual means, users of this information must employ critical thinking skills to sift through it all.

In today's information environment, what would be the best way to find valid information about climate change? Would it be Wikipedia, NASA, a printed encyclopedia from 1985, or a report from a political campaign?

If you chose any answer except the NASA website, can you see how the other answers may have a vested interest in encouraging readers to believe a particular theory? The encyclopedia may not intentionally attempt to mislead readers; however, the write-up is not current. And Wikipedia, being an open-source site where anyone may upload information, is not reliable enough to lend full credence to the articles. A professional, government organization that does not sell items related to the topic and provides its ethics policy for review is worthy of more consideration and research. This level of critical thinking and examined consideration is the only way to ensure you have all the information you need to make decisions.

You likely know how to find some sources when you conduct research. And remember—we think and research all the time, not just in school or on the job. If you're out with friends and someone asks where to find the best Italian food, someone will probably consult a phone app to present choices. This quick phone search may suffice to provide an address, hours, and possibly even menu choices, but you'll have to dig more deeply if you want to evaluate the restaurant by finding reviews, negative press, or personal testimonies.

Why is it important to verify sources? The words we write (or speak) and the sources we use to back up our ideas need to be true and honest, or we would not have any basis for distinguishing facts from opinions that may be, at the least damaging level, only uninformed musings but, at the worst level, intentionally misleading and distorted versions of the truth. Maintaining a strict adherence to verifiable facts is a hallmark of a strong thinker.

You probably see information presented as fact on social media daily, but as a critical thinker, you must practice validating facts, especially if something you see or read in a post conveniently fits your perception. You may be familiar with the Facebook and Instagram hoaxes requiring users to copy and paste a statement that they will not grant permission for these social media sites to make public the content from their private pages. Maybe you've seen any number of posts and memes that inaccurately associate famous people with memorable quotations. We may even allow ourselves to believe inaccurate claims as truth when we experience different emotions including anger, fear, or loneliness; we want to believe a claim is true because it aligns with how we are feeling, regardless of any verifiable source. Be diligent in your critical thinking to avoid misinformation!

Determining how valid a source is typically includes looking into the author's credentials, experience, and status in the discipline; the actual content of the source material; any evidence the source presents as support; and whether any biases exist that may make the source questionable. Once you know who controls the content of the source you've chosen, you need to determine what biases or special interests the site or article may exhibit.

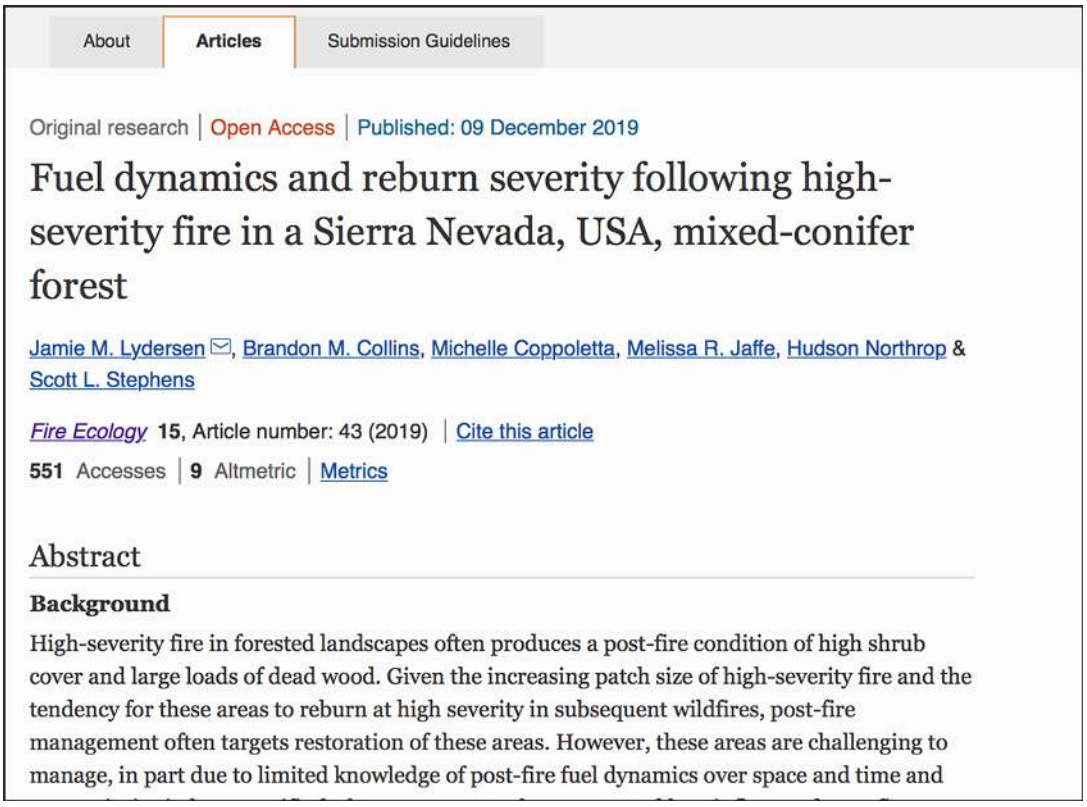
activity

Reflect on what bias the following sites may have. Without consulting the Internet, write one to two sentences on what ideas the following organizations may present. After you consider these on your own, conduct a search and see if you were accurate in your assumptions about the entities.

a. National Dairy Council
b. Yoga Society
c. People for the Ethical Treatment of Animals (PETA)
d. The American Medical Association

Whatever you write or declare based on sources should be correct and truthful. Reliable sources present current and honest information backed up with evidence you can check. Any source that essentially says you should believe this "because I said so" isn't a valid source for critically thinking, information-literate individuals.

Evaluating books, articles, and websites for validity presents different challenges. For books and scholarly articles, in print or online, you can typically establish if the source is current and from a reputable publisher or organization with information on the copyright page or journal publication information.


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Fuel dynamics and reburn severity following high-severity fire in a Sierra Nevada, USA, mixed-conifer forest

Jamie M. Lydersen, Brandon M. Collins, Michelle Coppoletta, Melissa R. Jaffe, Hudson Northrop & Scott L. Stephens

Fire Ecology **15**, Article number: 43 (2019) | Cite this article

551 Accesses | **9** Altmetric | Metrics

Abstract

Background

High-severity fire in forested landscapes often produces a post-fire condition of high shrub cover and large loads of dead wood. Given the increasing patch size of high-severity fire and the tendency for these areas to reburn at high severity in subsequent wildfires, post-fire management often targets restoration of these areas. However, these areas are challenging to manage, in part due to limited knowledge of post-fire fuel dynamics over space and time and

Figure 2.12.14 The most reliable sources of online information may be journals or related research-oriented websites, which include the author names, their credentials, and other data. However, unless they are "peer-reviewed," meaning independent experts have read and verified the quality of the information, even credible-looking sites may be more opinion- than fact-oriented. (Credit: Springer Open. https://fireecology.springeropen.com)

For a website, you should determine who owns this site. Is it a professional organization such as the American Medical Association? You can usually find this info in the *About* section of the site or in a copyright designation near the end of the landing page. Domain names can help you determine the purpose of the site, but you shouldn't rely solely on this website marker.

Domain	User
.edu	Used by **edu**cational institutions (i.e., colleges, universities, school districts); usually reliable sources of information, but individual members of these institutions may be able to create web pages on the site under the official domain that do not reflect the values of the school
.com/.biz	Used by **com**mercial or business groups; may be valid, but also may be used to sell products, services, or ideas
.gov	Used by **gov**ernment agencies; typically valid
.org	Used by **org**anizations, such as nonprofit groups or religious entities; may present information slanted toward a specific denomination or cause. You'll need to conduct additional research to verify validity.
.net	Originally created for networks or groups of people working on the same problem, .net is still a viable option for noncommercial sites such as personal blogs or family websites. You'll need to conduct additional research to verify validity.
Many other domains exist	Research the validity of domain names outside these most common ones.

Resources for Thinking

When you look into books, articles, and documentaries on thinking, you will find plenty of choices. Some books or articles on thinking may seem to apply only to a narrow group of readers, such as entrepreneurs or artists. For example, the audiences for these two books about thinking seem highly selective: Carl Sagan's *The Demon-Haunted World: Science as a Candle in the Dark* may be mostly directed to the science community, and James Lohan's *Lies My Teacher Told Me: Everything Your American History Textbook Taught Wrong* is likely of interest primarily to historians. And some chapters may focus specifically on those groups; however, most texts on thinking are also applicable to other disciplines. You may have to work a bit harder to find a common ground or generate your own examples that explain the concepts from the book, but you can still reap benefits from understanding different perspectives. Don't immediately disregard a book or article just because it doesn't seem to fit your thinking perspective on the surface; dig a bit more deeply to see what you can learn. Remember, being open-minded and considering as many alternate approaches as possible are two hallmarks of critical thinking.

Finding Print and Online Resources

When you need to research a topic, you probably start with a search engine. That can be helpful, but can easily lead you down incorrect paths and waste time. Use advanced searches, filters, and other means to target your results more specifically. However, don't limit yourself to just Internet sources; print journals, books, and articles are still significant sources of information.

Your college may have access to extensive stores of subscription-based site content, photos, videos, and other media through its library, providing more than enough information to start researching and analyzing any topic. Depending on the specific database and school, you may be able to access some of these resources remotely; others may require you to visit the library in person. Remember, when you are gathering and arranging pieces of information, keep track of the source and the URL so that you can both cite it correctly and return to learn more if needed.

Some other more general places to explore educational, inspirational, and thought-provoking material follow:

- Exploring the TED website is worth a few minutes of time. There you'll find short videos (limited to 18 minutes) of speaking demonstrations by diverse experts in fields covering all disciplines. If you are in an exploratory phase of your thinking and researching, you can scan the TED Talk topics related to your interest area.
- You may be familiar with the Khan Academy, created in 2008 by Salman Khan, as an online learning resource for students and teachers containing tutorials, videos, and practice sets in a variety of subjects from science and mathematics to grammar lessons.

- Massive Open Online Courses (MOOCs) provided by Coursera, Udemy, and Udacity, provide learners and thinkers the chance to take courses, attend webinars and discussions, and learn about a large number of subjects, often free of charge. Much of the content is provided by major universities, and the courses are often facilitated by faculty.
- For-profit companies and nonprofit groups such as the Foundation for Critical Thinking (FCT) can also help you hone your thinking. The FCT presents materials, seminars, and conferences to help people think with "clarity, relevance, logic, accuracy, depth, significance, precision, breadth, and fairness."

Creating a System for Managing Resources

You could have all the money (or time or cars or great ideas) in the world, but that won't do you any good if you haven't also created a system for managing all your resources. In the same way you might feel overwhelmed with all the choices when a waiter gives you a book-sized menu with hundreds of options, you can stall your thinking if you don't have an effective and efficient way to access all the great articles, websites, books, podcasts, webinars, and other idea resources you can amass for the life of a project or during a college course or for a life event.

Systems to manage your ideas and thoughts don't need to be elaborate. The best idea-management system is the one that gets used, so you need to be comfortable with what all is involved in managing these thoughts. Keep in mind, once you get into the swing of researching for and keeping good ideas, you're going to end up with resources in many different formats. Gone are the days when one shelf of an oak bookcase near your desk could contain all your thinking resources on a topic. You may still find books, so you don't need to discard the bookcase just yet, but very likely, you'll also have online resources including search results, document files, websites, blogs, audio files, videos, and more. You can use filing folders, binders, online folders, boxes, or computer systems to organize your ideas.

A word about stacking papers and clutter: don't. Clutter impedes creativity, steals focus, and represents procrastination. Fight the temptation to allow clutter to overwhelm your projects and workspace. File or trash anything you are not using right at the moment; this daily practice will save you a tremendous amount of time that you could waste looking for papers or articles you saved for later review.

Like physical clutter, a messy online environment can stall productivity and clear thinking. One key to effective information and idea management is a simple, consistent labeling system. Some companies call this a *naming protocol or naming convention*, a standard way all online files, folders, and drives are labeled for easier retrieval and long-term storage. If you don't think through a file name with this forward-looking approach and then you don't access that file for several months, you aren't likely to remember which file is which, and you may end up wasting valuable time opening random files in an attempt to find the one you need. This isn't a very efficient way to operate, and in some work environments would not be acceptable on large-scale and important projects. For example, if you were taking an upper-level literature course studying poetry, and remember you filed an excellent summary of one of the poems a few years earlier in your freshman composition class, you won't be too happy when you have 78 documents called *Notes*. Great idea—lousy document/idea management system.

If your searches will take place on multiple devices--a laptop and a smartphone, for example, you could use a notetaking app such as Evernote, which contains a wealth of organizational tools and has various levels of access. You can access the same note regardless of where you're searching. In the same way, you could even use a series of Google Docs or Sheets, as long as you consider the file naming and organizational conventions mentioned above. For example, if you needed to put together a research paper requiring 20 data sources, you could use a spreadsheet to keep track of the source article name, author, topics, potential data points you plan to use, the source, and the URL. Even if you didn't incorporate everything into the final paper, such a method would save you a lot of time trying to track down small pieces of information. (The sheet would also be a great reference when you write your bibliography.)

Finding print and online sources demands a great deal of time and effort. Understanding how different approaches to thinking are appropriate for various situations as you research will help you be more creative and critical as you identify and verify your sources.

ACTIVITY

Quite literally, all careers need thinkers. Many jobs today expect employees to come up with original ways of doing routine tasks. Nurses may consider a more effective way to convey necessary information about patient care to other members of the medical team. Teachers must reconcile individual student learning needs with the reality of large classrooms. Attorneys think

about all the consequences of presenting a client's case in a certain manner. And chefs balance the cost of using the finest ingredients with customer preferences and profit margins.

Any career you can imagine has some amount of thinking involved. The most successful workers in any industry are the ones who think beyond the ordinary limits or expectations established in that profession and create new and improved ways to do ordinary jobs.

Consider the types of thinking required for the jobs in the table below.

Industry	Job Title	Job Descriptions	Thinking type Required
Transportation	Air traffic controller	Regulates air traffic for outgoing and incoming aircraft; responds to emergencies; schedules planes to specific gates to minimize delays	
Healthcare	Pediatric oncology nurse	Cares for critically ill children; assists doctors in diagnoses, treatment, and examinations; communicates with patients and care providers	
Internet technology	Computer analyst	Maintains computer hardware and software systems; troubleshoots user problems; suggests modifications for improved productivity	
Education	College professor	Teaches, evaluates, and guides post-secondary students through various academic subjects working toward various degrees and certificates	

Footnotes

- 3 "Information Literacy." American Library Association. Accessed February 1, 2020. literacy.ala.org/information-literacy/

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2.13: Career Connection

All professions need thinkers to take good ideas and make them better and to tackle problems that seem unresolvable and make sense of them. No job or career area is exempt from this crucial human resource. Your critical thinking in college will help you succeed in the work you do after your academic journey. Make a list of your top three ideal careers. What types of thinking are required of each? How will your time in college better prepare you for this type of work?

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2.14: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

How do you feel about the ways you think? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning “least like me” and 4 meaning “most like me.”

a. I understand how to approach problem-solving.
b. I have creative potential.
c. I often think about how I’m learning
d. I know how to find and evaluate valid information.

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2.15: Where do you go from here?

Thinking isn’t something we can turn on and off when we enter or leave a classroom—we think about everything. We may have different strategies and processes for thinking in different environments, but all thinking starts with our own ideas coming into contact with new information and experiences. What would you like to learn more about? Choose topics from the list below, or create your own ideas relative to thinking and research them.

- learning to be a creative thinker
- technological advances in the study of the brain
- thinking and brain trauma
- thinking in leadership roles
- theories of nontraditional learning methods

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2.16: Chapter Activities

Chapter Takeaways

- Your ability to think critically and creatively is a key to your success in college and in life. You should develop and practice these skills.
- Bloom's taxonomy provides a framework to describe the many kinds of thinking we need to do. Up to this point, you probably have practiced most of the lower-level thinking skills but have not had much experience with the higher-level skills (critical thinking and creative thinking).
- Critical thinking involves evaluating the strength of ideas or concepts by asking questions about them. Critical thinking will also allow you to identify and weed out logical fallacies that weaken the value of an idea.
- Creative thinking is the process of generating new ideas, concepts, or solutions. This often involves adapting existing ideas or combining them in new ways to create a new solution.
- Problem solving is effectively achieved by applying both critical thinking and creative thinking to generate viable solutions and decisions.

Chapter Review

1. List the six levels of thinking described in Bloom's taxonomy.

   _____

   _____

   _____

   _____

   _____

   _____

2. Which thinking skill is most important for short answer quizzes? Why?

   _____

   _____

3. List five verbs that describe the application level of thought.

   _____

   _____

4. What thinking skills are you using if you are blogging? How do you use each one?

   _____

   _____

   _____

   _____

5. What is critical thinking?

   _____

   _____

6. Why is it important to pose some questions about the source of the material you read? What kinds of questions should you ask?

   _____

   _____

7. What is a logical fallacy? Give an example of two types.

8. List six words that signal a broad generalization and a recommended alternative that would resolve that problem of each.

9. What are some ways in which you can feed your curiosity?

10. Why is brainstorming more effective at generating new ideas than individual work?

11. List the four steps of problem solving.
    1. _____
    2. _____
    3. _____
    4. _____

12. How do you use critical thinking and creative thinking in solving problems?

? Make an Action List

Two things I will do to practice	Action	By when I expect to take the action	The expected results of that action
My critical thinking	1.		
	2.		
My creative thinking	1.		
	2.		
My problem solving	1.		
	2.		

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CHAPTER OVERVIEW

3: Self-Directed and Active Learning

3.1: Bloom’s Taxonomy
3.2: Active Learning from Lectures
3.3: Active Learning from Reading
3.4: Test Taking and Preparation
3.5: Collaborative Student Learning- The Art of Study Groups
3.6: Library Research- It's a Process

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3.1: Bloom's Taxonomy

In 1956, educational psychologist Benjamin Bloom and his associates conceptualized a taxonomy to classify aspects of human learning that included three basic domains: cognitive, affective, and psychomotor. The cognitive domain of this taxonomy represents a continuum of thinking that can be useful for teachers as they develop curricula for students, but also for students as they try to determine what a professor may be asking them to do on a particular test question or writing assignment. Bloom's Taxonomy can also help students challenge themselves as they are creating active learning study strategies and/ or developing questions for self-testing for an exam. In addition, once students have taken an exam in a particular course, conducting a post-test review of the levels of thinking required by exam questions will provide clues regarding how to effectively study for future exams.

Table 5-1: Bloom's Taxonomy: Cognitive Domain (1956)

Level of Cognitive Domain	Thinking Level	Generic Activity	Question Cues	Sample Questions	Example Activities of Products
Remembering	Basic thinking (lowest level)	Recalls facts, patterns, settings, etc.; remembers previously learned material	Cite, label, name, list, state, quote, reproduce, define, identify, describe(who, what, where, when)	Who is…? What is…? Where is…? Where was…?	List items. Make a timeline. Recite a passage. List certain memorized facts.
Understanding	Basic thinking	Understands what is being communicated; grasps the meaning of material and can state in own words; can infer causes and predict consequences	Explain, restate, paraphrase, summarize, describe, illustrate, give examples, discuss, distinguish, interpret	How would you put this into your own words? What is an example of _____? How would you translate ____ to a visual form? What was the main idea?	Create a flowchart to illustrate the sequence of events. Retell the story in your words. Write a summary.
Applying	Higher-level thinking	Uses the information in new concrete situations	Apply, classify, solve, demonstrate, calculate, illustrate(how it looks in new situation), complete, employ	Can you apply this idea to your own life? Can you come up with another example? What does "x" equal in this case?	Use this method to apply to a new case study. Solve different types of math problems.

Analyzing	Higher-level thinking	Breaks new information into parts to understand relationships; sees patterns and organizational structure	Diagram, analyze, diagnose, conclude, outline, separate, explain(relationships), infer, find, classify, discriminate, compare, contrast, why	Why did this happen? What were some of the motives behind _____? What was the problem with _____? Why did ____ changes occur? Can you explain what happened when _____? What difference exists between ____ and ____?	Construct a diagram that shows the relationships between the parts. Research the issue to find information that supports a view. Write a biography.
Evaluating	Higher-level thinking	Make judgement of the value of an idea, method, resource, etc.; assess the value of theories, presentations, texts; make choices based on argument; recognize subjectivity	Assess, appraise, critique, judge, weigh, recommend, convince, support, evaluate,rank, decide, select, grade, defend, justify, compare, contrast	Is this a good or bad thing? Can you defend your position on ____? What do you believe and why? What would you have done differently? How effective is ____? What do you think about ____? Is this a credible source?	Debate an issue from multiple perspectives.State your opinion and evidence for your opinion. Prepare a list of criteria used to judge something and apply it.
Creating	Higher-level thinking	Creates something new from the elements of the old information; generalizes from given facts; relates knowledge from different areas	Create, design, compose, develop, plan, propose, integrate, invent, generalize, combine, rewrite	What would happen if ____? How can we improve ____? Can you design a ___ to accomplish ___? How can this idea be combined with that idea to develop a better understanding of ____? How can we solve questions?	Invent a new machine. Write a story. Compose a new piece of music or work of art. Devise a new way to do something.

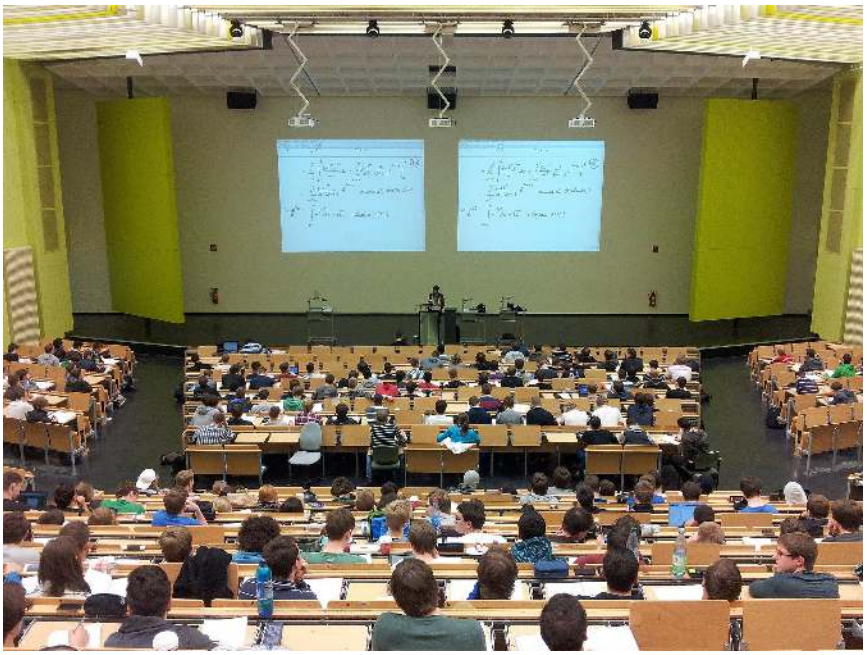
Students who challenge themselves to engage in higher-level thinking such as Applying, Analyzing, Evaluating, and Creating are using what professors on our campus would commonly characterize as “critical thinking.”

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3.2: Active Learning from Lectures

The learning of information and skills presented in class lectures or discussions should be viewed as a process: preparation to take in the new information, the act of taking in the new information, and then reviewing the information so that it is later accessible (recalled from memory) to use for a project, paper, or test.



The activities suggested for “Before Class” in Table 5-2 help students develop a mental framework into which this new information can be “filed” or organized which aids information recall (Bower, Clark, Lesgold, & Winzenz, 1969). It also makes note taking easier because you are familiar with the material and feel less panicked about getting everything noted in full detail.

Attending class and taking the notes is important primarily because the professor may be presenting information that is not presented in the text. It should also be seen as a structured opportunity to engage with the material that will further aid recall when needed. Oftentimes, students can also get clues as to what a professor perceives as important material from attending class that will aid in test preparation.

Table 5-2: Effective Techniques for Learning from Class

Before Class	During Class	After Class
Complete assigned readings to prepare for class. Take notes or mark your text for easy reference.	Take notes. Active engagement with the material (like writing down what you are hearing) helps improve memory and concentration and material to later review. Have a positive mindset about taking notes you are writing down answers to questions on the test.”	Review your notes and handouts within 24 hours of taking them. Fill in details that you remember but did not have time to write down. Write questions for the notes that you can use for self-testing later. Write a summary of the day’s notes.
Prepare questions that you may have about the reading.	Put a date on your note paper. It helps to also include the text chapter or general topic that might be related to these notes as well.	Compare your notes with a reliable classmate who may help give you ideas on what you missed that might be important or how to better organize the information. Discuss the notes to add another-layer of processing.

Before Class	During Class	After Class
Review notes from the previous class period to get a sense of where you may have left off.	Use active listening techniques. Refer to the informational box called “Ten Tips for Active Listening” for more information.	Follow up on questions that you have written down with your professor, the teaching assistant, or another reliable classmate.
Be sure you have your materials ready for class: text, three-ring notebook with paper, writing utensils, highlighters, charged laptop, etc.	Have your textbook accessible in case your faculty member refers to specific information. Write down that reference in your notes as it is probably important information.	Integrate your class notes with your text notes or markings. If you highlighted in your book, add some of that information to your notes for the “whole” picture.
Get a good night’s sleep. It is easier to concentrate on the lecture when you are alert.	Write down the main points a speaker is making along with any supple-mental details like examples or experiments. Do not expect to be able to write down every word the speaker says.	Develop tools that swill serve to help you review the material now, as well as later. Create visual diagrams* of concepts, develop ram cards* of concepts, reorganize your notes, etc. *Refer to informational boxes on “Visualize Your Information” and “Cram Cards for Long-Term Review.”
Make it a habit to attend every class. Put your classes on your schedule and treat them as a limited opportunity to engage with your professor and this material.	Use abbreviations for commonly used words to increase your speed in note taking. Create some abbreviations of your own.	Self-test your comprehension of the information on an ongoing basis. Do not just “look over” or read what you have written. Use the questions you have created. Cover up the “answer” and see if you can explain what is in the notes. Use the cram cards or visual diagrams to test yourself.
If you cannot attend class due to illness or an-other extraordinary reason, contact a classmate to arrange for notes. It is always a good idea to send an e-mail or call your professor as well.	Develop a system of organization for your notes that works for you. Common methods include the Cornell, Outlining, Mapping, Text-Class, and Sentence Methods. Refer to informational box called “Note Taking Methods: What Is Right for You?”	
	Leave space between main points so that you can add in new information that you may have missed or from the text.	
	If the professor writes it down or puts it on a PowerPoint slide, it is probably important, so write it down.	
	If the professor repeats it, it is important, so write it down.	
	Listen for cues like “very important,” “in summary,” or sequence words like “first,” “second,” etc. This information provides cues for what is important and possible note organization.	
	Ask questions you may have. If you are not comfortable talking in class, write them down and talk with your professor later.	

Adapted from Dembo Sell (2008) and Downing (2008).

Ten Tips for Active Listening

Effective note taking in class requires the use of active listening techniques for optimal results.

1. Accept responsibility as a listener.
2. Adopt a positive attitude toward listening. Listening is a choice.
3. Sit somewhere in the classroom that will minimize distractions and allow you to focus on the professor.
4. Maintain eye contact with your professor.
5. Focus on the content being presented rather than the delivery.
6. Ask questions in class.
7. Ask mental questions and search for the answer in the lecture or discussion.
8. Avoid emotional involvement that may impair your ability to concentrate or filter important information.
9. Clue in on non-verbal communication, such as exaggerated movements, excitement, etc., as it may serve as a cue to important information.
10. Monitor your concentration throughout the class period and continually refocus.

Adapted from Kline (2002) and Treuer (2006).



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3.3: Active Learning from Reading

As with learning from lectures and discussions, the learning of information and skills presented in readings, texts, and written text from a Web site should be viewed as a process: preparation to take in the new information, the act of taking in the new information, and then reviewing the information so that it is later accessible (recalled from memory) to use for a project, paper, or test.



Students who simply start and finish a reading with no further actions taken are really wasting their time. Reading a text needs to be approached properly in order to ensure comprehension and retention of the information. Planning for an active reading session by engaging in the "before reading" activities facilitates an active mindset to the reading session and discourages "auto-pilot reading" that results in scanning of the words but no real careful thought about what is being said.

Preparing for class by reading assigned texts related to the lecture material is extremely important to optimize the lecture experience. If you have a professor who tends to lecture at a fast pace, you have the foundational information and only need to focus on writing down unfamiliar information. If your professor expects class participation in discussions or utilizes active classroom techniques, such as case studies, small group activities and discussions, simulations, or demonstrations, you will understand what is happening and be able to contribute to the learning experience. Marking or highlighting your text for main ideas while reading not only keeps your mind focused on the reading but also serves to prepare you for easier exam review.

Table 5-3. Effective Techniques for Reading

Before Reading	During Reading	After Reading
Preview the reading headings to get a "big picture" of the outline of the reading. Look at the pictures and figures. Check out the bold and italicized words.	As you are reading, seek out the answers to the questions that the reading or you generated rather than passively scanning the words.	Take reading notes from the highlighted material from the text. Utilize visual organizers and summaries to capture information. Revisit the informational box on "Note-Taking Methods: What Is Right for You?" and visit "Visualize Your information and "Cram Cards for Long-term Review."
Preview any questions that the chapter may offer so that you can actively seek answers to those questions.	Monitor your concentration and comprehension. After each paragraph, ask yourself, "What was the main point of that paragraph?" After each section, summarize what you have read.	Answer the questions that a the reading may have provided or that you developed. Reread sections in which you remember little information.
Turn text headings into questions so that you can actively seek answers to those questions. Jot those questions down in the margin of the text or in your notes if you plan to take reading notes.	Mark your text. Highlight the main idea of a paragraph or write down the main idea of a paragraph in your notes. If you cannot mark your text, take reading notes on the main ideas. Refer to the informational box called "In Search of Main Ideas" for more information	Integrate your reading notes and lecture/discussion notes into one location for easier review for an exam.
Plan for a high energy time of the day to read. Consider breaking up a long reading assignment into multiple, shorter reading sessions.	Look up the definitions to words that you do not understand to help build your vocabulary and facilitate understanding of the topic.	Discuss readings with classmates on a regular basis. Take turns explaining to each other sections of the reading. Ask and answer reading questions. Jot down questions that are unclear to the study group to ask the professor in class or during office hours.
Be sure you have your materials ready for reading: text, notebook paper, writing utensils, high-lighters, charged laptop, etc.		

Adapted from Dembo and Seli (2008) and Downing (2008).

In Search of Main Ideas

Some students do not actively take notes or mark their readings and texts because they determine it is a lot of extra work to write down so much information. However, the problem is that students are usually writing down too much information and not really cluing in to the main ideas. Here are some tips for identifying the main ideas when reading:

1. The Table of Contents and chapter outlines provide a broad view of the main points that will be covered in a reading. Flesh out the outlines that are already provided for you.
2. Oftentimes in a textbook, the main idea is the first or last sentence of a paragraph. If it is not the first or the last sentence, then look back at the entire paragraph to see what the overall issue seems to be. Look for the overall pat- terns of your textbooks.
3. Titles, headings, and subheadings announce the major subject. Make these headings into questions, and the answers to the questions will likely be the main ideas.
4. Bold and italic words point to a main idea or key concept that you need to understand.
5. Repetition of key words or phrases throughout the text point to a main idea.
6. Chapter questions at the end of the chapter are about the main ideas of the text. Answer those questions and you will identify your main ideas.
7. Summaries presented at the end of the chapter also tend to restate the main ideas briefly. Flesh these ideas out with some supporting ideas, and you would have a good view of the entire chapter.
8. Stop and look at the visuals—pictures, diagrams, tables, etc. Oftentimes, the message depicted in the graph or picture is typically a main idea.
9. Detailed statistics, several examples in a row, and other details often signal that a main idea is being clarified, proven, supported, etc. Track back or ahead to find the main idea they are trying to illustrate.
10. Text that includes bullet points, numbering, or sequences is often a main idea.
11. Look for organizational patterns in the reading that might highlight the main ideas. For instance, are two issues being compared or contrasted? What was the effect of a certain event? Are problems and various solutions being presented? Is there a timeline of events that is important?
12. Be intentional about searching for the main ideas. Ask yourself at the end of each section or paragraph, "What is the point?" or "What is it that the author wants me to know?"
13. If you are reading a narrative, ask yourself questions like, "Who are the main characters?" "Why is this character important to this story?" "Why did the author chose to tell this part of the story?"

Finally, taking the time to think critically about the reading you have done further solidifies that information in your memory and can serve to prepare you for exam review. Summarizing material using visual organizers (refer to informational box "Visualize Your Information" and Figure 5-1) moves your thinking from low levels of thinking to high levels of thinking on Bloom's Taxonomy. Integrating text and lecture notes and discussing readings with your classmates and professor promotes memory storage of that information and thinking at higher levels as well.

Visualize Your Information

Summarizing main ideas of the readings or lectures can be difficult without the right tools. Visual organizers can help students condense important information into visual diagrams that can be easily reviewed for exams or help organize a writing assignment. Muskingum College's Center for Advancement and Learning (n.d.) hosts a useful Web site that summarizes and provides examples of various visual organizers (a.k.a. Information Organization Strategies) at

muskingum.edu/~cal/database/g...anization.html (Web site wants username and password now.)

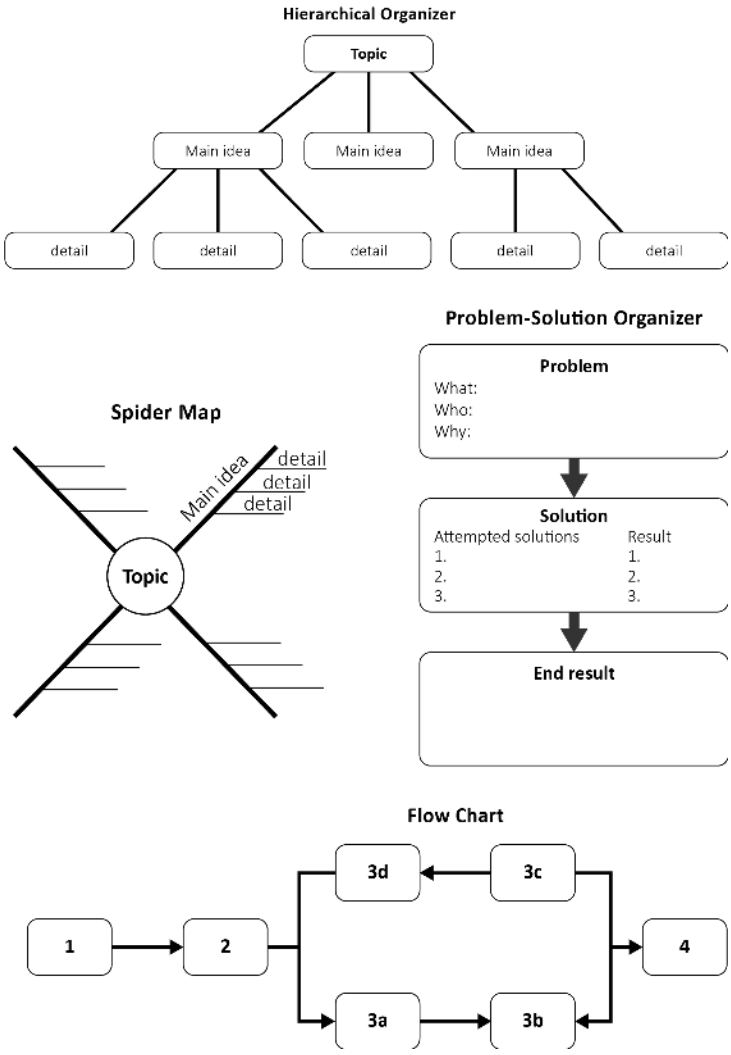
Consider how you might be able to apply several pages of text to a simple flowchart, hierarchical organizer, comparison-contrast organizer, spider map, etc. (See Figure 5-1.)

An additional benefit of using visual organizers is that you are thinking about the material at a deeper level as you identify the proper visual tool and apply the information. While at first it may take more time to determine the proper tool, it will get easier with practice and become second nature.

Activity 5-2

Utilizing what you have learned from the informational boxes "In Search of Main Ideas" and "Visualize Your Information," select a text chapter or a week of class notes and create some visual organizers that summarize the main ideas of that material. Ask a classmate to share in the same exercise and compare your work in a critical manner. What have you learned from this exercise and each other?

Figure 5-1. Examples of visual organizers



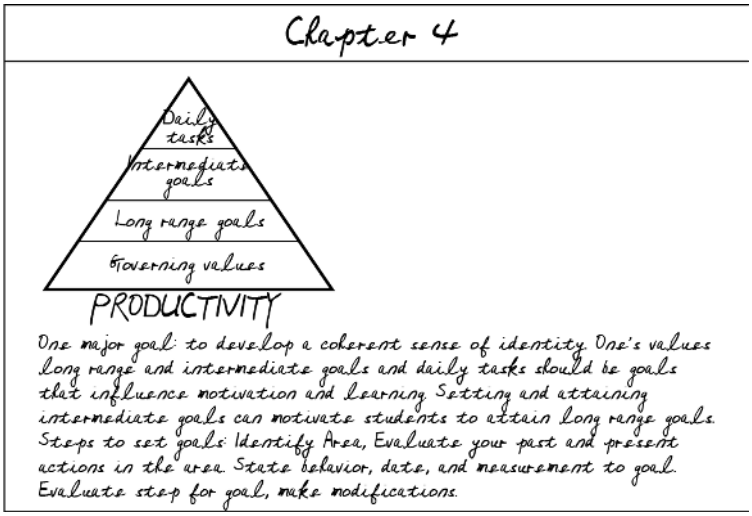
Source: Muskingum College's Center for Advancement and Learning (n.d)

Cram Cards for Long-term Review

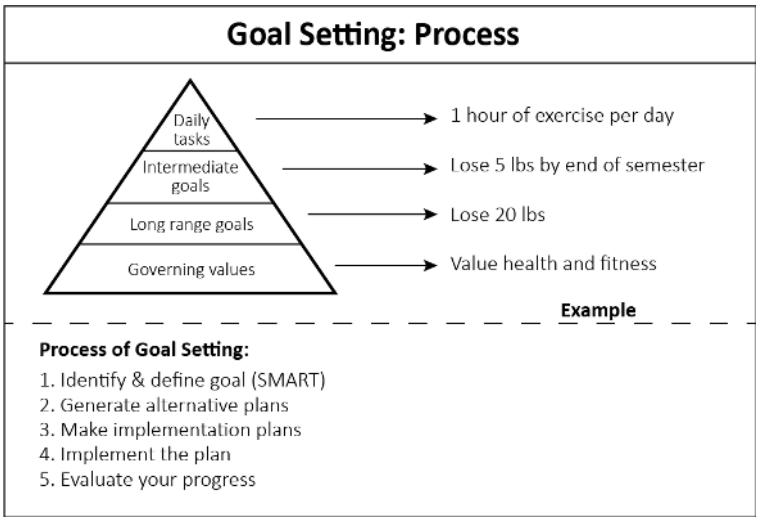
The use of "cram" in cram cards is deceiving. Cram cards are a study tool that promote the active learning of reading or lecture notes and allows for the easy and portable review of material over a longer period of time, therefore promoting later recall. It is a technique that will take some practice to hone your skills in selecting main ideas, but students who use cram cards indicate it is well worth their time.

Tips for Writing Cram Cards:

- Use 4 x 6 index cards (3 x 5 size tends to be too small)—some enthusiasts will even use the colored index cards for different sources of information (i.e., notes versus text reading) or topics (e.g., blue for English and green for Biology).
- Make one cram card per major concept or main idea.
- Do not simply take notes on the card; capture a summary of the main ideas maintaining the proper relationships of the concepts.
- Write the information in your own words.
- Include book examples or provide real-life examples for difficult concepts.
- Include key words.
- Be sure to write legibly.



Example of a Bad Cram Card



Example of a Good Cram Card

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3.4: Test Taking and Preparation

Students need to develop a mindset that every time they attend class or complete a reading assignment they are preparing for the next exam, because oftentimes so much of their grade rides on those exams. In college, it is not uncommon for your entire course grade to be based on two or three exams with no options for a retake or extra credit. Instead of an exam being over one or two chapters, exams are more likely to be over 5+ chapters of material, and in the case of a comprehensive exam, an entire semester's worth of material. Intentionally working through the process of preparing for, taking, and learning from the testing process will facilitate successful outcomes.



Table 5-4. Effective Technique for Test Preparation and Taking

Before the Test	During the Test	After the Test
Go to all of your classes and take lecture notes and read all of your assigned reading using techniques described in this chapter.	Mark your exam with the necessary identification. Read all instructions on the exam. Scan the exam for question types, point values, etc.	Conduct an error analysis for items missed on the test. Look up the correct answers. Determine the nature of the errors you made.
Develop a study plan and schedule the time to review for an exam over several days. Refer to "Create a Five-Day Study Plan for Exams."	Develop a plan for how you will use your time to complete all questions on the exam.	Talk with your professor about items you missed on the exam. Discuss adjustments in your test preparation methods if necessary.

Schedule study sessions with classmates in advance of the night before the exam.	Read each item carefully and fully before marking an answer. You might find clues to the answer and will be less likely to make a preventable mistake.	Analyze the test questions to see if patterns arise, such as,"Were most of the questions from the lecture, the book, or both?" "What types of questions were asked?" "What levels of thinking were being tested based on Bloom's Taxonomy?" etc.
Be sure you have materials you need for the exam ready at least the night before the exam, such as multiple writing utensils, scantrons, blue books, notebook paper, etc.	Skip difficult questions and come back to them if you are pressed for time. Caution: if using a scantron to record answers be very careful that you do not incorrectly record your answers on the wrong line and get off track.	Review the methods that you used to study for the exam and determine what adjustments you need to make in preparing for the next exam.
Get a good night's rest the night before the exam.	If time is available at the end of the exam, review questions you marked as "difficult" in order to check for errors.	Determine your overall grade in the course based on the new information that this grade has provided you. Talk with your professor and academic advisor if you have concerns about your overall grade.
Eat a good breakfast prior to the exam. Avoid caffeine prior to the exam.	If you have an essay question to write, take the time to briefly outline an answer to ensure that you are answering all aspects of the question and that you provide a well-organized answer for your faculty member to read.	Archive your exam for future reference.
To ensure that you are on time to your exam, set two alarm clocks or arrange to have a friend call you to make sure you are awake.	Try not to leave any answers blank. You might be awarded partial credit or even make a correct guess.	
	Take a moment to take some deep cleansing breaths (or any other quick relaxation techniques) if you feel stressed by a question or the exam as a whole.	

Preparation for an exam should begin the first day of class. Repeated exposure to material over a longer period of time (Baddeley, 1982; Bahrick & Hall, 1991) optimizes the recall of information when it is needed. Every assigned reading, every opportunity to take notes and engage in class activities, and a routine of reviewing notes should be considered activities toward exam preparation. The volume of information that students are responsible for on each exam is much larger than experienced in high school. Careful review of the material prior to each exam is required for optimal performance, and student reports tell us that the habit of "cramming" the night before the exam is not going to lead to positive, long-term results. Research of the brain supports this typical finding. Physical and neurochemical changes in the synapses of the brain occur when information is learned, a process called long-term potentiation (Kandel & Schwartz, 1982). Without proper time and repeated stimulation of the neural circuits, long-term learning of this information will not occur efficiently and may not be accessible when needed for a test. Planning for a review period over five days prior to the exam and healthy eating and sleep habits cannot be overemphasized.

Activity 5-4

Identify when your next substantial exam will be given in a class. Create a five-day study plan using the formula described in "Create a Five-Day Study Plan for Exams" and the "Five-Day Study Plan Worksheet" at the end of this chapter. Once you have created this plan, incorporate the schedule into your time management calendar for implementation.

Oftentimes, students jump right in to taking an exam feeling stressed and rushed with a need to regurgitate information immediately. However, approaching a test in a careful and methodical way can help ensure the best results. You can best utilize your exam time by taking the time to survey the exam directions and point values and planning how to approach sections of the

test. Strategy is particularly important for tests with mixed types of questions (i.e., multiple choice and essay) or tests with multiple essay questions. For ex- ample, if you were to spend too much time on the multiple choice questions and not allocate enough time to complete an essay question, you may have answered the majority of the total number of questions but still do poorly on the exam if the essay question was worth a larger portion of the exam's total points. Plan your time carefully and manage your stress.

Create a Five-Day Study Plan for Exams

Making a plan that will allow for the careful review of all of the assigned and presented material leads to less stress the day of an exam and the best conditions for recall and performance on an exam. Here is a simple method for creating a study plan:

1. Break the material for the exam into four manageable "chunks." If material can be logically divided by chapters, use that method. If not, make up your own chunks based on the content of the material. Note: It is not a good idea to break up information by the method of delivery (i.e., one chunk equals notes, one chunk equals readings, etc.). You want to include all information on specific topics together in one chunk (e.g., information about the topic of osmosis from the lecture notes and the textbook in a chunk).
2. Plan to spend about two hours studying on each of the five days.
3. You should work with the material on the exam in two ways, by preparing that material for review and by reviewing that material. Preparation of material incorporates study techniques discussed earlier in this chapter such as combining and clarifying lecture and textbook notes, creating visual organizers for topics, developing cram cards, solving practice problems, creating self-testing questions using multiple levels of Bloom's Taxonomy, etc. Once you get the hang of preparing material for review, you could do some of that along the way (for instance creating cram cards for readings and notes) to reduce the amount of time needed for preparation at this time, leaving more time for review.

Example of the Schedule for a Five-Day Study Plan

Day One
Prepare 1st Chunk – 2 hours

Day Two
Prepare 2nd Chunk – 2 hours
Review 1st Chunk – 30 minutes

Day Three
Prepare 3rd Chunk – 1.5 hours
Review 2nd Chunk – 30 minutes
Review 1st Chunk – 15 minutes

Day Four
Prepare 4th Chunk – 1 hour
Review 3rd Chunk – 30 minutes
Review 2nd Chunk – 15 minutes
Review 1st Chunk – 10 minutes

Day Five
Review 4th Chunk – 1 hour
Review 3rd Chunk – 30 minutes
Review 2nd Chunk – 30 minutes
Review 1st Chunk – 30 minutes

Taking some time to plan out what material will go into each chunk will ensure that you do not miss anything. Use the "Five-Day Study Plan Worksheet" at the end of this chapter as a guide for your planning.

This method typically works very well for courses that offer two or three tests throughout the semester; however, a similar method could be modified by the number of days or the amount of time spent each day if a course offers more exams with less material on each exam.

Tips for Better Test Taking

The types of test items on a test are as different as the professors who created the tests. "Objective" test questions refer to items in which students have to recognize the correct answer from a list of provided options (e.g., multiple choice, true-false, matching). In

most cases there is one best answer, though it is important to note that a professor could indicate in the directions that you can select more than one answer. “Subjective” test items are the fill-in-the-blank, short answer, or essay questions in which students must recall and produce the answer.

Multiple Choice Questions

- Read the question and all of the answer options first.
- Mark out any answers that you know are not correct.
- Once you have selected an answer, do not change it unless you misread the question and know the new answer is correct. Usually, your first answer is the correct one if you are making an educated guess.
- Many times, the correct answer has more information in it.
- If there is no penalty for guessing, do not leave any items blank—make an educated guess.
- If there is an “All of the Above” option and there are two options that are correct, select “All of the Above.”
- In a question with “All of the Above” and “None of the Above,” if you are certain that one of the answers is true, do not select “None of the Above” and, likewise, if one of the answers is false, then do not select “All of the Above.”

True-False Questions

- Read the statement carefully, but do not read too much into the statement. Base your answer on the information provided.
- With statements that have multiple facts, if any one of the facts is false the entire statement is false.
- Qualifying words like “always,” “never,” and “every” indicate that this would have to be true all of the time. If it is not true all of the time, then you should answer false.
- Qualifying words like “usually,” “sometimes,” and “generally” indicate that it could be true or false depending on the situation. Oftentimes the answer is true.

Essay Questions

- Most Important Rule: Make sure you understand what the question is asking you to do. An essay question is not an opportunity to simply regurgitate everything you know about a particular topic. Revisit Question Cues listed in the “Table 5-1: “Bloom’s Taxonomy: Cognitive Domain” and be sure you know what you are supposed to accomplish when you see those cues. Underline key words and let those words help guide you. If you are not sure, ask your professor for clarification on what he or she wants you to accomplish in your answer.
- Take a minute or so to plan out your answer and jot down a brief outline of key points to guide your writing before you start. A well-organized answer tends to score more points when graded.
- Formula for Essay Questions:
  - Introductory statements that define terms and describe what you will accomplish in your essay. This section should be brief.
  - State your first main idea, and then give supporting facts, examples, statistics, or details. Follow with your next main idea and continue the pattern until complete. The bulk of your time should be spent developing this section of the essay as it would likely include the details your professor wants to see in grading. Typically, each main idea would have its own paragraph. Use transitional works like “first, second, third…,” “next,” “also,” “however,” etc., to aid your reader.
  - End with a summary or final conclusion. This section is also likely to be brief.
- Budget time to proofread and revise if needed.
- Write legibly. Neater papers tend to receive higher marks.

Adapted from Dembo and Seli (2008) and TestTakingTips.com (2003–2009).

Once the exam has been completed, the learning experience is not over. Look over the test after you get it back from your professor and continue your review of the material that may be important for a comprehensive final or information that serves as a foundation for material to be learned in other courses. Even if only a scantron answer sheet is returned to you, professors are willing to give students access to review the test results during their office hours. Comprehensive post-test review not only includes reviewing your correct and incorrect answers to the question but also looking at where questions came from (i.e., lecture notes, readings, or both). Also, consider the study strategies you used and how they worked for you in order to help you prepare for future exams. Overall, it is important to emphasize the benefit of talking with your professor after each exam to gain insights into the information presented in the class as well as your learning and test strategies.

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3.5: Collaborative Student Learning- The Art of Study Groups

By nature, talking over course material promotes active learning. Some students shy away from studying with other people, because often study sessions deteriorate into “gripe” sessions about the course or certain members of the group do not contribute to the understanding of information. However, these distractions can be avoided with some study group “ground rules” that develop a habit for effective group work. Students who develop strong team working relation- ships with other students in their classes often report more motivation toward studying, less stress related to the course with this support system, and a better understanding of the material (University of Illinois–Chicago, 2008).



There are several types of study groups. Some groups simply get together prior to exams to go over the material. While this exercise can be helpful, typically these are not the type of study groups that actually promote long-term learning and social support. The most effective types of study groups tend to meet regularly—weekly or every couple of weeks—to work on homework problems, compare lecture notes, discuss current assigned readings, and create cram cards or other study tools that will aid later group review for an exam.

Activity 5-5:

Conduct a Post-Test Analysis for one of your exams by answering and reflecting on these relevant questions. It is best if you can complete this analysis prior to receiving your grade for the exam, but if you have already received a grade try to think about how you felt about the test before getting it back.

1. What grade do you think you made on this exam? (circle one)
   A B C D
2. How much time did you spend preparing for this exam?
   1. None
   2. 1/2 hour or less
   3. about an hour

4. about 2 hours
5. between 2 – 4 hours
6. between 4 – 6 hours
7. more than 6 hours

3. Approximately what percentage of the assigned reading did you read?
    1. Zero
    2. 100%
    3. Other (write in the approximate percentage)_____
4. What parts of the textbook did you use as you were preparing for the exam? (mark all that apply)
    1. Chapter headings
    2. Exercises
    3. Key points
    4. Follow-up activities
    5. Tables/graphs/photographs
    6. Chapter questions
5. Did you use your notes for the test?
    1. Yes
    2. No, I do not have any notes
    3. I have notes, but I did not review them before the test
    4. I borrowed notes from someone else and reviewed them
6. Did you review the handouts given in class before the test?
    1. Yes
    2. No, I do not have any handouts
    3. I have handouts, but I did not review them before the test
    4. I borrowed the handouts from someone else and reviewed them

Before the test did you:

- Read through each portion of the test when you got it? YES NO
- Set a time budget to pace yourself? YES NO

7. The objective portion of the test was:

For the Multiple Choice:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

For the True/False:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

For the Matching:

1. easy to complete
2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

8. The short answer portion of the test was:
    1. easy to complete
    2. too difficult
    3. reasonably challenging, but I feel confident about my ability to answer the questions
9. The essay portion of the test was:
    1. easy to complete

2. too difficult
3. reasonably challenging, but I feel confident about my ability to answer the questions

10. Did you study with other people? (mark all that apply)
    1. No
    2. Yes, one other person
    3. Yes, more than one other person at the same time
    4. Yes, I attended a Supplemental Instruction (SI) test review or a test review offered by the instructor or graduate assistant
11. If you studied with others, rate how effective the study sessions were on a scale of 1-10.
    (1= not at all effective in helping me review and understand the material, to 10 = highly effective in helping me review and understand the material)
12. What study techniques did you use to study for this exam? (mark all that apply)
    1. I consolidated my notes with my textbook notes
    2. I re-read the book chapters
    3. I re-read my class notes
    4. I made up questions and tried to answer them and then reviewed what I did not know
    5. I reviewed exams from an authorized test file
    6. Other explain what you did below

_____

_____

_____

1. Reflection Once you have received your grade, compare that with what you initially guessed you would receive. Consider some of these questions:
    1. What types of questions did you tend to miss more? What were the topics of content? Do you now understand the correct answer? Do you see any patterns in the types of mistakes thatyou may have made? Did you tend to second guess yourself and change a correct answer to an incorrect answer?
    2. Do you see any patterns in where the test items tended to come from? Mostly from the readings? Mostly from class notes? An even mix between the readings and notes? More from the notes, but some from the readings? From places you would not have thought of like thegraphs, photographs, or tables?
    3. Was there certain content that you were not as strong in answering correctly? What do you need to do to make sure you understand this material? Do you need to talk with your professor to better understand this material?
    4. Based on the answers to some of the questions throughout this assessment, what are you going to do differently next time? Be specific.

_____

_____

_____

_____

_____

Getting a strong start with a group of committed students at the beginning of the class is tremendously important. A group with mixed levels of academic expertise can be a very effective group as long as the members are committed to working with the group. Stronger students can benefit from teaching students who may be struggling with the material, while struggling students learn study strategies as well as the material the group is reviewing. Consider “Tips for Effective Study Groups” as you move forward with developing study groups.

Tips for Effective Study Groups

- Establish a study group with 2–4 other committed students in your class. Exchange contact information with those participants. You may begin a conversation with students who attend class regularly, take notes, sit toward the front, and appear to pay attention in class. You may ask the professor to help you identify other committed students that you can recruit.
- Set a regular time and place to meet.

- Meet in a public place like the library, empty classroom, residence hall study room, cafeteria, etc.
- At the first session, decide on the rules that your group will agree to adhere to in order to promote teamwork and accountability. For instance, some groups determine that if a member does not prepare for a session that they cannot stay to learn from the others. Some groups set a routine in which they study for 50 minutes and then spend ten minutes “blowing off steam” and problem solving (with a timekeeper keeping it limited to ten minutes).
- Set study goals for each session regarding what material you want to cover or what activities you want to perform as a group.
- Establish a “monitor” for a given session to watch the time, record notes for the group, and make sure that everyone is participating. This duty can be rotated throughout the group and may even become obsolete once a strong working team has been established.
- Make sure that everyone participates actively. Take turns presenting sections of lecture notes or readings, take turns taking a group through the solution of a problem, take turns asking each other questions and having others answer them, etc.
- Share study tools developed, summaries of topics, visual organizers, etc.
- Write down any questions that one or two group members can approach the professor or graduate assistant for help and then share with the group at the next session or via e-mail.
- At the end of the study session, establish what material you are going to focus on so that everyone in the group can prepare for the next session.

Adapted from Dembo & Seli (2008) and University of Illinois–Chicago (2008).

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3.6: Library Research- It's a Process

Not all of your college grades are based on exams given in class. Papers, oral presentations, and in-depth research projects throughout your academic career will require consultation with resources beyond a textbook or Google. Many students approach research haphazardly not realizing that they can use a step- by-step process to remove the mystery surrounding research and relieve anxiety.

About the Information Search Process

Carol Kuhlthau (n.d.), a professor at Rutgers University, developed a six-stage model called the Information Search Process (ISP) that describes students' thoughts, actions, and feelings as they move through the beginning stages of a research project to the final product. Though using a formal process may sound troublesome, in fact you already use the ISP in your everyday decisions. For example, the last time you went to the movies with a group of friends you gathered information on which movies were at which theaters, what the start times were, who could go, and how you would get there. Once you had all the specifics, you evaluated the information, made choices, and then acted on them. This is the Information Search Process, and you use it without even realizing it.

Breaking down the research process into similar steps and following the ISP model will make your task easier to conquer and help ensure that you have met assignment requirements and have turned in a well-thought-out, thorough research paper.

The ISP Model and You

It is easy to get lost in a research assignment's meaning, lose focus on your topic, get overwhelmed with information, and not seek help. In the movie example above, the ISP does not take long to start and finish. This is not the case with research papers.

This section will describe the challenges you can expect at each stage of the ISP model and give you strategies for managing them.

ISP Stage 1: Initiation – Before beginning any research, make certain you understand the requirements of the assignment.

Challenges:

1. Understanding instructor expectations
    - **Strategies:** Many instructors will use terms such as scholarly, popular, peer-reviewed, refereed, primary, secondary, authoritative, etc., to describe the types of sources they expect you to use in assignments. To learn what these mean, see UT Arlington Library's How to Find and Evaluate Sources (http://library.uta.edu/howTo/evaluateSources.pdf).
    - Listen carefully and take notes when the instructor assigns the paper or project and do not be afraid to ask questions. For tips, see University of North Carolina's Understanding Assignments (writingcenter.unc. edu/handouts/understanding-assignments).
2. Worrying about your ability to complete the assignment on time
    - Strategies: Use goal-setting processes learned in this class to create a timeline for completion of the assignment. For an online tool, see University of Minnesota's Assignment Calculator (www.lib.umn.edu/ apps/ac).

ISP Stage 2: Selection – Once you understand the assignment, select a general topic that meets its requirements.

Challenge: Finding interesting topic ideas

- **Strategies:** Begin by brainstorming ideas that are relevant to the assignment, but also reflect your personal interests. You may also look to academic encyclopedias, magazines, and journals within the subject area, current events publications, and class discussions for potential ideas.
- For help selecting a general topic, see Duke University Libraries' Choosing a Topic (library.duke.edu/services/ins...guide/choosing. html) or California State University Long Beach Library's Paper Topics (csulb.libguides.com/papertopics).

ISP Stage 3: Exploration – Once you have decided on a general topic, gather background information to understand it better.

Challenges:

1. Looking for general information about a topic
    - **Strategies**: When beginning research on an unfamiliar topic, consult sources that provide background information like academic encyclopedias, textbooks, and general Web sites. Although you may not use these sources in the final paper or project, they often provide the information necessary to progress to the next stage of your assignment.

- Library databases that contain general information (NetID and password required) can be found at www.libguides.uta.edu/az.php and include databases such as:
  - **CQ Researcher**
  - **Gale Virtual Reference Library**
  - **UT Arlington's Library Catalog**
  - **Points of View Reference Center**

2. Locating appropriate source types
   - **Strategies**: The topic and type of information needed determines the type of source (book, magazine article, newspaper article, Web site, journal article, etc.) that is best. To learn more about the information cycle as it relates to type of information needed, see UT Arlington Library's How to Find and Evaluate Sources (library.uta.edu/howTo/ evaluateSources.pdf).

ISP Stage 4: Formulation – Using what you have learned from your preliminary research, develop a thesis that is specific, significant, and arguable.

Challenge: Writing a thesis that is specific, significant, and arguable

- **Strategies**: After gathering background information about a topic, apply what you have learned to the development of a thesis. The thesis will act as the framework for your paper. For information about developing a thesis, see Dartmouth Writing Program's Developing Your Thesis (writing- speech.dartmouth.edu/learning/materials/materials-first-year-writers/ developing-your-thesis).

ISP Stage 5: Collection – Once you have developed a thesis, gather sources that specifically relate to it.

Challenges:

1. Developing a search strategy
   - **Strategies**: Have a plan of action before you begin your thesis-specific research. You may use some of the same sources found when gathering your background information.
     1. Brainstorm relevant keywords and combine these terms to retrieve relevant and specific information.
     2. Specify the type of sources (scholarly, peer-reviewed, primary, etc.) you require. For help, see Tisch Library's Database Search Strategy Worksheet (researchguides.library.tufts.edu/content. php?pid=68058&isd=502985).
     3. Select database(s) or search engine(s) you will use to find your sources. For subject-specific guides to research, see UT Arlington Library's Subject and Course Guides (http://libguides.uta.edu).
     4. Use research notes to track where you have searched for information and what you have selected for potential use in your assignment. For tips about keeping track of your research, see Princeton University's Working Habits that Work (www.princeton.edu/pr/ pub/integrity/pages/habits/).

1. Evaluating sources
   - Strategies: Evaluate each source to determine if it meets the requirements of the assignment and select sources that are written by experts and published (either in print or online) by reputable organizations or individuals. For information about evaluating sources, see UT Arlington Library's How to Find and Evaluate Sources (http://library.uta.edu/ howTo/evaluateSources.pdf).

ISP Stage 6: Presentation – Use the information you gathered to complete your assignment.

Challenges:

1. Incorporating sources into your assignment
   - Strategies: Once you have found your sources, incorporate them into your assignment in a way that both supports your thesis and observes the rules of academic integrity. For information about incorporating sources, see Western Oregon University's Incorporating Sources into Your Research Paper (www.wou.edu/provost/library/clip/tutori-als/incorp_sources.htm).
2. Citing your sources
   - Strategies: To make citing sources easier, you may use online citation generators like Son of Citation Machine (Warlick &The Landmark Project 2000–2010) (http://citationmachine.net/) or use citation genera- tors built into some of the library's databases. Always check your citations against appropriate style manuals, copies of which can be found in the Library's

reference area. For helpful tips about many citation styles, see UT Arlington Library's Citation How-Tos (library.uta.edu/how-to).

Adapted from Kuhlthau, C. C. (2009, August). Information search process. Retrieved from http://comminfo.rutgers.edu/~kuhlthau/information_search_process.htm

The Importance of Citing Sources

When you use outside sources like books or articles in your assignment, you make your arguments more credible. You demonstrate that your arguments are not just your opinion—they are based on evidence. But when you use other people's ideas in your work, you must observe the rules of academic integrity and say where they came from. You must be able to prove which ideas are yours and which ones you borrow.

Citations prevent any confusion over what is original to you and what you are borrowing while citation styles like MLA or APA supply a standard method for identifying other people's ideas. If you use someone else's idea without citing it properly, you have committed the serious offense of plagiarism.

For more information about plagiarism, see the section on "Academic Integrity" in Chapter 6.

Timeline

As discussed in Chapter 4 of this book, goal setting is an essential element to complete any project. S.M.A.R.T. goals clearly define your tasks and keep you motivated. Consider Figure 5-2. With the deadline of your research paper as your ultimate goal and considering the stages of the ISP model defined previously, create smaller, short-term goals to ensure your success. Note that each ISP stage should be a stop or short-term goal in your research timeline. Be sure to consider the suggested length of time at each stage when setting your goals.

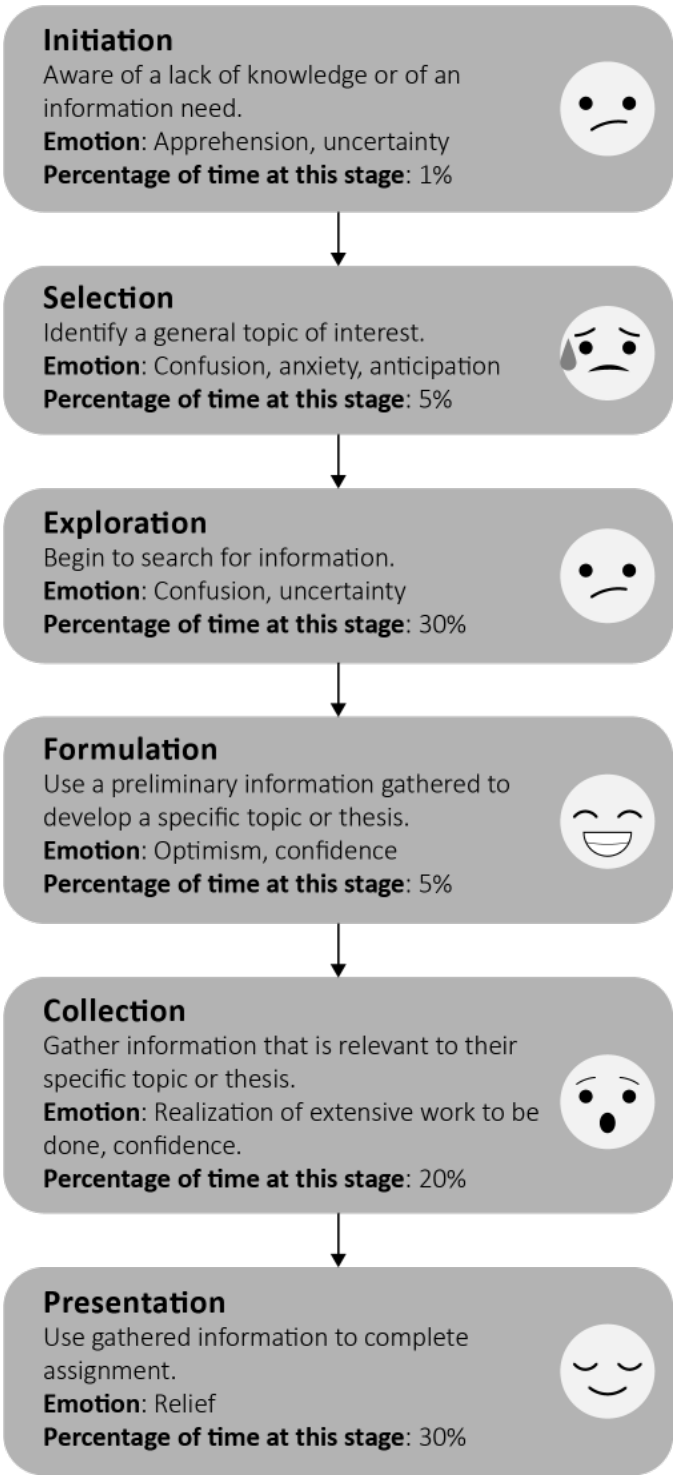


Figure 5-2. Timeline for the ISP Model

Tips for Success in Conducting Library Research

- Recognize that frustration and uncertainty are part of the process.
- Build a timeline with short-term S.M.A.R.T. goals.
- Reevaluate your progress and repeat steps if necessary, but do not completely eliminate any.
- Steps take time. Plan accordingly.
- Take advantage of outside resources to help get you through the uncertainty.

Activity 5-6

Pick an upcoming research assignment from any class. Using the Information Search Process model, create a series of short-term S.M.A.R.T. goals that will help you complete the assignment.

Activity 5-7

Go to UT Arlington Library's How to Find and Evaluate Sources (library. uta.edu/howTo/evaluateSources.pdf). What are the criteria for determining if a source is credible?

Thought Questions

- Consult "Chapter 10: Campus Resources" and review all of the resources and services offered by UT Arlington Libraries. What are the three library resources that you feel will help you the most? Evaluate the benefit of each resource and discuss with a classmate.
- What challenges do you face when citing sources? Think of at least three strategies that would help you overcome these challenges.
- Why is it important to cite the sources you use in your assignments?
- Examine the relationship between the information Search Process and Bloom's taxonomy. How does the required task at each stage of the ISP correlate with the types of thinking required in Bloom's Taxonomy?
- How can the active reading strategies you have learned be applied to evaluating sources for your assignments?

Five-day Study plan Worksheet

Date of Test: _____

Course: _____

Test Format:

- Objective
- Essay
- Mixed

Day	Task	Course Content	Time needed	Completed
Date of Day 1:	Prepare:			
Date of Day 2:	Prepare: Review:			
Date of Day 3:	Prepare: Review: Review:			
Date of Day 4:	Prepare: Review: Review: Review:			
Date of Day 5:	Prepare: Review: Review: Review: Self-Test:			

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CHAPTER OVERVIEW

4: Managing Your Time and Priorities

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4.4: Procrastination- The Enemy Within
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Thumbnail: https://pixabay.com/photos/diary-journal-pen-notebook-january-614149/

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4.1: Prelude to Managing Your Time and Priorities

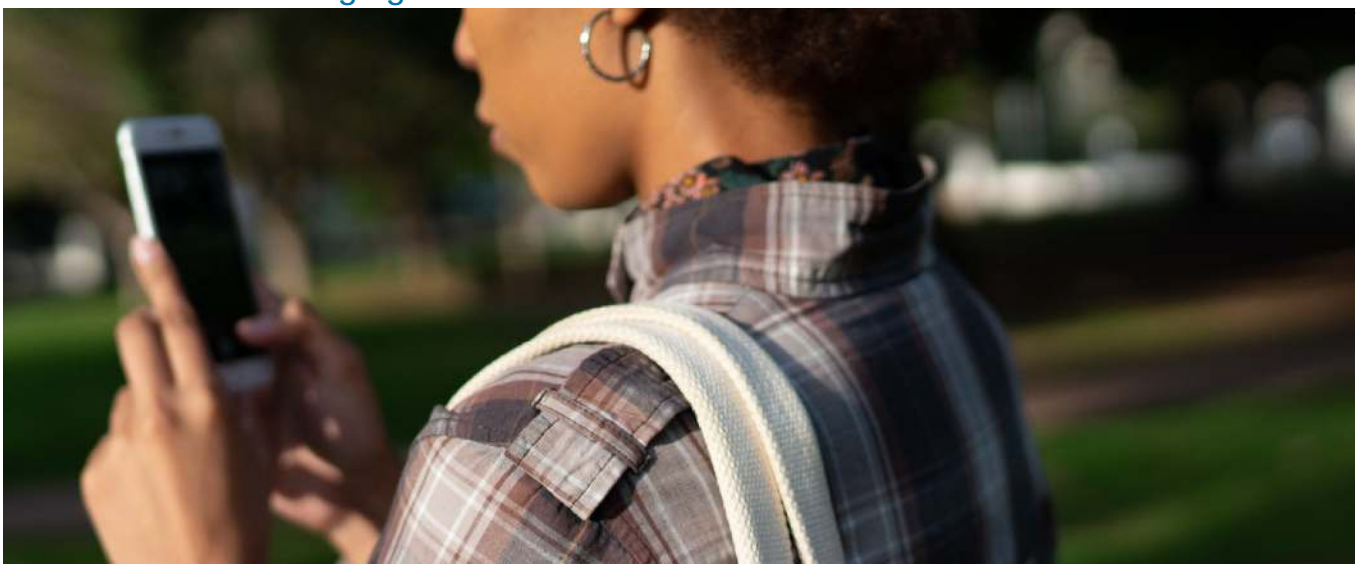


Figure 4.1.1: Our devices can be helpful tools for managing time, but they can also lead to distraction.

Student Survey

How do you feel about your time management abilities? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning “least like me” and 4 meaning “most like me.” These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We’ll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. I regularly procrastinate completing tasks that don't interest me or seem challenging.
2. I use specific time management strategies to complete tasks.
3. I find it difficult to prioritize tasks because I am not sure what is really important.
4. I am pleased with my ability to manage my time.

You can also take the Chapter 3 survey anonymously online.

STUDENT PROFILE

"Before I started college, I had heard that the amount of work would be overwhelming, and that it would be much harder than high school. That was true, but after being in college for a couple of weeks, I felt that people made it seem scarier than it actually was. I had some homework assignments here, some essays, some hard classes, but it wasn't that bad..until Midterms and Finals came knocking. I had so much to study and so little time. The pressure was unimaginable. And since there was so much material to learn, I kept procrastinating. The nights before the exams were a disaster.

"After the semester, I realized that I needed to do something differently. Instead of crashing before midterms and finals, I would study throughout the semester. I would review notes after class, do a few practice problems in the book even if homework wasn't assigned, and try to ask professors questions during their office hours if I was confused. This continual effort helped me do better on exams because I built up my understanding and was able to get a good night’s sleep before the big test. I still studied hard, but the material was in reach and understanding it became a reasonable goal, not an impossibility. I also felt more confident going into the exams, because I knew that I had a deeper knowledge — I could recall things more easily. Most importantly, I now had peace of mind throughout the day and during the tests themselves, since I knew that I was better prepared."

—Nachum Sash, Actuarial Science Major, City University of New York

About This Chapter

In this chapter you will learn about two of the most valuable tools used for academic success: prioritizing and time management. By the time you complete this chapter, you should be able to do the following:

- Articulate the ways in which time management differs from high school to college.
- Outline reasons and effects of procrastination, and provide strategies to overcome it.
- Describe ways to evaluate your own time management skills.
- Discuss the importance and the process of prioritization.
- Articulate the importance of goal setting and motivation.
- Detail strategies and specific tactics for managing your time.

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4.2: The Benefits of Time Management

> ***"Poor time management can set into motion a series of events that can seriously jeopardize a student's success."***

A very unfortunate but all-too-common situation in higher education is the danger students face from poor time management. Many college administrators that work directly with students are aware that a single mishap or a case of poor time management can set into motion a series of events that can seriously jeopardize a student's success. In some of the more extreme instances, the student may even fail to graduate because of it.

To better understand how one instance of poor time management can trigger a cascading situation with disastrous results, imagine that a student has an assignment due in a business class. She knows that she should be working on it, but she isn't quite in the mood. Instead she convinces herself that she should think a little more about what she needs to complete the assignment and decides to do so while looking at social media or maybe playing a couple more rounds of a game on her phone. In a little while, she suddenly realizes that she has become distracted and the evening has slipped away. She has little time left to work on her assignment. She stays up later than usual trying to complete the assignment but cannot finish it. Exhausted, she decides that she will work on it in the morning during the hour she had planned to study for her math quiz. She knows there will not be enough time in the morning to do a good job on the assignment, so she decides that she will put together what she has and hope she will at least receive a passing grade.

At this point in our story, an evening of procrastination has not only resulted in a poorly done business class assignment, but now she is going to take a math quiz that she has not studied for. She will take the quiz tired from staying up too late the night before. Her lack of time management has now raised potential issues in two courses. Imagine that each of these issues also causes additional problems, such as earning low scores on *both* the assignment and the quiz. She will now have to work harder in both courses to bring her grades up. Any other problems she has with future assignments in either course could cause a domino effect of circumstances that begins to overwhelm her.

In our imagined situation, you can see how events set into motion by a little procrastination can quickly spiral out of control. You can probably think of similar experiences in your own life, when one small bit of poor time management set off a chain of events that threatened to cause big problems.

The High Cost of Poor Time Management

It's not just your academic performance that can be affected by cascading events that have a domino effect on your college path. And dropping out of school is not your only danger. There are other consequences that affect the financial cost to you as a student if your lack of time management skills causes you to delay when you finish college.

Based on independent research, a *Washington Post* article details the financial impact delaying graduation by two semesters can have on a student.[1] (Spending a Few Extra Years in College May Cost You More Than You Think, Danielle Douglas-Gabriel, June 21, 2016)

According to the article, there is a significant cost associated with delaying graduation from college by only one year (by dropping and retaking courses, taking less than a full credit load, etc.). Not only will you pay for additional tuition, textbooks, and other fees associated with going to school, but if you are using student loans, you will also accumulate interest on those loans. On average this would come to an extra $12,557 in actual costs and $6,040 in interest at a public university, or $18,992 in tuition and fees and $7,823 in interest (over 10 years) at a private school. That's a lot of extra cost to you!

> ***"In the long run, just two extra semesters of college can cost you almost $150,000."***

While a loss of $26,815 may seem like a lot of money, it pales in comparison to the other financial areas impacted by a single extra year in school. The *Washington Post* article estimates that one year's delay of graduation would cost you an additional $46,355 based on average lost earnings. To make matters worse, like the story of the student that procrastinates finishing her business assignment, there is a spiraling effect that takes place with loss of income when it comes to retirement investments. The figure cited by the *Washington Post* as lost retirement earnings for taking five years instead of four years to graduate is $82,074. That brings the average total cost for only two extra semesters to over $150,000. Measured by the financial cost to you, even a slight delay of graduation can have a serious impact.

Table 3.1 Credit: Washington Post. Note the numbers in the table above have been averaged between the two scenarios described.

Average Cost of an Additional Year of College	
Tuition, textbooks, and fees	$15,774
Interest on student loans	$6,932
Lost wages	$46,335
Lost retirement earnings	$82,074
Average total loss:	$151,115

It is worth noting that any situation that brings about a delay in graduation has the potential to increase the cost of college. This also includes attending school on a part-time basis. While in some instances responsibilities may make it impossible to go to school full-time, from a financial perspective you should do all you can to graduate as soon as you can.

While it may not be possible to prevent life challenges while you are in college, you can do a great deal to prevent the chaos and the chain reaction of unfortunate events that they can cause. This can be accomplished through thoughtful prioritization and time management efforts.

What follows in the rest of this chapter is a close look at the nature of time management and prioritization in ways that can help keep you on track to graduate college on time.

ANALYSIS QUESTION

Can you identify any areas in your life that might be a potential problem if there were a temporary setback (e.g., temporary loss of transportation, temporary loss of housing, an illness that lasted more than a week, etc.)? What could you do for a backup plan if something did happen?

Footnotes

- 1 https://www.washingtonpost.com/news/...=.f06be365e5d6

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4.3: Time Management in College

Questions to consider:

- Is time management different in college from what I am used to?
- How different is college schoolwork from high school work?

You may find that time management in college is very different from anything you have experienced previously. For the last 12 years, almost all your school time was managed by educators and your parents. What you did and when you did it was controlled by others. In many cases, even after-school time was set by scheduled activities (such as athletics) and by nightly homework that was due the next day.

In the workplace, the situation is not very different, with activities and time on task being monitored by the company and its management. This is so much a part of the working environment that many companies research how much time each task should take, and they hold employees accountable for the time spent on these job functions. In fact, having these skills will help you stand out on the job and in job interviews.

K–12	College
Many class activities are planned.	Class time is given to receiving information.
Homework is often similar for each student.	You may have freedom in homework choices.
Time is managed by others more often.	Time is managed by the student.

In college, there is a significant difference because a great deal of time management is left up to you. While it is true that there are assignment due dates and organized classroom activities, learning at the college level requires more than just the simple completion of work. It involves decision-making and the ability to evaluate information. This is best accomplished when you are an active partner in your own learning activities.



Figure 4.3.2 Students may set aside specific times and specific places to study.

As an example of how this works, think about a college assignment that involves giving a classroom presentation. To complete the assignment, you are given time to research and reflect on the information found. As a part of the assignment, you must reach your own conclusions and determine which information that you have found is best suited for the presentation. While the date of the actual presentation and how long it will last are usually determined by the instructor, how much time you spend gathering information, the sources you use, and how you use them are left to you.

WHAT STUDENTS SAY

1. How difficult is it for you to keep track of multiple tasks over the course of a term?
   a. Extremely easy
   b. Somewhat easy

c. Somewhat difficult
d. Extremely difficult

2. Do you use a particular app to help you manage your time?
   a. I use Google calendar
   b. I use the calendar on my phone
   c. I use a paper/notebook planner
   d. I use the calendar on my learning management system
   e. I use another app or system
   f. I don't use any type of planner or app
3. Rank the following in terms of what you would most like to improve regarding your time management skills.
   a. My ability to predict how much time my tasks will take.
   b. My ability to balance various obligations.
   c. My ability to avoid procrastination.
   d. My ability to limit distractions.

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

How difficult is it for you to keep track of multiple tasks over the course of a term?

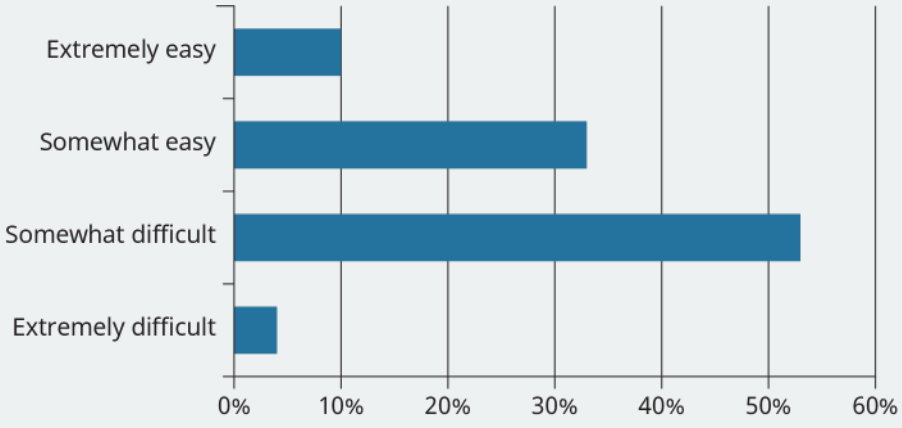


Figure 4.3.3

Do you use a particular app to help you manage your time?

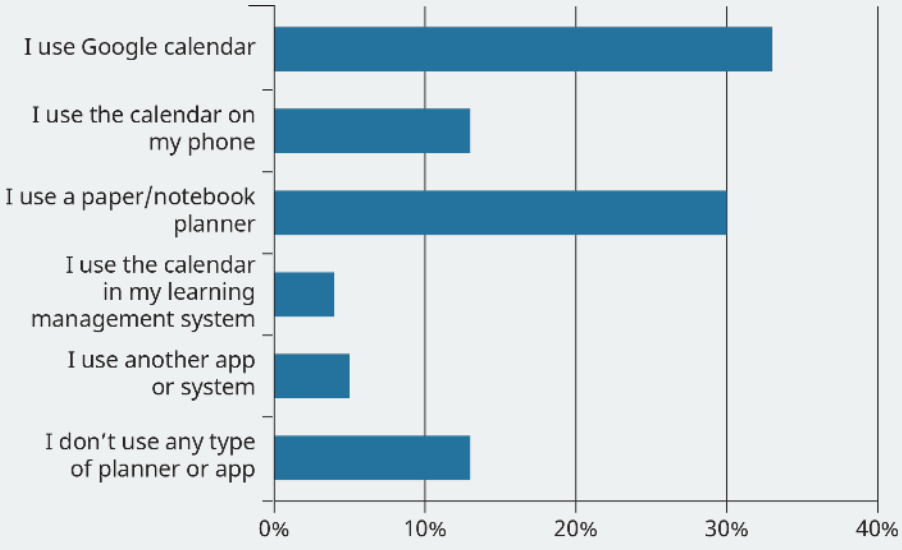


Figure 4.3.4

Rank the following in terms of what you would most like to improve regarding your time management skills.

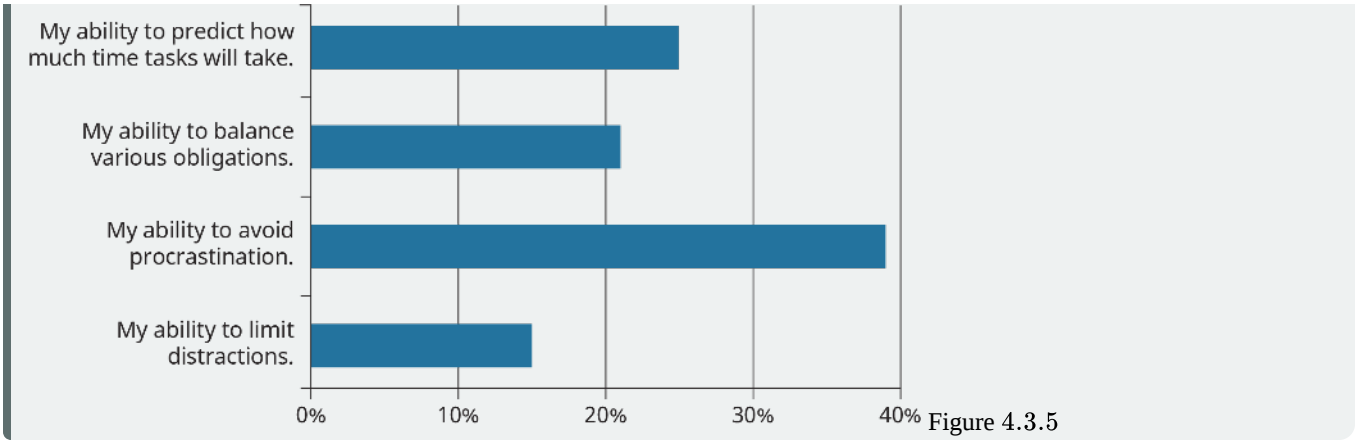


Figure 4.3.5

You Have Lots of Time to Manage

For college-level learning, this approach is important enough that you can expect to spend much more time on learning activities outside the classroom than you will in the classroom. In fact, the estimated time you should spend will be at least two hours of outside learning for every one hour of lecture. Some weeks may be more intense, depending on the time of the semester and the courses you are taking. If those hours are multiplied over several courses in a given session, you can see how there is a significant amount of time to manage. Unfortunately, many students do not always take this into consideration, and they spend far less time than is needed to be successful. The results of poor time management are often a shock to them.

> ***"In college, as an active participant in your own education, what you do and when you do it is largely determined by you."***

The Nature of What You Have to Do Has Changed

Returning to our example of the classroom-presentation assignment, you can see that the types of learning activities in college can be very different from what you have experienced previously. While there may have been similar assignments in high school, such as presentations or written papers, the level of expectation with length and depth is significantly different in college. This point is made very clear when comparing facts about the requirements of high school work to the type of work students produce in college. One very strong statistic that underscores this comes from a study conducted by the Pew Research Center. They found that 82 percent of teens report that their typical high school writing assignments were only a single paragraph to one page in length.[2] (Writing Technology and Teens, 2004, Pew Research Center) This is in stark contrast to a number of sources that say that writing assignments in lower-level college courses are usually 5–7 pages in length, while writing assignments in upper-level courses increase to 15–20 pages.

It is also interesting to note that the amount of writing done by a college student can differ depending on their program of study. The table below indicates the estimated average amount of writing assigned in several disciplines. To estimate the number of pages of assigned writing, the average number of writing assignments of a given page length was multiplied by an approximate number of pages for the assignment type (see **Estimating Number of Pages Written** for calculation details).

Table 3.2 Credit: Updated NSSE (Since 2013)3

Writing Assignments Vary in Length	
Discipline	**Number of Pages Assigned in Introductory Course**
Arts & Humanities	49
Biological Sciences, Agriculture, & Natural Resources	47
Physical Sciences, Mathematics, & Computer Science	44
Social Sciences	52
Business	48
Communications, Media, & Public Relations	50

Writing Assignments Vary in Length	
Education	46
Engineering	46
Health Professions	43
Social Service Professions	47

High school homework often consists of worksheets or tasks based on reading or classroom activities. In other words, all the students are doing the same tasks, at relatively the same time, with little autonomy over their own education.

Using the earlier example of the presentation assignment, not only will what you do be larger in scale, but the depth of understanding and knowledge you will put into it will be significantly more than you may have encountered in previous assignments. This is because there are greater expectations required of college graduates in the workplace. Nearly any profession that requires a college degree has with it a level of responsibility that demands higher-level thinking and therefore higher learning. An often-cited example of this is the healthcare professional. The learning requirements for that profession are strict because we depend on those graduates for our health and, in some cases, our lives. While not every profession may require the same level of study needed for healthcare, most do require that colleges maintain a certain level of academic rigor to produce graduates who are competent in their fields.

Footnotes

- 2 http://www.pewinternet.org/2008/04/2...ogy-and-teens/
- 3 nsse.indiana.edu/html/sample_...of_writing.cfm

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4.4: Procrastination- The Enemy Within

Questions to consider:

- Why do we procrastinate?
- What are the effects of procrastination?
- How can we avoid procrastination?



Figure 4.4.6 We can think of many creative ways to procrastinate, but the outcome is often detrimental. (Credit: University of the Fraser Valley / Flickr / Attribution 2.0 Generic (CC BY 2.0))

Simply put, procrastination is the act of delaying some task that needs to be completed. It is something we all do to greater and lesser degrees. For most people, a little minor procrastination is not a cause for great concern. But there are situations where procrastination can become a serious problem with a lot of risk. These include: when it becomes a chronic habit, when there are a number of tasks to complete and little time, or when the task being avoided is very important.

Because we all procrastinate from time to time, we usually do not give it much thought, let alone think about its causes or effects. Ironically, many of the psychological reasons for why we avoid a given task also keep us from using critical thinking to understand why procrastination can be extremely detrimental, and in some cases difficult to overcome.

To succeed at time management, you must understand some of the hurdles that may stand in your way. Procrastination is often one of the biggest. What follows is an overview of procrastination with a few suggestions on how to avoid it.

The Reasons behind Procrastination

There are several reasons we procrastinate, and a few of them may be surprising. On the surface we often tell ourselves it is because the task is something we do not want to do, or we make excuses that there are other things more important to do first. In some cases this may be true, but there can be other contributors to procrastination that have their roots in our physical well-being or our own psychological motivations.

Lack of Energy

Sometimes we just do not feel up to a certain task. It might be due to discomfort, an illness, or just a lack of energy. If this is the case, it is important to identify the cause and remedy the situation. It could be something as simple as a lack of sleep or improper diet. Regardless, if a lack of energy is continually causing you to procrastinate to the point where you are beginning to feel stress over not getting things done, you should definitely assess the situation and address it.

Lack of Focus

Much like having low physical energy, a lack of mental focus can be a cause of procrastination. This can be due to mental fatigue, being disorganized, or allowing yourself to be distracted by other things. Again, like low physical energy, this is something that may have farther-reaching effects in your life that go beyond the act of simply avoiding a task. If it is something that is recurring, you should properly assess the situation.

Fear of Failure

This cause of procrastination is not one that many people are aware of, especially if they are the person avoiding tasks because of it. To put it in simple words, it is a bit of trickery we play on ourselves by avoiding a situation that makes us psychologically uncomfortable. Even though they may not be consciously aware of it, the person facing the task is afraid that they cannot do it or will not be able to do it well. If they fail at the task, it will make them appear incompetent to others or even to themselves. Where the self-trickery comes in is by avoiding the task. In the person's mind, they can rationalize that the reason they failed at the task was because they ran out of time to complete it, not that they were incapable of doing it in the first place.

It is important to note that a fear of failure may not have anything to do with the actual ability of the person suffering from it. They could be quite capable of doing the task and performing well, but it is the fear that holds them back.

ANALYSIS QUESTION

Consider something right now that you may be procrastinating about. Are you able to identify the cause?

The Effects of Procrastination

In addition to the causes of procrastination, you must also consider what effects it can have. Again, many of these effects are obvious and commonly understood, but some may not be so obvious and may cause other issues.

Loss of Time

The loss of time as an effect of procrastination is the easiest to identify since the act of avoiding a task comes down to not using time wisely. Procrastination can be thought of as using the time you have to complete a task in ways that do not accomplish what needs to be done.

Loss of Goals

Another of the more obvious potentially adverse effects of procrastination is the loss of goals. Completing a task leads to achieving a goal. These can be large or small (e.g., from doing well on an assignment to being hired for a good job). Without goals you might do more than delay work on a task—you may not complete it at all. The risk for the loss of goals is something that is very impactful.

Loss of Self-Esteem

Often, when we procrastinate we become frustrated and disappointed in ourselves for not getting important tasks completed. If this continues to happen, we can begin to develop a low opinion of ourselves and our own abilities. We begin to suffer from low self-esteem and might even begin to feel like there is something wrong with us. This can lead to other increasingly negative mental factors such as anger and depression. As you can see, it is important for our own well-being to avoid this kind of procrastination effect.

Stress

Procrastination causes stress and anxiety, which may seem odd since the act of procrastination is often about avoiding a task we think will be stressful in itself! Anyone who has noticed that nagging feeling when they know there is something else they should be doing is familiar with this.

On the other hand, some students see that kind of stress as a boost of mental urgency. They put off a task until they feel that surge of motivation. While this may have worked in the past, they quickly learn that procrastinating when it comes to college work almost always includes an underestimation of the tasks to be completed— sometimes with disastrous results.

Strategies for Psyching Ourselves Out and Managing Procrastination

Now that you understand a few of the major problems procrastination can produce, let's look at methods to manage procrastination and get you on to completing the tasks, no matter how unpleasant you think they might be.

Get Organized

Much of this chapter is dedicated to defining and explaining the nature of time management. The most effective way to combat procrastination is to use time and project management strategies such as schedules, goal setting, and other techniques to get tasks accomplished in a timely manner.

Put Aside Distractions

Several of the methods discussed in this chapter deal specifically with distractions. Distractions are time-killers and are the primary way people procrastinate. It is too easy to just play a video game a little while longer, check out social media, or finish watching a movie when we are avoiding a task. Putting aside distractions is one of the primary functions of setting priorities.

Reward Yourself

Rewarding yourself for the completion of tasks or meeting goals is a good way to avoid procrastination. An example of this would be rewarding yourself with the time to watch a movie you would enjoy a*fter* you have finished the things you need to do, rather than using the movie to keep yourself from getting things done.

Be Accountable—Tell Someone Else

A strong motivational tool is to hold ourselves accountable by telling someone else we are going to do something and when we are going to do it. This may not seem like it would be very effective, but on a psychological level we feel more compelled to do something if we tell someone else. It may be related to our need for approval from others, or it might just serve to set a level of commitment. Either way, it can help us stay on task and avoid procrastination—especially if we take our accountability to another person seriously enough to warrant contacting that person and apologizing for not doing what we said we were going to do.

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4.5: How to Manage Time

Questions to consider:

- How can I use time-on-task estimates to improve time management?
- What behaviors can help or hinder when it comes to managing time?

In this next section you will learn about managing time and prioritizing tasks. This is not only a valuable skill for pursuing an education, but it can become an ability that follows you through the rest of your life, especially if your career takes you into a leadership role.



Figure 4.5.7 An online calendar is a very useful tool for keeping track of classes, meetings, and other events. Most learning management systems contain these features, or you can use a calendar application.

ANALYSIS QUESTION

Read each statement in the brief self-evaluation tool below, and check the answer that best applies to you. There are no right or wrong answers.

Table 3.3

	Always	Usually	Sometimes	Rarely	Never
I like to be given strict deadlines for each task. It helps me stay organized and on track.					
I would rather be 15 minutes early than 1 minute late.					
I like to improvise instead of planning everything out ahead of time.					

	Always	Usually	Sometimes	Rarely	Never
I prefer to be able to manage when and how I do each task.					
I have a difficult time estimating how long a task will take.					
I have more motivation when there is an upcoming deadline. It helps me focus.					
I have difficulty keeping priorities in the most beneficial order.					

This exercise is intended to help you recognize some things about your own time management style. The important part is for you to identify any areas where you might be able to improve and to find solutions for them. This chapter will provide some solutions, but there are many others that can be found by researching time management strategies.

After you have decided your best response to each statement, think about what they may mean in regard to potential strengths and/or challenges for you when it comes to time management in college. If you are a person that likes strict deadlines, what would you do if you took a course that only had one large paper due at the end? Would you set yourself a series of mini deadlines that made you more comfortable and that kept things moving along for you? Or, if you have difficulty prioritizing tasks, would it help you to make a list of the tasks to do and order them, so you know which ones must be finished first?

How to Manage Time

The simplest way to manage your time is to accurately plan for how much time it will take to do each task, and then set aside that amount of time. How you divide the time is up to you. If it is going to take you five hours to study for a final exam, you can plan to spread it over five days, with an hour each night, or you can plan on two hours one night and three hours the next. What you would not want to do is plan on studying only a few hours the night before the exam and find that you fell very short on the time you estimated you would need. If that were to happen, you would have run out of time before finishing, with no way to go back and change your decision. In this kind of situation, you might even be tempted to “pull an all-nighter,” which is a phrase that has been used among college students for decades. In essence it means going without sleep for the entire night and using that time to finish an assignment. While this method of trying to make up for poor planning is common enough to have a name, rarely does it produce the best work.

Table 3.4 Sample Time Estimate Table

Activity	Estimated Time	Actual Time
Practice Quiz	5 minutes	15 minutes
Lab Conclusions	20 minutes	35 minutes
Food shopping	45 minutes	30 minutes
Drive to work	20 minutes	20 minutes
Physical Therapy	1 hour	50 minutes

Of all the parts of time management, accurately predicting how long a task will take is usually the most difficult—and the most elusive. Part of the problem comes from the fact that most of us are not very accurate timekeepers, especially when we are busy applying ourselves to a task. The other issue that makes it so difficult to accurately estimate time on task is that our estimations must also account for things like interruptions or unforeseen problems that cause delays.?

When it comes to academic activities, many tasks can be dependent upon the completion of other things first, or the time a task takes can vary from one instance to another, both of which add to the complexity and difficulty of estimating how much time and effort are required.

For example, if an instructor assigned three chapters of reading, you would not really have any idea how long each chapter might take to read until you looked at them. The first chapter might be 30 pages long while the second is 45. The third chapter could be only 20 pages but made up mostly of charts and graphs for you to compare. By page count, it might seem that the third chapter would take the least amount of time, but actually studying charts and graphs to gather information can take longer than regular reading.?

To make matters even more difficult, when it comes to estimating time on task for something as common as reading, not all reading takes the same amount of time. Fiction, for example, is usually a faster read than a technical manual. But something like the novel *Finnegan's Wake* by James Joyce is considered so difficult that most readers never finish it.

ACTIVITY

To better understand how much time different kinds of material can take to read, try this experiment. You will use two examples of famous texts that are very close to being the same number of words: *The Gettysburg Address* and the opening paragraphs from *A Christmas Carol*. Before you begin, estimate how long it will take you to read each, and predict which you think will take longer. When you do the reading, use a stopwatch function on a device such as a phone or some other timer to see how long it actually takes.

Make certain that you are reading for understanding, not just skimming over words. If you must reread a section to better comprehend what is being said, that is appropriate. The goal here is to compare reading of different texts, not to see how fast you can sight-read the words on a page.

After you have finished *The Gettysburg Address*, read and time *A Christmas Carol* and compare both of your times.

The Gettysburg Address
Abraham Lincoln
Gettysburg, Pennsylvania November 19, 1863
Word count: 278

Four score and seven years ago our fathers brought forth on this continent, a new nation, conceived in Liberty, and dedicated to the proposition that all men are created equal.

Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battle-field of that war. We have come to dedicate a portion of that field, as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

But, in a larger sense, we can not dedicate -- we can not consecrate -- we can not hallow -- this ground. The brave men, living and dead, who struggled here, have consecrated it, far above our poor power to add or detract. The world will little note, nor long remember what we say here, but it can never forget what they did here. It is for us the living, rather, to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us -- that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion -- that we here highly resolve that these dead shall not have died in vain -- that this nation, under God, shall have a new birth of freedom -- and that government of the people, by the people, for the people, shall not perish from the earth.

A Christmas Carol
Charles Dickens
Chapman & Hall, 1843
Word count: 260

> Marley was dead: to begin with. There is no doubt whatever about that. The register of his burial was signed by the clergyman, the clerk, the undertaker, and the chief mourner. Scrooge signed it: and Scrooge's name was good upon 'Change, for anything he chose to put his hand to. Old Marley was as dead as a door-nail.
>
> Mind! I don't mean to say that I know, of my own knowledge, what there is particularly dead about a door-nail. I might have been inclined, myself, to regard a coffin-nail as the deadest piece of ironmongery in the trade. But the wisdom of our ancestors is in the simile; and my unhallowed hands shall not disturb it, or the Country's done for. You will therefore permit me to repeat, emphatically, that Marley was as dead as a door-nail.
>
> Scrooge knew he was dead? Of course he did. How could it be otherwise? Scrooge and he were partners for I don't know how many years. Scrooge was his sole executor, his sole administrator, his sole assign, his sole residuary legatee, his sole friend, and sole mourner. And even Scrooge was not so dreadfully cut up by the sad event, but that he was an excellent man of business on the very day of the funeral, and solemnised it with an undoubted bargain.
>
> The mention of Marley's funeral brings me back to the point I started from. There is no doubt that Marley was dead. This must be distinctly understood, or nothing wonderful can come of the story I am going to relate.
>
> In comparing the two, was one or the other easier to understand or faster to read? Was it the piece you predicted you would read faster?
>
> It is important to note that in this case both readings were only three paragraphs long. While there may have only been half a minute or so between the reading of each, that amount of time would multiply greatly over an entire chapter.

Knowing Yourself

While you can find all sorts of estimates online as to how long a certain task may take, it is important to know these are only averages. People read at different speeds, people write at different speeds, and those numbers even change for each individual depending on the environment.

If you are trying to read in surroundings that have distractions (e.g., conversations, phone calls, etc.), reading 10 pages can take you a lot longer than if you are reading in a quiet area. By the same token, you may be reading in a quiet environment (e.g., in bed after everyone in the house has gone to sleep), but if you are tired, your attention and retention may not be what it would be if you were refreshed.

In essence, the only way you are going to be able to manage your time accurately is to know yourself and to know how long it takes you to do each task. But where to begin?

Below, you will find a table of common college academic activities. This list has been compiled from a large number of different sources, including colleges, publishers, and professional educators, to help students estimate their own time on tasks. The purpose of this table is to both give you a place to begin in your estimates and to illustrate how different factors can impact the actual time spent.

You will notice that beside each task there is a column for the *unit*, followed by the average *time on task*, and a column for notes. The *unit* is whatever is being measured (e.g., pages read, pages written, etc.), and the *time on task* is an average time it takes students to do these tasks. It is important to pay attention to the notes column, because there you will find factors that influence the time on task. These factors can dramatically change the amount of time the activity takes.

Table 3.5 Time on task for common college activities.

Time on Task			
Activity	**Unit**	**Time on task**	**Notes**
General academic reading (textbook, professional journals)	1 page	5–7 minutes	Be aware that your personal reading speed may differ and may change over time.
Technical reading (math, charts and data)	1 page	10–15 minutes	Be aware that your personal reading speed may differ and may change over time.

Time on Task			
Simple Quiz or homework question: short answer—oriented toward recall or identification type answers	Per question	1–2 minutes	Complexity of question will greatly influence the time required.
Complex Quiz or homework question: short answer—oriented toward application, evaluation, or synthesis of knowledge	Per question	2–3 minutes	Complexity of question will greatly influence the time required.
Math problem sets, complex	Per question	15 minutes	For example, algebra, complex equations, financial calculations
Writing: short, no research	Per page	60 minutes	Short essays, single-topic writing assignments, summaries, freewriting assignments, journaling—includes drafting, writing, proofing, and finalizing
Writing: research paper	Per page	105 minutes	Includes research time, drafting, editing, proofing, and finalizing (built into per-page calculation)
Study for quiz	Per chapter	60 minutes	45–90 minutes per chapter, depending upon complexity of material
Study for exam	Per exam	90 minutes	1–2 hours, depending upon complexity of material

Again, these are averages, and it does not mean anything if your times are a little slower or a little faster. There is no "right amount of time," only the time that it takes you to do something so you can accurately plan and manage your time.

There is also another element to look for in the table. These are differentiations in the similar activities that will also affect the time you spend. A good example of this can be found in the first four rows. Each of these activities involves reading, but you can see that depending on the material being read and its complexity, the time spent can vary greatly. Not only do these differences in time account for the different types of materials you might read (as you found in the comparative reading exercise earlier in this chapter), but also they also take into consideration the time needed to think about what you are reading to truly understand and comprehend what it is saying.

GET CONNECTED

Which apps help you best prepare for success when managing your time?

Do you have trouble keeping track of multiple tasks over the course of a term?

Trello lets you organize all your obligations in helpful boards. You can share them with others (project collaborators), set alerts as reminders, and mark tasks off as you complete them.

Do you use a particular app to help you manage your time?

Sticky note apps are available for PC, Mac, and mobile devices. They let you post quick reminders, reorganize them as needed, and view them separately or as a full to-do list.

What do you wish you could improve about your time management skills?

> Toggl helps you keep track of how and where you are spending your time so you can budget better and make time management changes that free you up for the really important stuff.

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4.6: Prioritization- Self-Management of What You Do and When You Do It



Figure 4.6.8 Numbered lists are useful and easy tools to create.

Questions to consider:

- Why is prioritization important?
- What are the steps involved in prioritization?
- How do I deal with situation where others' priorities are not the same as my own?
- What do I do when priorities conflict?
- What are the best ways to make sure I complete tasks?

Prioritization: Self-Management of What You Do and When You Do It

Another key component in time management is that of prioritization. Prioritization can be thought of as ordering tasks and allotting time for them based on their identified needs or value.

This next section provides some insight into not only helping prioritize tasks and actions based on need and value, but also how to better understand the factors that contribute to prioritization.

How to Prioritize

The enemy of good prioritization is panic, or at least making decisions based on strictly emotional reactions. It can be all too easy to immediately respond to a problem as soon as it pops up without thinking of the consequences of your reaction and how it might impact other priorities. It is very natural for us to want to remove a stressful situation as soon as we can. We want the adverse emotions out of the way as quickly as possible. But when it comes to juggling multiple problems or tasks to complete, prioritizing them first may mean the difference between completing everything satisfactorily and completing nothing at all.

Make Certain You Understand the Requirements of Each Task

One of the best ways to make good decisions about the prioritization of tasks is to understand the requirements of each. If you have multiple assignments to complete and you assume one of those assignments will only take an hour, you may decide to put it off until the others are finished. Your assumption could be disastrous if you find, once you begin the assignment, that there are several extra components that you did not account for and the time to complete will be four times as long as you estimated. Or, one of the assignments may be dependent on the results of another—like participating in a study and then writing a report on the results. If you are not aware that one assignment depends upon the completion of the other before you begin, you could inadvertently do the assignments out of order and have to start over. Because of situations like this, it is critically important to understand exactly what needs to be done to complete a task before you determine its priority.

Make Decisions on Importance, Impact on Other Priorities, and Urgency

After you are aware of the requirements for each task, you can then decide your priorities based on the importance of the task and what things need to be finished in which order.

To summarize: *the key components to prioritization are making certain you understand each task and making decisions based on importance, impact, and urgency.*

ACTIVITY

To better see how things may need to be prioritized, some people make a list of the tasks they need to complete and then arrange them in a quadrant map based on importance and urgency. Traditionally this is called the Eisenhower Decision Matrix. Before becoming the 34th president of the United States, Dwight Eisenhower served as the Allied forces supreme commander during World War II and said he used this technique to better prioritize the things he needed to get done.

In this activity you will begin by making a list of things you need or want to do today and then draw your own version of the grid below. Write each item in one of the four squares; choose the square that best describes it based on its urgency and its importance. When you have completed writing each the tasks in its appropriate square, you will see a prioritization order of your tasks. Obviously, those listed in the Important and Urgent square will be the things you need to finish first. After that will come things that are "important but not urgent," followed by "not important, but urgent," and finally "not urgent and not important."

	Urgent	Not Urgent
Important	**Urgent and Important** • Paper due tomorrow • Apply for internship by deadline	**Not Urgent but Important** • Exam next week • Flu shot
Not Important	**Urgent but Not Important** • Amazon sale • Laundry	**Not Urgent and Not Important** • Check social • TV show

Figure 4.6.9 The Eisenhower Matrix can help organize priorities and ensure that you focus on the correct tasks.

Who Is Driving Your Tasks?

Another thing to keep in mind when approaching time management is that while you may have greater autonomy in managing your own time, many of your tasks are being driven by a number of different individuals. These individuals are not only unaware of the other things you need to do, but they often have goals that are in conflict with your other tasks. This means that different instructors, your manager at work, or even your friends may be trying to assert their needs into your priorities. An example of this might be a boss that would like for you to work a few hours of overtime, but you were planning on using that time to do research for a paper.

Just like assessing the requirements and needs for each priority, doing the same with how others may be influencing your available time can be an important part of time management. In some cases, keeping others informed about your priorities may help avert possible conflicts (e.g., letting your boss know you will need time on a certain evening to study, letting your friends know you plan to do a journal project on Saturday but can do something on Sunday, etc.).

It will be important to be aware of how others can drive your priorities and for you to listen to your own good judgment. In essence, time management in college is as much about managing all the elements of your life as it is about managing time for class and to complete assignments.

Making the Tough Decision When It Is Needed

Occasionally, regardless of how much you have planned or how well you have managed your time, events arise where it becomes almost impossible to accomplish everything you need to by the time required. While this is very unfortunate, it simply cannot be helped. As the saying goes, “things happen.”

Finding yourself in this kind of situation is when prioritization becomes most important. You may find yourself in the uncomfortable position of only being able to complete one task or another in the time given. When this occurs with college assignments, the dilemma can be extremely stressful, but it is important to not feel overwhelmed by the anxiety of the situation so that you can make a carefully calculated decision based on the value and impact of your choice.

> ***“What do you do when faced with priority conflicts?”***

As an illustration, imagine a situation where you think you can only complete one of two assignments that are both important and urgent, and you must make a choice of which one you will finish and which one you will not. This is when it becomes critical to understand all the factors involved. While it may seem that whichever assignment is worth the most points to your grade is how you make the choice, there are actually a number of other attributes that can influence your decision in order to make the most of a bad situation. For example, one of the assignments may only be worth a minimal number of points toward your total grade, but it may be foundational to the rest of the course. Not finishing it, or finishing it late, may put other future assignments in jeopardy as well. Or the instructor for one of the courses might have a “late assignment” policy that is more forgiving—something that would allow you to turn in the work a little late without too much of a penalty.

If you find yourself in a similar predicament, the first step is to try to find a way to get everything finished, regardless of the challenges. If that simply cannot happen, the next immediate step would be to communicate with your instructors to let them know about the situation. They may be able to help you decide on a course of action, or they may have options you had not thought of. Only then can you make the choices about prioritizing in a tough situation.

The key here is to make certain you are aware of and understand all the ramifications to help make the best decision when the situation dictates you make a hard choice among priorities.

Completing the Tasks

Another important part of time management is to develop approaches that will help you complete tasks in a manner that is efficient and works for you. Most of this comes down to a little planning and being as informed about the specifics of each task as you can be.

Knowing What You Need to Do

As discussed in previous parts of this chapter, many learning activities have multiple components, and sometimes they must occur in a specific order. Additionally, some elements may not only be dependent on the order they are completed, but can also be dependent on how they are completed. To illustrate this we will analyze a task that is usually considered to be a simple one: *attending a class session.* In this analysis we will look at not only what must be accomplished to get the most out of the experience, but also at how each element is dependent upon others and must be done in a specific order. The graphic below shows the interrelationship between the different activities, many of which might not initially seem significant enough to warrant mention, but it becomes obvious that other elements depend upon them when they are listed out this way.

Element or Task Needed for Success	Task it Depends on
Pre-class Prep	
• Completing previous homework • Reading appropriate material for lecture • Taking notes on areas that need clarification	• Understanding homework assigned from previous class • Making certain appropriate reading material is identified • Reading appropriate material for lecture
↓ **During Class**	
• Understanding lecture • Taking notes on lecture • Asking questions for clarification • Taking part in class discussion • Receive assignments for next class	• Reading appropriate material • Understanding lecture • Reading appropriate material, Understanding lecture • Reading appropriate material, Understanding lecture
↓ **Post-Class**	
• Understanding homework assigned • Making certain appropriate reading material is identified • Ask questions for clarification • Reviewing and rewriting notes	• Receive assignments for next class • Receive assignments for next class • Receive assignments for next class

Figure 4.6.10 Many of your learning activities are dependent on others, and some are the gateways to other steps.

As you can see from the graphic above, even a task as simple as "going to class" can be broken down into a number of different elements that have a good deal of dependency on other tasks. One example of this is preparing for the class lecture by reading materials ahead of time in order to make the lecture and any complex concepts easier to follow. If you did it the other way around, you might miss opportunities to ask questions or receive clarification on the information presented during the lecture.

Understanding what you need to do and when you need to do it can be applied to any task, no matter how simple or how complex. Knowing what you need to do and planning for it can go a long way toward success and preventing unpleasant surprises.

Knowing How You Will Get It Done

After you have a clear understanding of what needs to be done to complete a task (or the component parts of a task), the next step is to create a plan for completing everything.

This may not be as easy or as simple as declaring that you will finish part one, then move on to part two, and so on. Each component may need different resources or skills to complete, and it is in your best interest to identify those ahead of time and include them as part of your plan.

A good analogy for this sort of planning is to think about it in much the same way you would preparing for a lengthy trip. With a long journey you probably would not walk out the front door and then decide how you were going to get where you were going. There are too many other decisions to be made and tasks to be completed around each choice. If you decided you were going by plane, you would need to purchase tickets, and you would have to schedule your trip around flight times. If you decided to go by car, you would need gas money and possibly a map or GPS device. What about clothes? The clothes you will need are dependent on how long will you be gone and what the climate will be like. If it far enough away that you will need to speak another language, you may need to either acquire that skill or at least come with something or someone to help you translate.

What follows is a planning list that can help you think about and prepare for the tasks you are about to begin.

What Resources Will You Need?

The first part of this list may appear to be so obvious that it should go without mention, but it is by far one of the most critical and one of the most overlooked. Have you ever planned a trip but forgotten your most comfortable pair of shoes or neglected to book a hotel room? If a missing resource is important, the entire project can come to a complete halt. Even if the missing resource is a minor component, it may still dramatically alter the end result.

Learning activities are much the same in this way, and it is also important to keep in mind that resources may not be limited to physical objects such as paper or ink. Information can be a critical resource as well. In fact, one of the most often overlooked aspects in planning by new college students is just how much research, reading, and information they will need to complete assignments.



Figure 4.6.11: Allowing time to think is an important part of learning. Credit: Juhan Sonin / Flickr / Attribution 2.0 Generic (CC BY 2.0))

For example, if you had an assignment in which you were supposed to compare and contrast a novel with a film adapted from that novel, it would be important to have access to both the movie and the book as resources. Your plans for completing the work could quickly fall apart if you learned that on the evening you planned to watch the film, it was no longer available.

What Skills Will You Need?

Poor planning or a bad assumption in this area can be disastrous, especially if some part of the task has a steep learning curve. No matter how well you planned the other parts of the project, if there is some skill needed that you do not have and you have no idea how long it will take to learn, it can be a bad situation.

Imagine a scenario where one of your class projects is to create a poster. It is your intent to use some kind of imaging software to produce professional-looking graphics and charts for the poster, but you have never used the software in that way before. It seems easy enough, but once you begin, you find the charts keep printing out in the wrong resolution. You search online for a solution, but the only thing you can find requires you to recreate them all over again in a different setting. Unfortunately, that part of the project will now take twice as long.

It can be extremely difficult to recover from a situation like that, and it could have been prevented by taking the time to learn how to do it correctly before you began or by at least including in your schedule some time to learn and practice.

Set Deadlines

Of course, the best way to approach time management is to set realistic deadlines that take into account which elements are dependent on which others and the order in which they should be completed. Giving yourself two days to write a 20- page work of fiction is not very realistic when even many professional authors average only 6 pages per day. Your intentions may be well founded, but your use of unrealistic deadlines will not be very successful.

Setting appropriate deadlines and sticking to them is very important—so much so that several sections in the rest of this chapter touch on effective deadline practices.

Be Flexible

It is ironic that the item on this list that comes just after a strong encouragement to make deadlines and stick to them is the suggestion to be flexible. The reason that *being flexible* has made this list is because even the best-laid plans and most accurate time management efforts can take an unexpected turn. The idea behind being flexible is to readjust your plans and deadlines when something does happen to throw things off. The worst thing you could do in such a situation is panic or just stop working because the next step in your careful planning has suddenly become a roadblock. The moment when you see that something in your plan may become an issue is when to begin readjusting your plan.

Adjusting a plan along the way is incredibly common. In fact, many professional project managers have learned that it seems something *always* happens or there is always some delay, and they have developed an approach to deal with the inevitable need for some flexibility. In essence, you could say that they are even planning for problems, mistakes, or delays from the very beginning, and they will often add a little extra time for each task to help ensure an issue does not derail the entire project or that the completion of the project does not miss the final due date.

> ***"As you work through tasks, make certain you are always monitoring and adapting to ensure you complete them."***

STUDENT PROFILE

"While in college, I recall an instance where I was awake for two nights in a row trying to cram for upcoming midterms. I quickly learned that trying to navigate through college while working full time posed a significant challenge. Because of inability to manage my responsibilities, my first year of college was quite miserable. I went through a lot of trial and error to find out that *time management* was the key. From my experiences, I have extrapolated three important components to this skill. First, knowing your *values* is imperative. Values will serve as a guide, which will help you to determine which actions bring you closer to your goals and those that don't. Second, know your *constraints*. Constraints (in form of time or other responsibilities) can help you set the parameter within which you can function efficiently. The last component is *action*. This component was the hardest for me to master, but it was the most fruitful. Because knowing values and limitations without engaging in appropriate actions does not serve any meaningful purpose. I strongly believe that learning time management can contribute greatly towards positive university experience."

—Firdavs Khaydarov, Psychology Major, Minnesota State University, Mankato

The Importance of Where You Do Your Work



Figure 4.6.12 Where you do work can be as important as when. (Credit: Mads Bodker / Flickr / Attribution 2.0 Generic (CC BY 2.0))

A large part of ensuring that you can complete tasks on time comes to setting up conditions that will allow you to do the work well. Much of this has to do with the environment where you will do your work. This not only includes physical space such as a work area, but other conditions like being free from distractions and your physical well-being and mental attitude.

The Right Space

Simple things, like where you are set up to do your work, can not only aid in your efficiency but also affect how well you can work or even if you can get the work completed at all. One example of this might be typing on a laptop. While it might seem more comfortable to lie back on a couch and type a long paper, sitting up at a desk or table actually increases your typing speed and reduces the number of mistakes. Even the kind of mouse you use can impact how you work, and using one you are comfortable with can make a big difference.

There are a host of other factors that can come into play as well. Do you have enough space? Is the space cluttered, or do you have the room to keep reference materials and other things you might need within arm's reach? Are there other ways you could work that might be even more efficient? For example, buying an inexpensive second monitor—even secondhand—might be the key to decreasing the amount of time you spend when you can have more than one document displayed at a time.

The key is to find what works for you and to treat your work space as another important resource needed to get the task finished.

Distraction Free

Few things are more frustrating than trying to do work while distractions are going on around you. If other people are continually interrupting you or there are things that keep pulling your attention from the task at hand, everything takes longer and you are more prone to mistakes.[4]

Many people say they work better with distractions—they prefer to leave the television or the radio on—but the truth is that an environment with too many interruptions is rarely helpful when focus is required. Before deciding that the television or talkative roommates do not bother you when you work, take an honest accounting of the work you produce with interruptions compared to work you do without.

If you find that your work is better without distractions, it is a good idea to create an environment that reduces interruptions. This may mean you have to go to a private room, use headphones, or go somewhere like a library to work. Regardless, the importance of a distraction-free environment cannot be emphasized enough.

Working at the Right Time

Most people are subject to their own rhythms, cycles, and preferences throughout their day. Some are alert and energetic in the mornings, while others are considered “night owls” and prefer to work after everyone else has gone to sleep. It can be important to be aware of your own cycles and to use them to your advantage. Rarely does anyone do their best work when they are exhausted, either physically or mentally. Just as it can be difficult to work when you are physically ill, it can also be a hindrance to try to learn or do mental work when you are tired or emotionally upset.

Your working environment definitely includes your own state of mind and physical well-being. Both have a significant influence on your learning and production ability. Because of this, it is not only important to be aware of your own condition and work preferences, but to actually try to create conditions that help you in these areas. One approach is to set aside a specific time to do certain kinds of work. You might find that you concentrate better after you have eaten a meal. If that is the case, make it a habit of doing homework every night after dinner. Or you might enjoy reading more after you are ready for bed, so you do your reading assignments just before you go to sleep at night. Some people find that they are more creative during a certain time of the day or that they are more comfortable writing with subtle lighting. It is worth taking the time to find the conditions that work best for you so that you can take advantage of them.

ANALYSIS QUESTION

Student Survey on Work Environment

Analysis: Take the time to think about where you will do your work and when. What can you do to help ensure your working environment will be helpful rather than harmful? What do you know doesn’t work for you? What will you do to prevent those adverse conditions from creeping into your work environment?

Below is a quick survey to help you determine your own preferences in regard to your work space, the time you work, and distractions. Rank each option: 1–4, 1 meaning “least like me” and 4 meaning “most like me.”

- I like my workspace to be organized and clean.
- There are certain places where I am more comfortable when I work.
- I prefer to be alone when I work on certain things.
- I find it difficult to read with other sounds or voices around me.
- There are certain times of the day when I can be more focused.
- My moods or emotions can interfere with my ability to concentrate

Footnotes

- 4 https://en.calameo.com/read/00009178915b8f5b352ba

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4.7: Goal Setting and Motivation

Questions to consider:

- How do I set motivational goals?
- What are SMART goals?
- What's the importance of an action plan?
- How do I keep to my plan?

Motivation often means the difference between success and failure. That applies to school, to specific tasks, and to life in general. One of the most effective ways to keep motivated is to set goals.

Goals can be big or small. A goal can range from *I am going to write one extra page tonight*, to *I am going to work to get an A in this course*, all the way to *I am going to graduate in the top of my class so I can start my career with a really good position*. The great thing about goals is that they can include and influence a number of other things that all work toward a much bigger picture. For example, if your goal is to get an A in a certain course, all the reading, studying, and every assignment you do for that course contributes to the larger goal. You have motivation to do each of those things and to do them well.

Setting goals is something that is frequently talked about, but it is often treated as something abstract. Like time management, goal setting is best done with careful thought and planning. This next section will explain how you can apply tested techniques to goal setting and what the benefits of each can be.

Set Goals That Motivate You

The first thing to know about goal setting is that a goal is a specific end result you desire. If the goal is not something you are really interested in, there is little motivational drive to achieve it. Think back to when you were much younger and some well-meaning adult set a goal for you—something that didn't really appeal to you at all. How motivated were you to achieve the goal? More than likely, if you were successful at all in meeting the goal, it was because you were motivated by earning the approval of someone or receiving a possible reward, or you were concerned with avoiding something adverse that might happen if you did not do what you were told. From an honest perspective in that situation, your real goal was based on something else, not the meeting of the goal set for you. To get the most from the goals you set, make sure they are things that you are interested in achieving.

That is not to say you shouldn't set goals that are supported by other motivations (e.g., If I finish studying by Friday, I can go out on Saturday), but the idea is to be intellectually honest with your goals.

Set SMART Goals

Goals should also be SMART. In this case, the word *smart* is not only a clever description of the type of goal, but it is also an acronym that stands for Specific, Measurable, Attainable, Relevant, and Time-bound. The reason these are all desirable traits for your goals is because they not only help you plan how to meet the goal, but they can also contribute to your decision-making processes during the planning stage.

What does it mean to create SMART goals?

- Specific—For a goal to be specific, it must be defined enough to actually determine the goal. A goal of *get a good job when I graduate* is too general. It doesn't define what a good job is. In fact, it doesn't even necessarily include a job in your chosen profession. A more specific goal would be something like *be hired as a nurse in a place of employment where it is enjoyable to work and that has room for promotion.*
- Measurable—The concept of *measurable* is one that is often overlooked when setting goals. What this means is that the goal should have clearly defined outcomes that are detailed enough to measure and can be used for planning of how you will achieve the goal. For example, setting a goal of *doing well in school* is a bit undefined, but making a goal of *graduating with a GPA above 3.0* is measurable and something you can work with. If your goal is measurable, you can know ahead of time how many points you will have to earn on a specific assignment to stay in that range or how many points you will need to make up in the next assignment if you do not do as well as you planned.
- Attainable—*Attainable* or *achievable* goals means they are reasonable and within your ability to accomplish. While a goal of *make an extra one million dollars by the end of the week* is something that would be nice to achieve, the odds that you could make that happen in a single week are not very realistic.

- Relevant—For goal setting, *relevant* means it applies to the situation. In relation to college, a goal of *getting a horse to ride* is not very relevant, but *getting dependable transportation* is something that would contribute to your success in school.
- Time-bound—Time-bound means you set a specific time frame to achieve the goal. *I will get my paper written by Wednesday* is time-bound. You know when you have to meet the goal. *I will get my paper written sometime soon* does not help you plan how and when you will accomplish the goal.

In the following table you can see some examples of goals that do and do not follow the SMART system. As you read each one, think about what elements make them SMART or how you might change those that are not.

Table 3.6

Goal	Is it SMART?	
I am going to be rich someday.	No	There is nothing really specific, measurable, or time-bound in this goal.
I will graduate with my degree, on time.	Yes	The statement calls out specific, measureable, and time-bound details. The other attributes of attainable and relevant are implied.
I am going to save enough money to buy a newer car by June.	Yes	All SMART attributes are covered in this goal.
I would like to do well in all my courses next semester.	No	While this is clearly time-bound and meets most of the SMART goal attributes, it is not specific or measurable without defining what “do well” means.
I am going to start being a nicer person.	No	While most of the SMART attributes are implied, there is nothing really measurable in this goal.
I will earn at least a 3.0 GPA in all my courses next semester.	Yes	All of the SMART attributes are present in this goal.
I am going to start being more organized.	No	While most of the SMART attributes are implied, there is nothing really measurable in this goal.

APPLICATION

Try writing two SMART goals—something with a one-week time frame and something that you will accomplish over the next year. Make certain that you include all the appropriate elements—Specific, Measurable, Attainable, Relevant, and Time-bound.

Make an Action Plan

Like anything else, making a step-by-step action plan of how you will attain your goals is the best way to make certain you achieve them. It doesn’t matter if it is a smaller goal with immediate results (e.g., finish all your homework due by Friday) or something bigger that takes several years to accomplish (graduate with my degree in the proper amount of time).

The planning techniques you use for time management and achieving goals can be similar. In fact, accurate goal setting is very much a part of time management if you treat the completion of each task as a goal.

What follows is an example of a simple action plan that lists the steps for writing a short paper. You can use something like this or modify it in a way that would better suit your own preferences.

Table 3.7

Action Plan		
Task	**Objective**	**When**

Action Plan		
Choose topic.	Select something interesting.	Needs to be done by Monday!
Write outline, look for references.	Create structure of paper and outline each part.	Monday, 6:00 p.m.
Research references to support outline, look for good quotes.	Strengthen paper and resources.	Tuesday, 6:00 p.m.
Write paper introduction and first page draft.	Get main ideas and thesis statement down.	Wednesday, 7:00 p.m.
Write second page and closing draft.	Finish main content and tie it all together.	Thursday, 6:00 p.m.
Rewrite and polish final draft.	Clean up for grammar, writing style, and effective communication.	Friday, 5:00 p.m.

Another useful approach to goal setting is to create SMART goals and then write them down. For most people there is a higher level of commitment when we write something down. If you have your goals written out, you can refer to each component of the SMART acronym and make certain you are on track to achieve it.

Stick with It!

As with anything else, the key to reaching goals is to keep at it, keep yourself motivated, and overcome any obstacles along the way. In the following graphic you will find seven methods that highly successful people use to accomplish this.



Figure 4.7.13 These seven ways to stay motivated are good suggestions from highly successful people. What other strategies would you suggest?

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4.8: Enhanced Strategies for Time and Task Management

Questions to consider:

- What strategy helps me prioritize my top tasks?
- How do I make the best use of my time when prioritizing?
- How do I make sure I tackle unpleasant tasks instead of putting them off?
- What's the best way to plan for long-term tasks?
- How do I find time in a busy schedule?

Over the years, people have developed a number of different strategies to manage time and tasks. Some of the strategies have proven to be effective and helpful, while others have been deemed not as useful.

The good news is that the approaches that do not work very well or do not really help in managing time do not get passed along very often. But others, those which people find of value, do. What follows here are three unique strategies that have become staples of time management. While not everyone will find that all three work for them in every situation, enough people have found them beneficial to pass them along with high recommendations.

Daily Top Three

The idea behind the *daily top three* approach is that you determine which three things are the most important to finish that day, and these become the tasks that you complete. It is a very simple technique that is effective because each day you are finishing tasks and removing them from your list. Even if you took one day off a week and completed no tasks on that particular day, a *daily top three* strategy would have you finishing 18 tasks in the course of a single week. That is a good amount of things crossed off your list.

analysis question

Analysis: Think about what would be your top three tasks for today? What would you have on the list tomorrow?

Pomodoro Technique



Figure 4.8.14 The Pomodoro Technique is named after a type of kitchen timer, but you can use any clock or countdown timer. (Marco Verch /Flickr / Attribution 2.0 Generic (CC BY 2.0))

The Pomodoro Technique was developed by Francesco Cirillo. The basic concept is to use a timer to set work intervals that are followed by a short break. The intervals are usually about 25 minutes long and are called *pomodoros*, which comes from the Italian word for tomato because Cirillo used a tomato-shaped kitchen timer to keep track of the intervals.

In the original technique there are six steps:

1. Decide on the task to be done.
2. Set the timer to the desired interval.
3. Work on the task.
4. When the timer goes off, put a check mark on a piece of paper.
5. If you have fewer than four check marks, take a short break (3–5 minutes), then go to Step 1 or 2 (whichever is appropriate).
6. After four pomodoros, take a longer break (15–30 minutes), reset your check mark count to zero, and then go to Step 1 or 2.

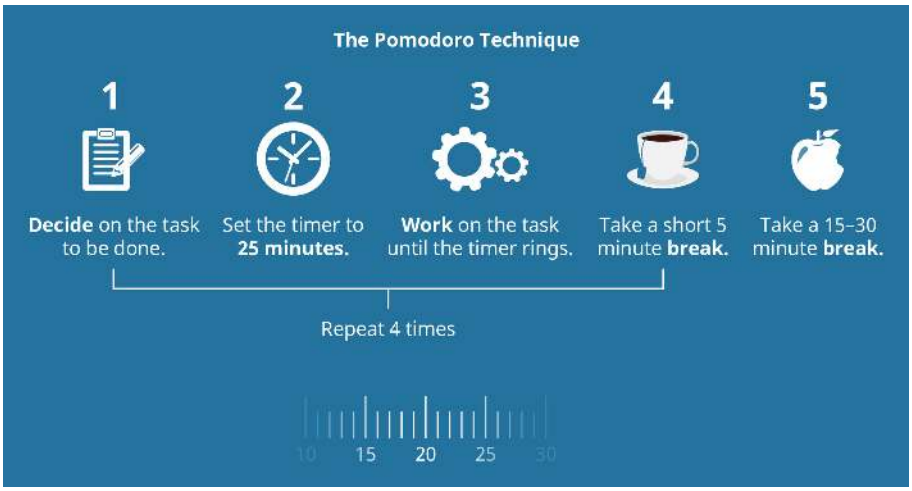


Figure 4.8.15 The Pomodoro Technique contains five defined steps.

There are several reasons this technique is deemed effective for many people. One is the benefit that is derived from quick cycles of work and short breaks. This helps reduce mental fatigue and the lack of productivity caused by it. Another is that it tends to encourage practitioners to break tasks down to things that can be completed in about 25 minutes, which is something that is usually manageable from the perspective of time available. It is much easier to squeeze in three 25-minute sessions of work time during the day than it is to set aside a 75- minute block of time.

Eat the Frog

Of our three quick strategies, *eat the frog* probably has the strangest name and may not sound the most inviting. The name comes from a famous quote, attributed to Mark Twain: “Eat a live frog first thing in the morning and nothing worse will happen to you the rest of the day.” *Eat the Frog* is also the title of a best-selling book by Brian Tracy that deals with time management and avoiding procrastination.

How this applies to time and task management is based on the concept that if a person takes care of the biggest or most unpleasant task first, everything else will be easier after that.

Although stated in a humorous way, there is a good deal of truth in this. First, we greatly underestimate how much worry can impact our performance. If you are continually distracted by anxiety over a task you are dreading, it can affect the task you are working on at the time. Second, not only will you have a sense of accomplishment and relief when the task you are concerned with is finished and out of the way, but other tasks will seem lighter and not as difficult.

Application: Try Three Time Management Strategies

Over the next two weeks, try each of these three methods to see which ones might work for you. Is there one you favor over the others? Might each of these three approaches serve you better in different situations or with different tasks? Do you have a creative alternative or possibly a way to use some combination of these techniques?

In addition to these three strategies, you could also develop whole new approaches from suggestions found earlier in this chapter. For example, you could apply some of the strategies for avoiding procrastination or for setting appropriate priorities and see how they work in combination with these techniques or on their own.

The key is to find which system works best for you.

Breaking Down the Steps and Spreading Them over Shorter Work Periods

Above, you read about several different tried-and-tested strategies for effective time management—approaches that have become staples in the professional world. In this section you will read about two more creative techniques that combine elements from these other methods to handle tasks when time is scarce and long periods of time are a luxury you just do not have.

The concept behind this strategy is to break tasks into smaller, more manageable units that do not require as much time to complete. As an illustration of how this might work, imagine that you are assigned a two-page paper that is to include references. You estimate that to complete the paper—start to finish—would take you between four and a half and five hours. You look at your

calendar over the next week and see that there simply are no open five-hour blocks (unless you decided to only get three hours of sleep one night). Rightly so, you decide that going without sleep is not a good option. While looking at your calendar, you do see that you can squeeze in an hour or so every night. Instead of trying to write the entire paper in one sitting, you break it up into much smaller components as shown in the table below:

Table 3.8: Breaking Down Projects into Manageable-Sized Tasks

Day/Time	Task	Time
Monday, 6:00 p.m.	Write outline; look for references.	60 minutes
Tuesday, 6:00 p.m.	Research references to support outline; look for good quotes.	60 minutes
Wednesday, 7:00 p.m.	Write paper introduction and first page draft.	60 minutes
Thursday, 6:00 p.m.	Write second page and closing draft.	60 minutes
Friday, 5:00 p.m.	Rewrite and polish final draft.	60 minutes
Saturday, 10:00 a.m.	*Only if needed—finish or polish final draft.*	60 minutes?

While this is a simple example, you can see how it would redistribute tasks to fit your available time in a way that would make completing the paper possible. In fact, if your time constraints were even more rigid, it would be possible to break these divided tasks down even further. You could use a variation of the Pomodoro Technique and write for three 20-minute segments each day at different times. The key is to look for ways to break down the entire task into smaller steps and spread them out to fit your schedule.

Table 3.9

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
8:00–10:00		Work		Work			
10:00–12:00	Algebra	Work	Algebra	Work	Algebra	10 a.m.–11 a.m. *Only if needed*	Work
12:00–2:00	Lunch/study	1 p.m. English Comp	Lunch/study	1 p.m. English Comp	Lunch/study	Family picnic	Work
2:00–4:00	History	English Comp	History	English Comp	History	Family picnic	
4:00–6:00	Study for Algebra quiz.	Grocery	Study for History exam.	Study for History exam.	5 p.m.–6 p.m. Rewrite and polish final draft.	Family picnic	Laundry
6:00–7:00	Write outline; look for references.	Research references to support outline; look for good quotes.	Research presentation project.	Write second page and closing draft	Create presentation.	Meet with Darcy.	Prepare school stuff for next week.
7:00–8:00	Free time	Free time	Write paper introduction and first page draft.	Research presentation project.	Create presentation.		Free time

STUDENT PROFILE

"Time management is probably one of the hardest things I had to pick up when I got to college. For starters, I didn't have anyone to come wake me up if I forgot to set an alarm or to tell me to get out of bed so that I wouldn't be late. I had to start placing my phone far away from my bed; so that way, I would have to get out of bed in order to turn the alarm off. Accomplishing work on time can also be difficult. It's tough to find the fine balance between when you have to stay in and work on assignments and when is acceptable to go out and do leisure activities.

"I learned the 8-8-8 rule. Every day you spend eight hours working on school work or going to class, eight hours of free time to do what you want, and then eight hours to sleep at night so that you will get enough rest. Sleep is crucial for time management. I learned very quickly that you cannot focus or be productive if you are struggling to keep your head from falling over because you are so tired. Basically, I've learned that if you want to be successful in college, then you have to be on top of your game when it comes to time. It's something thing you cannot make up once it's gone."

—Preston Allen, University of Central Arkansas

Analyzing Your Schedule and Creating Time to Work

Of all the strategies covered in this chapter, this one may require the most discipline, but it can also be the most beneficial in time management. The fact is most of us waste time throughout the day. Some of it is due to a lack of awareness, but it can also be caused by the constraints of our current schedules. An example of this is when we have 15 to 20 minutes before we must leave to go somewhere. We don't do anything with that time because we are focused on leaving or where we are going, and we might not be organized enough to accomplish something in that short of a time period. In fact, a good deal of our 24- hour days are spent a few minutes at a time waiting for the next thing scheduled to occur. These small units of time add up to a fair amount each day.

The intent of this strategy is to recapture those lost moments and use them to your advantage. This may take careful observation and consideration on your part, but the results of using this as a method of time management are more than worth it.

The first step is to look for those periods of time that are wasted or that can be repurposed. In order to identify them, you will need to pay attention to what you do throughout the day and how much time you spend doing it. The example of waiting for the next thing in your schedule has already been given, but there are many others. How much time do you spend in activities after you have really finished doing them but are still lingering because you have not begun to do something else (e.g., letting the next episode play while binge-watching, reading social media posts or waiting for someone to reply, surfing the Internet, etc.)? You might be surprised to learn how much time you use up each day by just adding a few unproductive minutes here and there.

If you set a limit on how much time you spend on each activity, you might find that you can recapture time to do other things. An example of this would be limiting yourself to reading news for 30 minutes. Instead of reading the main things that interest you and then spending an additional amount of time just looking at things that you are only casually interested in because that is what you are doing at the moment, you could stop after a certain allotted period and use the extra time you have gained on something else.

After you identify periods of lost time, the next step will be to envision how you might restructure your activities to bring those extra minutes together into useful blocks of time. Using the following scenario as an illustration, we will see how this could be accomplished.



Figure 4.8.16 Sarah has to balance a lot of obligations.

On Tuesday nights, Sarah has a routine: After work, she does her shopping for the week (2 hours driving and shopping) and then prepares and eats dinner (1 hour). After dinner, she spends time on homework (1 hour) and catching up with friends, reading the news, and other Internet activities (1 hour), and then she watches television or reads before going to bed (1 hour). While it may seem that there is very little room for improvement in her schedule without cutting out something she enjoys, limiting the amount of time she spends on each activity and rethinking how she goes about each task can make a significant difference.

In this story, Sarah's Tuesday-night routine includes coming home from work, taking stock of which items in her home she might need to purchase, and then driving to the store. While at the store, she spends time picking out and selecting groceries as she plans for meals she will eat during the rest of the week. Then, after making her purchases, she drives home. Instead, if she took the time to make a list and plan for what she needed at the store before she arrived, she would not spend as much time looking for inspiration in each aisle. Also, if she had a prepared list, not only could she quickly pick up each item, but she could stop at the store on the way home from work, thus cutting out the extra travel time. If purchasing what she needed took 30 minutes less because she was more organized and she cut out an additional 20 minutes of travel time by saving the extra trip to the store from her house, she could recapture a significant amount of her Tuesday evening. If she then limited the time she spent catching up with friends and such to 30 minutes or maybe did some of that while she prepared dinner, she would find that she had added almost an extra hour and a half to the time available to her on that evening, without cutting out anything she needed to do or enjoys. If she decided to spend her time on study or homework, this would more than double the time she previously had available in her schedule for homework.

Analysis Question: Reflection

Analysis: Identify areas in the way you spend your day where you may be able to recapture and repurpose time. Are there things you can move around to gain more time? Are there ways you can combine tasks or reduce travel time?

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4.9: Summary

This chapter began by pointing out the dangers of poor time management, both in cost and even the potential risk to graduation. After presenting why time management is important, sections of the text covered how time management for college can be different from what students may have experienced before. Following this, the chapter contained several sections on how to effectively manage time (including predicting time on task), how to use technology to your advantage, and how to prioritize tasks. Other topics included goal setting and motivation, some specific strategies for time and task management, and avoiding procrastination.

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4.10: Career Connection

Rick says: I've wanted to work in radio since I was in high school and had great opportunities in college to learn at the campus station. I interned for a semester at a local Top 40 station and, after graduation, was offered a position as the producer of the station's morning show.

The only problem: I had to be at the radio station by 4:45 a.m. I couldn't do it. I tried everything—alarms on my phone, clock radio alarms, friends calling me. This is not a job you can be late for—dead air is a radio DJ's greatest nightmare. But no matter what I tried, I could not wake up on time. The third time I arrived late, the radio station let me go.

Reflection question: How might you have handled the situation differently? How might this aspiring radio DJ have managed his time differently to ensure he was not late for work?

For discussion: Is the Internet responsible for most of our wasted work time? Read through this article. What do you think?

https://openstax.org/l/whowastestime

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4.11: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

1. I regularly procrastinate completing tasks that don't interest me or seem challenging.
2. I use specific time management strategies to complete tasks.
3. I find it difficult to prioritize tasks because I am not sure what is really important.
4. I am pleased with my ability to manage my time.

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4.12: Where do you go from here?

Refining your time management skills based on an honest assessment is something that should never stop. The benefits of good time management skills are something that will apply to the rest of your life. What would you like to learn more about? Choose a topic from the list below, and create an annotated bibliography that would direct further research.

- Psychological reasons for procrastinating
- Technology and social media as distractions
- Additional time management strategies
- Time management strategies that successful people use

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SECTION OVERVIEW

4.13: Time, Tools, and Study Environment

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CHAPTER OVERVIEW

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5.2: Comprehending College Level Reading by Using the Reading Apprenticeship Approach
5.3: Getting the Most Out of Your Textbooks
5.4: Reading Textbooks
5.5: Context Clues and Close Reading for Literature
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5.1: Words of Wisdom- Thinking Critically and Creatively

Dr. Andrew Robert Baker

Dr. Andrew Robert Baker

Critical and creative thinking skills are perhaps the most fundamental skills involved in making judgments and solving problems. They are some of the most important skills I have ever developed. I use them everyday and continue to work to improve them both.

The ability to think critically about a matter—to analyze a question, situation, or problem down to its most basic parts—is what helps us evaluate the accuracy and truthfulness of statements, claims, and information we read and hear. It is the sharp knife that, when honed, separates fact from fiction, honesty from lies, and the accurate from the misleading. We all use this skill to one degree or another almost every day. For example, we use critical thinking every day as we consider the latest consumer products and why one particular product is the best among its peers. Is it a quality product because a celebrity endorses it? Because a lot of other people may have used it? Because it is made by one company versus another? Or perhaps because it is made in one country or another? These are questions representative of critical thinking.

The academic setting demands more of us in terms of critical thinking than everyday life. It demands that we evaluate information and analyze a myriad of issues. It is the environment where our critical thinking skills can be the difference between success and failure. In this environment we must consider information in an analytical, critical manner. We must ask questions—What is the source of this information? Is this source an expert one and what makes it so? Are there multiple perspectives to consider on an issue? Do multiple sources agree or disagree on an issue? Does quality research substantiate information or opinion? Do I have *any* personal biases that may affect my consideration of this information? It is only through purposeful, frequent, intentional questioning such as this that we can sharpen our critical thinking skills and improve as students, learners, and researchers. Developing my critical thinking skills over a twenty year period as a student in higher education enabled me to complete a quantitative dissertation, including analyzing research and completing statistical analysis, and earning my Ph.D. in 2014.

While critical thinking analyzes information and roots out the true nature and facets of problems, it is *creative* thinking that drives progress forward when it comes to solving these problems. Exceptional creative thinkers are people that invent new solutions to existing problems that do not rely on past or current solutions. They are the ones who invent solution C when everyone else is still arguing between A and B. Creative thinking skills involve using strategies to clear the mind so that our thoughts and ideas can transcend the current limitations of a problem and allow us to see beyond barriers that prevent new solutions from being found.

Brainstorming is the simplest example of intentional creative thinking that most people have tried at least once. With the quick generation of many ideas at once we can block-out our brain's natural tendency to limit our solution-generating abilities so we can access and combine many possible solutions/thoughts and invent new ones. It is sort of like sprinting through a race's finish line only to find there is new track on the other side and we can keep going, if we choose. As with critical thinking, higher education both demands creative thinking from us and is the perfect place to practice and develop the skill. Everything from word problems in a math class, to opinion or persuasive speeches and papers, call upon our creative thinking skills to generate new solutions and perspectives in response to our professor's demands. Creative thinking skills ask questions such as—What if? Why not? What else is out there? Can I combine perspectives/solutions? What is something no one else has brought-up? What is being forgotten/ignored? What about _____? It is the opening of doors and options that follows problem-identification.

Consider an assignment that required you to compare two different authors on the topic of education and select and defend one as better. Now add to this scenario that your professor clearly prefers one author over the other. While critical thinking can get you as far as identifying the similarities and differences between these authors and evaluating their merits, it is creative thinking that you must use if you wish to challenge your professor's opinion and invent new perspectives on the authors that have not previously been considered.

So, what can we do to develop our critical and creative thinking skills? Although many students may dislike it, group work is an excellent way to develop our thinking skills. Many times I have heard from students their disdain for working in groups based on scheduling, varied levels of commitment to the group or project, and personality conflicts too, of course. True—it's not always easy, but that is why it is so effective. When we work collaboratively on a project or problem we bring many brains to bear on a subject. These different brains will naturally develop varied ways of solving or explaining problems and examining information. To the observant individual we see that this places us in a constant state of back and forth critical/creative thinking modes.

For example, in group work we are simultaneously analyzing information and generating solutions on our own, while challenging other's analyses/ideas and responding to challenges to our own analyses/ideas. This is part of why students tend to avoid group work—it challenges us as thinkers and forces us to analyze others while defending ourselves, which is not something we are used to or comfortable with as most of our educational experiences involve solo work. Your professors know this—that's why we assign it—to help you grow as students, learners, and thinkers!

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5.2: Comprehending College Level Reading by Using the Reading Apprenticeship Approach

Phyllis Nissila



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Most students entering college have not yet dealt with the level of difficulty involved in reading–and comprehending–scholarly textbooks and articles. The challenge may even surprise some who have pretty good reading and comprehension skills so far. Other students for whom reading has mostly consisted of social media, texts, forum chat rooms, and emails, find they are intimidated by the sheer *amount* of reading there is in college classes.

Reading Comprehension Definition

Reading comprehension is defined as the level of understanding of a message. This understanding comes from the interaction between the words that are written and how they trigger knowledge outside the text/message. Comprehension is a "creative, multifaceted process" dependent upon four language skills: phonology, syntax, semantics, and pragmatics. Proficient reading depends on the ability to recognize words quickly and effortlessly. It is also determined by an individual's cognitive development, which is "the construction of thought processes." Some people learn through education or instruction and others through direct experiences.

There are specific traits that determine how successfully an individual will comprehend text, including prior knowledge about the subject, well-developed language, and the ability to make inferences. Having the skill to monitor comprehension is a factor: "Why is this important?" and "Do I need to read the entire text?" are examples. Another trait is the ability to be self-correcting, which allows for solutions to comprehension challenges.

Reading Comprehension Levels

Reading comprehension involves two levels of processing, shallow (low-level) processing and deep (high-level) processing. Deep processing involves semantic processing, which happens when we encode the meaning of a word and relate it to similar words. Shallow processing involves structural and phonemic recognition, the processing of sentence and word structure and their associated sounds. This theory was first identified by Fergus I. M. Craik and Robert S. Lockhart.

Brain Region Activation

Comprehension levels can now be observed through the use of a fMRI, functional magnetic resonance imaging. fMRIs' are used to determine the specific neural pathways of activation across two conditions, narrative-level comprehension and sentence-level comprehension. Images showed that there was less brain region activation during sentence-level comprehension, suggesting a shared reliance with comprehension pathways. The scans also showed an enhanced temporal activation during narrative levels tests indicating this approach activates situation and spatial processing.

History

Initially most comprehension teaching was based on imparting selected techniques that when taken together would allow students to be strategic readers. However, in 40 years of testing these methods never seemed to win support in empirical research. One such strategy for improving reading comprehension is the technique called SQ3R: Survey, Question, Read, Recite, and Review, that was introduced by Francis Pleasant Robinson in his 1946 book *Effective Study*.

Between 1969 and to about 2000 a number of "strategies" were devised for teaching students to employ self-guided methods for improving reading comprehension. In 1969 Anthony Manzo designed and found empirical support for the ReQuest, or Reciprocal

Questioning Procedure, it was the first method to convert emerging theories of social and imitation learning into teaching methods through the use of a talk rotation between students and teacher called cognitive modeling.

Since the turn of the 21st century, comprehension lessons usually consist of students answering teachers' questions, writing responses to questions on their own, or both. The whole group version of this practice also often included "Round-robin reading", wherein teachers called on individual students to read a portion of the text. In the last quarter of the 20th century, evidence accumulated that the read-test methods were more successful assessing rather than teaching comprehension. Instead of using the prior read-test method, research studies have concluded that there are much more effective ways to teach comprehension. Much work has been done in the area of teaching novice readers a bank of "reading strategies," or tools to interpret and analyze text.

Instruction in comprehension strategy use often involves the gradual release of responsibility, wherein teachers initially explain and model strategies. Over time, they give students more and more responsibility for using the strategies until they can use them independently. This technique is generally associated with the idea of self-regulation and reflects social cognitive theory, originally conceptualized by Albert Bandura.

Vocabulary

Reading comprehension and vocabulary are inextricably linked. The ability to decode or identify and pronounce words is self-evidently important, but knowing what the words mean has a major and direct effect on knowing what any specific passage means. Students with a smaller vocabulary than other students comprehend less of what they read and it has been suggested that the most impactful way to improve comprehension is to improve vocabulary.

Most words are learned gradually through a wide variety of environments: television, books, and conversations. Some words are more complex and difficult to learn, such as homonyms, words that have multiple meanings and those with figurative meanings, like idioms, similes, and metaphors.

Three Tier Vocabulary Words

Several theories of vocabulary instruction exist, namely, one focused on intensive instruction of a few high value words, one focused on broad instruction of many useful words, and a third focused on strategies for learning low frequency, context specific vocabulary.

Broad Vocabulary Approach

The method of focusing of broad instruction on many words was developed by Andrew Biemiller who argued that more words would benefit students more, even if the instruction was short and teacher-directed. He suggested that teachers teach a large number of words before reading a book to students, by merely giving short definitions, such as synonyms, and then pointing out the words and their meaning while reading the book to students. The method contrasts with the approach by emphasizing quantity versus quality. There is no evidence to suggest the primacy of either approach.

Morphemic Instruction

Another vocabulary technique, strategies for learning new words, can be further subdivided into instruction on using context and instruction on using morphemes, or meaningful units within words to learn their meaning. Morphemic instruction has been shown to produce positive outcomes for students reading and vocabulary knowledge, but context has proved unreliable as a strategy and it is no longer considered a useful strategy to teach students. This conclusion does not disqualify the value in "learning" morphemic analysis – prefixes, suffixes and roots – but rather suggests that it be imparted incidentally and in context. Accordingly, there are methods designed to achieve this, such as Incidental Morpheme Analysis.

Reciprocal Teaching

In the 1980s Annemarie Sullivan Palincsar and Ann L. Brown developed a technique called reciprocal teaching that taught students to predict, summarize, clarify, and ask questions for sections of a text. The use of strategies like summarizing after each paragraph have come to be seen as effective strategies for building students' comprehension. The idea is that students will develop stronger reading comprehension skills on their own if the teacher gives them explicit mental tools for unpacking text.

Instructional Conversations

"Instructional conversations", or comprehension through discussion, create higher-level thinking opportunities for students by promoting critical and aesthetic thinking about the text. There are several types of questions that a teacher should focus on: remembering; testing understanding; application or solving; invite synthesis or creating; and evaluation and judging. Teachers

should model these types of questions through “think-alouds” before, during, and after reading a text. When a student can relate a passage to an experience, another book, or other facts about the world, they are “making a connection.” Making connections help students understand the author’s purpose and fiction or non-fiction story.

Text Factors

There are factors, that once discerned, make it easier for the reader to understand the written text. One is the genre, like folktales, historical fiction, biographies or poetry. Each genre has its own characteristics for text structure, that once understood help the reader comprehend it. A story is composed of a plot, characters, setting, point of view, and theme. Informational books provide real world knowledge for students and have unique features such as: headings, maps, vocabulary, and an index. Poems are written in different forms and the most commonly used are: rhymed verse, haiku, free verse, and narratives. Poetry uses devices such as: alliteration, repetition, rhyme, metaphors, and similes. “When children are familiar with genres, organizational patterns, and text features in books they’re reading, they’re better able to create those text factors in their own writing.”

The Reading Apprenticeship (RA) Approach to Comprehension

Now to some strategies to help you with some typical college-level comprehension challenges as well as some of your specific challenges identified in the previous exercise.

This lesson focuses on a method called Reading Apprenticeship. It is based on the premise that people who have become expert readers can assist learners by modeling what they have learned to do. As explained in the text, *Reading for Understanding, How Reading Apprenticeship Improves Disciplinary Learning in Secondary and College Classrooms*, “One literacy educator describes the idea of the cognitive apprenticeship in reading by comparing the process of learning to read with that of learning to ride a bike. In both cases, a more proficient other is present to support the beginner, engaging the beginner in the activity and calling attention to often overlooked or hidden strategies.”

This is a strategy that takes a metacognitive approach to comprehension, utilizing various strategies readers may already know they know how to do, then adding more. For example, most readers have learned to make predictions, ask questions concerning meanings (“I wonder about…”), visualize a scene being described, associate the material being read to some other material, and, at the end, summarize the material.

I like to call these our “hard drive” skills. Like a computer hard drive always humming in the background doing its thing behind the scenes, our metacognitive skills have already been assisting us as readers. We just don’t usually talk about what we are doing, for example, “Well, by golly, now I’m predicting what Godzilla will do to the poor villagers in about two scenes from now,” we just automatically predict, especially if we are familiar with characters and plot lines. For another example, “I am now going to visualize this scene in graveyard when Hamlet comes across the deceased court jester’s skull in Act V, Scene 1.” We just *see* it in our mind’s eye.

Now review and affirm important comprehension skills you already possess and complete the exercise below.

EXERCISE 22-1

Go back through the excerpt, above, on reading comprehension and THIS time, write marginal notes where you used any of the comprehension tools listed below:

- predicting
- asking questions of the material such as, “I wonder about,” “Could this mean?”
- visualizing
- connecting this material to something else you have learned
- noting where you think you might need to read something over again for comprehension
- summarizing

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5.3: Getting the Most Out of Your Textbooks

Phyllis Nissila

Reading Textbooks: Front and Back Matter



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Before diving into every line of text in a textbook reading assignment, it is helpful–and saves time–to find out, first, what resources the entire book has to offer you. Then, as those chapter readings are assigned, it helps to first skim read them for the big picture meaning.

The first exercise in this chapter will help you find all the resources in your textbook–and some textbooks have a lot more help in the front matter and back matter of the text than you may realize. I always think of one student who, when given this exercise to use on any textbook he had with him, picked his math book. He was at that time re-taking that math class because he had failed it the term before. As he did the exercise, he realized the back matter of the book included an answer key for half of the problems for every exercise. "Had I known this last term," he said, "I would have passed!" See if you, too, find something useful in your textbook that perhaps you didn't know was there, either.

The Exercises in this chapter cover strategies for skim reading specific chapters and a strategy for getting the most out of graphics included in textbooks.

EXERCISE 23-1

Here is a list of several kinds of resources typically in the front of a textbook, known as "front matter," and a list of typical "back matter" resources. For one of your textbooks, put a check mark next to the front and back matter features it includes, then answer the two questions, below.

Textbook title_____

FRONT MATTER

___Table of Contents

___Preface

___Introduction

___To the Teacher

___To the Student

___Other (list, here): _____

BACK MATTER

___Glossary of Terms

___Index of subjects

___Answer Keys

___Additional Exercises

___Additional Readings

___Tables, graphs, charts

___Maps

___Other (list, here): _____

Answer the following questions:

1. Were there any surprises for you?
2. How can you use the front and back matter in your text to help you with your studies? (3 or 4 sentences)

Skim Reading Textbook Chapters

Before doing a detailed reading of a textbook chapter, get the big picture by following these steps:

- Similar to reading the Table of Contents for the entire book, read the Introduction or Chapter Overview, whichever the textbook features, for the main ideas and how they are divided.
- Read the headings and sub-headings.
- Note the graphics (charts, tables, illustrations, etc.).
- Read the first one or two sentences in the paragraphs (the paragraph topic is sometimes covered in more than one sentence).
- Read the last sentence in each paragraph which might be a paragraph summary.
- Read the summary of the entire chapter, if given.
- Read any sentence with boldface or italicized words or word groups in it (usually key ideas or technical terms).
- Stop when needed if you come across a complicated idea or topic and take a little more time to skim it until you understand it.
- Skim the study questions, too. They will help you focus on key points.

EXERCISE 23-2

Using the recommendations on how to skim through textbook chapters, do so with a textbook chapter of your choice. When you are finished, close the book and write about the following: write down as many of the main ideas of this chapter as you can remember by skim reading it. Try not to look back. When finished, check your work to make sure you have transcribed the information correctly.

Reading Graphics



"Statistic" by JuralMin is in the Public Domain, CC0

Listed below are various types of data found on most graphics, whether a pie chart, bar graph, line chart, or other type.

The key to comprehending graphics and using them to get more meaning from a textbook chapter or an article, or to answer study questions, is to pay close attention to the typical elements of the graphic. Not every graphic includes all of the elements listed.

1. Title
2. Captions
3. Legend
4. Axis information (vertical information, or "Y" data, and horizontal information, or "X" data)
5. Publication date (important for the most current information)
6. Publisher (important for credibility)
7. Labels
8. Color (used to differentiate and compare data)
9. Size (also used to represent comparisons)

10. Spatial positions (helps for comparing and contrasting)
11. Patterns represented by the content, itself, and
12. Trends that appear more evident when viewing the visual representation of the data.

It is easy to overlook all of the information present in a graphic, so give yourself enough time to note all the elements and their meanings before answering questions about them. This exercise offers some practice.

EXERCISE 23-3

This exercise uses Thematic Maps of the United States Census Bureau.

1. Choose a theme of the many listed that include, for example, Agricultural, Business, Income and Poverty, and Natural Disasters. There are many categories to choose from.
2. Click through to the actual graphic for the information on that theme. For example, click on Natural Disasters, then Hurricane Katrina Resource Maps, then to more options listed from there.
3. Write down the title of the thematic graphic you choose, and list all of the elements of the graphic from the list, above. Not all may be present on the specific type of graphic you choose.
4. Summarize three things you learned about the information presented in this graphic form.

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5.4: Reading Textbooks

Dave Dillon

"There is more treasure in books than in all the pirate's loot on Treasure Island."

– Walt Disney

Practice

If you want to be a better swimmer, you practice. If you want to be a better magician, you practice. If you want to be a better reader, you practice. I encourage you to read. Read, read, read. Read newspapers. Read magazines. Read books. Use your library card (get one if you don't have one). Read blogs. Read tweets. Read Wikipedia articles. Read about history, politics, world leaders, current events, sports, art, music—whatever interests you. Why? Because the more you read, the better reader you become. And because the more you read, the more knowledge you will have. That is an important piece in learning and understanding. When we are learning new information, it's easier to learn if we have some kind of background knowledge about it.

Background Knowledge

In their book, *Content Area Reading: Literacy and Learning Across the Curriculum*, Vacca and Vacca postulate that a student's prior knowledge is "the single most important resource in learning with texts."[1]

Reading and learning are processes that work together. Students draw on prior knowledge and experiences to make sense of new information. "Research shows that if learners have advanced knowledge of how the information they're about to learn is organized — if they see how the parts relate to the whole before they attempt to start learning the specifics — they're better able to comprehend and retain the material."[2]

For example, you are studying astronomy and the lecture is about Mars. Students with knowledge of what Mars looks like, or how it compares in size to other planets or any information about Mars will help students digest new information and connect it to prior knowledge. The more you read, the more background knowledge you have, and the better you will be able to connect information and learn. "Content overlap between text and knowledge appears to be a necessary condition for learning from text."[3]

There are a lot of recent advances in technology that have made information more accessible to us. Use this resource! If you are going to read a chemistry textbook, experiment with listening or watching a podcast or a YouTube video on the subject you are studying. Ask your instructor if they recommend specific websites for further understanding.

"The greatest gift is a passion for reading. It is cheap, it consoles, it distracts, it excites, it gives you the knowledge of the world and experience of a wide kind. It is a moral illumination."

– Elizabeth Hardwick

The Seven Reading Principles

Read the assigned material. I know this sounds like a no-brainer, but you might be surprised to learn how many students don't read the assigned material. Often, it takes longer to read the material than had been anticipated. Sometimes it is not interesting material to us and we procrastinate reading it. Sometimes we're busy and it is just not a priority. It makes it difficult to learn the information your instructor wants you to learn if you do not read about it before coming to class.

Read it when assigned. This is almost as big of a problem for students as the first principle. You will benefit exponentially from reading assignments when they are assigned (which usually means reading them before the instructor lectures on them). If there is a date for a reading on your syllabus, finish reading it before that date. The background knowledge you will attain from reading the information will help you learn and connect information when your instructor lectures on it, and it will leave you better prepared for class discussions. Further, if your instructor assigns you 70 pages to read by next week, don't wait until the night before to read it all. Break it down into chunks. Try scheduling time each day to read 10 or so pages. It takes discipline and self-control but doing it this way will make understanding and remembering what you read much easier.

Take notes when you read. You may recall Hermann Ebbinghaus' research from a previous chapter. He determined that 42% of information we take in is lost after only 20 minutes without review. For the same reasons that it's important to take notes during lectures, it's important to take notes when you are reading. Your notes will help you concentrate, remember and review.

Relate the information to you. We remember information that we deem is important. The strategy then is to make what you are studying important to you. Find a way to directly relate what you are studying to something in your life. Sometimes it is easy and sometimes it is not. But if your attitude is "I will never use this information" and "it's not important," chances are good that you will not remember it.

Read with a dictionary or use an online dictionary. Especially with information that is new to us, we may not always recognize all the words in a textbook or their meanings. If you read without a dictionary and you don't know what a word means, you probably still won't know what it means when you finish reading. Students who read with a dictionary (or who look the word up online) expand their vocabulary and have a better understanding of the text. Take the time to look up words you do not know. Another strategy is to try to determine definitions of unknown words by context, thus eliminating the interruption to look up words.

Ask a classmate or instructor when you have questions or if there are concepts you do not understand. Visiting an instructor's office hours is one of the most underutilized college resources. I think some students are shy about going, and I understand that, but ultimately, it's your experience, and it's up to you if you want to make the most of it. If you go, you will get answers to your questions; at the same time, you'll demonstrate to your instructor that their course is important to you. Find out when your professor's office hours are (they are often listed in the syllabus), ask before or after class or e-mail your professor to find out. Be polite and respectful.

Read it again. Some students will benefit from reading the material a second or third time as it allows them to better understand the material. The students who understand the material the best usually score the highest on exams. It may be especially helpful to reread the chapter just after the instructor has lectured on it.

Strategies To Think About When You Open Your Textbook

Preview: Look at what you are reading and how it is connected with other areas of the class. How does it connect with the lecture? How does it connect with the course description? How does it connect with the syllabus or with a specific assignment? What piece of the puzzle are you looking at and how does it fit into the whole picture? If your textbook has a chapter summary, reading it first may help you preview and understand what you are going to be reading.

Headings and designated words: Pay close attention to section headings and subheadings, and boldface, underlined or italicized words and sentences. There is a reason why these are different than regular text. The author feels they are more important and so should you.

Highlighting: Highlighting is not recommended because there is not evidence supporting it helps students with reading comprehension or higher test scores.[4]

Pace: One of the biggest challenges I see students have with reading is accurately assessing how long it will take to read what is assigned. In many cases, it's important to break the information up in chunks rather than to try and read it all at once. If you procrastinate and leave it until the day before it needs to be read, and then find out it will take you longer than you anticipate, it causes problems. One strategy that works well for many students is to break the information up equally per day and adjust accordingly if it takes longer than you had thought. Accurately estimating how much time it will take to practice the seven reading principles applied to your reading assignments is a skill that takes practice.

"Drink Deeply from Good Books"

– John Wooden

It's Not All Equal

Keep in mind that the best students develop reading skills that are different for different subjects. The main question you want to ask yourself is: Who are you reading for? And what are the questions that drive the discipline? We read different things for different purposes. Reading texts, blogs, leisure books and textbooks are all different experiences, and we read them with different mindsets and different strategies. The same is true for textbooks in different areas. Reading a mathematics textbook is going to be different than reading a history textbook, a psychology textbook, a Spanish textbook or a criminal justice textbook. Further, students may be assigned to read scientific journals or academic articles often housed in college libraries' online databases. Scholarly articles require a different kind of reading and librarians are a resource for how to find and read this kind of information. Applying the principles in this chapter will help with your reading comprehension, but it's important to remember that you will need to develop specific reading skills most helpful to the particular subject you are studying.

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1. Richard T. Vacca and Jo Anne L. Vacca, *Content Area Reading: Literacy and Learning across the Curriculum*, 6th ed. (Menlo Park, CA: Longman, 1999). ↵
2. Joe Cuseo, Viki Fecas and Aaron Thompson, *Thriving in College AND Beyond: Research-Based Strategies for Academic Success and Personal Development*, (Dubuque, IA: Kendal Hunt Publishing, 2010), 115. ↵
3. W. Kintsch, "Text Comprehension, Memory, and Learning," *American Psychologist* 49 no. 4 (1994): 294-303, http://dx.doi.org/10.1037/0003-066X.49.4.294. ↵
4. Lucy Cui, "MythBusters: Highlighting Helps Me Study," Psychology in Action, accessed April 27, 2018, https://www.psychologyinaction.org/p...helps-me-study. ↵

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5.5: Context Clues and Close Reading for Literature

Phyllis Nissila

Context Clues

Besides clues to help you determine the pattern or genre of a reading selection, there are clues to help you figure out the meaning of specific words that are unfamiliar to you. Here are the five most common:

1. **Definition/Explanation Clues**: sometimes the meaning of a word or phrase is given right after its use.
   Example: Taxidermy, the art of preparing, stuffing, and mounting the skins of animals (especially vertebrates) for display or for other sources of study, is popular among museum curators.
2. **Restatement/Synonym Clues**: sometimes a word is presented in a simpler way.
   Example: Stuffing dead animals has been a dream of Stedman Nimblebody, author of *Taxidermy Through the Ages*, ever since his pet snake died when Steddie was six years old. He still misses Mr. Scaly Face.
3. **Contrast/Antonym Clues**: sometimes the meaning of a word is clarified by presenting a word or phrase opposite of its meaning.
   Example: Little Steddie wanted to visit the Taxidermy Museum but the rest of the family preferred a trip to the Zoo to see live animals.
4. **Inference/General Context Clues**: sometimes the meaning of a word or phrase is in the surrounding sentences, or must be inferred or implied by the general meaning of a selection.
   Example: When Steddie finally got the chance to visit the Taxidermy Museum, he was very excited. He even found a stuffed snake that looked exactly like Mr. Scaly Face! “Just think,” he exclaimed to his parents, “If Mr. Scaly Face was stuffed, I could still tease the cat and the dog with him!”
5. **Punctuation**: the correct use of punctuation helps a reader get the meaning of a term, phrase, or thought. Likewise, incorrectly placed or missing punctuation sometimes gives an entirely different and incorrect meaning across.
   Example:
   Missing punctuation: Is it time to eat Grandma?
   Corrected: Is it time to eat, Grandma?

EXERCISE 25-1

There are many examples online of punctuation errors in signs that change the meaning. Create a chart such as the one below for 5 of the signs that you really like.
WHAT THE SIGN SAYS WHAT THE SIGN REALLY MEANS
1.
2.
3.
4.
5.

Close Reading



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In addition to using reading comprehension skills such as predicting, visualizing, “talking to the text,” skimming a textbook before reading, and noting context clues, another strategy called “close reading” is helpful. This is popular with literature professors; however, the skills involved in close reading are applicable to any complex reading assignment.

Since this kind of comprehension starts with knowing nothing about the elements of a story, novel, poem, or essay, I stand with my arms spread wide.

I then discuss, briefly, each element of a work starting with the title as a place to begin comprehension, while slowly moving my arms toward one another, a few inches per element.

Titles, for starters, particularly of non-fiction works, usually tell you precisely what the main idea, or thesis, is. For example, a book about “The History of the Roman Empire” usually gives you just that–the history of the Roman Empire.

This is not usually true, however, for works of fiction, for which inference is the key to comprehension. For example, “Story of an Hour,” by Kate Chopin, while it might seem to be something about time, also suggests it is about something other than a clock ticking away seconds and minutes, and indeed it is.

I next add the author, as this might aid comprehension. For example, most students are familiar with Stephen King, who writes in the horror genre. Knowing this element brings the arms in a bit closer as the reader will know to anticipate (and predict) a horror story with a lot of plot twists and turns in some horrible ways. Prediction has begun.

Next, I briefly discuss how knowing about the remaining elements – plot, characters, and setting – help the reader close in on meaning enough to be able to discuss the theme or themes of the work with reasonable evidence to support one’s conclusion.

This visual of the arms getting closer together can continue through a discussion of close reading of small passages, individual sentences, and even specific words. Each level of careful attention and thought helps a reader “read between the lines” when meaning is not overtly stated, when themes are inferred rather than explained outright.

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Adaptions: Changed formatting, Changed title of chapter to Context Clues and Close Reading for Literature, combined chapter with content from Close Reading for Literature, removed Patterns content and exercise.

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SECTION OVERVIEW

5.6: Reading and Notetaking

5.6.1: Prelude to Reading and Notetaking

5.6.2: The Nature and Types of Reading

5.6.3: Effective Reading Strategies

5.6.4: Taking Notes

5.6.5: Summary

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5.6.8: Where do you go from here?

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5.6.1: Prelude to Reading and Notetaking

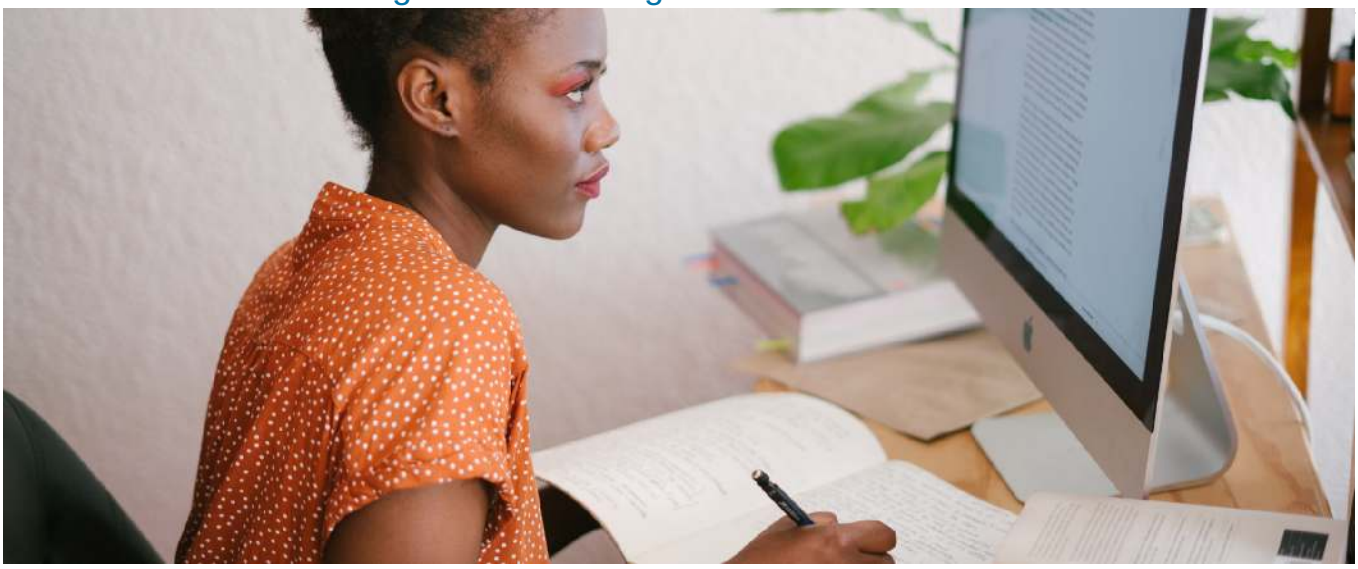


Figure 5.6.1.1 Each of us reads and records information in our own way.

Student Survey

These questions will help you determine how the chapter concepts relate to you right now. As we are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed.

On a scale of 1 (I need significant improvement) to 4 (I'm doing great), reflect on how you're doing right now on these statements:

1. I am reading on a college level.
2. I take good notes that help me study for exams.
3. I understand how to manage all the reading I need to do for college.
4. I recognize the need for different notetaking strategies for different college subjects.

You can also take the Chapter 5 survey anonymously online.

STUDENT PROFILE

"Before I came to college, I always loathed reading from the textbook, taking notes during class, and even listening to lectures. I've since learned that in most cases I should do what my teacher suggests. I have a course that requires me to read two textbook chapters each week. Taking notes on the chapters is optional, making it easy to brush off these assignments. But there are reasons that professors tell students to read and do other classwork. They believe it is valuable information for a student to learn. Note taking in class may become tedious and, in some cases, feel redundant. But you can't recall a whole class from memory. There is not much time to learn the contents of a class in one semester, and it can feel overwhelming. It's important to take notes because writing them helps you remember."

—Christopher Naldini, Westchester Community College

About this Chapter

In this chapter we will explore two skills you probably think you already understand—reading and notetaking. But the goal is to make sure you've honed these skills well enough to lead you to success in college. By the time you finish this chapter, you should be able to do the following:

- Discuss the way reading differs in college and how to successfully adapt to that change.
- Demonstrate the usefulness of strong notetaking for college students.

Reading and consuming information are increasingly important today because of the amount of information we encounter. Not only do we need to read critically and carefully, but we also need to read with an eye to distinguishing fact from opinion and identifying

solid sources. Reading helps us make sense of the world—from simple reminders to pick up milk to complex treatises on global concerns, we read to comprehend, and in so doing, our brains expand. An interesting study from Emory University in Atlanta, Georgia, used MRI scans to track the brain conductivity while participants were reading. The researchers assert that a biological change to your brain actually happens when you read, and it lingers. If you want to read the study, published in the journal *Brain Connectivity*, you can find it online at https://openstax.org/l/brainconnectivity.

In academic settings, as we deliberately work to become stronger readers and better notetakers, we are both helping our current situation and enhancing our abilities to be successful in the future. Seems like a win-win. Take advantage of all the study aids you have at hand, including human, electronic, and physical resources, to increase your performance in these crucial skill sets.

Why? You need to read. It improves your thinking, your vocabulary, and your ability to make connections between disparate parts, which are all parts of critical thinking. Educational researchers Anne Cunningham and Keith Stanovich discovered after extensive study with college students that "reading volume [how much you read] made a significant contribution to multiple measures of vocabulary, general knowledge, spelling, and verbal fluency."

Research continues to assess and support the fact that one of the most significant learning skills necessary for success in any field is reading. You may have performed this skill for decades already, but learning to do it more effectively and practicing the skill consistently is critical to how well you do in all subjects. If reading *isn't your thing*, strive to make that your challenge. Your academic journey, your personal well-being, and your professional endeavors will all benefit from your reading. Put forth the effort and make it your thing. The long-term benefits will far outweigh the sacrifices you make now.

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5.6.2: The Nature and Types of Reading

Questions to consider

- What are the pros and cons of online reading?
- How can distinguishing between reading types help you academically and personally?
- How can you best prepare to read for college?

Research supports the idea that reading is good for you. Students who read at or above reading level throughout elementary and secondary school have a higher chance of starting—and more importantly, finishing—college. Educational researchers convincingly claim that reading improves everything from grades to vocabulary (Cunningham 2).

If you don't particularly enjoy reading, don't despair. We read for a variety of reasons, and you may just have to step back and take a bigger picture of your reading habits to understand why you avoid engaging in this important skill. The myriad distractions we now face as well as the intense information overload we can suffer on a daily basis in all aspects of our lives can combine to make it difficult to slow down to read, an activity that demands at least a modicum of attention in a way that most television and music do not. You may need to adjust your schedule for more reading time, especially in college, because every class you take will expect you to read more pages than you probably have in the past.

Types of Reading

We may read small items purely for immediate information, such as notes, e-mails, or directions to an unfamiliar location. You can find all sorts of information online about how to fix a faucet or tie a secure knot. You won't have to spend too much time reading these sorts of texts because you have a specific goal in mind for them, and once you have accomplished that goal, you do not need to prolong the reading experience. These encounters with texts may not be memorable or stunning, but they don't need to be. When we consider why we read longer pieces—outside of reading for pleasure—we can usually categorize the reasons into about two categories: 1) reading to introduce ourselves to new content, and 2) reading to more fully comprehend familiar content.



Figure 5.6.2.2 A bookstore or library can be a great place to explore. Aside from books and resources you need, you may find something that interests you or helps with your course work.

Reading to Introduce New Content

Glenn felt uncomfortable talking with his new roommates because he realized very quickly that he didn't know anything about their major—architecture. Of course he knew that it had something to do with buildings and construction sites, but the field was so different from his discipline of biology that he decided he needed to find out more so he could at least engage in friendly conversation with his roommates. Since he would likely not go into their field, he didn't need to go into full research mode. When we read to introduce new content, we can start off small and increase to better and more sophisticated sources. Much of our further study and reading depends on the sources we originally read, our purpose for finding out about this new topic, and our interest level.

Chances are, you have done this sort of exploratory reading before. You may read reviews of a new restaurant or look at what people say about a movie you aren't sure you want to spend the money to see at the theater. This reading helps you decide. In

academic settings, much of what you read in your courses may be relatively new content to you. You may have heard the word *volcano* and have a general notion of what it means, but until you study geology and other sciences in depth, you may not have a full understanding of the environmental origins, ecological impacts, and societal and historic responses to volcanoes. These perspectives will come from reading and digesting various material. When you are working with new content, you may need to schedule more time for reading and comprehending the information because you may need to look up unfamiliar terminology and you may have to stop more frequently to make sure you are truly grasping what the material means. When you have few ways to connect new material to your own prior knowledge, you have to work more diligently to comprehend it.

Application

Try an experiment with a group of classmates. Without looking on the Internet, try to brainstorm a list of 10 topics about which all of you may be interested but for which you know very little or nothing at all. Try to make the topics somewhat obscure rather than ordinary—for example, the possibility of the non-planet Pluto being reclassified again as opposed to something like why we need to drink water.

After you have this random list, think of ways you could find information to read about these weird topics. Our short answer is always: Google. But think of other ways as well. How else could you read about these topics if you don't know anything about them? You may well be in a similar circumstance in some of your college classes, so you should listen carefully to your classmates on this one. Think beyond pat answers such as "I'd go to the library," and press for what that researcher would do once at the library. What types of articles or books would you try to find? One reason that you should not always ignore the idea of doing research at the physical library is because once you are there and looking for information, you have a vast number of other sources readily available to you in a highly organized location. You also can tap into the human resources represented by the research librarians who likely can redirect you if you cannot find appropriate sources.

Reading to Comprehend Familiar Content

Reading about unfamiliar content is one thing, but what if you do know something about a topic already? Do you really still need to keep reading about it? Probably. For example, what if during the brainstorming activity in the previous section, you secretly felt rather smug because you know about the demotion of the one-time planet Pluto and that there is currently quite the scientific debate going on about that whole de-planet-ation thing. Of course, you didn't say anything during the study session, mostly to spare your classmates any embarrassment, but you are pretty familiar with Pluto-gate. So now what? Can you learn anything new?

Again—probably. When did Pluto's qualifications to be considered a planet come into question? What are the qualifications for being considered a planet? Why? Who even gets to decide these things? Why was it called *Pluto* in the first place? On Amazon alone, you can find hundreds of books about the once-planet Pluto (not to be confused with the Disney dog also named Pluto). A Google search brings up over 34 million options for your reading pleasure. You'll have plenty to read, even if you do know something or quite a bit about a topic, but you'll approach reading about a familiar topic and an unfamiliar one differently.

With familiar content, you can do some initial skimming to determine what you already know in the book or article, and mark what may be new information or a different perspective. You may not have to give your full attention to the information you know, but you will spend more time on the new viewpoints so you can determine how this new data meshes with what you already know. Is this writer claiming a radical new definition for the topic or an entirely opposite way to consider the subject matter, connecting it to other topics or disciplines in ways you have never considered?

When college students encounter material in a discipline-specific context and have some familiarity with the topic, they sometimes can allow themselves to become a bit overconfident about their knowledge level. Just because a student may have read an article or two or may have seen a TV documentary on a subject such as the criminal mind, that does not make them an expert. What makes an expert is a person who thoroughly studies a subject, usually for years, and understands all the possible perspectives of a subject as well as the potential for misunderstanding due to personal biases and the availability of false information about the topic.

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5.6.3: Effective Reading Strategies

Questions to consider

- What methods can you incorporate into your routine to allow adequate time for reading?
- What are the benefits and approaches to active reading?
- Do your courses or major have specific reading requirements?

Allowing Adequate Time for Reading

You should determine the reading requirements and expectations for every class very early in the semester. You also need to understand why you are reading the particular text you are assigned. Do you need to read closely for minute details that determine cause and effect? Or is your instructor asking you to skim several sources so you become more familiar with the topic? Knowing this reasoning will help you decide your timing, what notes to take, and how best to undertake the reading assignment.

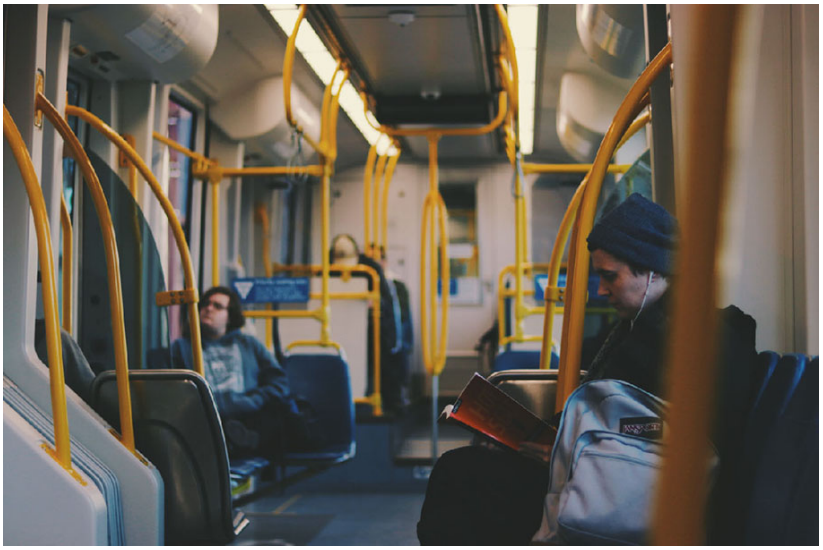


Figure 5.6.3.3 If you plan to make time for reading while you commute, remember that unexpected events like delays and cancellations could impact your concentration.

Depending on the makeup of your schedule, you may end up reading both primary sources—such as legal documents, historic letters, or diaries—as well as textbooks, articles, and secondary sources, such as summaries or argumentative essays that use primary sources to stake a claim. You may also need to read current journalistic texts to stay current in local or global affairs. A realistic approach to scheduling your time to allow you to read and review all the reading you have for the semester will help you accomplish what can sometimes seem like an overwhelming task.

When you allow adequate time in your hectic schedule for reading, you are investing in your own success. Reading isn't a magic pill, but it may seem like it when you consider all the benefits people reap from this ordinary practice. Famous successful people throughout history have been voracious readers. In fact, former U.S. president Harry Truman once said, "Not all readers are leaders, but all leaders are readers." Writer of the U.S. Declaration of Independence, inventor, and also former U.S. president Thomas Jefferson claimed "I cannot live without books" at a time when keeping and reading books was an expensive pastime. Knowing what it meant to be kept from the joys of reading, 19th-century abolitionist Frederick Douglass said, "Once you learn to read, you will be forever free." And finally, George R. R. Martin, the prolific author of the wildly successful *Game of Thrones* empire, declared, "A reader lives a thousand lives before he dies . . . The man who never reads lives only one."

You can make time for reading in a number of ways that include determining your usual reading pace and speed, scheduling active reading sessions, and practicing recursive reading strategies.

Determining Reading Speed and Pacing

To determine your reading speed, select a section of text—passages in a textbook or pages in a novel. Time yourself reading that material for exactly 5 minutes, and note how much reading you accomplished in those 5 minutes. Multiply the amount of reading you accomplished in 5 minutes by 12 to determine your average reading pace (5 times 12 equals the 60 minutes of an hour). Of

course, your reading pace will be different and take longer if you are taking notes while you read, but this calculation of reading pace gives you a good way to estimate your reading speed that you can adapt to other forms of reading.

Example Reading Times

Reader	Pages Read in 5 Minutes	Pages per Hour	Approximate Hours to Read 500 Pages
Marta	4	48	10 hours, 30 minutes
Jordi	3	36	13 hours
Estevan	5	60	8 hours, 20 minutes

So, for instance, if Marta was able to read 4 pages of a dense novel for her English class in 5 minutes, she should be able to read about 48 pages in one hour. Knowing this, Marta can accurately determine how much time she needs to devote to finishing the novel within a set amount of time, instead of just guessing. If the novel Marta is reading is 497 pages, then Marta would take the total page count (497) and divide that by her hourly reading rate (48 pages/hour) to determine that she needs about 10 to 11 hours overall. To finish the novel spread out over two weeks, Marta needs to read a little under an hour a day to accomplish this goal.

Calculating your reading rate in this manner does not take into account days where you're too distracted and you have to reread passages or days when you just aren't in the mood to read. And your reading rate will likely vary depending on how dense the content you're reading is (e.g., a complex textbook vs. a comic book). Your pace may slow down somewhat if you are not very interested in what the text is about. What this method *will* help you do is be realistic about your reading time as opposed to waging a guess based on nothing and then becoming worried when you have far more reading to finish than the time available.

Chapter 3, "Time Management and Prioritization," offers more detail on how best to determine your speed from one type of reading to the next so you are better able to schedule your reading.

Scheduling Set Times for Active Reading

Active reading takes longer than reading through passages without stopping. You may not need to read your latest sci-fi series actively while you're lounging on the beach, but many other reading situations demand more attention from you. Active reading is particularly important for college courses. You are a scholar actively engaging with the text by posing questions, seeking answers, and clarifying any confusing elements. Plan to spend at least twice as long to read actively than to read passages without taking notes or otherwise marking select elements of the text.

To determine the time you need for active reading, use the same calculations you use to determine your traditional reading speed and double it. Remember that you need to determine your reading pace for all the classes you have in a particular semester and multiply your speed by the number of classes you have that require different types of reading.

Example Active Reading Times

Reader	Pages Read in 5 Minutes	Pages per Hour	Approximate Hours to Read 500 Pages	Approximate Hours to Actively Read 500 Pages
Marta	4	48	10 hours, 30 minutes	21 hours
Jordi	3	36	13 hours	26 hours
Estevan	5	60	8 hours, 20 minutes	16 hours, 40 minutes

Practicing Recursive Reading Strategies

One fact about reading for college courses that may become frustrating is that, in a way, it never ends. For all the reading you do, you end up doing even more rereading. It may be the same content, but you may be reading the passage more than once to detect the emphasis the writer places on one aspect of the topic or how frequently the writer dismisses a significant counterargument. This rereading is called recursive reading.

For most of what you read at the college level, you are trying to make sense of the text for a specific purpose—not just because the topic interests or entertains you. You need your full attention to decipher everything that's going on in complex reading material—

and you even need to be considering what the writer of the piece may *not* be including and why. This is why reading for comprehension is recursive.

Specifically, this boils down to seeing reading not as a formula but as a process that is far more circular than linear. You may read a selection from beginning to end, which is an excellent starting point, but for comprehension, you'll need to go back and reread passages to determine meaning and make connections between the reading and the bigger learning environment that led you to the selection—that may be a single course or a program in your college, or it may be the larger discipline, such as all biologists or the community of scholars studying beach erosion.

People often say writing is rewriting. For college courses, reading is rereading.

Strong readers engage in numerous steps, sometimes combining more than one step simultaneously, but knowing the steps nonetheless. They include, not always in this order:

- bringing any prior knowledge about the topic to the reading session,
- asking yourself pertinent questions, both orally and in writing, about the content you are reading,
- inferring and/or implying information from what you read,
- learning unfamiliar discipline-specific terms,
- evaluating what you are reading, and eventually,
- applying what you're reading to other learning and life situations you encounter.

Let's break these steps into manageable chunks, because you are actually doing quite a lot when you read.



Figure 5.6.3.4 The six elements of recursive reading should be considered as a circular, not linear, process.

Asking Questions

Humans are naturally curious beings. As you read actively, you should be asking questions about the topic you are reading. Don't just say the questions in your mind; write them down. You may ask: Why is this topic important? What is the relevance of this topic currently? Was this topic important a long time ago but irrelevant now? Why did my professor assign this reading?

You need a place where you can actually write down these questions; a separate page in your notes is a good place to begin. If you are taking notes on your computer, start a new document and write down the questions. Leave some room to answer the questions when you begin and again after you read.

Inferring and Implying

When you read, you can take the information on the page and *infer*, or conclude responses to related challenges from evidence or from your own reasoning. A student will likely be able to infer what material the professor will include on an exam by taking good notes throughout the classes leading up to the test.

Writers may *imply* information without directly stating a fact for a variety of reasons. Sometimes a writer may not want to come out explicitly and state a bias, but may imply or hint at his or her preference for one political party or another. You have to read

carefully to find implications because they are indirect, but watching for them will help you comprehend the whole meaning of a passage.

Learning Vocabulary

Vocabulary specific to certain disciplines helps practitioners in that field engage and communicate with each other. Few people beyond undertakers and archeologists likely use the term *sarcophagus* in everyday communications, but for those disciplines, it is a meaningful distinction. Looking at the example, you can use context clues to figure out the meaning of the term *sarcophagus* because it is something undertakers and/or archeologists would recognize. At the very least, you can guess that it has something to do with death. As a potential professional in the field you're studying, you need to know the lingo. You may already have a system in place to learn discipline-specific vocabulary, so use what you know works for you. Two strong strategies are to look up words in a dictionary (online or hard copy) to ensure you have the exact meaning for your discipline and to keep a dedicated list of words you see often in your reading. You can list the words with a short definition so you have a quick reference guide to help you learn the vocabulary.

Evaluating

Intelligent people always question and evaluate. This doesn't mean they don't trust others; they just need verification of facts to understand a topic well. It doesn't make sense to learn incomplete or incorrect information about a subject just because you didn't take the time to evaluate all the sources at your disposal. When early explorers were afraid to sail the world for fear of falling off the edge, they weren't stupid; they just didn't have all the necessary data to evaluate the situation.

When you evaluate a text, you are seeking to understand the presented topic. Depending on how long the text is, you will perform a number of steps and repeat many of these steps to evaluate all the elements the author presents. When you evaluate a text, you need to do the following:

- Scan the title and all headings.
- Read through the entire passage fully.
- Question what main point the author is making.
- Decide who the audience is.
- Identify what evidence/support the author uses.
- Consider if the author presents a balanced perspective on the main point.
- Recognize if the author introduced any biases in the text.

When you go through a text looking for each of these elements, you need to go beyond just answering the surface question; for instance, the audience may be a specific field of scientists, but could anyone else understand the text with some explanation? Why would that be important?

Analysis Question

Think of an article you need to read for a class. Take the steps above on how to evaluate a text, and apply the steps to the article. When you accomplish the task in each step, ask yourself and take notes to answer the question: Why is this important? For example, when you read the title, does that give you any additional information that will help you comprehend the text? If the text were written for a different audience, what might the author need to change to accommodate that group? How does an author's bias distort an argument? This deep evaluation allows you to fully understand the main ideas and place the text in context with other material on the same subject, with current events, and within the discipline.

Applying

When you learn something new, it always connects to other knowledge you already have. One challenge we have is applying new information. It may be interesting to know the distance to the moon, but how do we apply it to something we need to do? If your biology instructor asked you to list several challenges of colonizing Mars and you do not know much about that planet's exploration, you may be able to use your knowledge of how far Earth is from the moon to apply it to the new task. You may have to read several other texts in addition to reading graphs and charts to find this information.

That was the challenge the early space explorers faced along with myriad unknowns before space travel was a more regular occurrence. They had to take what they already knew and could study and read about and apply it to an unknown situation. These explorers wrote down their challenges, failures, and successes, and now scientists read those texts as a part of the ever-growing

body of text about space travel. Application is a sophisticated level of thinking that helps turn theory into practice and challenges into successes.

Preparing to Read for Specific Disciplines in College

Different disciplines in college may have specific expectations, but you can depend on all subjects asking you to read to some degree. In this college reading requirement, you can succeed by learning to read actively, researching the topic and author, and recognizing how your own preconceived notions affect your reading. Reading for college isn't the same as reading for pleasure or even just reading to learn something on your own because you are casually interested.

In college courses, your instructor may ask you to read articles, chapters, books, or *primary sources* (those original documents about which we write and study, such as letters between historic figures or the Declaration of Independence). Your instructor may want you to have a general background on a topic before you dive into that subject in class, so that you know the history of a topic, can start thinking about it, and can engage in a class discussion with more than a passing knowledge of the issue.

If you are about to participate in an in-depth six-week consideration of the U.S. Constitution but have never read it or anything written about it, you will have a hard time looking at anything in detail or understanding how and why it is significant. As you can imagine, a great deal has been written about the Constitution by scholars and citizens since the late 1700s when it was first put to paper (that's how they did it then). While the actual document isn't that long (about 12–15 pages depending on how it is presented), learning the details on how it came about, who was involved, and why it was and still is a significant document would take a considerable amount of time to read and digest. So, how do you do it all? Especially when you may have an instructor who drops hints that you may also *love* to read a historic novel covering the same time period . . . in your *spare time*, not required, of course! It can be daunting, especially if you are taking more than one course that has time-consuming reading lists. With a few strategic techniques, you can manage it all, but know that you must have a plan and schedule your required reading so you *are* also able to pick up that recommended historic novel—it may give you an entirely new perspective on the issue.

Strategies for Reading in College Disciplines

No universal law exists for how much reading instructors and institutions expect college students to undertake for various disciplines. Suffice it to say, it's a LOT.

For most students, it is the volume of reading that catches them most off guard when they begin their college careers. A full course load might require 10–15 hours of reading per week, some of that covering content that will be more difficult than the reading for other courses.

You cannot possibly read word-for-word every single document you need to read for all your classes. That doesn't mean you give up or decide to only read for your favorite classes or concoct a scheme to read 17 percent for each class and see how that works for you. You need to learn to skim, annotate, and take notes. All of these techniques will help you comprehend more of what you read, which is why we read in the first place. We'll talk more later about annotating and notetaking, but for now consider what you know about skimming as opposed to active reading.

Skimming

Skimming is not just glancing over the words on a page (or screen) to see if any of it sticks. Effective skimming allows you to take in the major points of a passage without the need for a time-consuming reading session that involves your active use of notations and annotations. Often you will need to engage in that painstaking level of active reading, but skimming is the first step—not an alternative to deep reading. The fact remains that neither do you need to read everything nor could you possibly accomplish that given your limited time. So learn this valuable skill of skimming as an accompaniment to your overall study tool kit, and with practice and experience, you will fully understand how valuable it is.

When you skim, look for guides to your understanding: headings, definitions, pull quotes, tables, and context clues. Textbooks are often helpful for skimming—they may already have made some of these skimming guides in bold or a different color, and chapters often follow a predictable outline. Some even provide an overview and summary for sections or chapters. Use whatever you can get, but don't stop there. In textbooks that have some reading guides, or especially in text that does not, look for introductory words such as *First* or *The purpose of this article* . . . or summary words such as *In conclusion* . . . or *Finally*. These guides will help you read only those sentences or paragraphs that will give you the overall meaning or gist of a passage or book.

Now move to the meat of the passage. You want to take in the reading as a whole. For a book, look at the titles of each chapter if available. Read each chapter's introductory paragraph and determine why the writer chose this particular order. Depending on what

you're reading, the chapters may be only informational, but often you're looking for a specific argument. What position is the writer claiming? What support, counterarguments, and conclusions is the writer presenting?

Don't think of skimming as a way to buzz through a boring reading assignment. It is a skill you should master so you can engage, at various levels, with all the reading you need to accomplish in college. End your skimming session with a few notes—terms to look up, questions you still have, and an overall summary. And recognize that you likely will return to that book or article for a more thorough reading if the material is useful.

Active Reading Strategies

Active reading differs significantly from skimming or reading for pleasure. You can think of active reading as a sort of conversation between you and the text (maybe between you and the author, but you don't want to get the author's personality too involved in this metaphor because that may skew your engagement with the text).

When you sit down to determine what your different classes expect you to read and you create a reading schedule to ensure you complete all the reading, think about when you should read the material strategically, not just how to *get it all done*. You should read textbook chapters and other reading assignments *before* you go into a lecture about that information. Don't wait to see how the lecture goes before you read the material, or you may not understand the information in the lecture. Reading before class helps you put ideas together between your reading and the information you hear and discuss in class.

Different disciplines naturally have different types of texts, and you need to take this into account when you schedule your time for reading class material. For example, you may look at a poem for your world literature class and assume that it will not take you long to read because it is relatively short compared to the dense textbook you have for your economics class. But reading and understanding a poem can take a considerable amount of time when you realize you may need to stop numerous times to review the separate word meanings and how the words form images and connections throughout the poem.

The SQ3R Reading Strategy

You may have heard of the **SQ3R** method for active reading in your early education. This valuable technique is perfect for college reading. The title stands for **S**urvey, **Q**uestion, **R**ead, **R**ecite, **R**eview, and you can use the steps on virtually any assigned passage. Designed by Francis Pleasant Robinson in his 1961 book *Effective Study*, the active reading strategy gives readers a systematic way to work through any reading material.

Survey is similar to skimming. You look for clues to meaning by reading the titles, headings, introductions, summary, captions for graphics, and keywords. You can survey almost anything connected to the reading selection, including the copyright information, the date of the journal article, or the names and qualifications of the author(s). In this step, you decide what the general meaning is for the reading selection.

Question is your creation of questions to seek the main ideas, support, examples, and conclusions of the reading selection. Ask yourself these questions separately. Try to create valid questions about what you are about to read that have come into your mind as you engaged in the Survey step. Try turning the headings of the sections in the chapter into questions. Next, how does what you're reading relate to you, your school, your community, and the world?

Read is when you actually read the passage. Try to find the answers to questions you developed in the previous step. Decide how much you are reading in chunks, either by paragraph for more complex readings or by section or even by an entire chapter. When you finish reading the selection, stop to make notes. Answer the questions by writing a note in the margin or other white space of the text.

You may also carefully underline or highlight text in addition to your notes. Use caution here that you don't try to rush this step by haphazardly circling terms or the other extreme of underlining huge chunks of text. Don't over-mark. You aren't likely to remember what these cryptic marks mean later when you come back to use this active reading session to study. The text is the source of information—your marks and notes are just a way to organize and make sense of that information.

Recite means to speak out loud. By reciting, you are engaging other senses to remember the material—you read it (visual) and you said it (auditory). Stop reading momentarily in the step to answer your questions or clarify confusing sentences or paragraphs. You can recite a summary of what the text means to you. If you are not in a place where you can verbalize, such as a library or classroom, you can accomplish this step adequately by *saying* it in your head; however, to get the biggest bang for your buck, try to find a place where you can speak aloud. You may even want to try explaining the content to a friend.

Review is a recap. Go back over what you read and add more notes, ensuring you have captured the main points of the passage, identified the supporting evidence and examples, and understood the overall meaning. You may need to repeat some or all of the SQR3 steps during your review depending on the length and complexity of the material. Before you end your active reading session, write a short (no more than one page is optimal) summary of the text you read.

Reading Primary and Secondary Sources

Primary sources are original documents we study and from which we glean information; primary sources include letters, first editions of books, legal documents, and a variety of other texts. When scholars look at these documents to understand a period in history or a scientific challenge and then write about their findings, the scholar's article is considered a secondary source. Readers have to keep several factors in mind when reading both primary and secondary sources.

Primary sources may contain dated material we now know is inaccurate. It may contain personal beliefs and biases the original writer didn't intent to be openly published, and it may even present fanciful or creative ideas that do not support current knowledge. Readers can still gain great insight from primary sources, but readers need to understand the context from which the writer of the primary source wrote the text.

Likewise, secondary sources are inevitably another person's perspective on the primary source, so a reader of secondary sources must also be aware of potential biases or preferences the secondary source writer inserts in the writing that may persuade an incautious reader to interpret the primary source in a particular manner.

For example, if you were to read a secondary source that is examining the U.S. Declaration of Independence (the primary source), you would have a much clearer idea of how the secondary source scholar presented the information from the primary source if you also read the Declaration for yourself instead of trusting the other writer's interpretation. Most scholars are honest in writing secondary sources, but you as a reader of the source are trusting the writer to present a balanced perspective of the primary source. When possible, you should attempt to read a primary source in conjunction with the secondary source. The Internet helps immensely with this practice.

WHAT STUDENTS SAY

1. What is the most influential factor in how thoroughly you read the material for a given course?
    a. How engaging the material is or how much I enjoy reading it.
    b. Whether or not the course is part of my major.
    c. Whether or not the instructor assesses knowledge from the reading (through quizzes, for example), or requires assignments based on the reading.
    d. Whether or not knowledge or information from the reading is required to participate in lecture.
2. What best describes your reading approach for required texts/materials for your classes?
    a. I read all of the assigned material.
    b. I read most of the assigned material.
    c. I skim the text and read the captions, examples, or summaries.
3. What best describes your notetaking style?
    a. I use a systematic method such as the Cornell method or something similar.
    b. I highlight or underline all the important information.
    c. I create outlines and/or note-cards.
    d. I use an app or program.
    e. I write notes in my text (print or digital).
    f. I don't have a style. I just write down what seems important.
    g. I don't take many notes.

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

What is the most influential factor in how thoroughly you read the material for a given course?

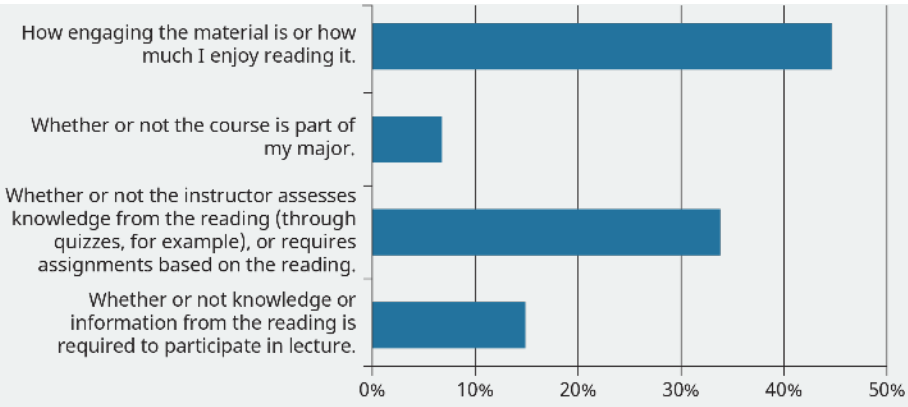


Figure 5.6.3.5

What best describes your reading approach for required texts/materials for your classes?

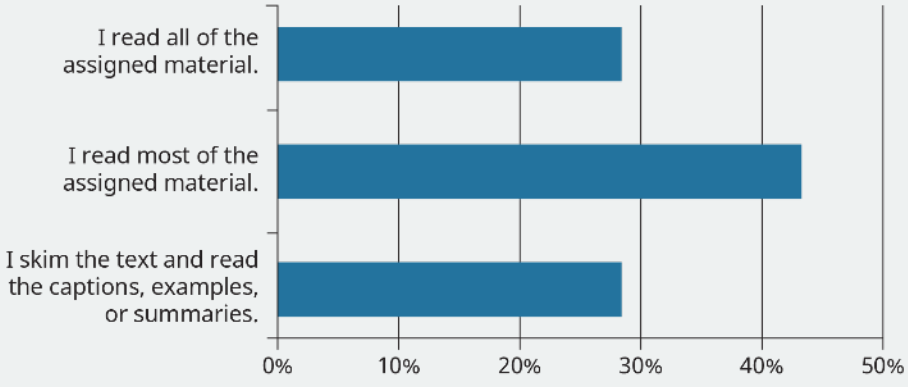


Figure 5.6.3.6

What best describes your notetaking style?

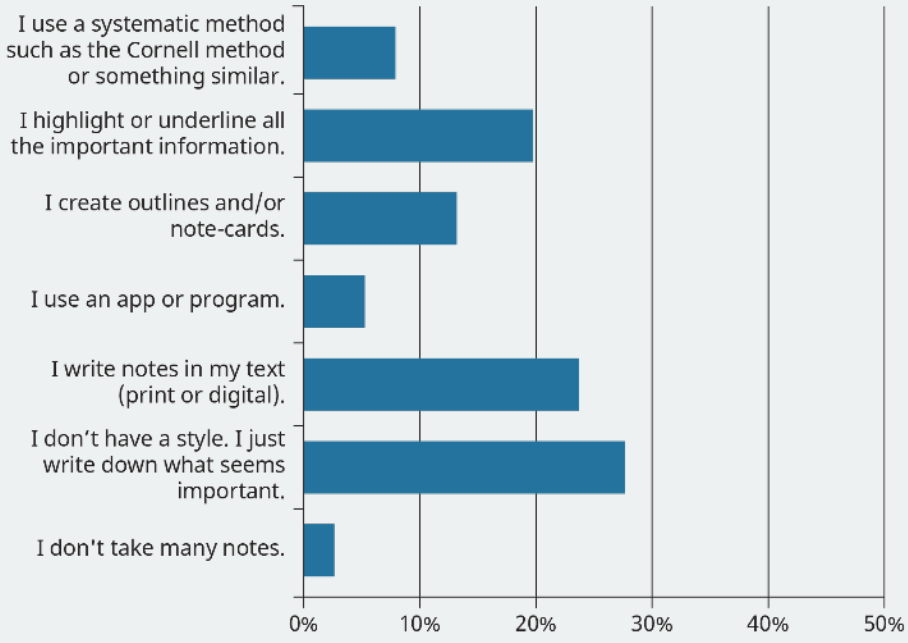


Figure 5.6.3.7

Researching Topic and Author

During your preview stage, sometimes called pre-reading, you can easily pick up on information from various sources that may help you understand the material you're reading more fully or place it in context with other important works in the discipline. If your selection is a book, flip it over or turn to the back pages and look for an author's biography or note from the author. See if the book itself contains any other information about the author or the subject matter.

The main things you need to recall from your reading in college are the topics covered and how the information fits into the discipline. You can find these parts throughout the textbook chapter in the form of headings in larger and bold font, summary lists, and important quotations pulled out of the narrative. Use these features as you read to help you determine what the most important ideas are.

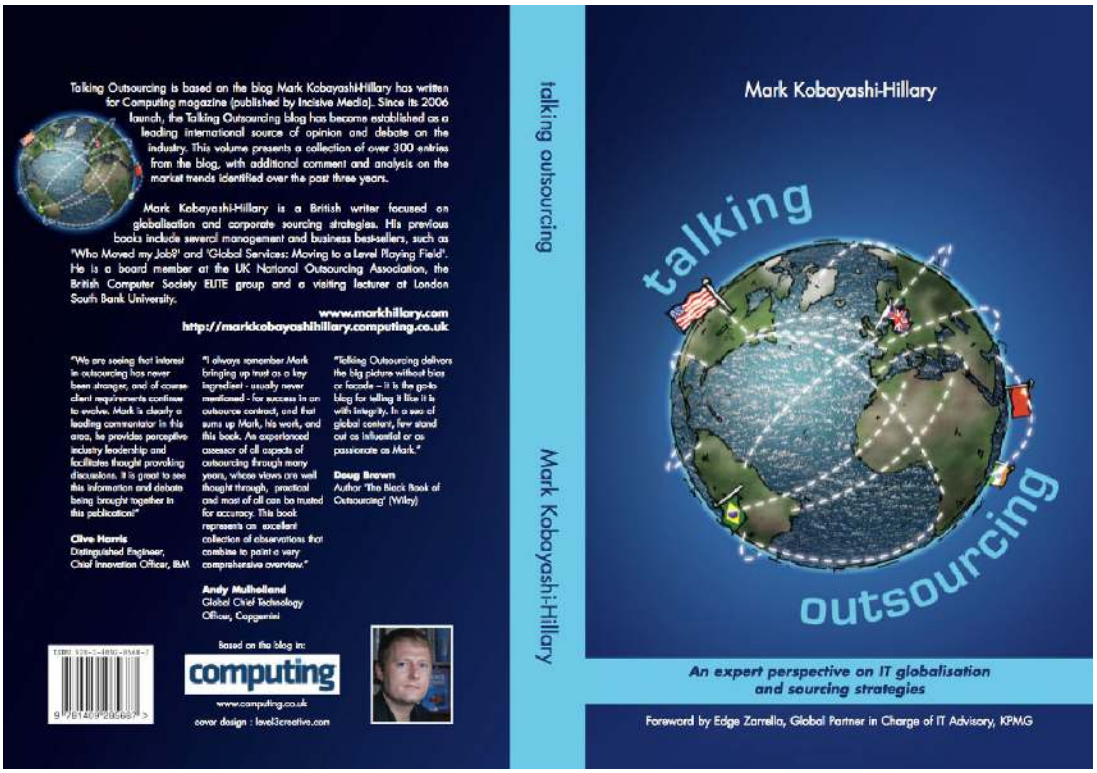


Figure 5.6.3.8 Learning about the book you're reading can provide good context and information. Look for an author's biography and forward on the back cover or in the first few pages. (Credit: Mark Hillary / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Remember, many books use quotations about the book or author as testimonials in a marketing approach to sell more books, so these may not be the most reliable sources of unbiased opinions, but it's a start. Sometimes you can find a list of other books the author has written near the front of a book. Do you recognize any of the other titles? Can you do an Internet search for the name of the book or author? Go beyond the search results that want you to buy the book and see if you can glean any other relevant information about the author or the reading selection. Beyond a standard Internet search, try the library article database. These are more relevant to academic disciplines and contain resources you typically will not find in a standard search engine. If you are unfamiliar with how to use the library database, ask a reference librarian on campus. They are often underused resources that can point you in the right direction.

Understanding Your Own Preset Ideas on a Topic

Laura really enjoys learning about environmental issues. She has read many books and watched numerous televised documentaries on this topic and actively seeks out additional information on the environment. While Laura's interest can help her understand a new reading encounter about the environment, Laura also has to be aware that with this interest, she also brings forward her preset ideas and biases about the topic. Sometimes these prejudices against other ideas relate to religion or nationality or even just tradition. Without evidence, thinking the way we always have is not a good enough reason; evidence can change, and at the very least it needs honest review and assessment to determine its validity. Ironically, we may not want to learn new ideas because that may mean we would have to give up old ideas we have already mastered, which can be a daunting prospect.

With every reading situation about the environment, Laura needs to remain open-minded about what she is about to read and pay careful attention if she begins to ignore certain parts of the text because of her preconceived notions. Learning new information can be very difficult if you balk at ideas that are different from what you've always thought. You may have to force yourself to listen to a different viewpoint multiple times to make sure you are not closing your mind to a viable solution your mindset does not currently allow.

Analysis Question

Can you think of times you have struggled reading college content for a course? Which of these strategies might have helped you understand the content? Why do you think those strategies would work?

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5.6.4: Taking Notes

Questions to consider

- How can you prepare to take notes to maximize the effectiveness of the experience?
- What are some specific strategies you can employ for better notetaking?
- Why is annotating your notes after the notetaking session a critical step to follow?

Beyond providing a record of the information you are reading or hearing, notes help you organize the ideas and help you make meaning out of something about which you may not be familiar, so notetaking and reading are two compatible skill sets. Taking notes also helps you stay focused on the question at hand. Nanami often takes notes during presentations or class lectures so she can follow the speaker's main points and condense the material into a more readily usable format. Strong notes build on your prior knowledge of a subject, help you discuss trends or patterns present in the information, and direct you toward areas needing further research or reading.



Figure 5.6.4.9 Strong notes build on your prior knowledge of a subject, help you discuss trends or patterns present in the information, and direct you toward areas needing further research or reading.

It is not a good habit to transcribe every single word a speaker utters—even if you have an amazing ability to do that. Most of us don't have that court-reporter-esque skill level anyway, and if we try, we would end up missing valuable information. Learn to listen for main ideas and distinguish between these main ideas and details that typically support the ideas. Include examples that explain the main ideas, but do so using understandable abbreviations.

Think of all notes as potential study guides. In fact, if you only take notes without actively working on them after the initial notetaking session, the likelihood of the notes helping you is slim. Research on this topic concludes that without active engagement after taking notes, most students forget 60–75 percent of material over which they took the notes—within two days! That sort of defeats the purpose, don't you think? This information about memory loss was first brought to light by 19th-century German psychologist Hermann Ebbinghaus. Fortunately, you do have the power to thwart what is sometimes called the Ebbinghaus Forgetting Curve by reinforcing what you learned through review at intervals shortly after you take in the material and frequently thereafter.

If you are a musician, you'll understand this phenomenon well. When you first attempt a difficult piece of music, you may not remember the chords and notes well at all, but after frequent practice and review, you generate a certain muscle memory and cognitive recall that allows you to play the music more easily.

Notetaking may not be the most glamorous aspect of your higher-education journey, but it is a study practice you will carry throughout college and into your professional life. Setting yourself up for successful notetaking is almost as important as the actual taking of notes, and what you do after your notetaking session is equally significant. Well-written notes help you organize your thoughts, enhance your memory, and participate in class discussion, and they prepare you to respond successfully on exams. With all that riding on your notes, it would behoove you to learn how to take notes properly and continue to improve your notetaking skills.

Analysis Question

Do you currently have a preferred way to take notes? When did you start using it? Has it been effective? What other strategy might work for you?

Preparing to Take Notes

Preparing to take notes means more than just getting out your laptop or making sure you bring pen and paper to class. You'll do a much better job with your notes if you understand why we take notes, have a strong grasp on your preferred notetaking system, determine your specific priorities depending on your situation, and engage in some version of efficient shorthand.

Like handwriting and fingerprints, we all have unique and fiercely independent notetaking habits. These understandably and reasonably vary from one situation to the next, but you can only improve your skills by learning more about ways to take effective notes and trying different methods to find a good fit.

The very best notes are the ones you take in an organized manner that encourages frequent review and use as you progress through a topic or course of study. For this reason, you need to develop a way to organize all your notes for each class so they remain together and organized. As old-fashioned as it sounds, a clunky three-ring binder is an excellent organizational container for class notes. You can easily add to previous notes, insert handouts you may receive in class, and maintain a running collection of materials for each separate course. If the idea of carrying around a heavy binder has you rolling your eyes, then transfer that same structure into your computer files. If you don't organize your many documents into some semblance of order on your computer, you will waste significant time searching for improperly named or saved files.

You may be interested in relatively new research on what is the more effective notetaking strategy: handwriting versus typing directly into a computer. While individuals have strong personal opinions on this subject, most researchers agree that the format of student notes is less important than what students do with the notes they take afterwards. Both handwriting notes and using a computer for notetaking have pros and cons.

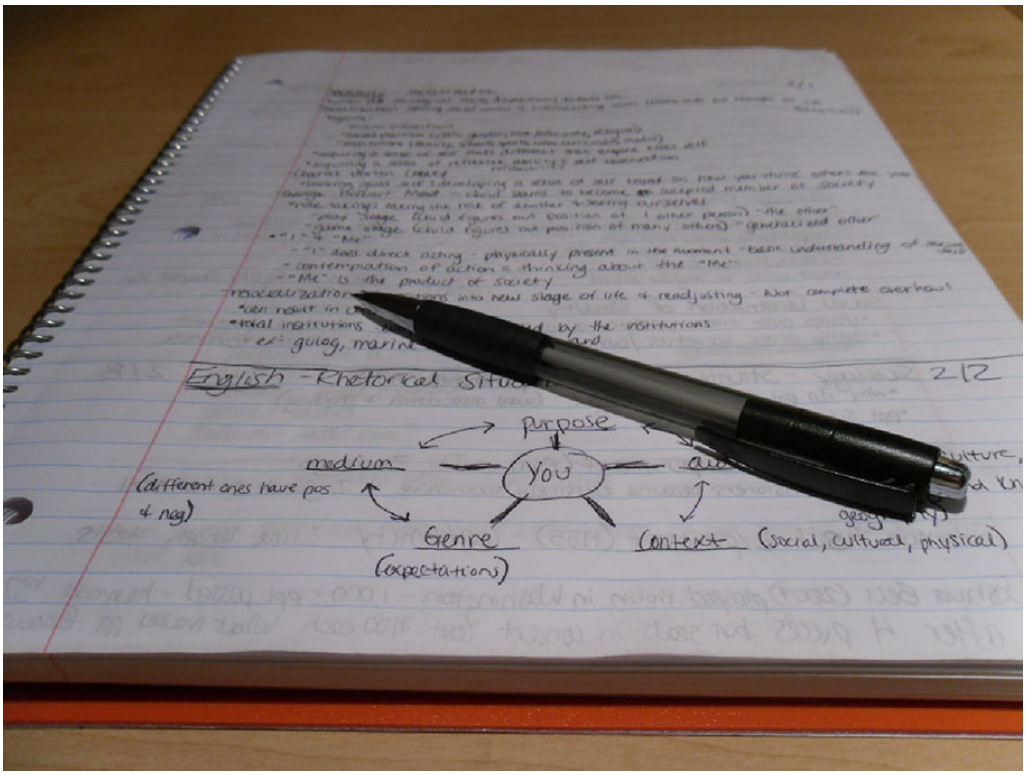


Figure 5.6.4.10 The best notes are the ones you take in an organized manner. Frequent review and further annotation are important to build a deep and useful understanding of the material. (Credit: English106 / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Managing Notetaking Systems (Computer, Paper/Pen, Note Cards, Textbook)

Whichever of the many notetaking systems you choose (and new ones seem to come out almost daily), the very best one is the one that you will use consistently. The skill and art of notetaking is not automatic for anyone; it takes a great deal of practice, patience, and continuous attention to detail. Add to that the fact that you may need to master multiple notetaking techniques for different classes, and you have some work to do. Unless you are specifically directed by your instructor, you are free to combine the best parts of different systems if you are most comfortable with that hybrid system.

Just to keep yourself organized, all your notes should start off with an identifier, including at the very least the date, the course name, the topic of the lecture/presentation, and any other information you think will help you when you return to use the notes for further study, test preparation, or assignment completion. Additional, optional information may be the number of notetaking sessions about this topic or reminders to cross-reference class handouts, textbook pages, or other course materials. It's also always a good idea to leave some blank space in your notes so you can insert additions and questions you may have as you review the material later.

Notetaking Strategies

You may have a standard way you take all your notes for all your classes. When you were in high school, this one-size-fits-all approach may have worked. Now that you're in college, reading and studying more advanced topics, your general method may still work some of the time, but you should have some different strategies in place if you find that your method isn't working as well with college content. You probably will need to adopt different notetaking strategies for different subjects. The strategies in this section represent various ways to take notes in such a way that you are able to study after the initial notetaking session.

Cornell Method

One of the most recognizable notetaking systems is called the *Cornell Method*, a relatively simple way to take effective notes devised by Cornell University education professor Dr. Walter Pauk in the 1940s. In this system, you take a standard piece of note paper and divide it into three sections by drawing a horizontal line across your paper about one to two inches from the bottom of the page (the summary area) and then drawing a vertical line to separate the rest of the page above this bottom area, making the left side about two inches (the recall column) and leaving the biggest area to the right of your vertical line (the notes column). You may want to make one page and then copy as many pages as you think you'll need for any particular class, but one advantage of this

system is that you can generate the sections quickly. Because you have divided up your page, you may end up using more paper than you would if you were writing on the entire page, but the point is not to keep your notes to as few pages as possible. The Cornell Method provides you with a well-organized set of notes that will help you study and review your notes as you move through the course. If you are taking notes on your computer, you can still use the Cornell Method in Word or Excel on your own or by using a template someone else created.

Topic/Objective:	Name:
	Class/Period:
	Date:
Essential Question:	

Questions:	Notes:

Summary:

Figure 5.6.4.11 The Cornell Method provides a straightforward, organized, and flexible approach

Now that you have the notetaking format generated, the beauty of the Cornell Method is its organized simplicity. Just write on one side of the page (the right-hand notes column)—this will help later when you are reviewing and revising your notes. During your notetaking session, use the notes column to record information over the main points and concepts of the lecture; try to put the ideas into your own words, which will help you not transcribe the speaker's words verbatim. Skip lines between each idea in this column. Practice the shortcut abbreviations covered in the next section and avoid writing in complete sentences. Don't make your notes too cryptic, but you can use bullet points or phrases equally well to convey meaning—we do it all the time in conversation. If you know you will need to expand the notes you are taking in class but don't have time, you can put reminders directly in the notes by adding and underlining the word *expand* by the ideas you need to develop more fully.

As soon as possible after your notetaking session, preferably within eight hours but no more than twenty-four hours, read over your notes column and fill in any details you missed in class, including the places where you indicated you wanted to expand your notes. Then in the recall column, write any key ideas from the corresponding notes column—you can't stuff this smaller recall column as if you're explaining or defining key ideas. Just add the one- or two-word main ideas; these words in the recall column serve as cues to help you remember the detailed information you recorded in the notes column.

Once you are satisfied with your notes and recall columns, summarize this page of notes in two or three sentences using the summary area at the bottom of the sheet. This is an excellent time to get with another classmate or a group of students who all heard the same lecture to make sure you all understood the key points. Now, before you move onto something else, cover the large notes column, and quiz yourself over the key ideas you recorded in the recall column. Repeat this step often as you go along, not just immediately before an exam, and you will help your memory make the connections between your notes, your textbook reading, your in-class work, and assignments that you need to succeed on any quizzes and exams.

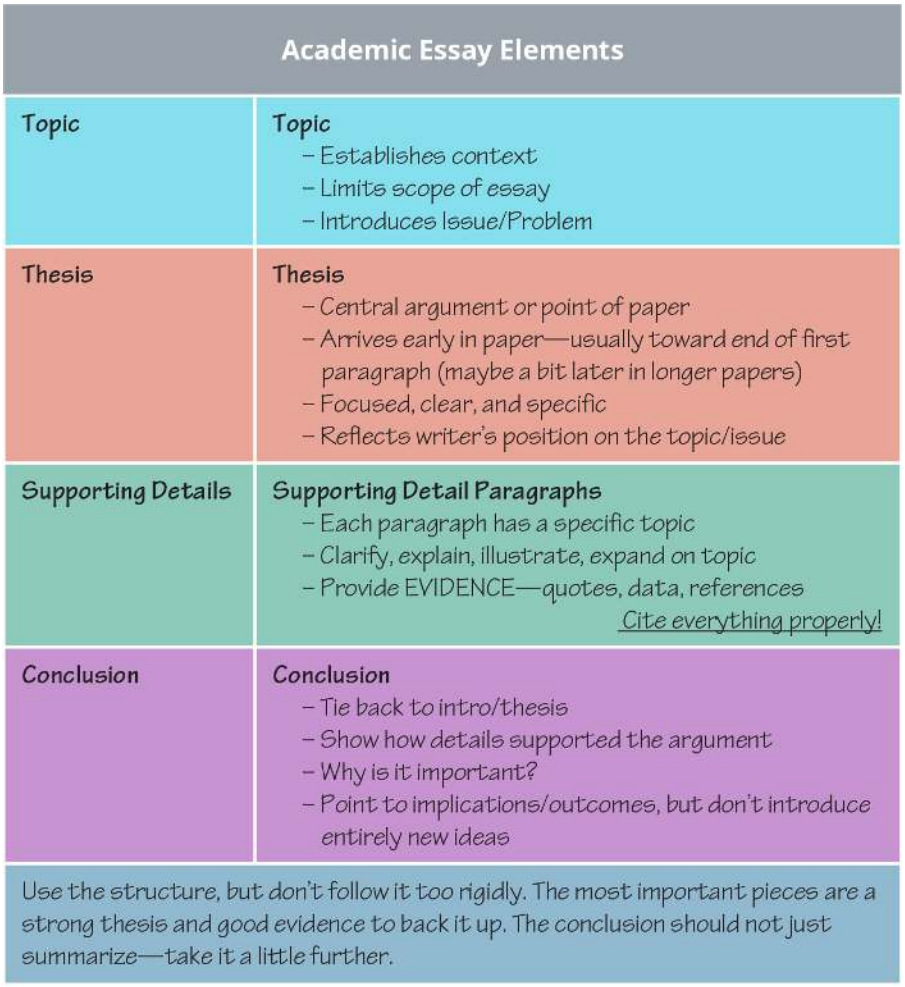


Figure 5.6.4.12 This sample set of notes in the Cornell Method is designed to make sense of a large amount of information. The process of organizing the notes can help you retain the information more effectively than less consistent methods.

The main advantage of the Cornell Method is that you are setting yourself up to have organized, workable notes. The neat format helps you move into study-mode without needing to re-copy less organized notes or making sense of a large mass of information you aren't sure how to process because you can't remember key ideas or what you meant. If you write notes in your classes without any sort of system and later come across something like "Napoleon—short" in the middle of a glob of notes, what can you do at this point? Is that important? Did it connect with something relevant from the lecture? How would you possibly know? You are your best advocate for setting yourself up for success in college.

Outlining

Other note organizing systems may help you in different disciplines. You can take notes in a formal outline if you prefer, using Roman numerals for each new topic, moving down a line to capital letters indented a few spaces to the right for concepts related to the previous topic, then adding details to support the concepts indented a few more spaces over and denoted by an Arabic numeral. You can continue to add to a formal outline by following these rules.

You don't absolutely have to use the formal numerals and letter, but you have to then be careful to indent so you can tell when you move from a higher level topic to the related concepts and then to the supporting information. The main benefit of an outline is how

organized it is. You have to be on your toes when you are taking notes in class to ensure you keep up the organizational format of the outline, which can be tricky if the lecture or presentation is moving quickly or covering many diverse topics.

The following formal outline example shows the basic pattern:

I. Dogs *(main topic–usually general)*
   A. German Shepherd *(concept related to main topic)*
      1. Protection *(supporting info about the concept)*
      2. Assertive
      3. Loyal
   B. Weimaraner *(concept related to main topic)*
      1. Family-friendly *(supporting info about the concept)*
      2. Active
      3. Healthy

II. Siamese

You would just continue on with this sort of numbering and indenting format to show the connections between main ideas, concepts, and supporting details. Whatever details you do not capture in your notetaking session, you can add after the lecture as you review your outline.

Chart or table

Similar to creating an outline, you can develop a chart to compare and contrast main ideas in a notetaking session. Divide your paper into four or five columns with headings that include either the main topics covered in the lecture or categories such as How?, What?, When used?, Advantages/Pros, Disadvantages/Cons, or other divisions of the information. You write your notes into the appropriate columns as that information comes to light in the presentation.

Example of a Chart to Organize Ideas and Categories

	Structure	Types	Functions in Body	Additional Notes
Carbohydrates				
Lipids				
Proteins				
Nucleic Acid				

This format helps you pull out the salient ideas and establishes an organized set of notes to study later. (If you haven't noticed that this *reviewing later* idea is a constant across all notetaking systems, you should…take note of that.) Notes by themselves that you never reference again are little more than scribblings. That would be a bit like compiling an extensive grocery list so you stay on budget when you shop, work all week on it, and then just throw it away before you get to the store. You may be able to recall a few items, but likely won't be as efficient as you could be if you had the notes to reference. Just as you cannot read all the many books, articles, and documents you need to peruse for your college classes, you cannot remember the most important ideas of all the notes you will take as part of your courses, so you must review.

Concept Mapping and Visual Notetaking

One final notetaking method that appeals to learners who prefer a visual representation of notes is called *mapping* or sometimes *mind mapping* or *concept mapping*, although each of these names can have slightly different uses. Variations of this method abound, so you may want to look for more versions online, but the basic principles are that you are making connections between main ideas through a graphic depiction; some can get rather elaborate with colors and shapes, but a simple version may be more useful at least to begin. Main ideas can be circled or placed in a box with supporting concepts radiating off these ideas shown with a connecting line and possibly details of the support further radiating off the concepts. You can present your main ideas vertically or horizontally, but turning your paper long-ways, or in landscape mode, may prove helpful as you add more main ideas.

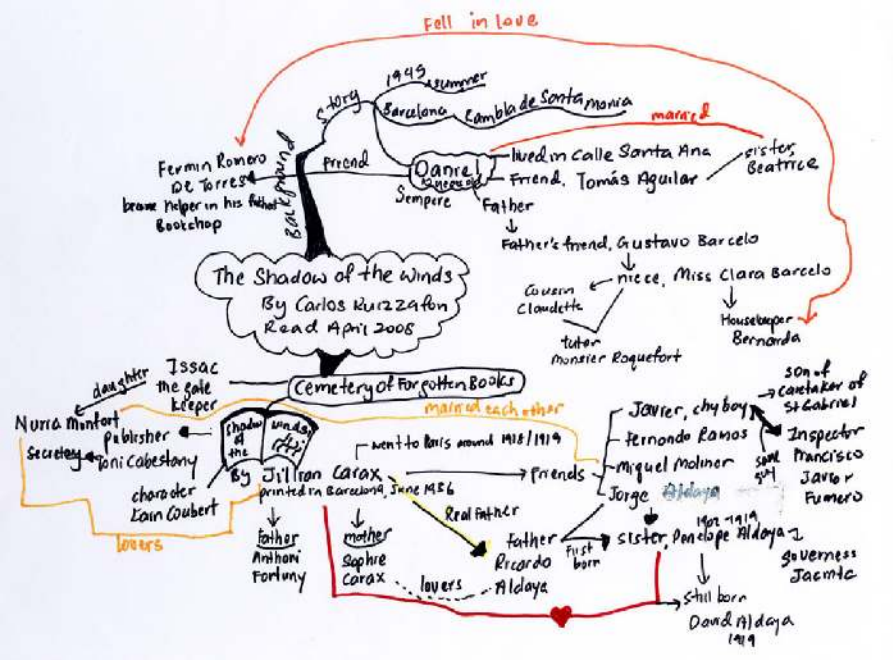


Figure 5.6.4.13 Concept mapping, sometimes referred to as mind mapping, can be an effective and very personalized approach to capturing information. (Credit: ArtistIvanChew / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

You may be interested in trying visual notetaking or adding pictures to your notes for clarity. Sometimes when you can't come up with the exact wording to explain something or you're trying to add information for complex ideas in your notes, sketching a rough image of the idea can help you remember. According to educator Sherrill Knezel in an article entitled "The Power of Visual Notetaking," this strategy is effective because "When students use images and text in notetaking, it gives them two different ways to pull up the information, doubling their chances of recall." Don't shy away from this creative approach to notetaking just because you believe you aren't an artist; the images don't need to be perfect. You may want to watch Rachel Smith's TEDx Talk called "Drawing in Class" to learn more about visual notetaking.

You can play with different types of notetaking suggestions and find the method(s) you like best, but once you find what works for you, stick with it. You will become more efficient with the method the more you use it, and your notetaking, review, and test prep will become, if not easier, certainly more organized, which can delete decrease your anxiety.

Practicing Decipherable Shorthand

Most college students don't take a class in shorthand, once the domain of secretaries and executive assistants, but maybe they should. That almost-lost art in the age of computers could come in very handy during intense notetaking sessions. Elaborate shorthand systems do exist, but you would be better served in your college notetaking adventures to hone a more familiar, personalized form of shorthand to help you write more in a shorter amount of time. Seemingly insignificant shortcuts can add up to ease the stress notetaking can induce—especially if you ever encounter an "I'm not going to repeat this" kind of presenter! Become familiar with these useful abbreviations:

Shortcut symbol	Meaning
w/, w/o, w/in	with, without, within
&	and
#	number
b/c	because
X, √	incorrect, correct
Diff	different, difference
etc.	and so on

ASAP	as soon as possible
US, UK	United States, United Kingdom
info	information
Measurements: ft, in, k, m	foot, inch, thousand, million
¶	paragraph or new paragraph
Math symbols: =, +, >, <, ÷	equal, plus, greater, less, divided by
WWI, WWII	World Wars I and II
impt	important
?, !, **	denote something is very significant; don't over use

Do you have any other shortcuts or symbols that you use in your notes? Ask your parents if they remember any that you may be able to learn.

Annotating Notes After Initial Notetaking Session

Annotating notes after the initial notetaking session may be one of the most valuable study skills you can master. Whether you are highlighting, underlining, or adding additional notes, you are reinforcing the material in your mind and memory.

Admit it—who can resist highlighting markers? Gone are the days when yellow was the star of the show, and you had to be very careful not to press too firmly for fear of obliterating the words you were attempting to emphasize. Students now have a veritable rainbow of highlighting options and can color-code notes and text passages to their hearts' content. Technological advances may be important, but highlighter color choice is monumental! Maybe.

The only reason to highlight anything is to draw attention to it, so you can easily pick out that ever-so-important information later for further study or reflection. One problem many students have is not knowing when to stop. If what you need to recall from the passage is a particularly apt and succinct definition of the term important to your discipline, highlighting the entire paragraph is less effective than highlighting just the actual term. And if you don't rein in this tendency to color long passages (possibly in multiple colors) you can end up with a whole page of highlighted text. Ironically, that is no different from a page that is not highlighted at all, so you have wasted your time. Your mantra for highlighting text should be *less is more*. Always read your text selection first before you start highlighting anything. You need to know what the overall message is before you start placing emphasis in the text with highlighting.

Another way to annotate notes after initial notetaking is underlying significant words or passages. Albeit not quite as much fun as its colorful cousin highlighting, underlining provides precision to your emphasis.

Some people think of annotations as only using a colored highlighter to mark certain words or phrases for emphasis. Actually, annotations can refer to anything you do with a text to enhance it for your particular use (either a printed text, handwritten notes, or other sort of document you are using to learn concepts). The annotations may include highlighting passages or vocabulary, defining those unfamiliar terms once you look them up, writing questions in the margin of a book, underlining or circling key terms, or otherwise marking a text for future reference. You can also annotate some electronic texts.

Realistically, you may end up doing all of these types of annotations at different times. We know that repetition in studying and reviewing is critical to learning, so you may come back to the same passage and annotate it separately. These various markings can be invaluable to you as a study guide and as a way to see the evolution of your learning about a topic. If you regularly begin a reading session writing down any questions you may have about the topic of that chapter or section and also write out answers to those questions at the end of the reading selection, you will have a good start to what that chapter covered when you eventually need to study for an exam. At that point, you likely will not have time to reread the entire selection especially if it is a long reading selection, but with strong annotations in conjunction with your class notes, you won't need to do that. With experience in reading discipline-specific texts and writing essays or taking exams in that field, you will know better what sort of questions to ask in your annotations

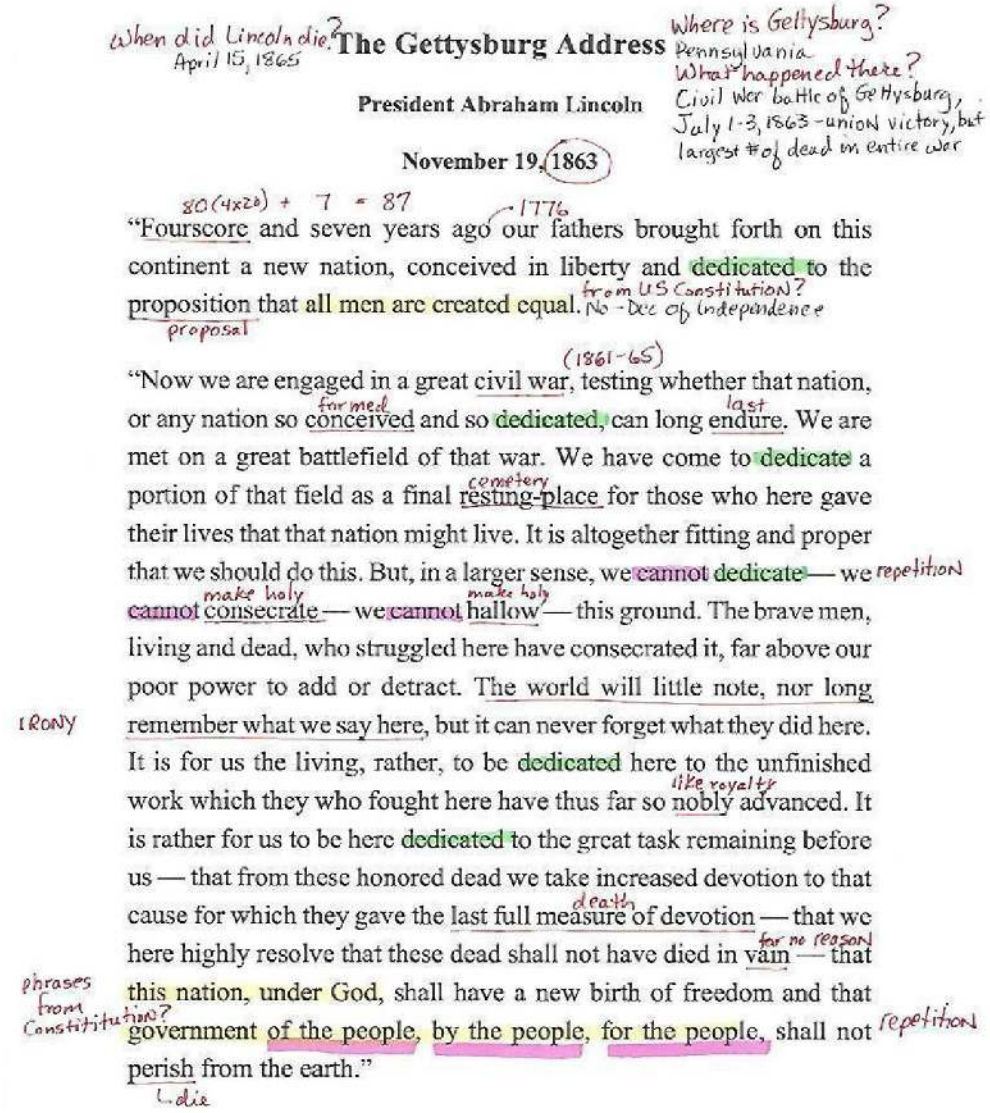


Figure 5.6.4.14 Annotations may include highlighting important topics, defining unfamiliar terms, writing questions in, underlining or circling key terms, or otherwise marking a text for future reference. Whichever approach you choose, try not to overdo it; neat, organized, and efficient notes are more effective than crowded or overdone notes.

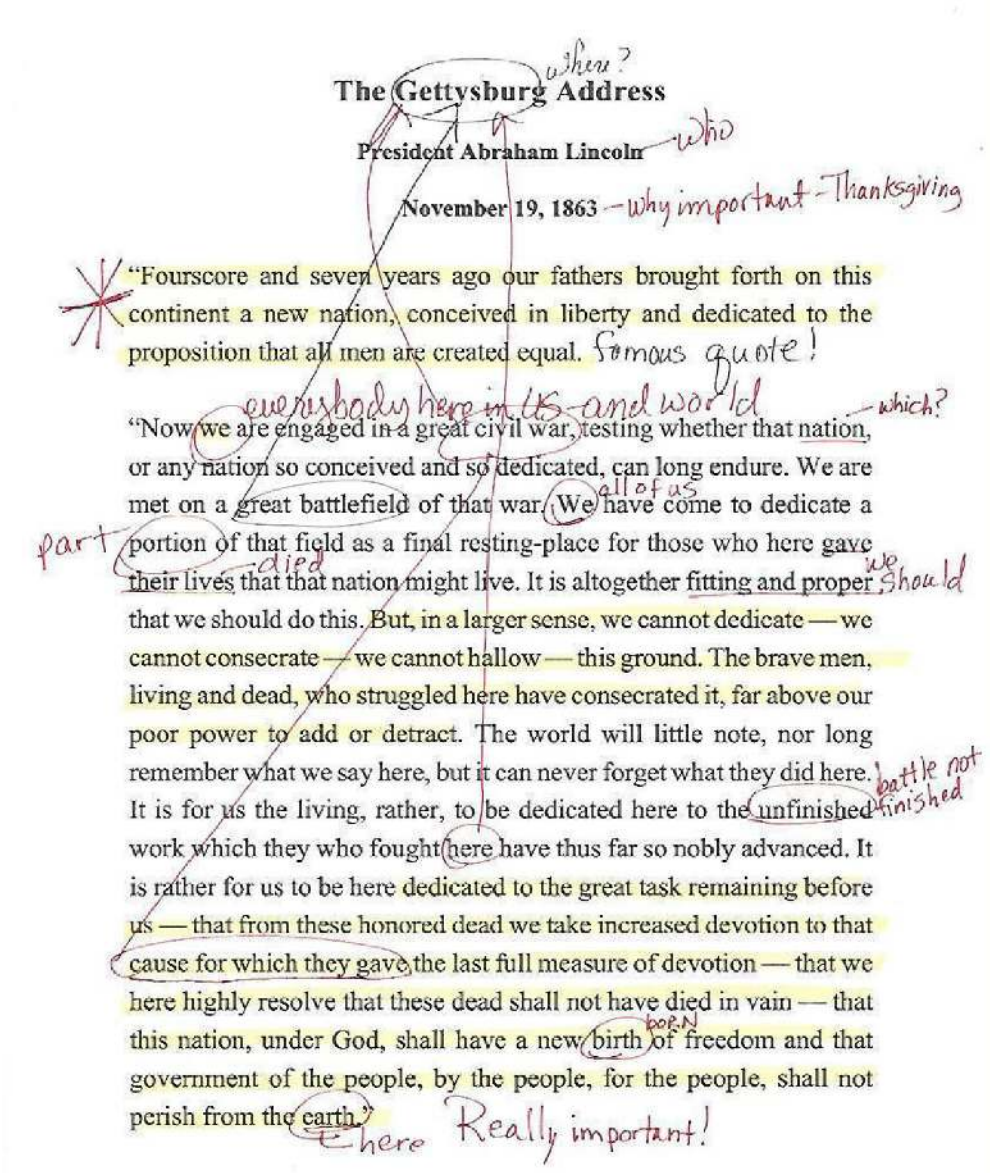


Figure 5.6.4.15 While these notes may be meaningful to the person who took them, they are neither organized nor consistent. For example, note that some of the more commonly used terms, like "we" and "unfinished," are defined, but less common ones -- "consecrate" and "hallow" -- are not.

What you have to keep in the front of your mind while you are annotating, especially if you are going to conduct multiple annotation sessions, is to not overdo whatever method you use. Be judicious about what you annotate and how you do it on the page, which means you must be neat about it. Otherwise, you end up with a mess of either color or symbols combined with some cryptic notes that probably took you quite a long time to create, but won't be worth as much to you as a study aid as they could be. This is simply a waste of time and effort.

You cannot eat up every smidgen of white space on the page writing out questions or summaries and still have a way to read the original text. If you are lucky enough to have a blank page next to the beginning of the chapter or section you are annotating, use this, but keep in mind that when you start writing notes, you aren't exactly sure how much space you'll need. Use a decipherable shorthand and write only what you need to convey the meaning in very small print. If you are annotating your own notes, you can make a habit of using only one side of the paper in class, so that if you need to add more notes later, you could use the other side. You can also add a blank page to your notes before beginning the next class date in your notebook so you'll end up with extra paper for annotations when you study.

Professional resources may come with annotations that can be helpful to you as you work through the various documentation requirements you'll encounter in college as well. Purdue University's Online Writing Lab (OWL) provides an annotated sample for

how to format a college paper according to guidelines in the Modern Language Association (MLA) manual that you can see, along with other annotations.

Adding Needed Additional Explanations to Notes

Marlon was totally organized and ready to take notes in a designated course notebook at the beginning of every philosophy class session. He always dated his page and indicated what the topic of discussion was. He had various colored highlighters ready to denote the different note purposes he had defined: vocabulary in pink, confusing concepts in green, and note sections that would need additional explanations later in yellow. He also used his own shorthand and an impressive array of symbols to indicate questions (red question mark), highly probable test material (he used a tiny bomb exploding here), additional reading suggestions, and specific topics he would ask his instructor before the next class. Doing everything so precisely, Marlon's methods seemed like a perfect example of how to take notes for success. Inevitably though, by the end of the hour-and-a-half class session, Marlon was frantically switching between writing tools, near to tears, and scouring his notes as waves of yellow teased him with uncertainty. What went wrong?

As with many of us who try diligently to do everything we know how to do for success or what we think we know because we read books and articles on success in between our course work, Marlon is suffering from trying to do too much simultaneously. It's an honest mistake we can make when we are trying to save a little time or think we can multitask and kill two birds with one stone.

Unfortunately, this particular error in judgement can add to your stress level exponentially if you don't step back and see it for what it is. Marlon attempted to take notes in class as well as annotate his notes to get them ready for his test preparation. It was too much to do at one time, but even if he could have done all those things during class, he's missing one critical point about notetaking.

As much as we may want to hurry and get it over with, notetaking in class is just the beginning. Your instructor likely gave you a pre-class assignment to read or complete before coming to that session. The intention of that preparatory lesson is for you to come in with some level of familiarity for the topic under consideration and questions of your own. Once you're in class, you may also need to participate in a group discussion, work with your classmates, or perform some other sort of lesson-directed activity that would necessarily take you away from taking notes. Does that mean you should ignore taking notes for that day? Most likely not. You may just need to indicate in your notes that you worked on a project or whatever other in-class event you experienced that date.

Very rarely in a college classroom will you engage in an activity that is not directly related to what you are studying in that course. Even if you enjoyed every minute of the class session and it was an unusual format for that course, you still need to take some notes. Maybe your first note could be to ask yourself why you think the instructor used that unique teaching strategy for the class that day. Was it effective? Was it worth using the whole class time? How will that experience enhance what you are learning in that course?

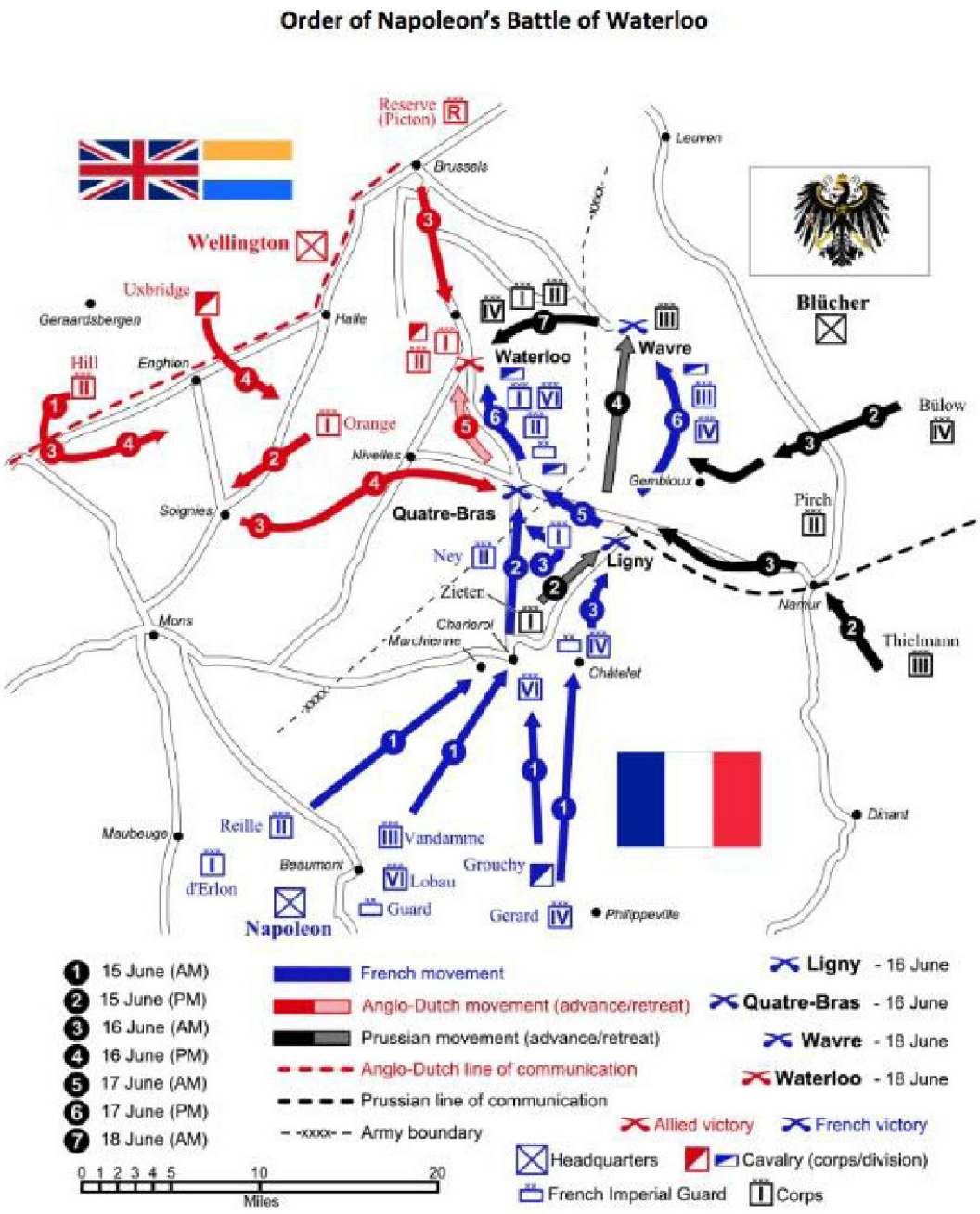
If you use an ereader or ebooks to read texts for class or read articles from the Internet on your laptop or tablet, you can still take effective notes. Depending on the features of your device, you have many choices. Almost all electronic reading platforms allow readers to highlight and underline text. Some devices allow you to add a written text in addition to marking a word or passage that you can collect at the end of your notetaking session. Look into the specific tools for your device and learn how to use the features that allow you to take notes electronically. You can also find apps on devices to help with taking notes, some of which you may automatically have installed when you buy the product. Microsoft's OneNote, Google Keep, and the Notes feature on phones are relatively easy to use, and you may already have free access to those.

Taking Notes on Non-Text Items (i.e., Tables, Maps, Figures, etc.)

You may also encounter situations as you study and read textbooks, primary sources, and other resources for your classes that are not actually texts. You can still take notes on maps, charts, graphs, images, and tables, and your approach to these non-text features is similar to when you prepare to take notes over a passage of text. For example, if you are looking at the following map, you may immediately come up with several questions. Or it may initially appear overwhelming. Start by asking yourself these questions:

What is the main point of this map?

- Who is the intended audience?
- Where is it?
- What time period does it depict?
- What does the map's legend (the explanation of symbols) include?
- What other information do I need to make sense of this map?



Source: Wikipedia Creative Commons, https://en.wikipedia.org/wiki/Order_of_battle_of_the_Waterloo_campaign

Figure 5.6.4.16 Graphics, charts, graphs, and other visual items are also important to annotate. Not only do they often convey important information, but they may appear on exams or in other situations where you'll need to use or demonstrate knowledge. Credit: "Lpankonin" / Wikipedia Commons / Attribution 3.0 Generic (CC BY 3.0)

You may want to make an extra copy of a graphic or table before you add annotations if you are dealing with a lot of information. Making sense of all the elements will take time, and you don't want to add to the confusion.

Returning to Your Notes

Later, as soon as possible after the class, you can go back to your notes and add in missing parts. Just as you may generate questions as you're reading new material, you may leave a class session or lecture or activities with many questions. Write those

down in a place where they won't get lost in all your other notes.

The exact timing of when you get back to the notes you take in class or while you are reading an assignment will vary depending on how many other classes you have or what other obligations you have in your daily schedule. A good starting place that is also easy to remember is to make every effort to review your notes within 24 hours of first taking them. Longer than that and you are likely to have forgotten some key features you need to include; must less time than that, and you may not think you need to review the information you so recently wrote down, and you may postpone the task too long.

Use your phone or computer to set reminders for all your note review sessions so that it becomes a habit and you keep on top of the schedule.

Your personal notes play a significant role in your test preparation. They should enhance how you understand the lessons, textbooks, lab sessions, and assignments. All the time and effort you put into first taking the notes and then annotating and organizing the notes will be for naught if you do not formulate an effective and efficient way to use them before sectional exams or comprehensive tests.

The whole cycle of reading, notetaking in class, reviewing and enhancing your notes, and preparing for exams is part of a continuum you ideally will carry into your professional life. Don't try to take short cuts; recognize each step in the cycle as a building block. Learning doesn't end, which shouldn't fill you with dread; it should help you recognize that all this work you're doing in the classroom and during your own study and review sessions is ongoing and cumulative. Practicing effective strategies now will help you be a stronger professional.

Activity

What resources can you find about reading and notetaking that will actually help you with these crucial skills? How do you go about deciding what resources are valuable for improving your reading and notetaking skills?

The selection and relative value of study guides and books about notetaking vary dramatically. Ask your instructors for recommendations and see what the library has available on this topic. The following list is not comprehensive, but will give you a starting point for books and articles on notetaking in college.

- *College Rules!: How to Study, Survive, and Succeed in College*, by Sherri Nist-Olejnik and Jodi Patrick Holschuh. More than just notetaking, this book covers many aspects of transitioning into the rigors of college life and studying.
- *Effective Notetaking*, by Fiona McPherson. This small volume has suggestions for using your limited time wisely before, during, and after notetaking sessions.
- *How to Study in College*, by Walter Pauk. This is the book that introduced Pauk's notetaking suggestions we now call the Cornell Method. It is a bit dated (from the 1940s), but still contains some valuable information.
- *Learn to Listen, Listen to Learn 2: Academic Listening and Note-taking*, by Roni S. Lebauer. The main point of this book is to help students get the most from college lectures by watching for clues to lecture organization and adapting this information into strong notes.
- *Study Skills: Do I Really Need this Stuff?*, by Steve Piscitelli. Written in a consistently down-to-earth manner, this book will help you with the foundations of strong study skills, including time management, effective notetaking, and seeing the big picture.
- "What Reading Does for the Mind," by Anne Cunningham and Keith Stanovich, 1998, https://www.aft.org/sites/default/files/periodicals/cunningham.pdf
- Adler, Mortimer J. and Charles Van Doren. *How to Read a Book: The Classic Guide to Intelligent Reading. NY: Simon & Schuster, 1940*.
- Berns, Gregory S., Kristina Blaine, Michael J. Prietula, and Brandon E. Pye. *Brain Connectivity.* Dec 2013.ahead of print http://doi.org/10.1089/brain.2013.0166

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5.6.5: Summary

Reading and notetaking are major elements of college studying and learning. The expectations in college is that you read considerable amounts of text for each subject. You may encounter reading situations, such as professional journal articles and long textbook chapters, that are more difficult to understand than texts you have read previously. As you progress through your college courses, you can employ reading strategies to help you complete your college reading assignments. Likewise, you will take notes in college that need to be complete so you can study and recall the information you learn in lectures and lab sessions. With so much significant information that you need to collect, study, and recall for your college courses, you need to be deliberate in your reading and notetaking.

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5.6.6: Career Connection

Sanvi is a pre-nursing student who is having trouble between all the reading she is expected to complete, her general dislike of reading, and her need to comprehend both her reading assignments and her own notes to be successful in nursing school. She has spoken with several of her instructors and a tutor at the Student Success Center on campus, and their advice centers around Sanvi's reluctance to read in general. She is working on how to manage her time so she has more dedicated time to read her assignments in between her classes and her work schedule.

That is helping some, but Sanvi is still worried because she knows one problem is that she doesn't exactly know what types of reading or notetaking she would need to know how to do as a professional nurse. This confusion makes her doubt that the extra reading she is doing now is really beneficial. After some reflection on what was holding her back, Sanvi mentioned this aspect of her studying to one of her instructors who had been a hospital RN for years before coming to the college to teach. She recalled that the first time she read a patient chart in the hospital, she had to think quickly about how to get all the meaning out of the chart in the same way she would have read a complex textbook chapter.

Sanvi's nursing instructor reminded her that all professions need their personnel to read. They may not all need to read books or articles, but all jobs involve reading to some extent. For example, consider this list of disciplines and the typical types of reading they do. You may be surprised that not all reading is in text form.

Nurses/doctors	Patient charts, prescription side effects, medical articles
Teachers	Student work, lesson plans, educational best practices
Architects	Blueprints, construction contracts, permit manuals
Accountants	Financial spreadsheets, tax guidelines, invoices, trend diagrams
Beauticians	Client hair and facial features, best practices articles, product information
Civil engineers	Work site maps, government regulations, financial spreadsheets
Auto mechanics	Car engines, auto manuals, government regulations

As this incomplete list shows, not every job you pursue will require you to read text-based documents, but all jobs require some reading.

- How could Sanvi and her instructor use this list to make more sense of how college reading will prepare Sanvi to be a stronger nurse?
- How would understanding the types of professional reading help you complete your reading assignments?
- If your chosen field of study is not listed above, can you think of what sort of reading those professionals would need to do?

Think about the questions that opened this chapter and what you have read. How do you feel about your reading and notetaking skills now that you have some more strategies?

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5.6.7: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

1. I am reading on a college level
2. I take good notes that help me study for exams
3. I understand how to manage all the reading I need to do for college
4. I recognize the need for different notetaking strategies for different college subjects

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5.6.8: Where do you go from here?

Reading is such a part of our everyday lives that we sometimes take it for granted. And even we don't formally write down our thoughts, we take notes in our heads far more often than we use our notetaking skills to make sense of a textbook passage or a graphic. Honing these fundamental skills can only help you succeed in college and beyond. What else about reading and note taking would you like to learn more about? Choose topics form the list below to research more.

- How to maximize e-readers to comprehend texts.
- How professional use reading and note taking in their careers.
- Is speed-reading a myth or a viable strategy?
- Compare reading and notetaking strategies from different countries to those you use

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SECTION OVERVIEW

5.7: Listening and Note-Taking

5.7.1: Preparation for Note-Taking

5.7.2: Taking Notes in Class

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5.7.1: Preparation for Note-Taking

Phyllis Nissila

Non-Verbal Communication

When we think about listening we think about, well, hearing sounds via the ears. However, when it comes to listening in order to pick up key points for note-taking, it takes more than just hearing. In this case, it takes a "critical ear," that is, absorbing key points by noticing not only the words spoken, but also by noting tones, volume, and even the body language that goes along. Additionally, being an active listener increases a note-taker's chances of getting the information needed. Exercise 1 illustrates common non-verbal communication.

EXERCISE 26-1

PART A

List as many non-verbal, emotional cues as you can by studying the faces in the pictures below.



"Universal Emotions" by Icerko Lýdia is licensed under CC BY 3.0

PART B

The image below illustrates non-verbal body language. Describe a few poses or body movements one or more of your teachers now, or from the past, takes or has taken that communicates: pay closer attention. It might be from these examples, or something quite different. For example, an instructor might move close to the front row and fold his/her arms to indicate that what he or she will be saying is of a more serious nature. For another example, if he or she moves toward the white board to write something, it's probably key information.



"Men Silhouette" by geralt is in the Public Domain, CC0

Active Listening

In previous units, we covered ways that students can actively engage in the learning process in order to get the most out of their education. There are ways to actively listen as well, in order to get the most out of lectures and, more importantly, take all of the notes that might be required. The video in the next exercise covers several active listening strategies along with why we sometimes have difficulty listening.

EXERCISE 26-2

PART A

Watch the TED talk below and answer the following questions:

Video: *5 Ways to Listen Better*, Julian Treasure at TED Global 2011



A TED element has been excluded from this version of the text. You can view it online here: https://press.rebus.community/blueprint2/?p=126

1. What 3 types of listening does the speaker discuss?
2. How and why have we been "losing our ability to listen," as the speaker suggests? He cites 5 ways.
3. What are the 5 tools we can use to listen better?

PART B

Taking into consideration all of the activities in the exercises above, write a one-page (250-300 words) reflection on how you can use the information on non-verbal and listening skills to enhance both your ability to pay attention to lectures and to take better notes on them.

Perhaps the most useful learning tools of all are notes taken from both lectures and course materials. By annotating for key information, then condensing it, students create personalized summaries helpful for studying.

Often, students are unsure about what constitutes "key information." Here is a list of items to highlight or annotate for in textbooks and a list of items to listen for in lectures.

Key Information in Textbooks

The following elements of a textbook chapter are especially important in helping you discern key information:

- Introductions
- Summaries
- Study questions
- Topic sentences (as the speaker in the video on "Skim Reading," exercise 3.2, also in Lesson 3.2 notes: sometimes the reader has to read the first two or even three sentences of a paragraph or section to get the entire main topic).
- Anything that is bolded, or in some other way set off from the default print size and style. Sub-topic titles are good examples of this.
- "Side bars," which are boxes of related information. These might include statistics, brief biographies of authors or persons of note related to the chapter content, price points on brochures for businesses, charts, graphs, photographs, and/or illustrations. They are typically a different color or in some other way set off for attention but not as the focal point of the text. Pay attention to the captions or legends that might accompany graphics. In this e-text, the exercises are set apart in side bars.
- Glossary terms that may be incorporated in the margins or otherwise set apart.
- Some textbooks include outlines of each chapter's main points in the introductory section.

Key Information in Lectures

As the lecturer, live or video, presents the material, there are two types of key information cues to be aware of.

NONVERBAL CUES

A speaker will often have unique facial and body nonverbal cues that alert you to several things, as you learn to "read" your professor:

- Stances or movements that alert you to when he/she will shift to a different topic or subtopic.
- Other cues that alert you to when the information is of special significance (including verbal clues, below).

VERBAL CLUES

- Pay attention to when the speaker uses any of the transition clues used in reading comprehension.
- Many speakers also announce when they are adding information or changing topics in various other ways.

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Adaptions: Changed formatting, removed emoticon image, embedded Ted Talk video, slight edits for consistency, combined Lessons 4.1 and 4.2, retitled chapter.

Julian Treasure: 5 Ways to Listen Better. Authored by TED.com Located at: https://www.ted.com/talks/julian_tre...ge=en#t-440931
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5.7.2: Taking Notes in Class

Dave Dillon

"He listens well who takes notes."

– Dante Alighieri

Take Notes To Remember

If for no other reason, you should take notes during class so that you do not forget valuable and important information. Despite living with incredible search engines on computers and smart phones that give us a plethora of information 24 hours a day, seven days a week, students do not have the ability to access those during exams. Instructors want to know what you know not what Google knows. We've become accustomed to searching for information on demand to find what we need when we need it. The consequence is that we don't often commit information to memory because we know it will be there tomorrow if we wish to search for it again. This causes challenges with preparation for exams as what we're tested on is in our brain rather than information we can search for. Thus, there is an importance of taking notes. "Note-taking facilitates both recall of factual material and the synthesis and application of new knowledge, particularly when notes are reviewed prior to exams."[1]

As you may recall from The Basics of Study Skills Chapter, Hermann Ebbinghaus studied the rate of forgetting and formulated his "forgetting curve" theory. Perform a web search for "Ebbinghaus forgetting curve."

The curve shows that after one month, only 20 percent of information is retained after initial memorization. Without review, 47 percent of learned information is lost after only 20 minutes. After one day, 62 percent of learned information is lost without review.

In order to try to retain information long term, we must move it from our short-term memory to our long-term memory. One of the best ways to do that is through repetition. The more we review information, and the sooner we review once we initially learn it, the more reinforced that information is in our long-term memory.

The first step in being able to review is to take notes when you are originally learning the information. Students who do not take notes in class in the first place will not be able to recall all of the information covered in order to best review.

Taking notes during lectures is a skill, just like riding a bike. If you have never taken notes while someone else is speaking before, it's important to know that you will not be an expert at it right away. It is challenging to listen to someone speak and then make a note about what they said, while at the same time continuing to listen to their next thought.

When learning to ride a bike, everyone is going to fall. With practice and concentration, we gain confidence and improve our skill. The more we practice, the better we get. In his book Outliers, Malcolm Gladwell refers to the "10,000-hour rule." Based on research by Anders Ericsson, the rule states that 10,000 hours of dedicated practice in your particular field will allow for the greatest potential of mastery. I do not expect you to practice taking notes for 10,000 hours, but the point is that practice, just like many things, is necessary to become more skilled[2].

Some instructors will give you cues to let you know something is important. If you hear or see one of these cues, it's something you should write down. This might include an instructor saying, "this is important," or "this will be covered on the exam." If you notice an instructor giving multiple examples, repeating information or spending a lot of time with one idea, these may be cues. Writing on the board or presenting a handout or visual information may also be a cue.

There are many different ways to take notes during lectures and I encourage you to find the way that works best for you. Different systems work best for different people. Experiment in different ways to find the most success.

Tips for Taking Notes During the Lecture

Arrive early and find a good seat. Seats in the front and center are best for being able to see and hear information. A seat at the 50-yard line for the Super Bowl is more expensive for a reason: it gives the spectator the greatest experience.

Do not try to write down everything the instructor talks about. It's impossible and inefficient. Instead, try to distinguish between the most important topics and ideas and write those down. This is also a skill that students can improve upon. You may wish to ask your instructor during office hours if you have identified the main topics in your notes, or compare your notes to one of your classmates.

Use shorthand and/or abbreviations. So long as you will be able to decipher what you are writing, the least amount of pen or pencil strokes, the better. It will free you up so you can pay more attention to the lecture and help you be able to determine what is most important.

Write down what your instructor writes. Anything on a dry erase board, chalkboard, overhead projector and in some cases in presentations; these are cues for important information.

Leave space to add information to your notes. You can use this space during or after lectures to elaborate on ideas.

Do not write in complete sentences. Do not worry about spelling or punctuation. Getting the important information, concepts and main ideas is much more important. You can always revise your notes later and correct spelling.

Often, the most important information is delivered at the beginning and/or the end of a lecture. Many students arrive late or pack up their belongings and mentally check out a few minutes before the lecture ends. They are missing out on the opportunity to write down valuable information. Keep taking notes until the lecture is complete.

The Cornell System

One way of taking notes in class is using the Cornell System. Created in the 1950s by Walter Pauk at Cornell University, the Cornell System is still widely used today. Perform a web search for “Cornell note taking method.”

The note-taking area is for you to use to record notes during lectures.

Students use the column on the left to create questions after the lecture has ended. The questions are based on the material covered. Think of it as a way to quiz yourself. The notes you took should answer the questions you create.

Tips for after the lecture

Consolidate notes as soon as possible after the lecture has ended. Identify the main ideas and underline or highlight them.

Test yourself by looking only at the questions on the left. If you can provide most of the information on the notes side without looking at it, you’re in good shape. If you cannot, keep studying until you improve your retention. Review periodically as needed to keep the information fresh in your mind.

Students use the bottom area for summarizing information. Practice summarizing information — it’s a great study skill. It allows you to determine how information fits together. It should be written in your own words (don’t use the chapter summary in the textbook to write your summary, but check the chapter summary after you write yours for accuracy).

The Outline Method

Another way to take notes is the outline method. Students use an outline to show the relationship between ideas in the lecture. Outlines can help students separate main ideas from supporting details and show how one topic connects to another.

Perform a web search for “outline note taking method” to see what they look like.

Mind Maps

Visual learners may want to experiment with mind maps (also called clustering). Invented by Tony Buzan in the 1960s, it’s another way of organizing information during lectures. Start with a central idea in the center of the paper (landscape is recommended). Using branches (like a tree), supporting ideas can supplement the main idea. Recall everything you can as the lecture is happening. Reorganization can be done later. Perform a web search for mind maps for note-taking.

Review

The most important aspect of reviewing your lecture notes is when your review takes place in relation to when your notes were taken. For maximum efficiency and retention of memory, it’s best to review within 20 minutes of when the lecture ends. For this reason, I do not advise students to take back-to-back classes without 30 minutes in between. It is important to have adequate review time and to give your brain a break. Reviewing shortly after the lecture will allow you to best highlight or underline main points as well as fill in any missing portions of your notes. Students who take lecture notes on a Monday and then review them for the first time a week later often have challenges recalling information that help make the notes coherent.

If you wish to go “above and beyond,” you may consider discussing your notes in a study group with your classmates, which can give you a different perspective on main points and deepen your understanding of the material. You may also want to make

flashcards for yourself with vocabulary terms, formulas, important dates, people, places, etc. Online flash cards are another option. Students can make them for free and test themselves online or on their phone.

The Big Picture

Keep in mind that students who know what their instructor is going to lecture on before the lecture are at an advantage. Why? Because the more they understand about what the instructor will be talking about, the easier it is to take notes. How? Take a look at the syllabus before the lecture. It won't take much time but it can make a world of difference. You will also be more prepared and be able to see important connections if you read your assigned reading before the lecture. It's not easy to do, but students that do it will be rewarded. If I have read information assigned before the lecture and know what the lecture will be about, I have best prepared myself for taking notes during the lecture and given myself the greatest potential for understanding relationships between the reading material and the lecture.

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1. Deborah DeZure, Matthew Kaplan, and Martha A. Deerman, "Research on Student Notetaking: Implications for Faculty and Graduate Student Instructors," 2001, http://www.math.lsa.umich.edu/~krasn...th156_crlt.pdf. ↵
2. Anders Ericsson et al., "The Role of Deliberate Practice in the Acquisition of Expert Performance," *Psychological Review*, (Washington, D.C.: American Psychological Association, 1993), 393-394. ↵

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CHAPTER OVERVIEW

6: Communicating

6.1: Prelude to Communicating
6.2: An Overview of Communication
6.3: Purpose of Communication
6.4: Communication and Technology
6.5: The Context of Communication
6.6: Barriers to Effective Communication
6.7: Summary
6.8: Career Connection
6.9: Rethinking
6.10: Where do you go from here?

Thumbnail: https://pixabay.com/photos/sculpture...ening-2209152/

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6.1: Prelude to Communicating



Figure 6.1.1: With so many individuals, subgroups, sections, soloists, sounds, variables, and technologies, an orchestra would be chaotic without someone directing: the conductor. Communication has a similar range of inputs and influences, and can become just as chaotic without direction. You need to be your own conductor and establish control in order to communicate effectively and productively. (Credit: Rob Swyston / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Student Survey

How do you communicate? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning "least like me" and 4 meaning "most like me." These questions will help you determine how the chapter concepts relate to you right now. As we are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. I think my mobile device is effective and appropriate for most communication.
2. I have a good sense of how to communicate in different environments/situations.
3. I listen more than I talk.
4. I have a lot of experience with research projects and essays.

You can also take the Chapter 8 Survey anonymously online.

STUDENT PROFILE

"My preferred communication methods are face-to-face and email. But no matter the method, clear goals are essential. I have had in-person meetings go terribly wrong and others be wildly successful. The difference: preparation! Have an agenda, possibly sending questions ahead of the meeting so that others have time to think about them or find answers. If you go to a meeting prepared like it is a court case, the victories will come far more than the failures. Have evidence to support your needs and positions.

"Be confident, but also be ready to learn. Communication is speaking *and* listening. Before you enter a conversation, consider the questions you need to ask to reach your goal. Asking what you need to know may open doors to understanding the issue better and finding the best avenue to finding solutions.

"I like emailing because it has the advantage to retain the communication, while allowing time to ponder and proofread a clear and concise response. It is essential to watch the tone of the email (never aggressive, always assertive). Use complete sentences, college-level grammar, a subject heading, and the correct greeting (Dr., Professor, Ms., Mr., Full Name) and closing salutations. Save important emails for your records to remember what was said or decided."

— Barbara Gooch, Volunteer State Community College

About This Chapter

> ***"The single biggest problem in communication is the illusion that it has taken place."***
>
> *— William H. Whyte*[1]

Communication has always been a complex life skill for everyone. How we pass information to others and how we understand what is being conveyed to us can often be complicated. And today, with the ever-increasing number of communication tools at our fingertips, our need to understand how, when, and what we communicate is even more crucial. Well-honed communication skills can improve all aspects of your life. This is true regarding relationships with friends, significant others, family, acquaintances, people with whom you work, colleagues in your classes, and professors. In other words, everyone! Communication is probably the most important skill you can develop in your life.

By the time you complete this chapter, you should be able to do the following:

- Articulate the variables to communication.
- Define the forms and purpose of communication.
- Understand how technology has changed communication.
- Discuss various contexts of communication.
- Describe barriers to effective communication.

Footnotes

- 1 "Is Anybody Listening?" William H. Whyte and the editors of Fortune Magazine. Simon And Schuster. 1952. (Note: Often misattributed.)

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6.2: An Overview of Communication

Questions to consider:

- Do I think about the ways in which I communicate?
- Do I consider the variables present in every communication method and situation?

> ***"We take communication for granted because we do it so frequently, but it's actually a complex process."***
>
> *— Joseph Sommerville*[2]

To begin with, let's look at the following two definitions of communication:

- *A process by which information is exchanged between individuals through a common system of symbols, signs, or behavior.*[3]
- *Communication is giving, receiving or exchanging ideas, information, signals or messages through appropriate media, enabling individuals or groups to persuade, to seek information, to give information or to express emotions.*[4]

These definitions offer an overview of the concept of communication. Within this chapter, however, you will be looking deeper into the "process" of communication and how infinitely complex it really is. To start with, let's take a look at both traditional and the newest forms of communication and see if you can determine rules for each.

ACTIVITY

In your opinion, what are the rules for different forms of communication? List the rules or guidelines related to each communication form listed in the table below. An example of a rule for the telephone might be identifying yourself when you call, in case the person didn't recognize your number.

Form of Communication	Rules for This Form
Face-to-face	
Phone	
Printed letters	
Email	
Texting	
Instant messaging/group chat	
Social media	

Were you able to discern different rules for the various forms of communication? Do you find yourself following these rules when texting or sending an email or talking to someone face-to-face? These questions are something to consider as we move through this chapter.

Variables of Communication

Technology has created new rules for communication because of the different structures of communication, everything from emoji protocols, to truncated words and spelling, to etiquette and how we form communication networks. AAMOF it is important to understand communication. However, BTAIM, you might think it is a CWOT. FWIW this chapter will help you navigate the myriad ways of communicating. SLAP? *(Meaning of acronyms should be included at bottom of page)* (AAMOF = as a matter of fact, BTAIM = be that as it may, CWOT = complete waste of time, FWIW = for what it's worth, SLAP = sounds like a plan)



Figure 6.2.2

Although using the acronyms (symbols of communication) above allow us to do more in less space and time, we need to be careful about how we pass information to others as well as think more clearly about what is being communicated to us. Certainly, with the scope of the Internet we are seeing briefer messages, a wider reach, and greater immediacy.

You are aware that the transfer of information can be done vocally—voice, phone, face-to-face, over radio or television. It can come to us in a written format such as correspondence or printed or digital media. We obtain information visually in logos, pictures, maps, menus, and street signs. And, of course, we find ourselves learning things nonverbally by observing body language, tone of voice, gestures, and so forth.

Communication means that there is at least one sender and one recipient, and in between, there is the message. The kind of communication tool you choose to use also has an effect on the message being conveyed. Will you choose a pencil? Pen? Phone? Email? Text? Picture? Or perhaps a face-to-face opportunity? Whatever you choose as your method of communicating with one person or a group of people guides how effectively you send your message. Additionally, there are always emotions behind a message. You could just be sharing a picture of yourself on the beach or sending out a call for help on a class assignment, or perhaps feeling sad because a friend is sick. Each of these would affect how you might communicate.

Have you ever sent a message to someone too quickly? For example, you heard that a friend just broke up with her boyfriend and is terribly heartbroken. You immediately think you should send some kind of “hope you are ok” comment and decide to use Facebook to do so. Later you find out that she didn’t want people to know about it at all and you kind of jumped the gun on your condolences. How did you feel? Could you have gone about it in any other way? Perhaps waited until she told you about it herself? A private email or phone call? This is one of those situations where you have to step back for a moment and clarify for yourself that what you are about to send will be received the way you intended. Learning a little about the concept of emotional intelligence (EQ) will also be helpful to your decision about how to communicate in various situations. More on that concept will be discussed in the sections on listening and miscommunication.

Additionally, there are other significant variables that play an important role in communicating. These range from ethnicity to culture to age to gender and are meaningful to what one is trying to “say” to someone else. Unfortunately, sometimes the message is lost or misconstrued because neither the sender nor the receiver has taken into account these important aspects of successful communication. You will learn more about this later in the chapter.

Context of Communication

It is also essential to understand the context of your communication. In other words, to whom are you talking? Why are you talking to this person or people? What, exactly, do you hope to achieve out of the communication you initiate? An effective communicator understands the audience to whom they are trying to send a message. This means that you use the correct venue—face-to-face conversation, phone, email, text, written letter, picture, or whatever else makes the most sense in a particular situation. This way your message can reach your audience (professor, boss, colleague, friend, parent, teammate) in a productive way, and hopefully the message you intend to convey is received accordingly.

An example of context might be the following: you need to ask your professor about a grade you received on an assignment because you think the grade was too low for the work you did. Would it be appropriate for you to send a text asking why you

received the grade? Might it be better to give your professor a call and hope she is available to talk with you? Or do you think it could be more useful and productive if you found out the professor's office hours and went in to discuss your concerns in person? These are decisions you have to make carefully so you can make the most of what you are trying to communicate.

Listening

Another aspect of communication is the art of listening. Remember, communication is a two-way street. It is not enough to just send out a message. One has to listen carefully to the response, and not only listen, but understand that the audience receiving your message might have a very different take on the topic. As noted earlier, this could be due to gender, age, culture, and so forth. All of these have an effect on how well the communication is transmitted and received. Later in this chapter we will discuss the difference between just "hearing" the response and actually "listening" to the response. Optimal communication occurs when both parties actively listen. And finally, it comes down to this: communication is any act that involves a sender and at least one receiver, where a message is conveyed and hopefully the message is received correctly.

> ***"We all feel better when we feel listened to. And we feel even better when we feel understood. In order to be understood, we must be listened to. Often it is more important to us to feel heard than to actually get what we said we wanted. On the other hand, feeling ignored and misunderstood is literally painful whether we are six or sixty."***[5] *— Steve Hein*

Many variables get in the way of messages being received correctly. One of these is emotion—both yours and that of the person with whom you are trying to communicate. Sometimes you have to use emotional information to help you make a decision about how you are communicating. What this means is that you need to be able to understand your own feelings and those of others. There are five components (self-awareness, self-regulation, motivation, empathy, and social skills) to emotional intelligence. Understanding how these components work to help you get in touch with your and others' emotional sides is an important part of listening.

Ultimately, communication is about information. The message you are sending may be as simple as one word (or even one letter), or as complex as an application for an internship. How you act on that information, how you expect others to act on it, and how it becomes knowledge are all part of the complexity of communication.

Footnotes

- 2 Sommerville, Joseph. *The Five Keys to Interpersonal Success*. 2004.
- 3 In Merriam-Webster online dictionary: https://www.merriam-webster.com/dict.../communication
- 4 Definitions of Communication. Communication Theory.Org. https://www.communicationtheory.org/...communication/
- 5 Hein, Steve. "Listening." Eqi.org. http://eqi.org/listen.htm

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6.3: Purpose of Communication

Questions to consider:

- Does everything I say or write have a purpose?
- Do I expect a response or a result from my communication?
- Do I change how I communicate depending on what response I want or need?

> ***"The difference between the right word and almost the right word is the difference between lightning and the lightning bug."***
>
> *— Mark Twain*[6]

Does Everything I Say or Write Have a Purpose?

There are many reasons that communication takes place. Some of our communication might be simply an attempt at being cordial and friendly. For instance, we might like to say hello to a friend down the hall, give a shout-out on Twitter to a family member living in another state, say "excuse me" to someone we've just bumped into, smile at a baby in a stroller going by, post a picture of our birthday party on Facebook, and stop to pet a new puppy in the park. Or maybe we just need some information, such as asking an instructor for guidelines for a project, telling a store owner what we are looking for, or going up to a stranger for directions to the nearest bus stop. As you can see, almost everything we do on a daily basis has something to do with communication. Additionally, we can communicate the same information to a wide range of people, and how this is received can vary greatly.

Another important purpose of communication is to forge relationships, whether these are of short or long duration or for particular purposes. What kind of relationships do you hope to develop when using various forms of communication? Are you looking for a partner for a project, or perhaps a date for the football game, or just want to nurture the relationships you have with friends already? The impact of flawed communication on relationships can be long-lasting, so it is important to be thoughtful when posting your thoughts and ideas.

Do I Expect a Response or a Result From My Communication?

There are times we are just sending out messages or information and not expecting a response, except perhaps a "like." For instance, your friend posts a picture of her new dog on Instagram and you click on "like." Other times we try to communicate an idea or ask a question and we do want a response, such as "What time is the exam on Friday?" This response is possibly from one person or many. There are instances when you need information, and you will either ask someone, do some web searching, or make a phone call to get the information that you need. Depending on what your need is, you must consider what form of communication will work best and get you the most satisfactory results. Your purpose for communicating is to get some kind of reply.

What Do I Bring to My Communication With Others?

You probably haven't thought of this, but whether you actively communicate or not, you are still communicating. Your facial expressions, body language, what you are wearing, your hairstyle, body art, where you choose to sit or stand in a room, the people you associate with, eye contact or lack thereof, and any other mannerisms that you have are a form of communication. We all pick up signals from each other in these nonverbal ways. So even though you might be shy, or reserved, or not interested in any interaction at all, you are still communicating some information to others.

Footnotes

- 6 The Art of Authorship: Literary Reminiscences, Methods of Work, and Advice to Young Beginners, Compiled and edited by George Bainton. 1890. Section: Mark Twain

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6.4: Communication and Technology

Questions to Consider:

- Is technology vital to your ability to communicate well?
- Are there rules to follow when using communication technology?
- How do you take control of your online communication?

> ***"Now we know that once computers connected us to each other, once we became tethered to the network, we really didn't need to keep computers busy. They keep us busy."***
>
> *— Sherry Turkle*[Z]

Is Technology Vital to Your Ability to Communicate Well?

Over a billion people use chat rooms, mailing lists, instant messengers, social network services, newsgroups, games, wikis, blogs, and more in order to share social relationships and organize collective action. Everything is connected: people, information, events, and places, all the more so with the advent of online social media. You live in a world where the traditional forms of education, conversations, relationships, and social activity in general have been transformed by the ubiquitous presence of technology. Digital media affects every student's life and that of their families, friends, and the wider community. Most of you have grown up while this transformation has taken place. The new technologies have created dramatic changes in the relationship between people and information. Though you will come across people who don't want to believe that these new technologies are here to stay, we, as humans, will never be able to separate ourselves from our own inventions, and trying to do so is perhaps only a step backward in an evolutionary sense. Therefore it is important that we learn to adapt our behavior to include the new inventions. Technology, after all, is an extension of the human mind, and the new technologies are only tools we have created over years of fashioning new ways to do things.

We continue to move from simple to complex tools. Advancements of technology go hand in hand with changes in communication options. The telegraph was replaced with landlines, those went out of style as the cordless phone became available, and this phone eventually morphed to a cell phone. When the Internet became accessible by cell phone, cell phones became devices that revolutionized personal communication.

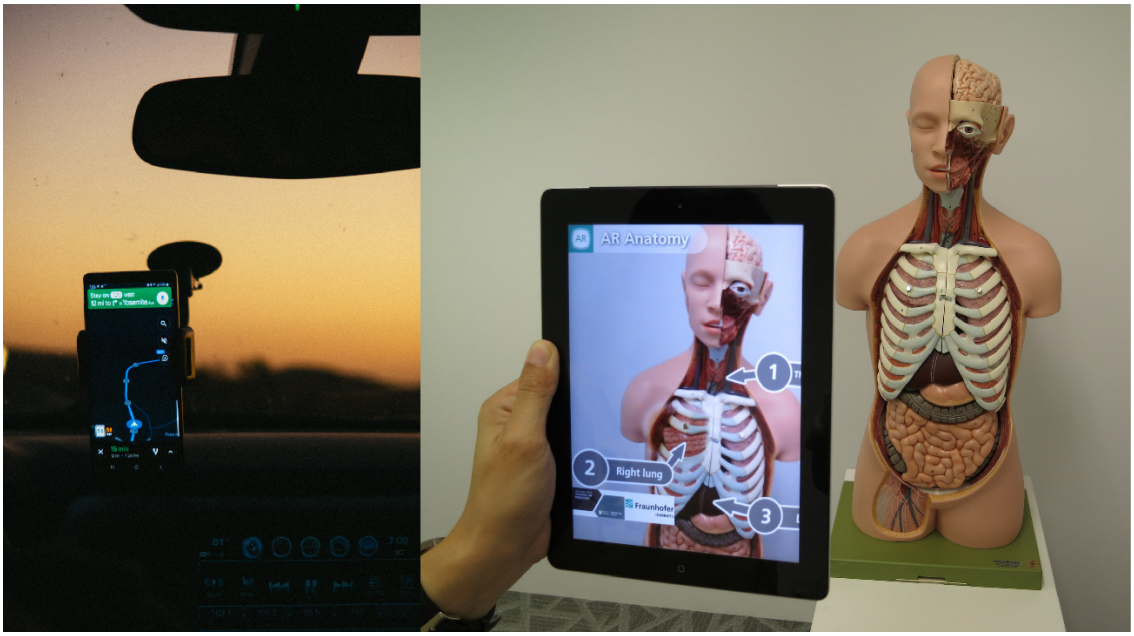


Figure 6.4.3 Just as mobile device roadmaps have replaced paper ones, augmented reality may replace our typical means interacting with the world. From learning about anatomy to cooking a meal to assembling a child's toy, we may reach a point in which we can't imagine living without AR. (Credit Zedinteractive / Pixabay)

The following activity is a good way for you to reflect on your own use of technology. It is always interesting to step back and actually see what platforms you use and how much time you spend using them.

ACTIVITY

Share your personal story about when you started using social media. Include what social media you use, how you use it, and how much time you spend doing so. At the end of this story, discuss what you might like to see in the future of social media. What other communication technologies do you wish were available to you, and why?

Are There Rules to Follow When Using Communication Technology?

Did you find anything significant about how you use social media? When you carefully looked at how much time you spent on the different platforms, were you surprised? It is probably a good thing to sometimes step back and take a look at how we use our communication tools, and even more importantly, we need to ask ourselves if we are using them to our advantage and not just to pass the time.

Netiquette

Just as it is important to know your responsibilities in using communication technologies, it is necessary for you to understand that there is a code of honor and etiquette to go along with them.

Here are a few pointers on how to go about being active on the Internet without offending or annoying others.

1. Don’t write emails, post to social media sites, or talk in chat rooms in ALL CAPS. CAPS can be interpreted as screaming or talking in a very loud voice.
2. Don’t make fun of others.
3. Apologize if someone was offended and did not “hear” what you were saying in the way you meant it.
4. When stating a strong opinion, it is not a bad idea to use the abbreviation of IMHO (in my humble opinion). It might keep people from reacting strongly right back at you.
5. Remember, no one can hear your tone of voice or see your facial expression, so use words carefully to get your message across.
6. Be respectful of your audience with the level of familiarity used.

College Netiquette

While these Netiquette guidelines are applicable in nearly every environment, communication in college may have additional or more stringent rules to consider. Always be particularly mindful of how you communicate in any official environments, such as online courses, course discussion boards, and even on social media specifically related to your college, such as a club or team page.

For example, if your political science class requires students to post in a discussion forum after each night’s reading, students may have the opportunity to argue about issues or politics. Vibrant discussion, and even argument, may be acceptable, but personal attacks or insults won’t advance the discussion and could result in more significant consequences. Just as you wouldn’t—and couldn't—become overly animated in an in-class argument, online arguments should remain civil. The goal is to make your points with evidence and reason, not emotion and assertiveness.

Finally, just as a note of caution, college codes of conduct regarding communication often apply to *any* interaction between members of the community, whether or not they occur on campus or in a campus online environment. Any inappropriate, offensive, or threatening comments or messages may have severe consequences.

Our communication in college conveys how we feel about others and how we’d like to interact with them. Unless you know for certain they don’t like it, you should use professional or semi-formal communication when interacting with college faculty and staff. For example, if you need to send a message explaining something or making a request, the recipient will likely respond more favorably to it if you address them properly and use thoughtful, complete sentences.

In a similar manner, you can make or break relationships with your classmates depending on how you communicate with them. Consider the following scenario:

Demetrius sends an email to several classmates about the details of a group assignment. He asks about availability and about which member of the group will take responsibility for which aspect of the project. He’s received four responses addressing availability, but no one volunteers for the responsibilities. Demetrius replies to all with an attempt at creating a division of responsibilities by typing different names next to each role. He uses ALL CAPS to make sure his classmates notice the suggestions. Lee responds

immediately. They don't like being forced into a specific role, and think Demetrius should have waited until the first group session instead of forcing his opinion on the group. Shirisha jumps in to mention that she's upset Demetrius chose to put her in a non-speaking role of recording secretary.

What mistake did Demetrius make? How might he have handled the situation more smoothly?

ACTIVITY

You most likely have considerable experience on a variety of social media platforms. Can you add three more suggestions for how to navigate these sites politely and with consideration for others?

Now, add three suggestions specifically related to considerate communication in online educational environments.

How Do You Control Your Online Communication Strategies?

> ***"Whether digital media will be beneficial or destructive in the long run doesn't depend on the technologies, but on the literacy of those who use them."***
>
> *— Howard Rheingold*

What is important is that we have to decide what we are going to do with the new communication tools for our future. We need to understand when to log on and when to log off. These days you sometimes find yourself being bombarded with new technologies and social media platforms, and you don't know how you will keep up with them all. You have multiple sites sending you continuous notifications and find yourself scrambling to look at them and perhaps respond. Perhaps turning off those notifications will free up your mind a bit. Sitting at your desk in your dorm room and trying to do an assignment for a class can be difficult if your phone is blinking messages at you continuously.

It is probably important sometimes to take the focus away from the media itself and look at oneself. What is happening to our minds, our sense of self, and our ways of representing ourselves to others when we spend a significant portion of our time on various online sites? How do we mediate our relationships differently? What kinds of signals do we send, knowingly and unknowingly? Are we shaping the media we use, or is it shaping us? Sometimes we hide behind our on-screen identities as well as navigate social media sites in ways that make us communicate with people that are like ourselves. Do we use these new communication tools appropriately?

The following activity might help clarify how well you utilize your social media platforms.

ANALYSIS QUESTION

Go outside your usual comfort zone and friend group. Find someone with whom you disagree, and think about how what they said had an effect on you. Did they use correct etiquette when saying what they said? If you respond, what would you do to make certain your response was heard correctly and was not offensive?

Ways to Take Control of Your Online Communication

Howard Rheingold, a technology guru who coined the term "virtual community" in 1993, has been thinking and writing about the changes that technology has been making over the years. He has come to the opinion that in order for us to deal with the new communication opportunities, we must learn about what he calls "mindful participation."[8] Rheingold doesn't suggest, as many others do, that these new technologies are bad for us. He offers ways to engage online that keep us in control of our actions and make us a bit more productive about our use of online platforms. He believes in social media literacy and suggests that learning the following five literacies will make our life on the Internet more productive, less stressful, and ultimately more enjoyable. If social media is our most often used form of communication, then the following five literacies should help us manage our time online and keep us in control of the tools we use for purposes of communication.



Figure 6.4.4 Howard Rheingold explores ways we can consider our use and consumption of media technologies, such as social media, in terms of five literacy areas. Asking ourselves questions will lead us to thoughtfully consider how an online environment may be changing us and our relationships. (Credit: Modification of work by Howard Rheingold.)

Attention

Attention is the first literacy and is the fundamental building block of how individuals think. It is sometimes difficult to focus our attention since our minds tend to wander in a random manner. It is therefore essential that you become more aware of how you are directing your attention. Consider being in a lecture hall and trying to focus on the professor and what she is saying. Is your full attention there? Are you also scrolling through some social media feed while listening to the lecture? When you are in your dorm room working on a class assignment, are you also watching your social media notifications, listening to music, talking to your roommate, and clicking on various ads on a website? On what is your attention most focused? Probably on everything and consequently on nothing. Learning how to pay attention to what is most important at the moment will help you fine-tune your skills.



Figure 6.4.5 Paying attention in class, in the face of many distractions, takes effort and awareness. The benefits, both for the class and for the long-term ability to retain your focus, will be

extremely valuable. (Credit: Pixabay / Pexels)

Participation

And even though you might be really good at using online applications and connecting with friends, that does not necessarily mean that you always understand the implications of your participation or that you are actually participating.

Participation, the next literacy, is much broader as it recognizes the vast population of users that are connected. Participation is connecting with the tool, not people. It is a way of becoming an active citizen and not just a passive consumer. There are multiple ways to participate on a variety of social media platforms. In fact, you probably don't realize that clicking on a "like," making a short comment on a picture, or whatever else one does on a site is actually participating. Of course, the effect of your participation can vary, but it can also be very powerful. You participate when you post, fill out a survey, start your own blog, respond to others' blogs, or just watch a video on YouTube. All of these actions are a form of participation.

In college, participation with communication environments and other resources is often essential for success and for your grade. If you use learning management systems, online homework systems, polling or attendance software, or other educational media, you need to understand the levels and types of participation, as well as the implications of each. As with social media platforms, learning technology can be a powerful tool, and you'll likely engage with it throughout your academic and even your professional career.

Collaboration

The third literacy, **collaboration**, refers to your being able to work together using technology. Doing things together gives us more power than doing them alone. Think of all the times Twitter was used by multitudes of people to pass on information about major storms. When there was a bombing in Paris, people went to Twitter to let those people in the streets who'd been displaced know they had apartments and homes that they would open up to them. Of course, there are many collective intelligence projects, such as helping Coke come up with a new flavor, or GoFundMe sites to help people in need of money for health reasons. The collaborative efforts of people communicating around a big project are endless and a perfect way to use communication technologies. Tools allowing collaboration allow you to share resources and work as a team, and build on each other's ideas.

ACTIVITY

Think of a time when you collaborated with others to get something done. This could be organizing a party, planning transportation to an event, doing a school project, building a stage for a play, or any other activity that was done as a group. What forms of communication did you use to work as a team? How did the environment and the other people in the group influence tools and methods you used? Complete the table below to illustrate the challenges, opportunities, and communication approaches you might use (or have used) for each situation.

Table 8.1

	Challenges	Opportunities	Communication Methods and Tools
Group project for an on campus (traditional) course.			
Group project for an online-only course.			
Planning an event with your extended family.			
Planning an event with your friends/peers.			

Network Awareness

Network awareness is the fourth literacy. Technological networks now allow us to have a greater number of people we can contact. These networks multiply human capacity for social networking and allow connection in a matter of seconds. You can become a member of newsgroups, virtual communities, gossip sites, forums, and other organizations. Making use of these possibilities

expands your ability to contribute to the vast stores of information on the Internet. At the same time, you should be conscious of the people whom you're inviting to hear you and influence you. Have you ever been intrigued, angered, or persuaded by a friend of a friend (someone you don't know at all) who commented on a social media posting? If so, you are in a relationship with that stranger, and they are affecting you.



Figure 6.4.6 Do you follow influencers? What is their impact on you? (Credit: The Lazy Artist / Pexels)

Critical Consumption

The last literacy, critical consumption, helps us to discern what is true and what is not. We have to learn how to differentiate fact from fiction. Humans have a difficult time trusting people in everyday life; this also translates to the millions of people on the Internet using social media. Before believing what others have written, communicating with them, or using a tool, it is wise to do some detective work. Check the claims, the author's background, sources, and accuracy.

Critical consumption is closely related to Informational Literacy, which is discussed in Chapter 7 on Thinking.

Evolving Our Strategies to Match Our Evolving Technologies

Communication has changed because of the way we are using technology. Yes, we still write and talk, but where and how? There are myriad social media platforms that you can use for communication, from Snapchat to Twitter, each with its own set of rules and limitations. These platforms have completely changed many of the ways we transfer ideas and information, find romantic partners, keep in touch with friends and family, connect with our professors and classmates, make plans with teammates, look for employment, and so much more.

When using a device for communication, there are fewer nonverbal cues we can pick up on, only what the other person is posting or showing. In certain situations, such as talking on the phone, a person can't see hand gestures but can still hear a tone of voice. When typing, however, there is no tone of voice or hand gesture or body language. Sometimes typing may not convey the same message as saying what you're feeling.

Social media has made it easier to keep in contact with many people, but it also creates missed opportunities for new relationships since we are too often looking down at our phones instead of talking with the person standing next to us.

ANALYSIS QUESTION

Technology has definitely had an effect on our society. Think about how it has this effect.

- Is that cell phone in your pocket something that has made life better?
- Are we empowering those who most often don't have access to power in our society?
- Or are we further alienating them?
- Does the ability to access global communications create people who are more open and free with their ideas?
- Is an email to a colleague in another country more significant than a snail mail letter?
- Are there any new platforms or apps that you are reluctant to try?

Socialization is an integral part of human behavior, and over time new technologies have made networking and communication more complex. The tools you have available for communication within your networks are powerful and fulfilling, but they can also stand in the way of real-time thinking, doing, relating, and communicating. The past twenty years have seen an explosion in new tools and means of communication, but the next twenty may see similarly rapid growth and change. Adaptability may be as important a skill as any method specific to a certain platform. The key is mindfully participating and knowing when to use and when not to use the new technological tools available to us, which may require learning and acceptance. In this way your communication with others will be positive and allow you to be productive in all aspects of your life.

GET CONNECTED

Information is processed and transferred faster than ever. Social media has become the place where people obtain information. This could be news on YouTube, shocking events on IGTV, or even fake rumors on Facebook spread from friends of friends. It almost seems that information can't travel fast enough today, but it's vital to take everything you see with a grain of salt and evaluate the information given based on what it is, its source, context, and credibility.

- The Verge published a how-to guide on checking facts and sources online.
- Social networking addiction occurs when people become so dependent on Instagram, Snapchat, Twitter, Facebook, and related platforms that all of their communication seems to take place within these virtual places. Many researchers conclude that addiction to social media is much stronger than an addiction to cigarettes or alcohol.
- Six Ways Social Media Changed the Way We Communicate discusses how our ability and need to share and consume information quickly can lead to changes in our relationships and ourselves. The article also provides related links.

Footnotes

- 7 Turkle, Sherry. *Alone Together.* New York: Basic Books. 2011.
- 8 Rheingold, Howard. *Net Smart: How to Thrive Online*. Cambridge: MIT Press. 2012.

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6.5: The Context of Communication

Questions to Consider:

- Does my form of communication change in certain situations?
- Do I use an altered style of talking when I am with different people?
- What role does listening play in communication?

Does My Form of Communication Change in Certain Situations?

The circumstances surrounding a message provide the context. These include the setting you are in, the culture that guides you and whomever you are communicating with, and the purpose of the communication to begin with. Context also includes the values people have, appropriateness of the message, the timing you choose to convey your message, and the reason behind your wanting to communicate. This means considering your audience, the place, the time, and all other variables that impact communicating constructively.



Figure 6.5.7: Your career area, work environment, its accepted style of dress, and the relationships with your colleagues or clients all add context to your communication. (Credit (both photos): Lyncconf Games / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Generally, all communication happens for a reason. When you are communicating with people, are you always on the same wavelength? Are you wide-awake and your roommate almost asleep? Is the baseball game really important to you but totally boring to the person you are talking with? It is important that everyone involved understands the context of the conversation. Is it a party, which lends itself to frivolous banter? Is the conversation about something serious that occurred? What are some of the relevant steps to understanding context? First of all, pay attention to timing. Is there enough time to cover what you are trying to say? Is it the right time to talk to the boss about a raise? What about the location? Should your conversation take place in the elevator, over email, in a chat room? Is everyone in the conversation involved for the same reason?

The following is an activity that might help you understand what is meant by context.

ANALYSIS QUESTION

Consider the context of a family dinner. You are at the table with siblings, cousins, parents, aunts and uncles, and grandparents. A wide variety of age groups are present around the dinner table. Are there any rules about how you behave in this circumstance? What are they?

Then put yourself in the context of a chat room with people you might know and some that you do not know. Are there rules for communicating in that situation? What are they?

Sometimes we have misconceptions about what is going on in a group situation. Perhaps we think that everyone there knows what we are talking about. Or we think we know everyone's opinions on an issue or situation. Or we come into the conversation already thinking we are right and they are wrong. Communication in these instances can go very wrong. Why? We aren't listening or even preparing ourselves adequately for the conversation we hope to have. So often we are only concerned about what we have to say to an individual or a group and we don't step back long enough to reflect on what our message might mean to them. We seem to not

care about how the message will be received and are often surprised by how poorly the communication actually went. Why? Because we didn't step back and think, "Hmmmm, my aunt is a really religious person and probably would be offended by a conversation about sexual intimacy." Or, "My father is having a bit of financial trouble, and this might not be the right time to bring up money I need for a new car."

Do I Use an Altered Style of Talking When I Am With Different People?

There are so many instances in our lives when we think about our needs first and blurt out what we are thinking, leading to some critical misunderstandings. It is really important not only to be concerned about our need to communicate, but to take into consideration with whom we are communicating, when and where we are communicating, and how we are going to do so in a positive way. First, you should step back and think about what you want to say and why. Then reflect on with whom you are attempting to communicate.

WHAT STUDENTS SAY

1. Of the following methods, which is your preferred method of communication?
    a. In person/face-to-face
    b. Voice call
    c. Video call
    d. Email
    e. Texting (including texting apps)
    f. Social media environments
2. Which element of communication do you find most challenging?
    a. Understanding the audience/situation and using the best form/tone to fit it
    b. Speaking in front of a group of people
    c. Writing papers or reports
    d. Listening and interpreting
3. When writing a paper for a course, which aspect do you find most challenging?
    a. Coming up with an original idea/thesis/research question
    b. Finding sources and background information
    c. Evaluating the quality of sources or data
    d. Organizing the paper
    e. Writing/editing the paper
    f. Writing the bibliography/works cited list

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

Of the following methods, which is your preferred method of communication?

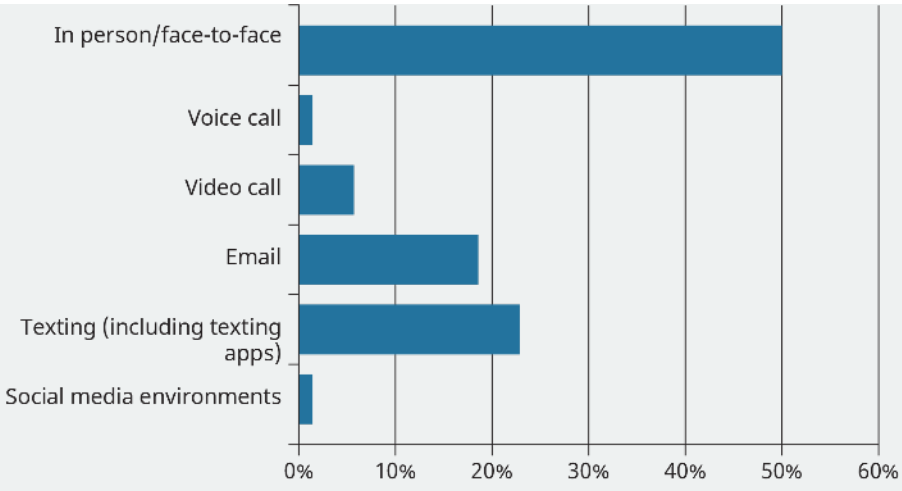


Figure 6.5.8

Which element of communication do you find most challenging?

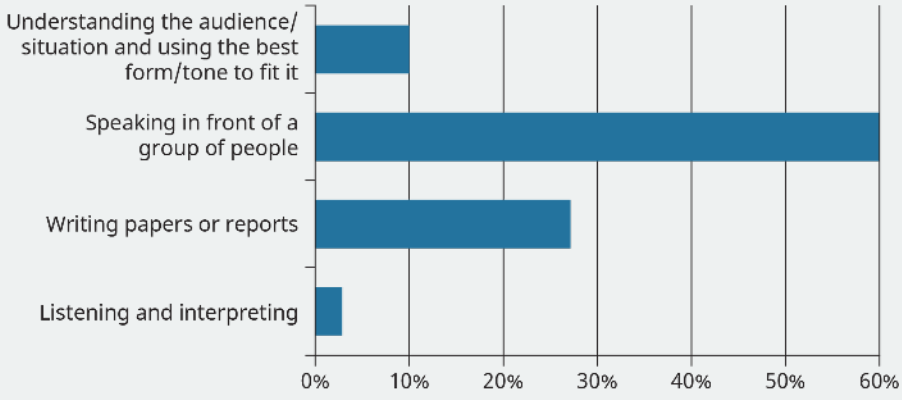


Figure 6.5.9

When writing a paper for a course, which aspect do you find most challenging?

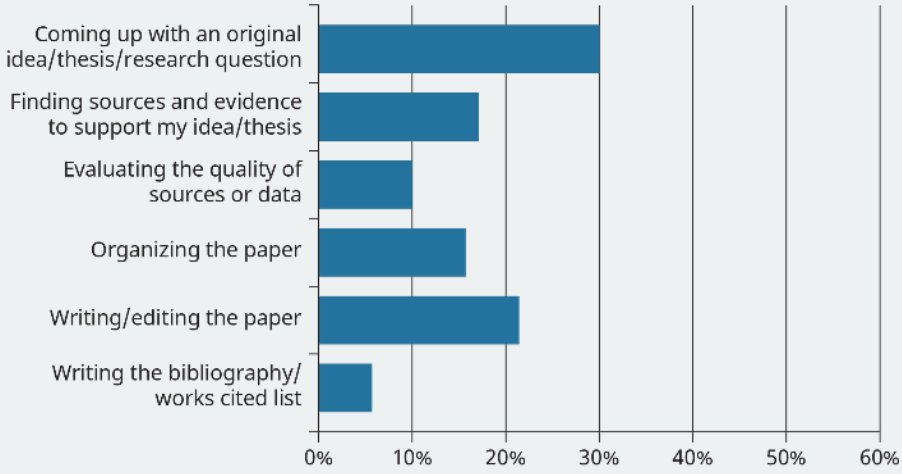


Figure 6.5.10

Emotional Intelligence

We've talked about emotional intelligence when it comes to listening. Recognizing your own emotions and those of others will help you avoid miscommunication as well. When you are aware of your own emotional state and you have the skills to address and adjust, your communication with others will improve. You're less likely to blurt out an angry retort to a perceived criticism, for example.

You're better able to manage communication when you recognize someone else's emotions, as well. A conversation can veer into hostile territory if someone feels attacked, or perhaps simply because they've had an emotional experience related to the

conversation that you don't understand. Taking note of other people's emotional responses during a conversation and listening and speaking with empathy will help you manage the situation.

When conversations begin to feel heated, it's a good idea to pause and ask yourself why. If it's you who are feeling defensive and angry, make an effort to recognize the source of your frustration and try to take a step back, perhaps leaving the conversation until you're better able to control your emotions and communicate in a way that's more clearheaded and calm.

If it's someone else who's emotional, again, ask yourself why. Can you see reasons that this person may feel attacked, belittled, or usurped? If you can recognize their emotion and address it, you may be able to get the communication back on solid footing.

ACTIVITY

Think of what context and what communication tool you would consider in the following situations:

1. You need to let your professor know you won't be able to hand in your assignment on time. What will you say, when and where will you say it, and what form of communication will you use and why?
2. Your roommate wants to have friends over for a party and you aren't sure you are up for that. What and how do you tell your roommate?
3. The weekend is full of activities, but you are expected home for a family gathering. How do you let your parents know you aren't coming?

Listening Is a Communication Action

Our communication includes both sending and, especially, receiving messages. Unfortunately, we often don't take the time to focus on the latter part. Often we are already thinking about what we are going to say next and not listening to what is being said to us. This lack of focus occurs in intense, oppositional discussions, but it can also be common in one-on-one conversations and when someone is confiding in us. When we listen, we need to embrace the concept of empathy, meaning you understand what a person might be feeling, and understand why that person's actions made sense to them at the time. This way our ideas can be communicated in a way that makes sense to others, and it helps us understand others when they communicate with us.

Even though it is silent, listening is communication. We can often "hear" what is being said but don't really listen well enough to discern what is meant by the person trying to communicate with us. In order to listen effectively, we should consider it an active process, in the same way we think about speaking or messaging.

So what does active listening entail? There are some strategies you can use to help you become a good listener. First of all, stop talking. You can't listen if you are talking. Secondly, turn off the television, put your phone in your pocket, silence the music and, if needed, go somewhere quiet, so you can actually focus on what is being said. Next, have empathy for the person talking to you. In other words, don't begin thinking of ways to answer. Even if someone has a problem (with you or something else), avoid trying to immediately solve it; consider whether the person speaking to you really wants advice or action, or might simply want to be seen and heard. Finally, before you say anything as a reply, repeat what you heard so the other person can confirm that you heard them correctly. You would be amazed at how well these strategies work to help avoid misunderstandings and confusion.



Figure 6.5.8.11 Being a good listener takes practice and focus. To help, try to eliminate distraction and avoid giving too much advice or telling your own related stories. Even if you're only listening to a brief summary after running into someone in the hallway, do your best to internalize what they're saying. (Credit: University of the Fraser Valley / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Think about all the times you have gone through a drive-through for food or coffee. The scenario is most often the same, right? You order, let's say, medium fries, a burger with no cheese or onions, and a large soft drink. You then listen to the person inside the restaurant say back to you, "You want medium fries, a quarter pounder with no cheese or onions, and a large Coke." If that is the right order, you say yes and move on to pay. This can be seen as active listening on both sides. The following activity can help you reflect on active listening.

ANALYSIS QUESTION

This is an activity of self-analysis. As said above, listening and hearing are not the same thing, and the difference can often lead to faulty communication. Think back on a time when your attempt at communicating with someone (face-to-face or online) didn't go the way you intended. The message you were trying to convey wasn't received in the way you meant it, and this led to some discord between you and whomever you were "talking" to. Write down what happened. Then think a bit about what could have been done differently. Was the problem yours? Did you send a message that wasn't very clear? Did the receiver of this message not really "listen" to what you were saying? What got in the way of what should have been just a simple bit of communication between you and someone else?

As said earlier, emotions are frequently involved in communication.It would be nice if everything was logical and everyone was always coming from that place of no emotion. But that's not how it works in most instances. People have opinions, needs, desires, and outcomes they are looking for; feelings that can be hurt; and differing attitudes. The list could go on and on. What is important is that we need to be aware of our own emotions, and those of others, when attempting to communicate. Consider other people's feelings as well as your own. Have empathy. And in the midst of trying to do that, listen, don't just hear!

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6.6: Barriers to Effective Communication

Questions to consider:

- Can you remember a time when you were surprised that what you communicated was not well received?
- What are some other barriers to effective communication?

> ***"Words are the source of misunderstandings."***
>
> *— Antoine de Saint-Exupéry, The Little Prince*[9]

Meredith and Anvi are working together on a project on marketing for a communications class: Anvi will create content for a flier, and Meredith will determine the best platform for advertising. In their brainstorming session the two realized they had some outstanding questions about how much content the flier should contain and whether they needed to turn in additional documentation. Meredith left it to Anvi to clarify this material since the content of the flier was her responsibility. Meredith waited impatiently the entire class session for Anvi to ask about the assignment. With class time almost up, Meredith spoke up, telling the instructor in front of the class that Anvi had a question about the assignment.

Anvi clarified the assignment with the professor, but when Meredith tried to find her after class to talk about next steps, Anvi had gone. Meredith was surprised to receive an angry text from Anvi soon after class accusing Meredith of embarrassing her. Anvi pointed out that she'd managed to complete every assignment so far in the course and she didn't need Meredith to take over on this one.

Communication can go awry for a number of reasons. One could use jargon or technical language that is unfamiliar. There can be differences in the perception of an issue. People may speak different languages, or the colloquialisms that one uses don't make sense to everyone.

As in the case with Meredith and Anvi, cultural considerations can also affect the way people communicate. Anvi, for instance, prefers not to speak to the instructor during class because she feels that she's interrupting. She prefers to approach the instructor after class time is over. Meredith, on the other hand, usually has a task list she likes to tick off one by one to make sure everything is moving on time, and she can sometimes become insensitive to the communication styles of others.

Some barriers are likely to be emotional, often caused by topics that are sometimes considered problematic, such as sex, politics, or religion, which can interfere with effective communication. Sometimes what you are trying to communicate is embarrassing or otherwise a bit personal, and you kind of skirt around the edges of really saying what you want to say. Other emotions, such as stress, anger, depression, sadness, and the like, can have an effect on how well you communicate with another person, or they with you. Physical disabilities, such as hearing loss, can also come into play and get in the way of successful communication.

Some of our behavior and communication is based on previous encounters, and we don't see past that and start fresh. Sometimes the barrier can be a lack of interest or attention on the part of the receiver. There are also expectations about what might be said or stereotyping on the part of the sender or the receiver. Often when we communicate with people we have preconceptions about who they are, what they are thinking, and how they will react to whatever we say. These preconceptions can get in the way of productive communication. A person could have an attitude that comes with whatever is being said or written. Or perhaps there is a lack of motivation to clarify what you want to communicate, and the end result is not what you were hoping for.

ACTIVITY

Take into consideration some of your own stereotypes and preconceptions, and try them out on the following scenario.

You are walking down the street and need to ask someone for change for a dollar because you need it for the parking meter. There are only a few people around you, and you have to choose whom to ask for help. Which person would you choose, and why?

- A person with tattoos all over their arms
- An elderly woman who is hunched over and walking gingerly
- A person of color who is absorbed in their own phone
- A parent with three children who is frantically trying to keep them together
- A well-dressed man, with shiny leather shoes, walking briskly to wherever he is going

Preconceptions and Assumptions

Have you ever thought about the message you are conveying to others? If you were the one standing on the street corner, what would others see? How do you play into others' preconceptions simply based on your appearance?

Of course, you should be yourself, but certain environments or situations require us to consider and, perhaps, change our appearance. Wearing a T-shirt with a "message" may be appropriate when you're at leisure, but you wouldn't wear it to a job interview.

College presents us with many situations where people's preconceived notions of our appearance may come into play. For example, while it might not be fair, faculty may have a certain perception of students who attend lecture or office hours in pajamas. Consider the implications of sitting in your instructor's office, asking for help, when they think you haven't changed your clothes since you woke up. You are absolutely free to express yourself in a certain manner, but your appearance may miscommunicate your motivation or intent. Recognizing how our own preconceptions come into play, and acknowledging those of others, generally leads to more effective interactions.

One of the biggest changes about the way we interact is the vast number of people available with whom we can communicate. This is a wonderful thing as we get to meet many people from diverse places. It can also be challenging because we are not always prepared to communicate with people from varying cultures, genders, ages, or religious and political views. Sometimes a simple lack of familiarity can lead to errors or even offense.

ACTIVITY

Think about how you communicate to different types of people. For each person in the left-most column and each example of something you need to describe, write some notes on how you might communicate, the types of words you might use, or what you may consider when speaking to them.

	Describing a sporting event you watched.	**Describing an argument you got into on social media.**	**Describing a night out with friends.**
An eight-year-old			
A 20-year-old woman			
A middle-aged man			
An elderly person			

Did your answers come from stereotypes or experience? (Or both?) Did you choose your words carefully with the child? Did you assume the man would know more about sports than the woman? Did you assume the elderly person wouldn't know about Twitter or Instagram? Perhaps being mindful in your interactions with others will help bring clarity to your communication.

Unfortunately, relying on stereotypes often results in failed communication. Our understanding of others is often masked by the stereotypes that have infiltrated our society. Think about if you bring your own stereotypes to the table. Do you think others do the same? If so, those probably get in the way of a successful conversation.

Look in more detail at the issues of stereotypes, assumptions, and avoiding offense (microaggressions) in Chapter 9.

> ***"Precision of communication is important, more important than ever, in our era of hair trigger balances, when a false or misunderstood word may create as much disaster as a sudden thoughtless act."***
>
> *— James Thurber*[10]

How Can Identities and Experiences Lead to Communication Barriers?

Aside from our actual communication abilities and tools, we bring to each interaction many unique aspects based on who we are and where we come from. Diversity, as important and great as it is, requires us to consider the different perspectives and experiences others bring to a discussion or interaction, and to understand that our own views and contexts may be unfamiliar to

others. While we shouldn't shy away from this diversity, we should exercise patience and practice when communicating with new people.

Part of this consideration is known as cultural competency, which you'll learn more about in Chapter 9. Below are several aspects of people's lives that you might consider when communicating.

Identity is generally a feeling of belonging to a group. It is your self-perception and is usually related to nationality, ethnicity, religion, social class, sexual orientation, gender, generation, region or any social group that has its own distinct identity. Examples of cultural identity markers include the rituals people observe, the music that a group prefers, the style of clothing that is worn, the languages actual ethnic group one belongs to and its various foods and celebrations, or possibly the games that are a preferred sport in some communities. All of these variables can constitute a cultural identity for people. And belonging to these groups gives people an identity and a frame of reference on how to communicate and relate to the world around them.

Gender identity refers to the deeply held, internal sense of a person's gender. Sometimes, a person's genetically assigned sex does not line up with their gender identity. These individuals might refer to themselves as transgender, nonbinary, or gender-nonconforming.[11] Thus, gender is what a person identifies with.

While gender is internal, social influences and perceptions can shape a person's attitude and method of communication. For example, in some families and cultures, men are raised to be more dominant or less emotionally expressive. Their use of that approach may lead to communication problems with others. However, people's *assumptions* about men may also lead to communication problems. The same can happen with other gender identities.

What are your communication experiences with different genders? Have you seen people communicate a specific way based on the genders involved in the conversation? For example, does a classmate have a way of speaking to men that is different from their way of speaking to women? Does that difference become a barrier or issue in the communication?

Age can have a very significant impact on communication. This is a little easier to understand, as people from varying generations bring very different experiences to their contact with others. We all grow up surrounded by certain music, clothing styles, language, and cultural influences. Modes of parenting have evolved, food choices have expanded, and tragedies and world politics have occurred, and each of these had an effect on the generation that experienced them firsthand. And, of course, most of us live or have lived with multiple generations in our lives and have experienced many of the differences ourselves. Think of the times you've tried to explain what you do on your social media platforms to your grandparent (though some grandparents are pretty good at all the new technologies!). And think of how very young family members—age three or four—describe the videos they watch or the games they play.

As you can see from the above categories of cultural identity, gender, age, and our own stereotypes about people, there are many barriers that can come into play when you are trying to communicate with someone. In fact, on a college campus you probably will run into a large variety of differences in the people you meet. Many come from other countries, cultures, religions, and family backgrounds. Some may be in the country solely for the purpose of going to college, and intend to return home when they graduate. Some may have a lot of life experience, while others could be high school students in a dual enrollment program. All of that will have an effect on how they communicate, as your own upbringing and experiences have had an influence on who you are. Keep that in mind as you try to create relationships with the many people that are available to you, both face-to-face and online.

Footnotes

- 9 Saint-Exupéry, Antoine de, and Katherine Woods. The Little Prince. New York: Harcourt Brace Jovanovich, 1961.
- 10 Thurber, James. Lanterns and Lances. Harper and Brothers. 1961.
- 11 Newman, Tim. "Sex and gender: What's the Difference?" *Medical News Today*. February 7, 2018 http://www.medicalnewstoday.com/articles/232363.php

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6.7: Summary

Communication is one of the basic components of how we live our lives. It's a foundation of society and civilization as a whole. And the better we become at navigating through all of our various communication options, the more fulfilled and productive we will become. You have the capability to communicate with myriad people and groups in faraway places, as well as just next door or the room down the hall. In all of those interactions, the sender and recipient of each message brings their own context, purpose, and perspective. Your communication will be much more effective if you think about those differences before sending and especially before *responding* to people.

Sometimes thinking so deeply about a simple conversation seems overwhelming and unnecessary, but keeping in mind the reasons you're communicating and focusing on the words you use can lead to better relationships and outcomes. Listening, practicing empathy, and working on your cultural competence will enrich you and the people around you.

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6.8: Career Connection

Check the methods of communication you would most likely use for each of the following. Then write an explanation for why you have chosen the various forms of communication and how your choice had a link to the purpose of communicating with these different people.

	Face-to-Face	Email	Letter	Phone	Facebook	Instagram	Snapchat
Parent							
Peer							
Sibling							
Boss							
Doctor							
Professor							
Waitress							
Office assistant							
Significant other							

Take a close look at how you filled out the above chart. Do you find that there were definitely different purposes to how and why you used email instead of the phone, or Snapchat instead of a letter? It is good for you to reflect on your communication choices so that they are always most effective.

Look at the forms of communication you chose for “boss.” Perhaps you chose face-to-face and email as the two forms of communication you would use with your boss. Think through how those might have had an effect on the success of your communication with them. Now select two other forms of communication. Would you have been able to get the same response from your boss?

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6.9: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

1. I think my mobile device is effective and appropriate for most communication.
2. I have a good sense of how to communicate in different environments/situations.
3. I listen more than I talk.
4. I have a lot of experience with research projects and essays.

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6.10: Where do you go from here?

Staying aware of how and when you communicate is important to every aspect of your life. As you learned throughout this chapter, there are many variables that come into play when you communicate. Most of the time none of us really think about all of these before we send out some kind of communication. Perhaps you would like to learn a little more about how to be mindful of your methods of communication. It will serve you well throughout your life.

Choose a topic that interests you from the list below. Then search for sources that inform this topic and create an annotated bibliography that would be useful to someone who is interested in doing further research.

- Communication using social media can be detrimental to mental health.
- It is imperative that you pay attention to cultural norms when trying to communicate with others.
- Listening is important to successful communication, and there are steps that can be taken to hone listening skills.
- Men and women are said to communicate differently.

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CHAPTER OVERVIEW

7: Studying, Memory, and Test Taking

7.1: Prelude to Studying, Memory, and Test Taking
7.2: Memory
7.3: Studying
7.4: Test Taking
7.5: Summary
7.6: Career Connection
7.7: Rethinking
7.8: Where do you go from here?
7.9: Avoiding the Hazards Along the Way
7.10: Test-Taking Strategies
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7.10.2: Test-Taking Strategy Specifics

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7.1: Prelude to Studying, Memory, and Test Taking



Figure 7.1.1: How we study is as important as what we study. The environment is a critical element of success.

Student Survey

How confident are you in preparing for and taking tests? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning "least like me" and 4 meaning "most like me." These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed.

1. I set aside enough time to prepare for tests.
2. If I don't set aside enough time, or if life gets in the way, I can usually cram and get positive results.
3. I prefer to pull all-nighters. The adrenaline and urgency help me remember what I need come test time.
4. I study my notes, highlight book passages, and use flash cards, but I still don't feel like I'm as successful as I should be on tests.

You can also take the Chapter 6 Survey anonymously online.

STUDENT PROFILE

"I didn't have to study much for tests in high school, but I learned really quick that you have to for college. One of the best strategies is to test yourself over the material. This will help you improve your retrieval strength and help you remember more when it comes to the test. I also learned about reviewing your graded tests. This will help you see where you went wrong and why. Being able to see your mistakes and correct them helps the storage and retrieval strength as well as building those dendrites. Getting a question wrong will only improve those things helping you remember the next time it comes up."

—Lilli Branstetter, University of Central Arkansas

About this Chapter

By the time you finish this chapter, you should be able to do the following:

- Outline the importance of memory when studying, and note some opportunities to strengthen memory.
- Discuss specific ways to increase the effectiveness of studying.
- Articulate test-taking strategies that minimize anxiety and maximize results.

Kerri didn't need to study in high school. She made good grades, and her friends considered her lucky because she never seemed to sweat exams or cram. In reality, Kerri did her studying during school hours, took excellent notes in class, asked great questions, and read the material before class meetings—all of these are excellent strategies. Kerri just seemed to do them without much fuss.

Then when she got to college, those same skills weren't always working as well. Sound familiar? She discovered that, for many classes, she needed to read paragraphs and textbook passages more than once for comprehension. Her notes from class sessions

were longer and more involved—the subject material was more complicated and the problems more complex than she had ever encountered. College isn't high school, as most students realize shortly after enrolling in a higher ed program. Some old study habits and test-taking strategies may serve as a good foundation, but others may need major modification.

It makes sense that, the better you are at studying and test taking, the better results you'll see in the form of high grades and long-term learning and knowledge acquisition. And the more experience you have using your study and memorization skills and employing success strategies during exams, the better you'll get at it. But you have to keep it up—maintaining these skills and learning better strategies as the content you study becomes increasingly complex is crucial to your success. Once you transition into a work environment, you will be able to use these same skills that helped you be successful in college as you face the problem-solving demands and expectations of your job. Earning high grades is one goal, and certainly a good one when you're in college, but true learning means committing content to long-term memory.

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7.2: Memory

Questions to consider

- How does working memory work, exactly?
- What's the difference between working and short-term memory?
- How does long-term memory function?
- What obstacles exist to remembering?
- When and how should you memorize things?

In what situations is it best to memorize, and what do you memorize?

What can you do consistently to improve both your short- and long-term memory?

Memory is one of those cherished but mysterious elements in life. Everyone has memories, and some people are very good at rapid recall, which is an enviable skill for test takers. We know that we seem to lose the capacity to remember things as we age, and scientists continue to study how we remember some things but not others and what memory means, but we don't know that much about memory, really.

Nelson Cowan is one researcher who is working to explain what we do know about memory. His article "What Are the Differences between Long-Term, Short-Term, and Working Memory?" breaks down the different types of memory and what happens when we recall thoughts and ideas. When we remember something, we actually do quite a lot of thinking.[1]

We go through three basic steps when we remember ideas or images: we encode, store, and retrieve that information. Encoding is how we first perceive information through our senses, such as when we smell a lovely flower or a putrid trash bin. Both make an impression on our minds through our sense of smell and probably our vision. Our brains encode, or label, this content in short-term memory in case we want to think about it again.

If the information is important and we have frequent exposure to it, the brain will store it for us in case we need to use it in the future in our aptly named long-term memory. Later, the brain will allow us to recall or retrieve that image, feeling, or information so we can do something with it. This is what we call remembering.



Figure 7.2.2

Analysis Question

Take a few minutes to list ways you create memories on a daily basis. Do you think about how you make memories? Do you do anything that helps you keep track of your memories?

Foundations of Memory

William Sumrall et al. in the *International Journal of Humanities and Social Science* explain the foundation of memory by noting: "Memory is a term applied to numerous biological devices by which living organisms acquire, retain, and make use of skills and knowledge. It is present in all forms of higher order animals. The most evolutionary forms of memory have taken place in human beings. Despite much research and exploration, a complete understanding of human memory does not exist."[2]

Working Memory

Working memory is a type of short-term memory, but we use it when we are actively performing a task. For example, nursing student Marilyn needs to use her knowledge of chemical reactions to suggest appropriate prescriptions in various medical case studies. She does not have to recall every single fact she learned in years of chemistry classes, but she does need to have a working memory of certain chemicals and how they work with others. To ensure she can make these connections, Marilyn will have to review and study the relevant chemical details for the types of drug interactions she will recommend in the case studies.

In working memory, you have access to whatever information you have stored in your memory that helps you complete the task you are performing. For instance, when you begin to study an assignment, you certainly need to read the directions, but you must also remember that in class your professor reduced the number of problem sets the written instructions indicated you needed to finish. This was an oral addition to the written assignment. The change to the instructions is what you bring up in working memory when you complete the assignment.

Short-Term Memory

Short-term memory is a very handy thing. It helps us remember where we set our keys or where we left off on a project the day before. Think about all the aids we employ to help us with short-term memory: you may hang your keys in a particular place each evening so you know exactly where they are supposed to be. When you go grocery shopping, do you ever choose a product because you recall an advertising jingle? You see the box of cereal and you remember the song on the TV commercial. If that memory causes you to buy that product, the advertising worked. We help our memory along all the time, which is perfectly fine. In fact, we can modify these everyday examples of memory assistance for purposes of studying and test taking. The key is deliberate use of strategies that are not so elaborate that they are too difficult to remember in our short-term memory.

Activity

Consider this list of items. Look at the list for no more than 30 seconds. Then, cover up the list and use the spaces below to complete an activity.

Baseball	Picture frame	Tissue	Paper clip
Bread	Pair of dice	Fingernail polish	Spoon
Marble	Leaf	Doll	Scissors
Cup	Jar of sand	Deck of cards	Ring
Blanket	Ice	Marker	String

Without looking at the list, write down as many items as you can remember.

Now, look back at your list and make sure that you give yourself credit for any that you got right. Any items that you misremembered, meaning they were not in the original list, you won't count in your total. TOTAL ITEMS REMEMBERED _____.

There were 20 total items. Did you remember between 5 and 9 items? If you did, then you have a typical short-term memory and you just participated in an experiment, of sorts, to prove it.

Harvard psychology professor George A. Miller in 1956 claimed humans can recall about five to nine bits of information in our short-term memory at any given time. Other research has come after this claim, but this concept is a popular one. Miller's article is entitled "The Magical Number Seven, Plus or Minus Two" and is easily accessible online if you're interested in learning more about this seminar report.[3]

Considering the vast amount of knowledge available to us, five to nine bits isn't very much to work with. To combat this limitation, we clump information together, making connections to help us stretch our capacity to remember. Many factors play into how much we can remember and how we do it, including the subject matter, how familiar we are with the ideas, and how interested we are in the topic, but we certainly cannot remember absolutely everything, for a test or any other task we face. As such, we have to use effective strategies, like those we cover later in this chapter, to get the most out of our memories.

Activity

Now, let's revisit the items above. Go back to them and see if you can organize them in a way that you would have about five groups of items. See below for an example of how to group them.

Row 1: Items found in a kitchen

Row 2: Items that a child would play with

Row 3: Items of nature

Row 4: Items in a desk drawer/school supplies

Row 5: Items found in a bedroom

Cup	Spoon	Ice	Bread	
Baseball	Marble	Pair of dice	Doll	Deck of cards
Jar of sand	Leaf			
Marker	String	Scissors	Paper clip	
Ring	Picture frame	Fingernail polish	Tissue	Blanket

Now that you have grouped items into categories, also known as chunking, you can work on remembering the categories and the items that fit into those categories, which will result in remembering more items. Check it out below by covering up the list of items again and writing down what you can remember.

Now, look back at your list and make sure that you give yourself credit for any that you got right. Any items that you misremembered, meaning they were not in the original list, you won't count in your total. TOTAL ITEMS REMEMBERED _____. Did you increase how many items you could remember?

Long-Term Memory

Long-term memory is exactly what it sounds like. These are things you recall from the past, such as the smell of your elementary school cafeteria or how to pop a wheelie on a bicycle. Our brain keeps a vast array of information, images, and sensory experiences in long-term memory. Whatever it is we are trying to keep in our memories, whether a beautiful song or a list of chemistry vocabulary terms, must first come into our brains in short-term memory. If we want these fleeting ideas to transfer into long-term memory, we have to do some work, such as causing frequent exposure to the information over time (such as studying the terms every day for a period of time or the repetition you performed to memorize multiplication tables or spelling rules) and some relevant manipulation for the information.

According to Alison Preston of the University of Texas at Austin's Center for Learning and Memory, "A short-term memory's conversion to a long-term memory requires changes within the brain . . . and result[s] in changes to neurons (nerve cells) or sets of neurons. . . . For example, new synapses—the connections between neurons through which they exchange information—can form to allow for communication between new networks of neurons. Alternatively, existing synapses can be strengthened to allow for increased sensitivity in the communication between two neurons."[4]

When you work to convert your thoughts into memories, you are literally *changing your mind.* Much of this brain work begins in the part of the brain called the *hippocampus*. Preston continues, "Initially, the hippocampus works in concert with sensory-processing regions distributed in the neocortex (the outermost layer of the brain) to form the new memories. Within the neocortex, representations of the elements that constitute an event in our life are distributed across multiple brain regions according to their content. . . . When a memory is first formed, the hippocampus rapidly combines this distributed information into a single memory, thus acting as an index of representations in the sensory-processing regions. As time passes, cellular and molecular changes allow for the strengthening of direct connections among the neocortical regions, enabling access to the memory independent of the hippocampus."

We learn the lyrics of a favorite song by singing and/or playing the song over and over. That alone may not be enough to get that song into the coveted long-term memory area of our brain, but if we have an emotional connection to the song, such as a painful breakup or a life-changing proposal that occurred while we were listening to the song, this may help. Think of ways to make your study session memorable and create connections with the information you need to study. That way, you have a better chance of keeping your study material in your memory so you can access it whenever you need it.

Analysis Question

What are some ways you convert short-term memories into long-term memories?

Do your memorization strategies differ for specific courses (e.g., how you remember for math or history)?

Obstacles to Remembering

If remembering things we need to know for exams or for learning new disciplines were easy, no one would have problems with it, but students face several significant obstacles to remembering, including a persistent lack of sleep and an unrealistic reliance on cramming. Life is busy and stressful for all students, so you have to keep practicing strategies to help you study and remember successfully, but you also must be mindful of obstacles to remembering.

Lack of Sleep

Let's face it, sleep and college don't always go well together. You have so much to do! All that reading, all those papers, all those extra hours in the science lab or tutoring center or library! And then we have the social and emotional aspects of going to school, which may not be the most critical aspect of your life as you pursue more education but are a significant part of who you are. When you consider everything you need to attend to in college, you probably won't be surprised that sleep is often the first thing we give up as we search for more time to accomplish everything we're trying to do. That seems reasonable—just wake up an hour earlier or stay up a little later. But you may want to reconsider picking away at your precious sleep time.

Sleep benefits all of your bodily functions, and your brain needs sleep time to dream and rest through the night. You probably can recall times when you had to do something without adequate sleep. We say things like "I just can't wake up" and "I'm walking around half asleep."

In fact, you may actually be doing just that. Lack of sleep impairs judgment, focus, and our overall mood. Do you know anyone who is always grumpy in the morning? A fascinating medical study from the University of California Los Angeles (UCLA) claims that sleep deprivation is as dangerous as being drunk, both in what it does to our bodies and in the harm we may cause to ourselves and others in driving and performing various daily tasks.[56]

If you can't focus well because you didn't get enough sleep, then you likely won't be able to remember whatever it is you need to recall for any sort of studying or test-taking situation. Most exams in a college setting go beyond simple memorization, but you still have a lot to remember for exams. For example, when Saanvi sits down to take an exam on introductory biology, she needs to recall all the subject-specific vocabulary she read in the textbook's opening chapters, the general connections she made between biological studies and other scientific fields, and any biology details introduced in the unit for which she is taking the exam.

Trying to make these mental connections on too little sleep will take a large mental toll because Saanvi has to concentrate even harder than she would with adequate sleep. She isn't merely tired; her brain is not refreshed and primed to conduct difficult tasks. Although not an exact comparison, think about when you overtax a computer by opening too many programs simultaneously. Sometimes the programs are sluggish or slow to respond, making it difficult to work efficiently; sometimes the computer shuts down completely and you have to reboot the entire system. Your body is a bit like that on too little sleep.

On the flip side, though, your brain on adequate sleep is amazing, and sleep can actually assist you in making connections, remembering difficult concepts, and studying for exams. The exact reasons for this is still a serious research project for scientists, but the results all point to a solid connection between sleep and cognitive performance.

If you're interested in learning more about this research, the American Academy of Sleep Medicine (AASM) is a good place to start. One article is entitled "College Students: Getting Enough Sleep Is Vital to Academic Success."

Analysis Question

How long do you sleep every night on average? Do you see a change in your ability to function when you haven't had enough sleep? What could you do to limit the number of nights with too little sleep?

Downside of Cramming

At least once in their college careers, most students will experience the well-known pastime called *cramming*. See if any of this is familiar: Shelley has lots of classes, works part-time at a popular restaurant, and is just amazingly busy, so she puts off serious study sessions day after day. She isn't worried because she has set aside time she would have spent sleeping to cram just before the exam. That's the idea anyway. Originally, she planned to stay up a little late and study for four hours from 10 p.m. to 2 a.m. and still get several hours of refreshing sleep. But it's Dolphin Week or Beat State Day or whatever else comes up, and her study session doesn't start until midnight—she'll pull an *all-nighter* (to be more precise, this is actually an *all-really-early-morning-er*, but it doesn't quite have the same ring to it). So, two hours after her original start time, she tries to *cram* all the lessons, problems,

and information from the last two weeks of lessons into this one session. Shelley falls asleep around 3 a.m. with her notes and books still on her bed. After her late night, she doesn't sleep well and goes into the morning exam tired.

Shelley does OK but not great on the exam, and she is not pleased with her results. More and more research is showing that the stress Shelley has put on her body doing this, combined with the way our brains work, makes cramming a seriously poor choice for learning.

One sleep researcher, Dr. Susan Redline from Boston, says, "Sleep deficiency can affect mood and the ability to make memories and learn, but it also affects metabolism, appetite, blood pressure, levels of inflammation in the body and perhaps even the immune response."[7]

Your brain simply refuses to cooperate with cramming—it sounds like a good idea, but it doesn't work. Cramming causes stress, which can lead to paralyzing test anxiety; it erroneously supposes you can remember and understand something fully after only minimal exposure; and it overloads your brain, which, however amazing it is, can only focus on one concept at a time and a limited number of concepts all together for learning and retention.

Leading neuroscientist John Medina claims that the brain begins to wander at about 10 minutes, at which point you need a new stimulus to spark interest.[8] That doesn't mean you can't focus for longer than 10 minutes; you just have to switch gears a lot to keep your brain engaged. Have you ever heard a speaker drone on about one concept for, say, 30 minutes without somehow changing pace to engage the listeners? It doesn't take much to re-engage—pausing to ask the listeners questions or moving to a different location in the room will do it—but without these subtle attention markers, listeners start thinking of something else. The same thing happens to you if you try to cram all reading, problem-solving, and note reviewing into one long session; your brain will wander.

WHAT STUDENTS SAY

1. Which of the following is your most common method of studying?
    a. Reading or rereading the text or my class notes.
    b. Watching videos of my instructor's lecture or other people discussing the topics.
    c. Taking practice quizzes/tests.
    d. Creating/using study tools (flashcards, mnemonic devices, etc.)
    e. Working with a study group, tutor, or academic support.
2. Which of the following do you have the most difficulty remembering?
    a. Vocabulary and facts (such as Biology vocab, Historical facts.)
    b. Problem-solving methods (such as in Math)
    c. Details from text and literature
    d. Skills and processes (such as a lab technique or a building process)
    e. Computer functions/locations/processes
    f. Which formulas, processes, or categories to apply in situations (such as in Physics or Accounting)
3. How much anxiety do you feel when an exam or other major course evaluation is approaching?
    a. A great deal
    b. A lot
    c. A moderate amount
    d. A little
    e. None at all

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

Which of the following is your most common method of studying?

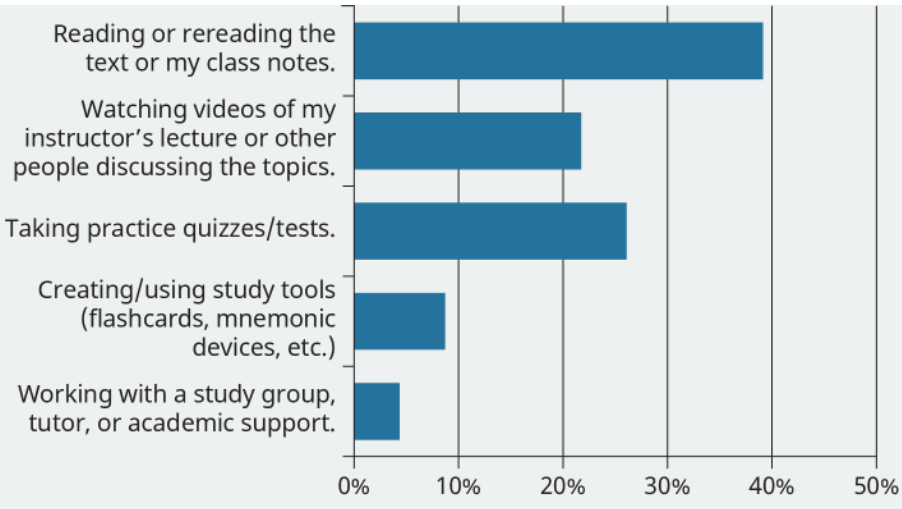


Figure 7.2.3

Which of the following do you have the most difficulty remembering?

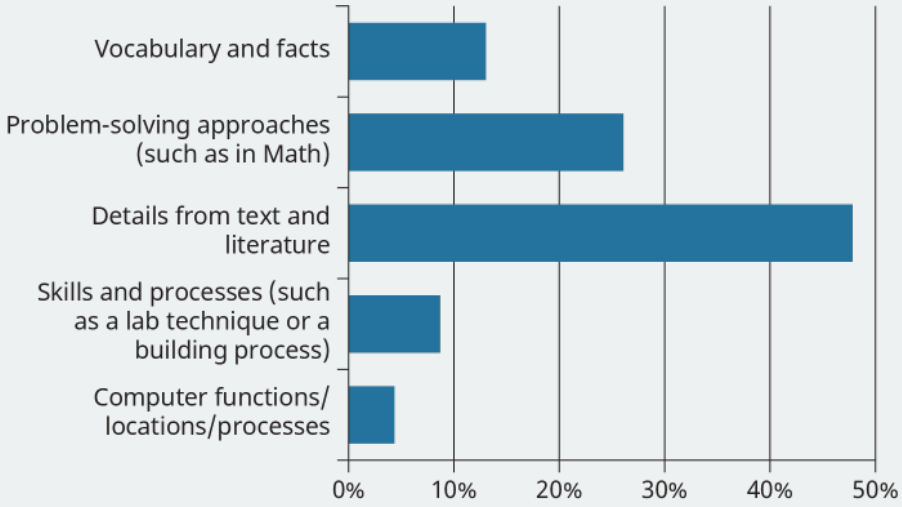


Figure 7.2.4

How much anxiety do you feel when an exam or other major course evaluation is approaching?

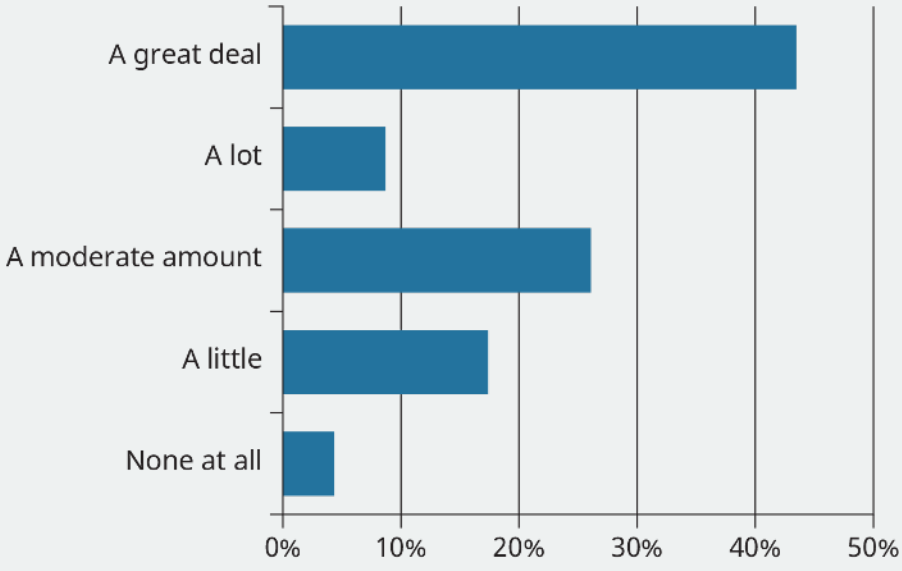


Figure 7.2.5

Determining When/What to Memorize

In the realm of learning and studying, some conditions warrant memorization as the most effective way to work with information. For instance, if you are expected to have a working knowledge of conversational French or Spanish, you will have to memorize some words. Simply knowing a long list of terms isn't going to help you order food in a café or ask for directions in a foreign country because you also need to understand the other language's grammar and have some sort of context for what needs to be said from your vocabulary list. But you cannot say the words in a different language if you cannot remember your vocabulary. From this scenario, you can assume that memorization is a good fit for some parts of language acquisition.

A worthwhile book on memory, thinking, and learning is a short study called *Make It Stick: The Science of Successful Learning* by Peter Brown, Henry Roediger, and Mark McDaniel. The authors conclude, after extensive research, that our attempts to speed up learning and make studying easier are not good ideas. Studying is hard work, and it should be. For learning to *stick*, we need to work hard to pull the information out of our memory and use it by continually pushing ourselves to accomplish increasingly difficult tasks.[9]

Footnotes

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7.3: Studying

Questions to consider

- How do you prepare yourself and your environment for successful studying?
- What study strategies will be most beneficial to you?
- What are learning preferences and strategies, and how can you leverage those to your advantage?

Preparing to Study

Studying is hard work, but you can still learn some techniques to help you be a more effective learner. Two major and interrelated techniques involve avoiding distractions to the best of your ability and creating a study environment that works to help you concentrate.

Avoiding Distractions

We have always had distractions—video games, television shows, movies, music, friends—even housecleaning can distract us from doing something else we need to do, like study for an exam. That may seem extreme, but sometimes vacuuming is the preferred activity to buckling down and working through calculus problems! Cell phones, tablets, and portable computers that literally bring a world of possibilities to us anywhere have brought *distraction* to an entirely new level. When was the last time you were with a large group of people when you didn't see at least a few people on devices?



Figure 7.3.6 Video games are a common distraction, but we need to be aware that even tedious activities like cleaning can be a distraction from studying.

When you study, your biggest challenge may be to block out all the competing noise. And letting go of that connection to our friends and the larger world, even for a short amount of time, can be difficult. Perhaps the least stressful way to allow yourself a distraction-free environment is to make the study session a definite amount of time: long enough to get a significant amount of studying accomplished but short enough to hold your attention.

You can increase that attention time with practice and focus. Pretend it is a professional appointment or meeting during which you cannot check e-mail or texts or otherwise engage with your portable devices. We have all become very attached to the ability to check in—anonymously on social media or with family and friends via text, chat, and calls. If you set a specific amount of time to study without interruptions, you can convince your wandering mind that you will soon be able to return to your link to the outside world. Start small and set an alarm—a 30-minute period to review notes, then a brief break, then another 45-minute study session to quiz yourself on the material, and so on.

When you prepare for your optimal study session, remember to do these things:

- Put your phone out of sight—in another room or at least some place where you will not see or hear it vibrate or ring. Just flipping it over is not enough.
- Turn off the television or music (more on that in the next section).

- Unless you are deliberately working with a study group, study somewhere alone if possible or at least away from others enough to not hear them talking.

If you live with lots of other people or don't have access to much privacy, see if you can negotiate some space alone to study. Ask others to leave one part of the house or an area in one room as a quiet zone during certain hours. Ask politely for a specific block of time; most people will respect your educational goals and be willing to accommodate you. If you're trying to work out quiet zones with small children in the house, the bathtub with a pillow can make a fine study oasis.

Study Environment

You may not always be in the mood or inspired to study. And if you have a long deadline, maybe you can blow off a study session on occasion, but you shouldn't get into the habit of ignoring a strong study routine. Jane Austen once wrote in a letter, "I am not at all in a humor for writing; I must write on till I am." Sometimes just starting is the hard part; go ahead and begin. Don't wait around for your study muse; start working, and she'll show up.

Sometimes you just need to plop down and study whenever and wherever you can manage—in the car waiting for someone, on the bus, at the Little League field as you cheer on your shortstop. And that's OK if this is the exception. For long-term success in studying, though, you need a better study setting that will help you get the most out of your limited study time. Whatever your space limitations, carve out a place that you can dedicate to reading, writing, note taking, and reviewing. This doesn't need to be elaborate and expensive—all you truly need is a flat surface large enough to hold either your computer or writing paper, book or notes, pens/pencils/markers, and subject-specific materials you may need (e.g., stand-alone calculators, drawing tools, and notepads). Your space should be cool or warm enough for you to be comfortable as you study. What do you have now that you consider your study space? Is it set up for your optimal success?



Figure 7.3.7: Which is before, and which is after? (Credit: Ali West / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

If it is at all possible, try to make this area exclusive to your study sessions and something you can leave set up all the time and a place out of the way of family or roommate traffic. For example, Martina thought setting up her study station on the dining room table was a good idea at first. The view was calming, and the table was big enough to spread out and could even hold all her materials to study architectural drawings, her favorite subject. But then she needed the table for a small family dinner party, so she had to find a cubbyhole to hide away her supplies with some needing to go into a closet in the next room. Now she was spread out over multiple study spaces. And the family TV was in an adjacent room, not visible from the table but certainly an auditory distraction. Martina ultimately decided to forgo her view and create a smaller station in an unused bedroom so she could leave her supplies out and have a quieter area. You may have to try out numerous places to determine what works best for you.

Wherever you study, try to make it a welcoming place you want to be in—not an uncomfortable environment that makes you want to just do the minimum you must complete and leave. You should include the basics: a good chair, a work surface, and whatever materials, books, notes, and other supplies you need for the subject you are studying. If you want to make it even more of a productive place, you can look in magazines for ideas or search the web to see how others have set up simple areas or more elaborate arrangements. Don't let decorating your workspace be an excuse to get out of studying!

You don't need an elaborate setting, but you may want to consider including a few effective additions if you have the space:

- small bulletin board for often-used formulas
- encouraging quotes or pictures of your goal
- whiteboard for brainstorming
- sticky notes for reminders in texts and notes

- file holder for most-used documents
- bookshelf for reference books

Activity

Describe every element in your ideal study environment and explain why it's there as well as how it will make more efficient use of your time, limit distractions, or in some other way strengthen your ability to study.

After you have described your ideal study environment, think about how you can adapt that environment if you cannot be in your favorite place to study. How do you *make your own space* in the library, a student lounge, or a dedicated space on campus for student studying?

Debunking Study Myths

MYTH #1: You can multitask while studying.

How many times do you eat in the car? Watch TV while you write out a grocery list? Listen to music while you cook dinner? What about type an e-mail while you're on the phone with someone else and jot down notes about the call? The common term for this attempt to do more than one thing at a time is multitasking, and almost everyone does it at some point. On some days, you simply cannot accomplish all that you want to get done, so you double up. The problem is, multitasking doesn't really work. Of course, it exists, and we do it. For instance, we walk and chew gum or drive and talk, but we are not really thinking about two or more distinct things or doing multiple processes simultaneously.

MYTH #2: Highlighting main points of a text is useful.

Another myth of studying that seems to have a firm hold is that the idea of highlighting text—in and of itself—is the best way to review study material. It is one way, and you can get some benefit from it, but don't trick yourself into spending too much time on this surface activity and consider your study session complete. Annotating texts or notes is a first-step type of study practice. If you allow it to take up all your time, you may want to think you are fully prepared for an exam because you put in the time. Actually, you need much more time reviewing and retrieving your lessons and ideas from the text or class lecture as well as quizzing yourself to accomplish your goal of learning so you can perform well on the exam. Highlighting is a task you can do rather easily, and it makes you feel good because you are actively engaging with your text, but true learning needs more steps.

MYTH #3: Studying effectively is effortless.

There is nothing effortless, or even pleasant at times, about studying. This is why so many students don't put in the time necessary to learn complex material: it takes time, effort, and, in some cases, a little drudgery. This is not to say that the outcome, learning—and maybe making an A—is not pleasant and rewarding. It is just that when done right, learning takes focus, deliberate strategies, and time. Think about a superstar athlete who puts in countless hours of drills and conditioning so that she makes her work on the field look easy. If you can also *enjoy* the studying, the skill development, and the knowledge building, then you will most likely be more motivated to do the work.

Analysis Question

When are you most liable to multitask? How could you be more aware of this practice and try to eliminate it, especially when it comes to studying? How can you make your initial text highlighting more time efficient so you can include other study practices?

Study Strategies

Everyone wishes they had a better memory or a stronger way to use memorization. You can make the most of the memory you have by making some conscious decisions about how you study and prepare for exams. Incorporate these ideas into your study sessions:

Practicing effective memorization is when you use a trick, technique, or strategy to recall something—for another class, an exam, or even to bring up an acquaintance's name in a social situation. Really whatever works for you to recall information is a good tool to have. You can create your own quizzes and tests to go over material from class. You can use mnemonics to jog your memory. You can work in groups to develop unique ways to remember complex information. Whatever methods you choose to enhance your memory, keep in mind that repetition is one of the most effective tools in any memory strategy. Do whatever you do over and over for the best results.

Using Mnemonics

Mnemonics (pronounced new-monics) are a way to remember things using reminders. Did you learn the points of the compass by remembering NEWS (north, east, west, and south)? Or the notes on the music staff as FACE or EGBDF (every good boy does fine)? These are mnemonics. When you're first learning something and you aren't familiar with the foundational concepts, these help you bring up the information quickly, especially for multistep processes or lists. After you've worked in that discipline for a while, you likely don't need the mnemonics, but you probably won't forget them either.

Here are some familiar mnemonics you may find useful:

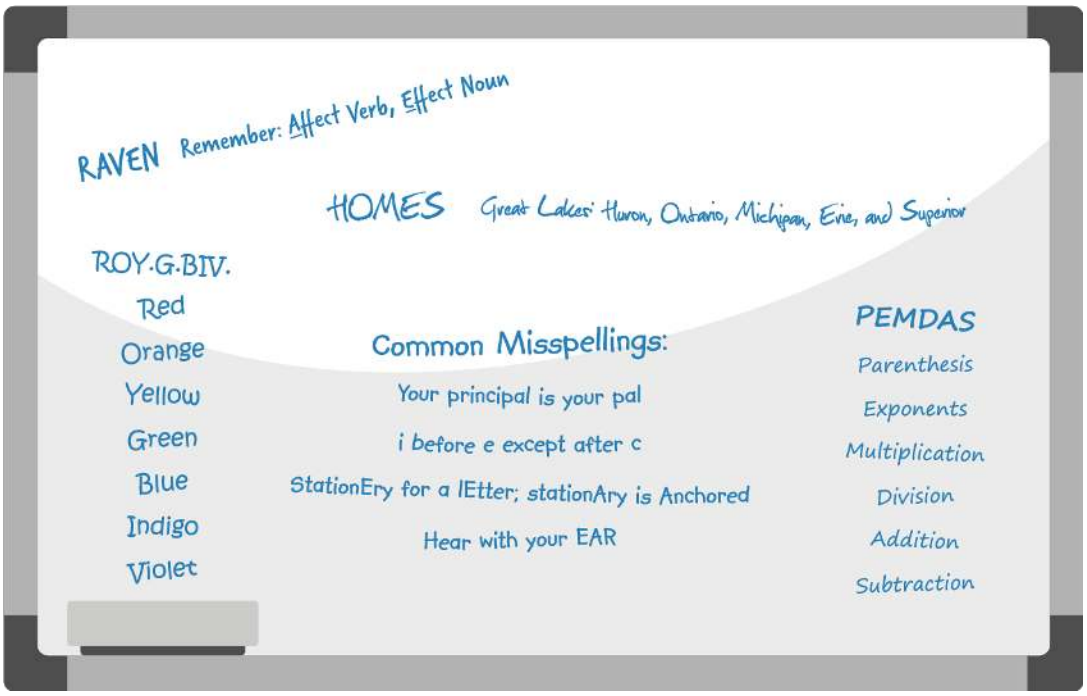


Figure 7.3.8

You can certainly make up your own mnemonics, but be careful that your reminder isn't so complex and convoluted that it is more difficult to remember than the information you were relating it to!

Analysis Question

Do you have other mnemonics that help you remember difficult material? What are they? How have they helped you with remembering important things?

Practicing Concept Association

When you study, you're going to make connections to other things—that's a good thing. It shows a highly intelligent ability to make sense of the world when you can associate like and even somewhat unlike components. If, for instance, you were reading Martin Luther King Jr.'s "Letter from a Birmingham Jail," and you read the line that he had been in Birmingham, you may remember a trip you took with your family last summer through Alabama and that you passed by and visited the civil rights museum in Birmingham. This may remind you of the different displays you saw and the discussions you had with your family about what had happened concerning civil rights in the 1950s,'60s, and '70s in the United States.

This is a good connection to make, but if your assignment is to critique the literary aspects of King's long epistle, you need to be able to come back to the actual words of the letter and see what trends you can see in his writing and why he may have used his actual words to convey the powerful message. The connection is fine, but you can't get lost in going down rabbit holes that may or may not be what you're supposed to be doing at the time. Make a folder for this assignment where you can put things such as a short summary of your trip to Alabama. You may eventually include notes from this summary in your analysis. You may include something from a website that shows you information about that time period. Additionally, you could include items about Martin Luther King Jr.'s life and death and his work for civil rights. All of these elements may help you understand the significance of this one letter, but you need to be cognizant of what you're doing at the time and remember it is not usually a good idea to just try to

keep it all in your head. The best idea is to have a way to access this information easily, either electronically or in hard copy, so that if you are able to use it, you can find it easily and quickly.

Generating Idea Clusters

Like mnemonics, idea clusters are nothing more than ways to help your brain come up with ways to recall specific information by connecting it to other knowledge you already have. For example, Andrea is an avid knitter and remembers how to create complicated stitches by associating them with nursery rhymes she read as a child. A delicate stitch that requires concentration because it makes the yarn look like part of it is hiding brings to mind Red Riding Hood, and connecting it to that character helps Andrea recall the exact order of steps necessary to execute the design. You can do the same thing with song lyrics, lines from movies, or favorite stories where you draw a connection to the well-known phrase or song and the task you need to complete.

Application

Choose one of the following, and create an idea cluster to group and organize:

- Example A: aviation jobs in North America
- Example B: the use of analytics in sports to determine team rosters
- Example C: how social media affects political campaigns

Start the idea cluster with the topic circled in the middle of the page. For Example A, you might make one cluster off the main circle for specific positions; you could add another cluster for salary ranges and another for geographic regions.

Three Effective Study Strategies

There are more than three study strategies, but focusing on the most effective strategies will make an enormous difference in how well you will be able to demonstrate learning (also known as “acing your tests”). Here is a brief overview of each of the three strategies:

- Spacing—This has to do with *when* you study. Hint: Don’t cram; study over a period of days, preferably with “breaks” in between.
- Interleaving—This has to do with *what* you study. Hint: Don’t study just one type of content, topic, chapter, or unit at a time; instead, mix up the content when you study.
- Practice testing—This has to do with *how* you study. Hint: Don’t just reread content. You must quiz or test your ability to retrieve the information from your brain.

Spacing

We all know that cramming is not an effective study strategy, but do we know why? Research on memory suggests that giving yourself time in between study sessions actually helps you forget the information. And forgetting, which sounds like it would be something you *don’t* want to do, is actually good for your ability to remember information long-term. That’s because every time you forget something, you need to relearn it, leading to gains in your overall understanding and “storage” of the material. The table below demonstrates how spacing works. Assume you are going to spend about four hours studying for a Sociology exam. Cramming would have you spending most of those four hours the night before the exam. With spacing, on the other hand, you would study a little bit each day.

Table 6.1

Spacing							
	Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
Cramming				Study for 1 hour	Study for 3		
Spacing	Study for 1 hour		Study for 30 minutes	Study for 1 hour	Study for 90 minutes		

Interleaving

One particular studying technique is called interleaving, which calls for students to mix up the content that is being studied. This means not just spending the entire study session on one sort of problem and then moving on to a different sort of problem at a later

time.

If you take the schedule we used for the spacing example above, we can add the interleaving concepts to it. Notice that interleaving includes revisiting material from a previous chapter or unit or revisiting different types of problems or question sets. The benefit is that your brain is “mixing up” the information, which can sometimes lead to short-term forgetting but can lead to long-term memory and learning.

Table 6.2

Interleaving					
Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**
Reread Sociology, Chapter 1. Reorganize notes		Reread Sociology, Chapter 1 and 2 Take Ch 1 online quiz. Create Chapter 2 concept map	Reread Sociology, Chapters 1-3. Take online quizzes for chapters 2 and 3. Reorganize notes. Create practice test	Reread notes. Review items missed on online quizzes. Take practice test and review challenge areas.	**TEST in sociology, Chapters 1-3**

Practice Testing

You can do a practice “test” in two ways. One is to test yourself as you are reading or taking in information. This is a great way to add a little variety to your studying. You can ask yourself what a paragraph or text section means as you read. To do this, read a passage in a text, cover up the material, and ask yourself, “What was the main idea of this section?” Recite aloud or write down your answer, and then check it against the original information.

Another, more involved, way to practice test is to create flashcards or an actual test by writing a test. This takes more time, but there are online programs such as Quizlet that make it a little easier. Practice testing is an effective study strategy because it helps you practice *retrieving* information, which is what you want to be able to do when you are taking the real test.

One of the best ways to learn something is to teach it to someone else, so ask a friend or family member if you can explain something to them, and *teach* them the lesson. You may find you know more about the subject than you thought . . . or you may realize quickly that you need to do more studying. Why does teaching someone else rank as one of the most effective ways to learn something? It is a form of practice testing that requires you to demonstrate you know something in front of someone else! No one wants to look like they don’t know what they are talking about, even if it your audience is another classmate.

Recognizing Strengths/Weaknesses of Preferred Study Approaches

Most children don’t learn to ride a bicycle by reading a manual; they learn by watching other kids, listening to instructions, and getting up on the seat and learning to balance—sometimes with training wheels or a proud parent holding on, but ultimately without any other support. They may fall over and feel insecure, but usually, they learn to make the machine go. Most of us employ multiple methods of study all the time. You usually only run into trouble if you stubbornly rely on just one way to learn or study and the material you’re studying or the task you want to accomplish doesn’t lend itself to that preference. You can practice specific strategies to help you learn in your preferred learning approach. Can you think of a time when the way you usually study a situation didn’t work?

When deciding on a study approach, consider what you know about the material and the type of knowledge it involves. Is it a group of concepts related to problem-solving methods, such as those you’d find in a physics class? Or is it a literary analysis of a novel? Consider as many elements as possible about the material -- and the way the material will be assessed -- to help choose a study approach.

You should also consider your instructor’s preferred method of teaching and learning. Watching the way they teach lessons or convey necessary course information to the class. Do they almost always augment lessons with video clips to provide examples or create a memorable narrative? Do they like to show you how something works by demonstrating and working with their hands—for instance, assembling a piece of equipment by taking it apart and putting it back together again? Echoing their teaching approach may help your study. That doesn’t mean you have to change your entire learning approach to match your instructors’ methods. Many instructors understand that their students will have different ways of learning and try to present information in multiple ways.

Practicing Active Continuous Improvement for All Preferences

You can certainly learn through specific approaches or according to specific preferences, but you will also need to adapt to different situations, skills, and subject areas. Don't limit yourself to thinking you can *only* learn one way or another. That mindset induces anxiety when you encounter a learning situation that doesn't match your preference. What if your instructor *only* uses a spoken lecture to teach concepts in your chemistry class, and you consider yourself a visual learner? Or what if the only method presented to you for learning mathematical computations is to see videos of others working problems, and you're more hands-on? You may have to concentrate in a different way or devise other strategies to learn, but you can do it. In fact, you should sometimes work on the styles/preferences that you feel are your least favorite; it will actually strengthen your overall ability to learn and retain information.[10]

Dr. Stephen Covey, famous leadership coach and businessman, called this attention to knowing and honing all your skill sets, not just your favorites, *sharpening the saw.* He advised that people should be aware of their strengths but should always hone their weaknesses by saying, "We must never become too busy sawing to take time to sharpen the saw."[11] For instance, in the chemistry lecture example, you may need to take good notes from the spoken lecture and then review those notes as you sketch out any complex ideas or formulas. If the math videos are not enough for you to grasp difficult problems, you may ask for or find your own problems for additional practice covering that particular mathematical concept to solve on your own.

Footnotes

- Newton, Phillip M., & Miah, Mahallad. "Evidence-Based Higher Education—Is the Learning Style 'Myth' Important?" *Frontiers in Psychology* 8:444 (2017) DOI: 10. 3389/FPSYG. 2017.00444.
- Covey, Stephen. The 7 Habits of Highly Effective People ® www.franklincovey.com/the-7-habits.html

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7.4: Test Taking

Questions to consider

- What are the differences between test prep and taking the actual test?
- How can you take a *whole person* approach to test taking?
- What can you do on test day to increase your confidence and success?
- What should you know about test anxiety?

Once you are practicing good study habits, you'll be better prepared for actual test taking. Since studying and test taking are both part of learning, honing your skills in one will help you in the other.

Probably the most obvious differences between your preparation for an exam and the actual test itself is your level of urgency and the time constraints. A slight elevation in your stress level can actually be OK for testing—it keeps you focused and *on your game* when you need to bring up all the information, thinking, and studying to show what you've learned. Properly executed, test preparation mixed in with a bit of stress can significantly improve your actual test-taking experience.

Preparation vs. Actual Test

You can replicate the effective sense of urgency an actual test produces by including timed writing into your study sessions. You don't need all of your study time to exactly replicate the test, but you would be well served to find out the format of the exam in advance and practice the skills you'll need to use for the various test components. On one early exam in history, Stuart learned the prof was going to include several short-answer essay questions—one for each year of the time period covered. Stuart set up practice times to write for about 15 to 20 minutes on significant events from his notes because he estimated that would be about how much time he could devote out of the hour-long testing session to write one or two required short-answer questions. He would write a prompt from his notes, set a timer, and start writing. If you're ready and you have practiced and know the material, 20 minutes is adequate to prepare, draft, and revise a short response, but you don't have a lot of extra time.

Likewise, in a math exam, you will need to know what kinds of problems you will have to solve and to what extent you'll need to show your computational work on the exam. If you are able to incorporate this sort of timed problem-solving into your study time, you'll be more prepared and confident when you actually come to the exam. Making yourself adhere to a timed session during your study can only help. It puts a sense of urgency on you, and it will help you to find out what types of problems you need to practice more than ones that perhaps you're more comfortable solving.

Leveraging Study Habits for Test Prep

In your mind, you probably know what you need to do to be prepared for tests. Occasionally, something may surprise you—emphasis on a concept you considered unimportant or a different presentation of a familiar problem. But those should be exceptions. You can take all your well-honed study habits to get ready for exams. Here's a checklist for study and test success for your consideration:



Figure 7.4.9

Read this list with each separate class in mind, and check off the items you already do. Give yourself one point for every item you checked. If you always take the success steps—congratulations! They are not a guarantee, but doing the steps mindfully will give you a nice head start. If you do fewer than five of the steps—you have some work to do. But recognition is a good place to start, and you can incorporate these steps starting now.

As strange as this may sound, you can find some interesting research articles online about using the taste or smell of peppermint to increase memory, recall, and focus. Read more at: http://naturalsociety.com/mint-scent...gnition-memory. While sucking on a peppermint disk won't replace studying, why not experiment with this relatively easy idea that seems to be gaining some scientific traction?

Whole Person Approach to Testing

Just because you are facing a major exam in your engineering class (or math or science or English class) doesn't mean everything else in your life comes to a stop. Perhaps that's somewhat annoying, but that's reality. Allergies still flare up, children still need to eat, and you still need to sleep. You must see your academic life as one segment of who you are—it's an important segment, but just one aspect of who you are as a whole person. Neela tries to turn off everything else when she has exams coming up in her nursing program, which is pretty often. She ignores her health, puts off her family, tries to reschedule competing work tasks, and focuses all her energy on the pending exam. On the surface, that sounds like a reasonable approach, but if she becomes really sick by ignoring a minor head cold, or if she misses an important school deadline for one of her children, Neela risks making matters worse by attempting to compartmentalize so strictly. Taking care of her own health by eating and sleeping properly; asking for help

in other aspects of her busy life, such as attending to the needs of her children; and seeing the big picture of how it all fits together would be a better approach. Pretending otherwise may work sporadically, but it is not sustainable for the long run.

A whole person approach to testing takes a lot of organization, scheduling, and attention to detail, but the life-long benefits make the effort worthwhile.

Establishing Realistic Expectations for Test Situations

Would you expect to make a perfect pastry if you've never learned how to bake? Or paint a masterpiece if you've never tried to work with paints and brushes? Probably not. But often we expect ourselves to perform at much higher levels of achievement than that for which we've actually prepared. If you become very upset and stressed if you make any score lower than the highest, you probably need to reevaluate your own expectations for test situations. Striving to always do your best is an admirable goal. Realistically knowing that your current *best* may not achieve the highest academic ratings can help you plot your progress.

Realistic continuous improvement is a better plan, because people who repeatedly attempt challenges for which they have not adequately prepared and understandably fail (or at least do not achieve the desired highest ranking) often start moving toward the goal in frustration. They simply quit. This doesn't mean you settle for mediocre grades or refrain from your challenges. It means you become increasingly aware of yourself and your current state and potential future. Know yourself, know your strengths and weaknesses, and be honest with yourself about your expectations.

Understanding Accommodations and Responsibilities

As with so many parts of life, some people take exams in stride and do just fine. Others may need more time or change of location or format to succeed in test-taking situations. With adequate notice, most faculty will provide students with reasonable accommodations to assist students in succeeding in test situations. If you feel that you would benefit from receiving these sorts of accommodations, first speak with your instructor. You may also need to talk to a student services advisor for specific requirements for accommodations at your institution.

If you need accommodations, you are responsible for understanding what your specific needs are and communicating your needs with your instructors. Before exams in class, you may be allowed to have someone else take notes for you, receive your books in audio form, engage an interpreter, or have adaptive devices in the classroom to help you participate. Testing accommodations may allow for additional time on the test, the use of a scribe to record exam answers, the use of a computer instead of handwriting answers, as well as other means to make the test situation successful. Talk to your instructors if you have questions about testing accommodations.

Prioritizing Time Surrounding Test Situations

Keep in mind that you don't have any more or less time than anyone else, so you can't *make time* for an activity. You can only use the time everyone gets wisely and realistically. Exams in college classes are important, but they are not the only significant events you have in your classes. In fact, everything leading up to the exam, the exam itself, and the post-exam activities are all one large continuum. Think of the exam as an event with multiple phases, more like a long-distance run instead of a 50-yard dash. Step back and look at the big picture of this timeline. Draw it out on paper. What needs to happen between now and the exam so you feel comfortable, confident, and ready?

If your instructor conducts some sort of pre-exam summary or prep session, make sure to attend. These can be invaluable. If this instructor does not provide that sort of formal exam prep, create your own with a group of classmates or on your own. Consider everything you know about the exam, from written instructions to notes you took in class, including any experiential notes you may have from previous exams, such as the possibility of bonus points for answering an extra question that requires some time management on your part. You can read more about time management in Chapter 3.

Get Connected

Which apps can help you study for a test, increase your memory, and even help you overcome test anxiety?

Personal Zen is a free online gaming app clinically proven to reduce stress and anxiety. The games retrain your brain to think more positively, reducing stress to help you focus on the experiences around you.

Games like solitaire, hangman, and Simon Says all build on your memory, keeping it sharp and active. There are loads of fun, free online memory games you can use to make time wasting a little less wasteful. For more than 250 options, visit the Memory Improvement Tips website.

iTunes University might be able to help you dig into a research topic or find additional content to help you if you're struggling with a course. Their library of free lectures and content comes from some of the most highly respected universities around the world.

Chegg Prep is a flashcard-based self-quizzing resource. It provides millions of pre-made flashcards and decks organized by course and topic, which you can search, sort, bookmark, and use in a variety of ways. The service is free and does not require a login unless you'd like to save or create your own cards.

Test Day

Once you get to the exam session, try your best to focus on nothing but the exam. This can be very difficult with all the distractions in our lives. But if you have done all the groundwork to attend the classes, completed the assignments, and scheduled your exam prep time, you are ready to focus intently for the comparatively short time most exams last.

Arriving to class:

Don't let yourself be sidetracked right at the end. Beyond the preparation we've discussed, give yourself some more advantages on the actual test day:

- Get to the testing location a few minutes early so you can settle into your place and take a few relaxing breaths.
- Don't let other classmates interrupt your calmness at this point.
- Just get to your designated place, take out whatever supplies and materials you are allowed to have, and calm your mind.

Taking the test:

Once the instructor begins the test:

- Listen carefully for any last-minute oral directions that may have changed some detail on the exam, such as the timing or the content of the questions.
- As soon as you receive the exam sheet or packet, make a quick scan over the entire test.
- Don't spend a lot of time on this initial glance, but make sure you are familiar with the layout and what you need to do.
- Using this first review, decide how you will allocate your available time for each section.
- You can even jot down how many minutes you can allow for the different sections or questions.

Then for each section, if the exam is divided this way, be sure you **read the section directions** very carefully so you don't miss an important detail. For example, instructors often offer options—so you may have four short-answer questions from which to choose, but you only need to answer two of them. If you had not read the directions for that section, you may have thought you needed to provide answers to all four prompts. Working on extra questions for which you likely will receive no credit would be a waste of your limited exam time. The extra time you spend at the beginning is like an investment in your overall results.

Answer every required question on the exam. Even if you don't complete each one, you may receive some credit for partial answers. Whether or not you can receive partial credit would be an excellent question to ask before the exam during the preparation time. If you are taking an exam that contains multiple-choice questions, go through and answer the questions about which you are the most confident first.

Read the entire question carefully even if you think you know what the stem (the introduction of the choices) says, and read all the choices. Skip really difficult questions or ones where your brain goes blank. Then you can go back and concentrate on those skipped ones later after you have answered the majority of the questions confidently. Sometimes a later question will trigger an idea in your mind that will help you answer the skipped questions.

And, in a similar fashion to spending a few minutes right at the beginning of the test time to read the directions carefully and identify the test elements, **allow yourself a few minutes at the end of the exam session to review your answers.** Depending on what sort of exam it is, you can use this time to check your math computations, review an essay for grammatical and content errors, or answer the difficult multiple-choice questions you skipped earlier. Finally, **make sure you have completed the entire test:** check the backs of pages, and verify that you have a corresponding answer section for every question section on the exam. It can be easy to skip a section with the idea you will come back to it but then forget to return there, which can have a significant impact on your test results.

After the Test

As you leave the exam room, the last thing you may want to think about is that particular test. You probably have numerous other assignments, projects, and life obligations to attend to, especially if you pushed some of those off to study for this completed exam. Give yourself some space from this exam, but only for the duration of the time when your instructor is grading your exam. Once you have your results, study them—whether you did really well (Go, you!) or not as well as you had hoped (Keep your spirits up!). Both scenarios hold valuable information if you will use it.

Thandie had a habit of going all-out for exams before she took them, and she did pretty well usually, but once the instructor passed back the graded tests, she would look at the letter grade, glance half-heartedly at the instructor's comments, and toss the exam away, ready to move on to the next chapter, section, or concept. A better plan would be to learn from her exam results and analyze both what she did well and where she struggled. After a particularly unimpressive exam outing in her statistics class, Thandie took her crumpled-up exam to the campus tutoring center, where the tutor reviewed the test with her section by section. Together they discovered that Thandie did particularly well on the computational sections, which she admitted were her favorites, and not well at all on the short-answer essay questions that she did not expect to find in a stats class, which in her experience had been more geared toward the mathematical side of solving statistical problems.

Going forward in this class, Thandie should practice writing out her explanations of how to compute the problems and talk to her instructor about ways to hone this skill. This tutoring session also proved to Thandie the benefit of holding on to important class papers—either electronically or in hard copy, depending on the class setup—for future reference. For some classes, you probably don't need to keep every scrap of paper (or file) associated with your notes, exams, assignments, and projects, but for others, especially for those in your major, those early class materials may come in very handy in your more difficult later undergraduate courses or even in grad school when you need a quick refresher on the basic concepts.

Test Anxiety



Figure 7.4.10 Text anxiety can be a common occurrence, but you can use strategies to manage it.

Test anxiety is very real. You may know this firsthand. Almost everyone gets a little nervous before a major exam, in the same way most people get slightly anxious meeting a new potential date or undertaking an unfamiliar activity. We second-guess whether we're ready for this leap, if we prepared adequately, or if we should postpone this potentially awkward situation. And in most situations, testing included, that reasonable level of nervous anticipation can be a good thing—enhancing your focus and providing you with a bit of bravado to get you through a difficult time.

Test anxiety, however, can cause us to doubt ourselves so severely that we underperform or overcompensate to the point that we do not do well on the exam. Don't despair; you can still succeed if you suffer from test anxiety. The first step is to understand what it is and what it is not, and then to practice some simple strategies to cope with your anxious feelings relative to test taking. Whatever you do, don't use the label *test anxiety* to keep you from your dreams of completing your education and pursuing whatever career you have your eyes on. You are bigger than any anxiety.

Understanding Test Anxiety

If someone tries to tell you that test anxiety is *all in your head*, they're sort of right. Our thinking is a key element of anxiety of any sort. On the other hand, test anxiety can manifest itself in other parts of our bodies as well. You may feel queasy or light-headed if you are experiencing test anxiety. Your palms may sweat, or you may become suddenly very hot or very cold for no apparent

reason. At its worst, test anxiety can cause its sufferers to experience several unpleasant conditions including nausea, diarrhea, and shortness of breath. Some people may feel as though they may throw up, faint, or have a heart attack, none of which would make going into a testing situation a pleasant idea. You can learn more about symptoms of test anxiety from the Anxiety and Depression Association of America that conducts research on this topic.[12]

Back to our minds for a minute. We think constantly, and if we have important events coming up, such as exams, but other significant events as well, we tend to think about them seemingly all the time. Almost as if we have a movie reel looping in our heads, we can anticipate everything that may happen during these events—both sensational results and catastrophic endings. What if you oversleep on the test day? What if you're hit by a bus on the way to campus? What if you get stung by a mysterious insect and have to save the world on the very day of your exam?

How about the other way? You win the lottery! Your screenplay is accepted by a major publisher! You get a multimillion-dollar record deal! It could happen. Typically, though, life falls somewhere in between those two extremes, unless you live in an action movie. Our minds, however, (perhaps influenced by some of those action movies or spy novels we've seen and read) often gravitate to those black-and-white, all-or-nothing results. Hence, we can become very nervous when we think about taking an exam because if we do really poorly, we think, we may have to face consequences as dire as dropping out of school or never graduating. Usually, this isn't going to happen, but we can literally make ourselves sick with anxiety if we dwell on those slight possibilities. You actually may encounter a few tests in your academic careers that are so important that you have to alter your other life plans temporarily, but truly, this is the exception, not the rule. Don't let the most extreme and severe result take over your thoughts. Prepare well and do your best, see where you land, and then go from there.

Using Strategies to Manage Test Anxiety

You have to work hard to control test anxiety so it does not take an unhealthy hold on you every time you face a test situation, which for many of you will last well into your careers. One of the best ways to control test anxiety is to be prepared for the exam. You can control that part. You can also learn effective relaxation techniques including controlled breathing, visualization, and meditation. Some of these practices work well even in the moment: at your test site, take a deep breath, close your eyes, and smile —just bringing positive thoughts into your mind can help you meet the challenges of taking an exam without anxiety taking over.

The tests in the corporate world or in other career fields may not look exactly like the ones you encounter in college, but professionals of all sorts take tests routinely. Again, being prepared helps reduce or eliminate this anxiety in all these situations. Think of a presentation or an explanation you have provided well numerous times—you likely are not going to feel anxious about this same presentation if asked to provide it again. That's because you are prepared and know what to expect. Try to replicate this feeling of preparation and confidence in your test-taking situations.

Many professions require participants to take frequent licensing exams to prove they are staying current in their rapidly changing work environments, including nursing, engineering, education, and architecture, as well as many other occupations. You have tools to take control of your thinking about tests. Better to face it head-on and let test anxiety know who's in charge!

Footnotes

- Reteguiz, Jo-Ann. "Relationship between anxiety and standardized patient test performance in the medicine clerkship." Journal of general internal medicine vol. 21,5 (2006): 415-8. doi:10.1111/j.1525-1497.2006.00419.

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7.5: Summary

Studying and taking tests will always be a large part of college, so learning now to do these well can only help you be more successful. Experts provide us with many tools, techniques, and ideas to use when we determine how best to study, use our memories effectively, and prepare to take exams. You can help yourself by taking these guidelines seriously and tracking your progress. If one strategy works better for you in some classes and another is more suited to a different course, keep that in mind when you begin to study. Use all the resources available to you, and you'll be well on your way to success in college.

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7.6: Career Connection

Studies have shown that parents contribute to test anxiety in children by drawing students' attention to the test day and increasing pressure to perform well. Do you think that worrying about an upcoming test is as harmful as anxiety while taking the test? What do you think can be done to minimize worry?

This article discusses how to help with test anxiety.

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7.7: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might change your answer to one of them.

How confident are you in your skills at preparing for and taking tests? Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning “least like me” and 4 meaning “most like me.”

1. I believe I set aside enough time to prepare for tests.
2. If I don’t set aside enough time, or if life gets in the way, I can usually cram and get similar results.
3. I prefer to pull all-nighters. The adrenaline and urgency help me remember what I need come test time.
4. I study my notes, highlight book passages, and use flash cards, but I still don’t feel like I’m as successful as I should be on tests.

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7.8: Where do you go from here?

Studying and test taking skills often need to evolve to meet the needs of college responsibilities. What would you like to learn more about? Choose a topic from the list below and create an annotated bibliography that would direct further research.

- the importance of memory in learning new material
- strategies to increase memory
- strategies to increase the effectiveness of studying
- test anxiety

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SECTION OVERVIEW

7.9: Avoiding the Hazards Along the Way

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SECTION OVERVIEW

7.10: Test-Taking Strategies

7.10.1: Pre- Mid- and Post-Test-Taking Strategies

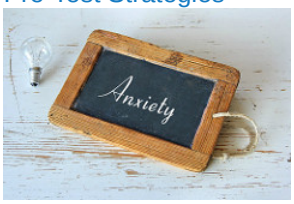
7.10.2: Test-Taking Strategy Specifics

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7.10.1: Pre- Mid- and Post-Test-Taking Strategies

Phyllis Nissila

Pre-Test Strategies



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Q: When should you start preparing for the first test? Circle…

1. The night before.
2. The week prior.
3. The first day of classes.

If you answered "3. The first day of classes," you are correct. If you circled all three, you are also correct. Preparing to pass tests is something that begins when learning begins and continues all the way through to the final exam.

Many students, however, don't start thinking about test taking, whether weekly exams, mid-terms, or finals, until the day before when they engage in an all-nighter, or cramming. From the previous unit on memory, you might recall that the brain can only process an average of 5-7 new pieces of information at a time. Additionally, unless memory devices are used to aid memory and to cement information into long term memory (or at least until the test is over tomorrow!) chances are slim that students who cram will effectively learn and remember the information.

Additionally, a lot of students are unaware of the many strategies available to help with the test-taking experience before, during, and after. For starters, take a look at what has helped you so far.

EXERCISE 30-1

Pre-Test Taking Strategies

PART A:

Put a check mark next to the pre-test strategies you already employ.

____ Organize your notebook and other class materials the first week of classes.

____ Maintain your organized materials throughout the term.

____ Take notes on key points from lectures and other materials.

____ Make sure you understand the information as you go along.

____ Access your instructor's help and the help of a study group, as needed.

____ Organize a study group, if desired.

____ Create study tools such as flashcards, graphic organizers, etc. as study aids.

____ Complete all homework assignments on time.

____ Review likely test items several times beforehand.

____ Ask your instructor what items are likely to be covered on the test.

____ Ask your instructor if she or he can provide a study guide or practice test.

____ Ask your instructor if he/she gives partial credit for test items such as essays.

____ Maintain an active learner attitude.

____ Schedule extra study time in the days just prior to the test.

____ Gather all notes, handouts, and other materials needed before studying.

____ Review all notes, handouts, and other materials.

____ Organize your study area for maximum concentration and efficiency.

____ Create and use mnemonic devices to aid memory.

____ Put key terms, formulas, etc., on a single study sheet that can be quickly reviewed.

____ Schedule study times short enough (1-2 hours) so you do not get burned out.

____ Get plenty of sleep the night before.

____ Set a back-up alarm in case the first alarm doesn't sound or you sleep through it.

____ Have a good breakfast with complex carbs and protein to see you through.

____ Show up 5-10 minutes early to get completely settled before the test begins.

____ Use the restroom beforehand to minimize distractions.

PART B

By reviewing the pre-test strategies, above, you have likely discovered new ideas to add to what you already use. Make a list of them.

Mid-Test Strategies

Here is a list of the most common–and useful–strategies to survive this ubiquitous college experience.

- Scan the test, first, to get the big picture of how many test items there are, what types there are (multiple choice, matching, essay, etc.), and the point values of each item or group of items.
- Determine which way you want to approach the test: Some students start with the easy questions first, that is, the ones they immediately know the answers to, saving the difficult ones for later, knowing they can spend the remaining time on them. Some students begin with the biggest-point items first, to make sure they get the most points.
- Determine a schedule that takes into consideration how long you have to test, and the types of questions on the test. Essay questions, for example, will require more time than multiple choice, or matching questions.
- Keep your eye on the clock.
- If you can mark on the test, put a check mark next to items you are not sure of just yet. It is easy to go back and find them to answer later on. You might just find help in other test questions covering similar information.
- Sit where you are most comfortable. That said, sitting near the front has a couple of advantages: You may be less distracted by other students. If a classmate comes up with a question for the instructor and there is an important clarification given, you will be better able to hear it and apply it, if needed.
- Wear ear plugs, if noise distracts you.
- You do NOT have to start with #1! It you are unsure of it, mark it to come back to later on.
- Bring water…this helps calm the nerves, for one, and water is also needed for optimum brain function.
- If permitted, get up and stretch (or stretch in your chair) from time to time to relieve tension and assist the blood to the brain!
- Remember to employ strategies to reduce test-taking anxiety (covered in the next lesson)
- If despite all of your best efforts to prepare for a test you just cannot remember the answer to a given item for multiple choice, matching, and/or true/false questions, employ one or more of the following educated guessing (also known as "educated selection") techniques. By using these techniques, you have a *better* chance of selecting the correct answer. It is usually best to avoid selecting an extreme or all-inclusive answer (also known as 100% modifiers) such as "always," and "never". Choose, instead, words such as "usually," "sometimes," etc. (also known as in-between modifiers). If the answers are numbers, choose one of the middle numbers. If you have options such as "all of the above," or "both A and B," make sure each item is true before selecting those options. Choose the longest, or most inclusive, answer. Make sure to match the grammar of question and answer. For example, if the question indicates a plural answer, look for the plural answer. Regarding matching tests: count both sides to be matched. If there are more questions than answers, ask if you can use an answer more than once. Pay close attention to items that ask you to choose the "best" answer. This means one answer is better or more inclusive than a similar answer. Read all of the response options.

Post-Test Strategies

In addition to sighing that big sigh of relief, here are a few suggestions to help with future tests.

- If you don't understand why you did not get an item right, ask the instructor. This is especially useful for quizzes that contain information that may be incorporated into more inclusive exams such as mid-terms and finals.
- Analyze your results to help you in the future. For example, see if most of your incorrect answers were small things such as failing to include the last step in a math item, or neglecting to double-check for simple errors in a short-answer or essay item. See where in the test you made the most errors: beginning, middle, or end. Also analyze which type of questions, true/false, multiple choice, essay, etc. And which topics were missed. This will help you pay closer attention to those sections in the future.

EXERCISE 30-2

Write a letter of advice to Chen incorporating 10 test-taking tips and strategies you think will help him.

Chen believes he is good at organization, and he usually is–for about the first two weeks of classes. He then becomes overwhelmed with all of the handouts and materials and tends to start slipping in the organization department. When it comes to tests, he worries that his notes might not cover all of the right topics and that he will not be able to remember all of the key terms and points–especially for his math class. During tests, he sometimes gets stuck on an item and tends to spend too much time there. He also sometimes changes answers but finds out later that his original selection was correct. Chen is also easily distracted by other students and noises which makes it hard for him to concentrate sometimes, and, unfortunately, he does admit to occasionally "cramming" the night before.

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Adaptions: Changed formatting, removed one exercise.

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7.10.2: Test-Taking Strategy Specifics

Dave Dillon

"By failing to prepare, you are preparing to fail."

– Benjamin Franklin

Discipline, Preparation and Execution

From what I have seen in my own educational experiences, along with coaching and teaching at the college and university level for over 20 years, test taking (with few exceptions) comes down to discipline, preparation and execution. Students wanting to be successful have to have the self-discipline to schedule time to study well in advance of the exam. They have to actually do the work: the preparation needed in order to have the best opportunity for success on the exam. Then they must execute: they have to be able to apply their preparation accordingly and perform well on the exam.

Preparation for an exam is not glamorous. It's easy to find other things to do that are more interesting and fun. Students need to keep themselves motivated with their "eyes on the prize." Think of it like this: if the most important event of your life was coming up and you wanted to perform to the best of your ability in that event, you would likely spend some time preparing for it, rehearsing for it, practicing it, etc. A student may argue that an exam they will be taking would not be the most important event of their life, but think back to the chapter on Passion. If you're already spending the time, effort, energy and money to attend college, why not do it to the best of your ability?

It would be beneficial to spread this preparation and practice out over time and prepare periodically rather than to wait until the last minute and binge study or cram. Your preparation would not be the same and this may affect your test score. Binge studying and cramming also are not healthy. Staying up late puts stress on our brain and body, and not getting adequate sleep places our bodies at risk for getting sick.

"One of the most important keys to success is having the discipline to do what you know you should do, even when you don't feel like doing it."

– Unknown

"The will to succeed is important, but what's more important is the will to prepare."

– Bobby Knight

Everyone wants to be successful. When the exam is passed out, everyone wants to perform well. But what often separates successful students and less successful students is the preparation time put in.

Studying the right thing is a process and a skill. As you gain more experience, you will learn how to become better at knowing what to study. It can be very frustrating to spend a lot of time preparing and studying and then finding out that what you studied was not on the exam. You will see a lot of variance with exams due to different instructors, classes and types of tests. The better you become at predicting what will be on the exam and study accordingly, the better you will perform on your exams. Try placing yourself in your instructor's shoes and design questions you think your instructor would ask. It's often an eye-opening experience for students and a great study strategy.

Preparation for Exam Strategies

Find out as much about the exam in advance as you can.

Some professors will tell you how many questions there will be, what format the exam will be in, how much time you will have, etc., and others will not. I encourage students to ask questions about the exam if there is not information given. I also encourage students to ask those questions before class, after class, in professors' office hours or via e-mail rather than during class.

Know the test

If you know how many questions, what the format is, and/or how much time you will have, you can start to mentally prepare for the exam much more so than if you are coming in with no information. There are two more important aspects that you may or may not know: a) what will be covered or asked on the exam; b) how the exam will be scored. Obviously, the more you know about what will be covered, the easier it is for you to be able to prepare for the exam. Most exam scoring is standardized, but not always.

Look for opportunities where some areas of the exam are worth more points than others. For example: An exam consists of 21 questions, with 10 being True/False, 10 being multiple choice, and one essay question. The T/F questions are worth 1 point each (10 points), the multiple-choice questions are worth 2 points each (20 points), and the essay question is worth 30 points. We know that the essay question is the most valuable (it is worth half of the value of the exam). And we should allocate our time for it accordingly. I would advise starting with the essay question. Do a quick analysis of time to be able to spend your time on the exam wisely. You want to spend some time with the exam question since it is so valuable, without sacrificing adequate time to ensure the T/F and multiple-choice questions are answered.

Often, the order of the exam in this scenario will be: T/F first, multiple choice second and essay third. Most students will go in the chronological order of the exam, but a savvy student would start with the essay. If an exam were to last for 30 minutes with this format of questions, I might recommend a student spent 15 minutes on the essay question, ten minutes on the multiple choice, three minutes on the T/F and two minutes reviewing their answer.

Also, look for situations where exams penalize students for incorrectly answering a question. This does not occur very often, but is the case with some exams. With the SAT for example, students are awarded one point for a correct answer and ¼ of a point subtracted for an incorrect answer. Points are not awarded nor subtracted for leaving a question blank. Thus, the strategy for a multiple-choice question is: if you can narrow down the potentially correct answer to two rather than four or five, it is statistically advantageous to answer the question and guess between the two answers; however, if a student had no idea if any of the answers were correct or incorrect, it would be best to leave the answer blank. Remember, this is rare, but it is important to understand the strategy when students take these exams.

In conclusion, the more information you have about the exam, the better you can prepare for content, allocation of time spent on aspects of the exam, and the more confident you will be in knowing how and when to attempt to answer questions.

Take care of your body

Before the exam, it is important to prepare your brain and body for optimal performance for your exam. Do not cram the night before. Get a good night's sleep. Make sure you eat (nutritiously) before the exam. I recommend exercising the day before and if possible a few hours before the exam.

Strategies for Specific Exam Formats

True or False Questions

Look for qualifiers. A qualifier is a word that is absolute. Examples are: all, never, no, always, none, every, only, entirely. They are often seen in false statements. This is because it is more difficult to create a true statement using a qualifier like never, no, always, etc. For example, "All cats chase mice." Cats may be known for chasing mice, but not all of them do so. The answer here is false and the qualifier "all" gave us a tip. Qualifiers such as: sometimes, many, some, most, often, and usually are commonly found in true statements. For example: "Most cats chase mice." This is true and the qualifier "most" gave us a tip.

Make sure to read the entire statement. All parts of a sentence must be true if the whole statement is to be true. If one part of it is false, the whole sentence is false. Long sentences are often false for this reason.

Students should guess on True or False questions they do not know the answer to unless there is a penalty for an incorrect answer.

Multiple Choice Questions

Think of multiple choice questions as four (or five) true or false statements in one. One of the statements is true (the correct answer) and the others will be false. Apply the same strategy toward qualifiers. If you see an absolute qualifier in one of the answer choices, it is probably false and not the correct answer. Try to identify the true statement. If you can do this, you have the answer as there is only one. If you cannot do this at first, try eliminating answers you know to be false.

If there is no penalty for incorrect answers, my suggestion is to guess if you are not certain of the answer. If there is a penalty for incorrect answers, common logic is to guess if you can eliminate two of the answers as incorrect (pending what the penalty is). If there's a penalty and you cannot narrow down the answers, it's best to leave it blank. You may wish to ask your instructor for clarification.

Answers that are strange and unrelated to the question are usually false. If two answers have a word that looks or sounds similar, one of those is usually correct. For example: abductor/ adductor. If you see these as two of the four or five choices, one of them is usually correct. Also look for answers that are grammatically incorrect. These are usually incorrect answers. If you have to completely guess, choose B or C. It is statistically proven to be correct more than 25 percent of the time. If there are four answers

for each question, and an exam had standardized the answers, each answer on the exam A, B, C and D would be equal. But most instructors do not standardize their answers, and more correct answers are found in the middle (B and C then the extremes A and D or E). “People writing isolated four-choice questions hide the correct answer in the two middle positions about 70% of the time.”[1] This is 20 percent more correct answers found in B or C than a standardized exam with equal correct answers for each letter.

Matching Questions

Although less common than the other types of exams, you will likely see some matching exams during your time in college. First, read the instructions and take a look at both lists to determine what the items are and their relationship. It is especially important to determine if both lists have the same number of items and if all items are to be used, and used only once.

Matching exams become much more difficult if one list has more items than the other or if items either might not be used or could be used more than once. If your exam instructions do not discern this, you may wish to ask your instructor for further clarification. I advise students to take a look at the whole list before selecting an answer because a more correct answer may be found further into the list. Mark items when you are sure you have a match (pending the number of items in the list this may eliminate answers for the future). Guessing (if needed) should take place once you have selected answers you are certain about.

Short-Answer Questions

Read all of the instructions first. Budget your time and then read all of the questions. Answer the ones you know best or feel the most confident with. Then go back to the other ones. If you do not know the answer and there is no penalty for incorrect answers, guess. Use common sense. Sometimes instructors will award partial credit for a logical answer that is related even if it is not the correct answer.

Essay Questions

Keep in mind that knowing the format of the exam can help you determine how to study. If I know that I am taking a True-False exam, I know that I will need to discern whether a statement is True or False. I will need to know subject content for the course. But if I am studying for short answer and especially for essay questions, I must know a lot more. For essay questions, I must have much greater content knowledge and be able to make a coherent argument that answers the question using information from textbooks, lectures or other course materials. I have to place a lot more time and thought into studying for an essay exam than for True-False or Multiple-Choice exams.

Read the essay question(s) and the instructions first. Plan your time wisely and organize your answer before you start to write. Address the answer to the question in your first or second sentence. It may help to restate the original question. Write clearly and legibly. Instructors have difficulty grading essays that they cannot read. Save some time for review when you have finished writing to check spelling, grammar and coherent thought in your answer. Make sure you have addressed all parts of the essay question.

During the Exam:

Always read the directions first. Read them thoroughly.

Preview the exam to help you allocate proper time for each area.

Skip questions if you do not know the answer but make a mark somewhere to ensure you are able to go back to those questions (you may need to reallocate your prepared time for this depending on how many there are).

Allocate some time to review your answers before submitting your exam or the exam time expiring.

One of the biggest mistakes that students make after they take an exam in a course is that they do not use the exam for the future. The exam contains a lot of information that can be helpful in studying for future exams. Students that perform well on an exam often put it away thinking they do not need it anymore. Students who do poorly on an exam often put it away, not wanting to think about it any further.

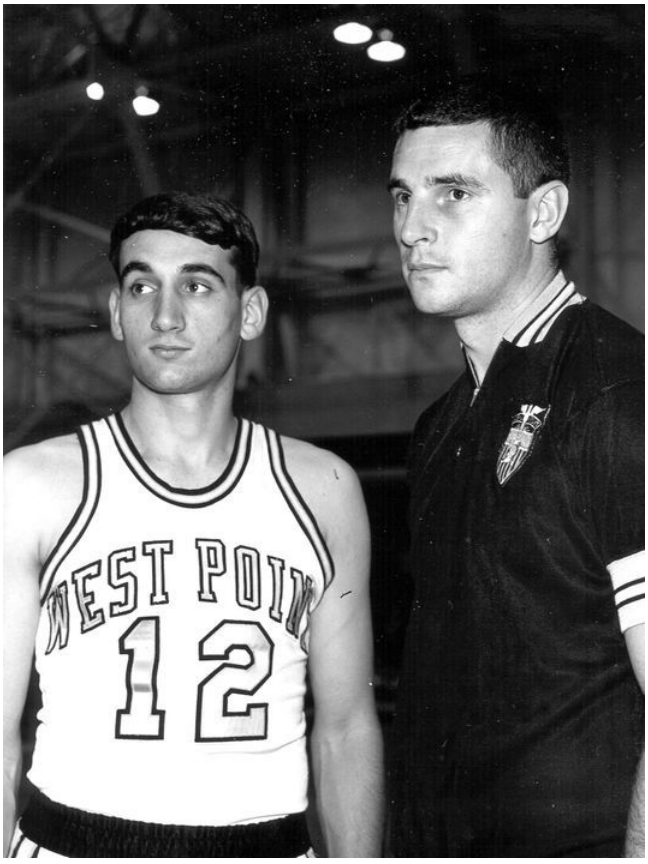
In both cases, students are missing out on the value of reviewing their exams. It is wise to review exams for three reasons: 1) students should review the answers that were correct because they may see those questions on future exams and it is important to reinforce learning; 2) students should review the answers that were incorrect in order to learn what the correct answer was and why. These questions also may appear on a future exam. In addition, occasionally an answer is marked incorrect, when it should have been marked correct. The student would never know this if they didn’t review their exam; and 3) there is value in reviewing the exam to try to predict what questions or what format will be used by a professor for a future exam in the same course.

Author's Story

What does it mean to be a "poor test taker?" Think about that. Does it mean that the student has put effort into studying but has difficulty under pressure? Does it mean that a student studies the wrong material? Is the student prepared but does not execute well? Could the student have a learning disability? Are they missing key strategies for taking tests? It could mean any of those things. And while I believe that it may be true that a student may be a "poor test taker," it does not by any means mean it is permanent. Students willing to work hard and learn can improve their test taking skills and raise their confidence.

In high school chemistry, I earned a D grade. In microeconomics at UC Santa Cruz, I struggled and barely passed. Both of these classes had grading systems that were heavily weighted by exams. I was an above average student in my other classes in both high school and college, and so I was told (and believed for a long time) that I was not a "good test taker." I no longer believe this. I will not make excuses. The responsibility for the grade I earned rests solely with me. I mention this because many students come to my office and complain that their professor grades in a way that is unfair to them because so much emphasis is on exams and that they understand the material but are "not good test takers." It may be the case that my grade or another students' grade would have been better had the course grade been determined with less weight levied to exams. That to me is irrelevant. It does not absolve me from being responsible for knowing what the grading metrics were at the beginning of the course and choosing to continue in the course after learning this knowledge. In the end, I realized I was not a poor test taker and that I needed to spend more time studying and preparing to perform well on exams. I changed my attitude from being afraid of exams to one of believing I was going to do well regardless of the class or the format of the exam. Once I had confidence that I had the necessary tools and was willing to work hard, it changed my entire perspective and experience with exams.

Note: if you think you may have a learning disability and would like to get assessed, contact your college to see what steps to follow to begin the assessment process.



Mike Krzyzewski, point guard at Army with Bob Knight, coach at Army.

Thinking about excuses reminds me of a story about Mike Krzyzewski, the successful Duke University men's basketball coach. Before Krzyzewski coached, he was a student at the United States Military Academy at West Point. One day in his first year, Krzyzweski and his roommate were walking and his roommate stepped in a puddle. Mud splashed onto Krzyzewski's uniform. Immediately, an upperclassman screamed at Krzyzewski about not knowing the rules of wearing a clean uniform. Plebes (first-year

students at military academies) are allowed three answers when asked a question: “Yes sir!” “No sir!” And “No excuse sir!” Krzyzewski repeated himself, “No excuse sir!” Despite wanting to explain what had happened and that it was not his fault, he realized that there was no excuse. It was his responsibility to keep a clean uniform.

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1. Yigal Attali and Maya Bar-Hillel, “Guess Where: The Position of Correct Answers in Multiple-Choice Test Items as a Psychometric Variable,” *Journal of Educational Measurement* 40 no. 2 (2003):109-128. ↵

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CHAPTER OVERVIEW

8: Understanding Civility and Cultural Competence

8.1: Understanding Civility and Cultural Competence
8.2: What Is Diversity, and Why Is Everybody Talking About It?
8.3: Categories of Diversity
8.4: Navigating the Diversity Landscape
8.5: Inclusivity and Civility- What Role Can I Play?
8.6: Summary
8.7: Career Connection
8.8: Rethinking
8.9: Where do you go from here?

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8.1: Understanding Civility and Cultural Competence



Figure 8.1.1: (Credit John Martinez Pavliga / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Student Survey

How do you feel about diversity, equity, and inclusion? These questions will help you determine how the chapter concepts relate to you right now. As you are introduced to new concepts and practices, it can be informative to reflect on how your understanding changes over time. We'll revisit these questions at the end of the chapter to see whether your feelings have changed. Take this quick survey to figure it out, ranking questions on a scale of 1–4, 1 meaning "least like me" and 4 meaning "most like me."

1. I'm aware of the different categories of diversity and the various populations I may encounter.
2. I think we sometimes go too far in trying to be sensitive to different groups.
3. I think nearly everybody in our society has equal opportunity.
4. It's not my role to ensure equity and inclusiveness among my peers or colleagues.

You can also take the Chapter 9 survey anonymously online.

STUDENT PROFILE

"For the vast majority of my life, I thought being an Asian-American—who went through the Palo Alto School District—meant that I was supposed to excel in academics. But, in reality, I did the opposite. I struggled through college, both in classes and in seeking experiences for my future. At first, I thought I was unique in not living up to expectations. But as I met more people from all different backgrounds, I realized my challenges were not unique.

"I began capturing videos of students sharing their educational issues. Like me, many of my peers lack the study skills required to achieve our academic goals. The more I researched and developed videos documenting this lack of skill, the more I realized that student identities are often lost as they learn according to a traditional pedagogy. I began documenting students' narratives and the specific strategies they used to overcome difficulty. Once we can celebrate a diverse student body and showcase their strengths and identities as well as the skills necessary to excel academically, my hope is that students of all backgrounds can begin to feel that they belong."

—Henry Fan, Foothill College and San Jose State University

About This Chapter

In this chapter you will learn about diversity and how it plays a role in personal, civic, academic, and professional aspects of our lives. By the end of the chapter, you should be able to do the following:

- Articulate how diverse voices have been historically ignored or minimized in American civic life, education, and culture.
- Describe categories of identity and experience that contribute to diverse points of view.
- Acknowledge implicit bias and recognize privilege.
- Evaluate statements and situations based on their inclusion of diverse perspectives.

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8.2: What Is Diversity, and Why Is Everybody Talking About It?

Questions to Consider:

- Historically, has diversity always been a concern?
- What does it mean to be civil?
- Why do people argue about diversity?

What Would Shakespeare Say?

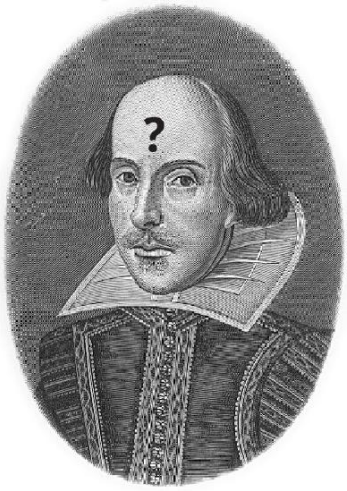


Figure 8.2.1: (Credit: Sourced originally from Helmolt, H.F., ed. History of the World. Dodd, Mead and Company, 1902 / Perry-Castañeda Library, University of Texas at Austin / Wikimedia Commons / Public Domain).

> ***In our classroom, everyone is the same…***

Consider a classroom containing 25 college students and their instructor. In this particular class, all of the students and the instructor share the same racial group—white. In fact, everyone in the class is a white American from the Midwest.

The instructor is leading the class through reading a scene from William Shakespeare's drama *Romeo and Juliet*. As students read their parts, each one is thinking carefully about the role he or she has been given.

One of the male students wonders what it would be like to read the part of Juliet; after all, men originally played the part in Shakespeare's day. The young woman reading Juliet wonders if anyone would object to her taking the role if they knew she was a lesbian. What would it be like, she wonders, if Romeo, her love interest, were also played by a woman? One reader strongly identifies as German American, but he is reading the part of an Italian. Another student has a grandmother who is African American, but he looks like every other white student in the room. No one recognizes his mixed-race heritage.

After the students finish reading the scene, the instructor announces, "In our classroom, everyone is the same, but these days when Shakespeare is staged, there is a tendency for nontraditional casting. Romeo could be black, Juliet could be Latina, Lady Montague could be Asian. Do you think that kind of casting would disrupt the experience of seeing the play?"

In this case, the instructor makes the assumption that because everyone in the class *looks* the same, they *are* the same. What did the instructor miss about the potential for diversity in his classroom? Have you ever made a similar mistake?

Diversity is more than what we can recognize from external clues such as race and gender. Diversity includes many unseen aspects of identity, like sexual orientation, political point of view, veteran status, and many other aspects that you may have not considered. To be inclusive and civil within your community, it is essential that you avoid making assumptions about how other people define or identify themselves.

In this chapter we will discover that each person is more than the sum of surface clues presented to the world. Personal experience, social and family history, public policy, and even geography play a role in how diversity is constructed. We'll also explore elements of civility and fairness within the college community.

One important objective of civility is to become culturally competent. Culturally competent people understand the complexity of their own personal identity, values, and culture. In addition, they respect the personal identities and values of others who may not share their identity and values. Further, culturally competent people remain open-minded when confronted with new cultural

experiences. They learn to relate to and respect difference; they look beyond the obvious and learn as much as they can about what makes each person different and appreciated.

These concepts tie closely to Chapter 8: Communication, particularly the section on Emotional Intelligence and Overcoming Barriers to Communication.

WHAT STUDENTS SAY

1. Do you think the diversity of your school's student body is reflected in course offerings and campus activities?
   a. Yes
   b. Somewhat
   c. No
2. How comfortable are you when discussing issues of race, sexuality, religion, and other aspects of civility?
   a. Extremely comfortable
   b. Somewhat comfortable
   c. Somewhat uncomfortable
   d. Extremely uncomfortable
3. Do you generally feel welcomed and included on campus?
   a. Yes
   b. No
   c. It varies significantly by class or environment.

You can also take the anonymous What Students Say surveys to add your voice to this textbook. Your responses will be included in updates.

Students offered their views on these questions, and the results are displayed in the graphs below.

Do you think the diversity of your school's student body is reflected in course offerings and campus activities?

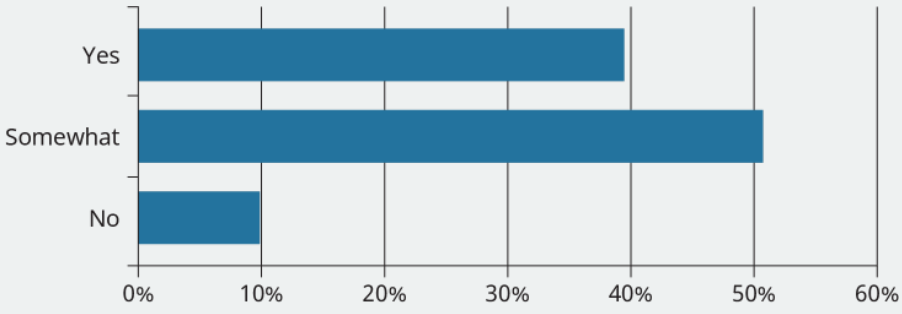


Figure 8.2.3

How comfortable are you when discussing issues of race, sexuality, religion, and other aspects of civility?

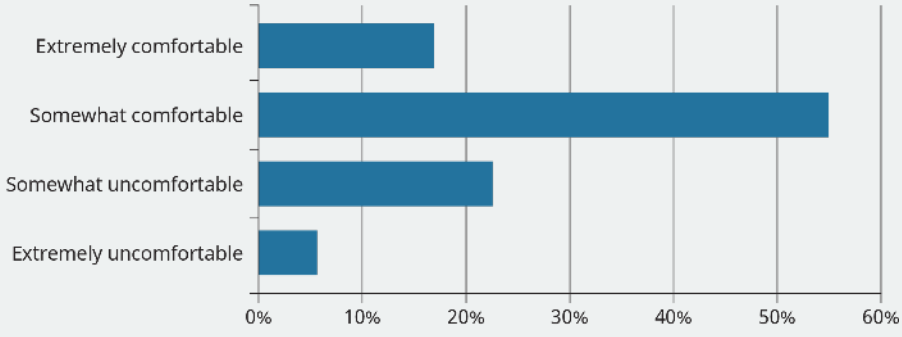


Figure 8.2.4

Do you generally feel welcomed and included on campus?

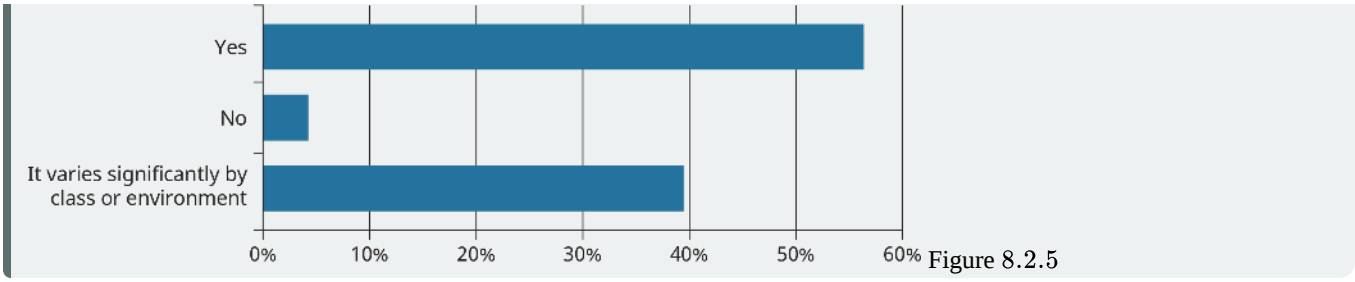


Figure 8.2.5

Why Diversity Matters

The United States of America is viewed the world over as a leader in democracy and democratic ideals. Our nation, young by most standards, continues to evolve to make the freedoms and opportunities available to all. Where the benefits of citizenship have been imperfect, discord over issues related to civil rights and inclusion have often been at the center of the conflict.

To understand the importance of civility and civil engagement, it is necessary to acknowledge our country's history. The United States is a country born out of protest. Colonists protesting what they felt were unfair taxes under King George III was at the foundation of the Revolutionary War. Over time, many groups have been given their civil liberties and equal access to all that our country has to offer through that same spirit of protest and petition.


Figure 8.2.6 (Credit: Carl Campbell / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

The United States is often described as a "melting pot," a rich mixture made up of people of many colors, religions, abilities, etc. working together to make one great big stew. That is the image generations of Americans grew up learning, and it is a true one. The United States is a nation of immigrants, and cultural influences from around the world have added to its strength.

Historically, however, not all contributions and voices have been acknowledged equally or adequately. Some groups have had to struggle to have their contributions acknowledged, be treated fairly, and be allowed full participation in the civic life of the country. Entire populations of people have been oppressed as a part of the nation's history, something important for Americans to confront and acknowledge. For example, in what is known as the Trail of Tears, the U.S. government forcibly removed Native Americans from their homelands and made them walk to reservations; some had to travel more than 1,000 miles, and over 10,000 died on the journey. Further, in an act of forced assimilation, Native American children were taken from their families and placed in schools where they were not allowed to practice cultural traditions or speak their Native languages. This practice continued as late as the 1970s. As a result, many Native American languages have been lost or are at risk of being lost.

The slavery of Africans occurred in America for close to 250 years. Much of the wealth in the United States during that time came directly from the labor of enslaved people; however, the enslaved people themselves did not benefit financially. During World War II, Japanese Americans were placed into internment camps and considered a danger to our country because our nation was at war with Japan.

For many years, all women and minority men were traditionally left out of public discourse and denied participation in government, industry, and even cultural institutions such as sports. For example, the United States Supreme Court was founded in

1789; however, the court's first female justice, Sandra Day O'Connor, was not appointed until 1981, almost 200 years later. Jackie Robinson famously became the first African American major league baseball player in 1947 when he was hired by the Brooklyn Dodgers, although the major leagues were established in 1869, decades earlier. The absence of white women and minorities was not an accident. Their exclusion was based on legal discrimination or unfair treatment.

These are all examples of mistreatment, inequality, and discrimination, and they didn't end without incredible sacrifice and heroism. The civil rights movement of the 1950s and 1960s and the equal rights movement for women's rights in the 1970s are examples of how public protests work to bring attention to discriminatory practices and to create change. Because racism, anti-Semitism, sexism, and other forms of bias and intolerance still exist, civil engagement and protests continue, and policies must be constantly monitored. Many people still work to ensure the gains these communities have made in acquiring the rights of full citizenship are not lost.

Diversity refers to differences in the human experience. As different groups have gained in number and influence, our definition of diversity has evolved to embrace many variables that reflect a multitude of different backgrounds, experiences, and points of view, not just race and gender. Diversity takes into account age, socioeconomic factors, ability (such as sight, hearing, and mobility), ethnicity, veteran status, geography, language, sexual orientation, religion, size, and other factors. At one time or another, each group has had to make petitions to the government for equal treatment under the law and appeals to society for respect. Safeguarding these groups' hard-won rights and public regard maintains diversity and its two closely related factors, *equity* and *inclusion.*

ACTIVITY

Our rights and protections are often acquired through awareness, effort, and, sometimes, protest. Each one of the following groups has launched protests over discrimination or compromises to their civil rights. Choose three of the groups below and do a quick search on protests or efforts members of the group undertook to secure their rights. To expand your knowledge, choose some with which you are not familiar.

Record the name, time frame, and outcomes of the protest or movements you researched.

The groups are as follows:

- Veterans
- Senior citizens
- Blind or visually impaired people
- Muslims
- Christians
- LGBTQ+ community
- Hispanic/Latinos
- People with intellectual disabilities
- Undocumented immigrants
- Little people
- College students
- Jewish Americans
- Farm workers
- Wheelchair users

The Role of Equity and Inclusion

Equity plays a major part in achieving fairness in a diverse landscape. Equity gives everyone equal access to opportunity and success. For example, you may have seen interpreters for deaf or hard of hearing people in situations where a public official is making an announcement about an impending weather emergency. Providing immediate translation into sign language means that there is no gap between what the public official is saying and when all people receive the information. Simultaneous sign language provides equity.[1] Similarly, many students have learning differences that require accommodations in the classroom. For example, a student with attention-deficit/hyperactivity disorder (ADHD) might be given more time to complete tests or writing assignments. The extra time granted takes into account that students with ADHD process information differently.

If a student with a learning difference is given more time than other students to complete a test, that is a matter of equity. The student is not being given an advantage; the extra time gives them an equal chance at success.

The Americans with Disabilities Act (ADA, 1990) is a federal government policy that addresses equity in the workplace, housing, and public places. The ADA requires "reasonable accommodations" so that people with disabilities have equal access to the same services as people without disabilities. For example, wheelchair lifts on public transportation, automatic doors, entrance ramps, and elevators are examples of accommodations that eliminate barriers of participation for people with certain disabilities.

Without the above accommodations, those with a disability may justly feel like second-class citizens because their needs were not anticipated. Further, they might have to use their own resources to gain equal access to services although their tax dollars contribute to providing that same access and service to other citizens.

Equity levels the playing field so that everyone's needs are anticipated and everyone has an equal starting point. However, understanding equity is not enough.

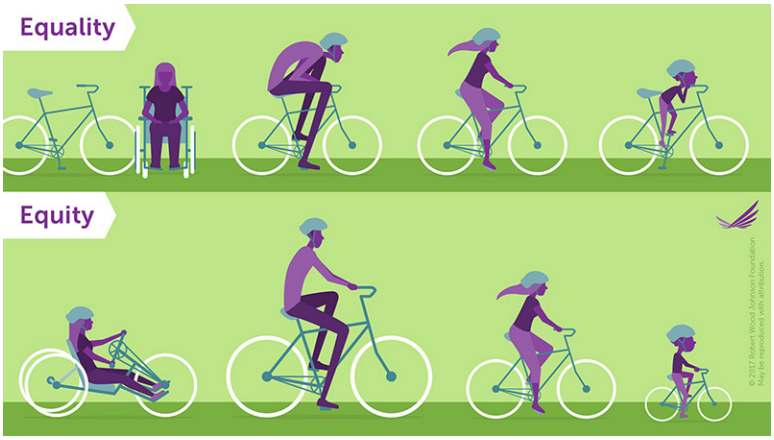


Figure 8.2.7 Equality is a meaningful goal, but it can leave people with unmet needs; equity is more empowering and fair. In equality portion of the graphic, people all sizes and a person who uses a wheelchair are all given the same bicycle, which is unusable for most. In the equity portion, each person gets a bicycle specifically designed for them, enabling them to successfully ride it. Credit: Robert Wood Johnson Foundation / Custom License: "May be Produced with Attribution[2]")

When equity is properly considered, there is also inclusion. *Inclusion* means that there are a multiplicity of voices, skills, and interests represented in any given situation. Inclusion has played a major role in education, especially in terms of creating inclusion classrooms and inclusive curricula. In an inclusion classroom, students of different skill levels study together. For example, students with and without developmental disabilities study in the same classroom. Such an arrangement eliminates the stigma of the "special education classroom" where students were once segregated. In addition, in inclusion classrooms all students receive support when needed. Students benefit from seeing how others learn. In an inclusive curriculum, a course includes content and perspectives from underrepresented groups. For example, a college course in psychology might include consideration of different contexts such as immigration, incarceration, or unemployment in addition to addressing societal norms.

Inclusion means that these voices of varied background and experience are integrated into discussions, research, and assignments rather than ignored.

Our Country Is Becoming More Diverse

You may have heard the phrase "the browning of America," meaning it is predicted that today's racial minorities will, collectively, be the majority of the population in the future. The graph from the Pew Research Center projects that by the year 2065, U.S. demographics will have shifted significantly. In 2019, the white population made up just over 60% of the population. In 2065, the Pew Research Center predicts that whites will be approximately 46% of the population. The majority of Americans will be the non-white majority, 54% Hispanic/Latinos, blacks, and Asians.

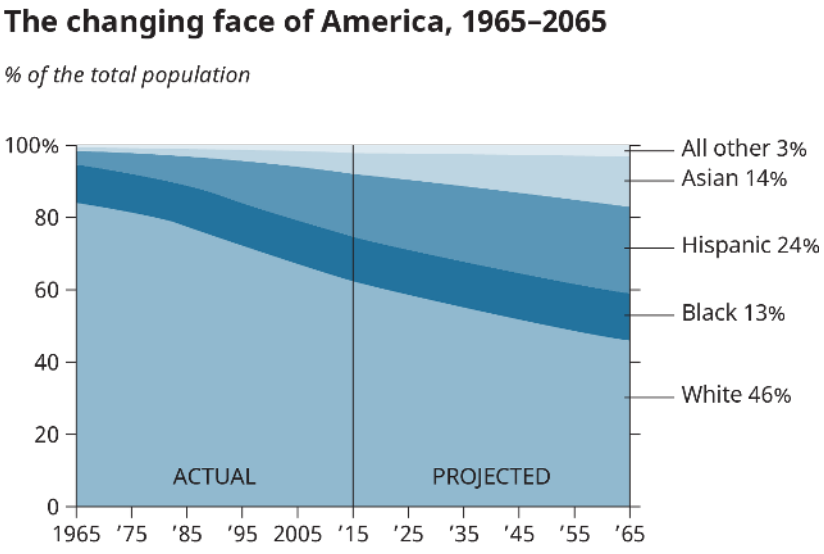


Figure 8.2.8 United States demographics (or statistical characteristics of populations) are changing rapidly. In just over 35 years, the country as a whole will be a "majority minority" nation, with ethnic/racial minorities making up more than half of the population. (Credit: Based on work by the Pew Research Center.)

What does this mean? It could mean that the United States begins accepting Spanish as a mainstream language since the Hispanic/Latino population will be significantly larger. It could mean a changing face for local governments. It could mean that our country will elect its second nonwhite president. Beyond anything specific, the shifting demographics of the United States could mean greater attention is paid to diversity awareness, equity, and inclusion.

ANALYSIS QUESTION

How should the United States prepare for its projected demographic shift? What changes do you suppose will take place as part of the "browning of America"?

Education: Equity for All

Education has been one of the most significant arenas for social change related to our rights as Americans. And the effects of that change have significantly impacted other power dynamics in society. You need look no further than the landmark case *Brown v. Board of Education of Topeka* (1954) to see how our nation has responded passionately in civil and uncivil ways to appeals for equity and inclusion in public education.

For much of the 20th century, African Americans lived under government-sanctioned separation better known as segregation. Not only were schools segregated, but Jim Crow laws allowed for legal separation in transportation, hospitals, parks, restaurants, theaters, and just about every aspect of public life. These laws enacted that there be "whites only" water fountains and restrooms. Only white people could enter the front door of a restaurant or sit on the main level of a movie theater, while African Americans had to enter through the back door and sit in the balcony. The segregation also included Mexican Americans and Catholics, who were forced to attend separate schools. *Brown v. Board of Education* was a landmark Supreme Court case that challenged the interpretation of the 14th Amendment to the Constitution of the United States. The case involved the father of Linda Brown suing the Topeka, Kansas, board of education for denying his daughter the right to attend an all-white school. Oliver Brown maintained that segregation left his black community with inferior schools, a condition counter to the equal protection clause contained in Section I of the 14th Amendment:

> ***"All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and the State wherein they reside. No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws."***

There was widespread heated opposition to desegregated education across the country. Passions were even more severe after *Brown v. Board of Education* was won by the plaintiff on appeal to the United States Supreme Court. In effect, the case changed the power dynamics in America by leveling the playing field for education. No longer were white schools (and their better resources) legally segregated. In principal, there was equity—equal access.

Debates in the courtrooms surrounding *Brown* were passionate but professional. Protests and debate in those communities directly affected by the decision, especially in the South, were intense, violent confrontations that demonstrated the height of incivility. One thing you may notice about uncivil behavior is the difficulty most have looking back on those actions.



Figure 8.2.9 After the Brown v Board of Education decision, Americans pursued their rights for equal education in other districts. In Arkansas, a group of teenagers, which would come to be known as the Little Rock Nine, were blocked from entering a formerly whites-only school. Facing angry protestors, the state governor, and even the National Guard, the nine students finally took their rightful place in the school after a judge ruled in their favor and President Eisenhower sent the 101st Airborne Division to secure the situation. (Credit: Courtesy of the National Archives, sourced from The US Army / Flickr / Attribution 2.0 Generic (CC-BY))

Educational institutions like colleges and school districts are critically important spaces for equity and inclusion, and debates around them remain challenging. Transgender students in America's schools face discrimination, harrassment, and bullying, which causes nearly 45 percent of LGBTQ+ to feel unsafe becuase of their gender expression and 60 percent of to feel unsafe due to their sexual orientation. Many of these students miss school or experience significant stress, which usually has a negative impact on their grades, participation, and overall success.[3] In essence, this hostility creates inequality. Regardless of individual state or district laws on bathroom use and overall accommodation, federal law protects *all* students from discrimination, especially that based on categories such as gender. But implementation of these federal protections varies, and, in general, many outside the transgender community do not fully unerstand, empathize with, or support transgender rights.

How can the circumstances improve for transgender students? In other societal changes throughout our nation's history, court decisions, new legislation, protests, and general public opinion combined to right past wrongs and provide justice and protection for mistreated people. For example, in 2015, the Supreme Court upheld the right to same-sex marriage under the 14th Amendment. Just as African Americans publicly debated and protested educational inequality, the gay community used discusion, protest, and debate to sway public and legal opinion. Proponents of gay marriage faced fervent argument against their position based on religion and culture; like other minority groups, they were confronted with name-calling, job insecurity, family division, religious isolation, and physical confrontation. And as has often been the case, success in achieving marriage equality eventually came through the courts.

Legal remedies are significant, but can take a very long time. Before they see success in the courts or legislatures, transgender students in America's schools will continue to undergo harsh treatment. Their lives and education will remain very difficult until people from outside their community better understand their situation.

Debates: Civility vs. Incivility

Healthy debate is a desirable part of a community. In a healthy debate, people are given room to explain their point of view. In a healthy airing of differences, people on opposing sides of an argument can reach common ground and compromise or even agree to disagree and move on.

However, incivility occurs when people are not *culturally competent*. An individual who is not culturally competent might make negative assumptions about others' values, lack an open mindset, or be inflexible in thinking. Instead of being tolerant of different points of view, they may try to shut down communication by not listening or by keeping someone with a different point of view from being heard at all. Out of frustration, a person who is uncivil may resort to name-calling or discrediting another person only with the intention of causing confusion and division within a community. Incivility can also propagate violence. Such uncivil reaction to difficult issues is what makes many people avoid certain topics at all costs. Instead of seeking out diverse communities, people retreat to safe spaces where they will not be challenged to hear opposing opinions or have their beliefs contested.

Debates on difficult or divisive topics surrounding diversity, especially those promoting orchestrated change, are often passionate. People on each side may base their positions on deeply held beliefs, family traditions, personal experience, academic expertise, and a desire to orchestrate change. With such a strong foundation, emotions can be intense, and debates can become uncivil.

Even when the disagreement is based on information rather than personal feelings, discussions can quickly turn to arguments. For example, in academic environments, it's common to find extremely well-informed arguments in direct opposition to each other. Two well-known economics faculty members from your college could debate for hours on financial policies, with each professor's position backed by data, research, and publications. Each person could feel very strongly that they are right and the other person is wrong. They may even feel that the approach proposed by their opponent would actually do damage to the country or to certain groups of people. But for this debate—whether it occurs over lunch or on an auditorium stage—to remain civil, the participants need to maintain certain standards of behavior.

ACTIVITY

1. Describe a time when you could not reach an agreement with someone on a controversial issue.
2. Did you try to compromise, combining your points of view so that each of you would be partially satisfied?
3. Did either of you shut down communication? Was ending the conversation a good choice? Why or why not?

Civility is a valued practice that takes advantage of cultural and political systems we have in place to work through disagreements while maintaining respect for others' points of view. Civil behavior allows for a respectful airing of grievances. The benefit of civil discussion is that members of a community can hear different sides of an argument, weigh evidence, and decide for themselves which side to support.

You have probably witnessed or taken part in debates in your courses, at social events, or even at family gatherings. What makes people so passionate about certain issues? First, some may have a personal stake in an issue, such as abortion rights. Convincing other people to share their beliefs may be intended to create a community that will protect their rights. Second, others may have deeply held beliefs based on faith or cultural practices. They argue based on deeply held moral and ethical beliefs. Third, others may be limited in their background knowledge about an issue but are able to speak from a "script" of conventional points of view. They may not want to stray from the script because they do not have enough information to extend an argument.

Rules for Fair Debate



Figure 8.2.10 You'll participate in classroom or workplace debate throughout your academic or professional career. Civility is important to productive discussions, and will lead to worthwhile outcomes. (Credit: Creative Sustainability / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

The courtroom and the public square are not the only places where serious debate takes place. Every day we tackle tough decisions that involve other people, some of whom have strong opposing points of view. To be successful in college, you will need to master sound and ethical approaches to argument, whether it be for a mathematical proof or an essay in a composition class.

You probably already know how to be sensitive and thoughtful when giving feedback to a family member or friend. You think about their feelings and the best way to confront your disagreement without attacking them. Of course, sometimes it's easier to be less sensitive with people who love you no matter what. Still, whether in a classroom, a workplace, or your family dinner table, there are rules for debating that help people with opposing points of view get to the heart of an issue while remaining civil:

1. Avoid direct insults and personal attacks—the quickest way to turn someone away from your discussion is to attack them personally. This is actually a common logical fallacy called ad hominem, which means "to the person," and it means to attack the person rather than the issue.
2. Avoid generalizations and extreme examples—these are two more logical fallacies called bandwagon, or ad populum, and reduction to absurdity, or argumentum ad absurdum. The first is when you argue that everyone is doing something so it must be right. The second is when you argue that a belief or position would lead to an absurd or extreme outcome.
3. Avoid appealing to emotions rather than facts—it's easy to get emotional if you're debating something about which you feel passionate. Someone disagreeing with you can feel like a personal affront. This fallacy, called argument to compassion, appeals to one's emotions and happens when we mistake feelings for facts. While strong and motivating, our feelings are not great arbiters of the truth.
4. Avoid irrelevant arguments—sometimes it's easy to change the subject when we're debating, especially if we feel flustered or like we're not being heard. Irrelevant conclusion is the fallacy of introducing a topic that may or may not be sound logic but is not about the issue under debate.
5. Avoid appeal to bias—you may not have strong opinions on every topic but, no doubt, you are opinionated about things that matter to you. This strong view can create a bias, or a leaning toward an idea or belief. While there's nothing wrong with having a strong opinion, you must be mindful to ensure that your bias doesn't create prejudice. Ask yourself if your biases influence the ways in which you interact with other people and with ideas that differ from your own.
6. Avoid appeal to tradition—just because something worked in the past or was true in the past does not necessarily mean that it is true today. It's easy to commit this fallacy, as we often default to "If it ain't broke, don't fix it." It's appealing because it seems to be common sense. However, it ignores questions such as whether the existing or old policy truly works as well as it could and if new technology or new ways of thinking can offer an improvement. Old ways can certainly be good ways, but not simply because they are old.
7. Avoid making assumptions—often, we think we know enough about a topic or maybe even more than the person talking, so we jump ahead to the outcome. We assume we know what they're referring to, thinking about, or even imagining, but this is a dangerous practice because it often leads to misunderstandings. In fact, most logical fallacies are the result of assuming.
8. Strive for root cause analysis—getting at the root cause of something means to dig deeper and deeper until you discover why a problem or disagreement occurred. Sometimes, the most obvious or immediate cause for a problem is not actually the most significant one. Discovering the root cause can help to resolve the conflict or reveal that there isn't one at all.
9. Avoid obstinacy—in the heat of a debate, it's easy to dig in your heels and refuse to acknowledge when you're wrong. Your argument is at stake, and so is your ego. However, it's important to give credit where it's due and to say you're wrong if you are. If you misquoted a fact or made an incorrect assumption, admit to it and move on.

10. Strive for resolution—while some people like to debate for the sake of debating, in the case of a true conflict, both parties should seek agreement, or at least a truce. One way to do this is to listen more than you speak. Listen, listen, listen: you'll learn and perhaps make better points of your own if you deeply consider the other point of view.

ANALYSIS QUESTION

Have you ever witnessed incivility in person or an argument in the news? Briefly describe what happened. Why do you think individuals are willing to shut down communication over issues they are passionate about?

Online Civility

The Internet is the watershed innovation of our time. It provides incredible access to information and resources, helping us to connect in ways inconceivable just a few decades ago. But it also presents risks, and these risks seem to be changing and increasing at the same rate as technology itself. Because of our regular access to the Internet, it's important to create a safe, healthy, and enjoyable online space.

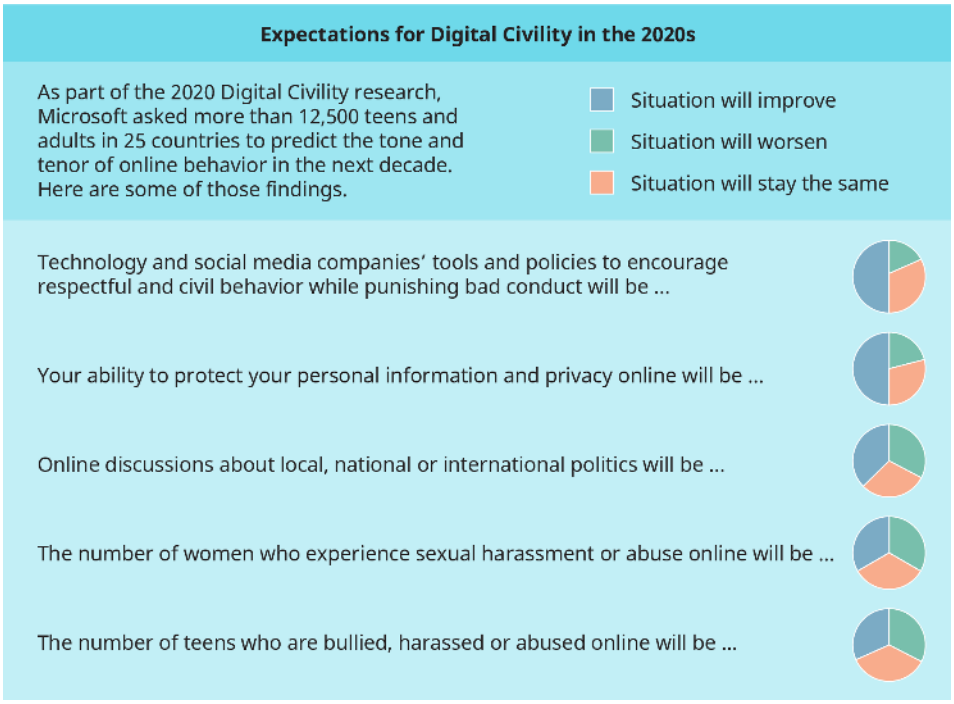


Figure 8.2.11: Microsoft's Digital Civility Research survey asked people their opinions on the future of online behavior and communication. While in some cases, the respondents thought circumstances would improve, predictions about the others, such as harassment and bullying, are more bleak. (Credit: Based on work from Microsoft, "Expectations for Digital Civility 2020."[4])

In the survey conducted by Microsoft, "nearly 4 in 10 [respondents] feel unwanted online contact (39%), bullying (39%) and unwelcome sexual attention (39%) will worsen [in 2020]. A slightly smaller percentage (35%) expect people's reputations, both professional and personal, will continue to be attacked online. One-quarter (25%) of respondents see improvement across each of these risk areas in 2020."

Digital civility is the practice of leading with empathy and kindness in all online interactions and treating each other with respect and dignity. This type of civility requires users to fully understand and appreciate potential harms and to follow the new rules of the digital road. You can find a discussion on best practices for online communication, often referred to as Netiquette, in Chapter 8 on Communicating. Following, are some basic guidelines to help exercise digital civility:

- **Live the "Golden Rule"** and treat others with respect and dignity both online and off.
- **Respect differences** of culture, geography, and opinion, and when disagreements surface, engage thoughtfully.
- **Pause before replying** to comments or posts you disagree with, and ensure responses are considerate and free of name-calling and abuse.
- **Stand up for yourself and others** if it's safe and prudent to do so.

Footnotes

- 1 https://www.nad.org/resources/americ...ked-questions/
- 2 https://www.rwjf.org/en/library/info...html#/download
- 3 2017 National School Climate Survey, GLESN. https://www.glsen.org/research/school-climate-survey
- 4 Expectations for Digital Civility. Note: Link leads to direct download.

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8.3: Categories of Diversity

Questions to consider:

- What is identity?
- Can a person have more than one identity?
- Can identity be ambiguous?
- What are fluidity and intersectionality?

The multiple roles we play in life—student, sibling, employee, roommate, for example—are only a partial glimpse into our true identity. Right now, you may think, "I really don't know what I want to be," meaning you don't know what you want to do for a living, but have you ever tried to define yourself in terms of the sum of your parts?

Social roles are those identities we assume in relationship to others. Our social roles tend to shift based on where we are and who we are with. Taking into account your social roles as well as your nationality, ethnicity, race, friends, gender, sexuality, beliefs, abilities, geography, etc., who are you?

Who Am I?

Popeye, a familiar 20th-century cartoon character, was a sailor-philosopher. He declared his own identity in a circular manner, landing us right where we started: "I am what I am and that's all that I am." Popeye proves his existence rather than help us identify him. It is his title, "The Sailor Man," that tells us how Popeye operates in the social sphere.

According to the American Psychological Association, personal identity is an individual's sense of self defined by (a) a set of physical, psychological, and interpersonal characteristics that is not wholly shared with any other person and (b) a range of affiliations (e.g., ethnicity) and social roles. Your identity is tied to the most dominant aspects of your background and personality.[1] It determines the lens through which you see the world and the lens through which you receive information.

ACTIVITY

Complete the following statement using no more than four words:

I am _____.

It is difficult to narrow down our identity to just a few options. One way to complete the statement would be to use gender and geography markers. For example, "I am a male New Englander" or "I am an American woman." Assuming they are true, no one can argue against those identities, but do those statements represent everything or at least most things that identify the speakers? Probably not.

Try finishing the statement again by using as many words as you wish.

I am _____.

If you ended up with a long string of descriptors that would be hard for a new acquaintance to manage, don't worry. Our identities are complex and reflect that we lead interesting and multifaceted lives.

To better understand identity, consider how social psychologists describe it. Social psychologists, those who study how social interactions take place, often categorize identity into four types: personal identity, role identity, social identity, and collective identity.

Personal identity captures what distinguishes one person from another based on life experiences. No two people, even identical twins, live the same life.

Role identity defines how we interact in certain situations. Our roles change from setting to setting, and so do our identities. At work you may be a supervisor; in the classroom you are a peer working collaboratively; at home, you may be the parent of a 10-year-old. In each setting, your bubbly personality may be the same, but how your coworkers, classmates, and family see you is different.

Social identity shapes our public lives by our awareness of how we relate to certain groups. For example, an individual might relate to or "identify with" Korean Americans, Chicagoans, Methodists, and Lakers fans. These identities influence our interactions with others. Upon meeting someone, for example, we look for connections as to how we are the same or different. Our awareness

of who we are makes us behave a certain way in relation to others. If you identify as a hockey fan, you may feel an affinity for someone else who also loves the game.

Collective identity refers to how groups form around a common cause or belief. For example, individuals may bond over similar political ideologies or social movements. Their identity is as much a physical formation as a shared understanding of the issues they believe in. For example, many people consider themselves part of the collective energy surrounding the #metoo movement. Others may identify as fans of a specific type of entertainment such as Trekkies, fans of the Star Trek series.

"I am large. I contain multitudes." Walt Whitman

In his epic poem *Song of Myself*, Walt Whitman writes, "Do I contradict myself? Very well then I contradict myself (I am large. I contain multitudes.)." Whitman was asserting and defending his shifting sense of self and identity. Those lines importantly point out that our identities may evolve over time. What we do and believe today may not be the same tomorrow. Further, at any one moment, the identities we claim may seem at odds with each other. Shifting identities are a part of personal growth. While we are figuring out who we truly are and what we believe, our sense of self and the image that others have of us may be unclear or ambiguous.

Many people are uncomfortable with identities that do not fit squarely into one category. How do you respond when someone's identity or social role is unclear? Such ambiguity may challenge your sense of certainty about the roles that we all play in relationship to one another. Racial, ethnic, and gender ambiguity, in particular, can challenge some people's sense of social order and social identity.

When we force others to choose only one category of identity (race, ethnicity, or gender, for example) to make ourselves feel comfortable, we do a disservice to the person who identifies with more than one group. For instance, people with multiracial ancestry are often told that they are too much of one and not enough of another.

The actor Keanu Reeves has a complex background. He was born in Beirut, Lebanon, to a white English mother and a father with Chinese-Hawaiian ancestry. His childhood was spent in Hawaii, Australia, New York, and Toronto. Reeves considers himself Canadian and has publicly acknowledged influences from all aspects of his heritage. Would you feel comfortable telling Keanu Reeves how he must identify racially and ethnically?

There is a question many people ask when they meet someone whom they cannot clearly identify by checking a specific identity box. Inappropriate or not, you have probably heard people ask, "What are you?" Would it surprise you if someone like Keanu Reeves shrugged and answered, "I'm just me"?

Malcom Gladwell is an author of five New York Times best-sellers and is hailed as one of Foreign Policy's Top Global Thinkers. He has spoken on his experience with identity as well. Gladwell has a black Jamaican mother and a white Irish father. He often tells the story of how the perception of his hair has allowed him to straddle racial groups. As long as he kept his hair cut very short, his fair skin obscured his black ancestry, and he was most often perceived as white. However, once he let his hair grow long into a curly Afro style, Gladwell says he began being pulled over for speeding tickets and stopped at airport check-ins. His racial expression carried serious consequences.



Figure 8.3.12 Writer Malcolm Gladwell's racial expression has impacted his treatment by others and his everyday experiences. (Credit: Kris Krug, Pop!Tech / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Gender

More and more, gender is also a diversity category that we increasingly understand to be less clearly defined. Some people identify themselves as gender fluid or non-binary. "Binary" refers to the notion that gender is only one of two possibilities, male or female. Fluidity suggests that there is a range or continuum of expression. Gender fluidity acknowledges that a person may vacillate between male and female identity.

Asia Kate Dillon is an American actor and the first non-binary actor to perform in a major television show with their roles on *Orange is the New Black* and *Billions*. In an article about the actor, a reporter conducting the interview describes his struggle with trying to describe Dillon to the manager of the restaurant where the two planned to meet. The reporter and the manger struggle with describing someone who does not fit a pre-defined notion of gender identity. Imagine the situation: You're meeting someone at a restaurant for the first time, and you need to describe the person to a manager. Typically, the person's gender would be a part of the description, but what if the person cannot be described as a man or a woman?

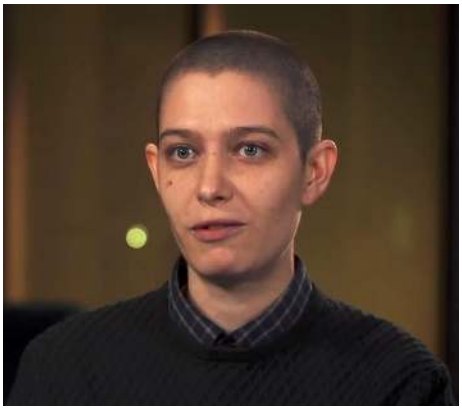


Figure 8.3.13 Asia Kate Dillon is a non-binary actor best known for their roles on *Orange Is the New Black* and *Billions*. (Credit: *Billions* Official Youtube Channel / Wikimedia Commons / Attribution 3.0 Unported (CC-BY 3.0))

Within any group, individuals obviously have a right to define themselves; however, collectively, a group's self-determination is also important. The history of black Americans demonstrates a progression of self-determined labels: Negro, Afro-American, colored, black, African American. Similarly, in the nonbinary community, self-described labels have evolved. Nouns such as *genderqueer* and pronouns such as *hir, ze*, and *Mx*. (instead of *Miss, Mrs. or Mr.)* have entered not only our informal lexicon, but the dictionary as well.

> ***Merriam-Webster's dictionary includes a definition of "they" that denotes a nonbinary identity, that is, someone who fluidly moves between male and female identities.***

Transgender men and women were assigned a gender identity at birth that does not fit their true identity. Even though our culture is increasingly giving space to non-heteronormative (straight) people to speak out and live openly, they do so at a risk. Violence against gay, nonbinary, and transgender people occurs at more frequent rates than for other groups.

To make ourselves feel comfortable, we often want people to fall into specific categories so that our own social identity is clear. However, instead of asking someone to make us feel comfortable, we should accept the identity people choose for themselves. Cultural competency includes respectfully addressing individuals as they ask to be addressed.

Table 9.1 The website Transstudent.org provides educational resources such as the above graphic for anyone seeking clarity on gender identity. Note that these are only examples of some gender pronouns, not a complete list.

Table Gender Pronoun Examples				
Subjective	**Objective**	**Possessive**	**Reflexive**	**Example**
She	Her	Hers	Herself	She is speaking. I listened to her. The backpack is hers.
He	Him	His	Himself	He is speaking. I listened to him. The backpack is his.
They	Them	Theirs	Themself	They are speaking. I listened to them. The backpack is theirs.
Ze	Hir/Zir	Hirs/Zirs	Hirself/Zirself	Ze is speaking. I listened to hir. The backpack is zirs.

Intersectionality

The many layers of our multiple identities do not fit together like puzzle pieces with clear boundaries between one piece and another. Our identities overlap, creating a combined identity in which one aspect is inseparable from the next.

The term intersectionality was coined by legal scholar Kimberlé Crenshaw in 1989 to describe how the experience of black women was a unique combination of gender and race that could not be divided into two separate identities. In other words, this group could not be seen solely as women or solely as black; where their identities overlapped is considered the “intersection,” or crossroads, where identities combine in specific and inseparable ways.

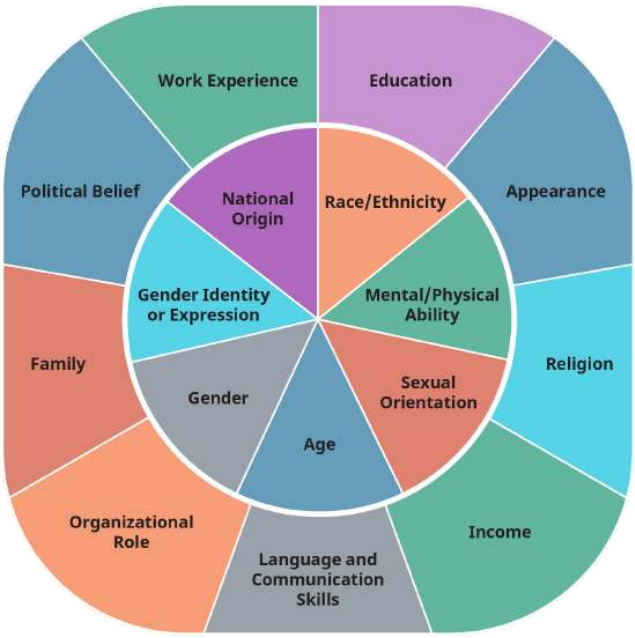


Figure 8.3.14 Our identities are formed by dozens of factors, sometimes represented in intersection wheels. Consider the subset of identity elements represented here. Generally, the outer ring are elements that may change relatively often, while the inner circle are often considered more permanent. (There are certainly exceptions.) How does each contribute to who you are, and how would possible change alter your self-defined identity?

Intersectionality and awareness of intersectionality can drive societal change, both in how people see themselves and how they interact with others. That experience can be very inward-facing, or can be more external. It can also lead to debate and challenges. For example, the term “Latinx” is growing in use because it is seen as more inclusive than “Latino/Latina,” but some people—including scholars and advocates—lay out substantive arguments against its use. While the debate continues, it serves as an important reminder of a key element of intersectionality: Never assume that all people in a certain group or population feel the same way. Why not? Because people are more than any one element of their identity; they are defined by more than their race, color, geographic origin, gender, or socio-economic status. The overlapping aspects of each person’s identity and experiences will create a unique perspective.

ANALYSIS QUESTION

Consider the intersectionality of race, gender, and sexuality; religion, ethnicity, and geography; military experience; age and socioeconomic status; and many other ways our identities overlap. Consider how these overlap in you.

Do you know people who talk easily about their various identities? How does it inform the way you interact with them?

Footnotes

1. APA Dictionary of Psychology https://dictionary.apa.org/identity proper citation to come

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8.4: Navigating the Diversity Landscape

Questions to consider:

- What happens when we make assumptions about others?
- Are microaggressions honest mistakes?
- How do I know if I have a diversity "problem"?
- How important is diversity awareness in the college classroom?

Avoid Making Assumptions

By now you should be aware of the many ways diversity can be both observable and less apparent. Based on surface clues, we may be able to approximate someone's age, weight, and perhaps their geographical origin, but even with those observable characteristics, we cannot be sure about how individuals define themselves. If we rely too heavily on assumptions, we may be buying into stereotypes, or generalizations.

Stereotyping robs people of their individual identities. If we buy into stereotypes, we project a profile onto someone that probably is not true. Prejudging people without knowing them, better known as prejudice or bias, has consequences for both the person who is biased and the individual or group that is prejudged. In such a scenario, the intimacy of real human connections is lost. Individuals are objectified, meaning that they only serve as symbolic examples of who we assume they are instead of the complex, intersectional individuals we know each person to be.

Stereotyping may be our way of avoiding others' complexities. When we stereotype, we do not have to remember distinguishing details about a person. We simply write their stories for ourselves and let those stories fulfill who we expect those individuals to be. For example, a hiring manager may project onto an Asian American the stereotype of being good at math, and hire her as a researcher over her Hispanic counterpart. Similarly, an elementary school teacher may recruit an Indian American sixth-grader to the spelling bee team because many Indian American students have won national tournaments in the recent past. A real estate developer may hire a gay man as an interior designer because he has seen so many gay men performing this job on television programs. A coach chooses a white male student to be a quarterback because traditionally, quarterbacks have been white men. In those scenarios, individuals of other backgrounds, with similar abilities, may have been overlooked because they do not fit the stereotype of who others suspect them to be.

Earlier in this chapter, equity and inclusion were discussed as going hand in hand with achieving civility and diversity. In the above scenarios, equity and inclusion are needed as guiding principles for those with decision-making power who are blocking opportunity for nontraditional groups. Equity might be achieved by giving a diverse group of people access to internships to demonstrate their skills. Inclusion might be achieved by assembling a hiring or recruiting committee that might have a better chance of seeing beyond stereotypical expectations.

APPLICATION

Often, our assumptions and their impacts are not life-changing, but they can be damaging to others and limiting to our own understanding. Consider the following scenarios, and answer the questions that follow.

Scenario 1:

During an in-class conversation about a new mission to explore Mars, two classmates offer opinions.

- Student A says, "We should focus on this planet before we focus on others."
- Student B responds immediately with, "If we're going to stop climate change, we'll probably find the answer through science related to space travel."

What assumption did student B make about student A's point? What else, aside from climate change, could student A have been considering?

Scenario 2:

For an important group project, an instructor designates teams of six students and gives them time to set up their work schedule for the assignment. One group of students, most of whom don't know each other well, agrees to meet two nights later. They initially propose to get together in the library, but at the last moment one member suggests an off-campus restaurant; several of the others agree right away and move on to other topics. The remaining two students look at each other uncomfortably. One

interjects, suggesting they go back to the original idea of meeting in the library, but the others are already getting up to leave. It's clear that two of the students are uncomfortable meeting at the restaurant.

What might be the reason that two of the students are not comfortable meeting over dinner? What assumptions did the others make?

Being civil and inclusive does not require a deep-seated knowledge of the backgrounds and perspectives of everyone you meet. That would be impossible. But avoiding assumptions and being considerate will build better relationships and provide a more effective learning experience. It takes openness and self-awareness and sometimes requires help or advice, but learning to be sensitive—practicing assumption avoidance—is like a muscle you can strengthen.

Be Mindful of Microaggressions

Whether we mean to or not, we sometimes offend people by not thinking about what we say and the manner in which we say it. One danger of limiting our social interactions to people who are from our own social group is in being insensitive to people who are not like us. The term *microaggression* refers to acts of insensitivity that reveal our inherent biases, cultural incompetency, and hostility toward someone outside of our community. Those biases can be toward race, gender, nationality, or any other diversity variable. The individual on the receiving end of a microaggression is reminded of the barriers to complete acceptance and understanding in the relationship. Let's consider an example.

Ann is new to her office job. Her colleagues are friendly and helpful, and her first two months have been promising. She uncovered a significant oversight in a financial report, and, based on her attention to detail, was put on a team working with a large client. While waiting in line at the cafeteria one day, Ann's new boss overhears her laughing and talking loudly with some colleagues. He then steps into the conversation, saying, "Ann, this isn't a night at one of your clubs. Quiet down." As people from the nearby tables look on, Ann is humiliated and angered.

What was Ann's manager implying? What could he have meant by referring to "*your* clubs?" How would you feel if such a comment were openly directed at you? One reaction to this interaction might be to say, "So what? Why let other people determine how you feel? Ignore them." While that is certainly reasonable, it may ignore the pain and invalidation of the experience. And even if you could simply ignore some of these comments, there is a compounding effect of being frequently, if not constantly, barraged by such experiences.

Consider the table below, which highlights common examples of microaggressions. In many cases, the person speaking these phrases may not mean to be offensive. In fact, in some cases the speaker might think they are being *nice*. However, appropriate terminology and other attitudes or acceptable descriptions change all the time. Before saying something, consider how a person could take the words differently than you meant them. As we discussed in Chapter 8, emotional intelligence and empathy can help understand another's perspective.

Table 9.2 Have you made statements like these, perhaps without realizing the offense they might cause? Some of these could be intended as compliments, but they could have the unintended effect of diminishing or invalidating someone. (Credit: Modification of work by Derald Wing Sue[1].)

Microaggressions		
Category	**Microaggression**	**Why It's Offensive**
Educational Status or Situation	"You're an athlete; you don't need to study."	Stereotypes athletes and ignores their hard work.
	"You don't get financial aid; you must be rich.	"Even an assumption of privilege can be invalidating.
	"Did they have honors classes at your high school?"	Implies that someone is less prepared or intelligent based on their geography.
Race, Ethnicity, National Origin"	You speak so well for someone like you."	Implies that people of a certain race/ethnicity can't speak well.
	"No, where are you *really* from?"	Calling attention to someone's national origin makes them feel separate."

	Microaggressions	
	You must be good at _____.”	Falsely connects identity to ability.
	“My people had it so much worse than yours did.”	Makes assumptions and diminishes suffering/difficulty.
	“I’m not even going to try your name. It looks too difficult.”	Dismisses a person’s culture and heritage.
	“It’s so much easier for black people to get into college.”	Assumes that merit is not the basis for achievement.
Gender and Gender Identity	“They’re *so* emotional.”	Assumes a person cannot be emotional and rational.
	“I guess you can’t meet tonight because you have to take care of your son?”	Assumes a parent (of any gender) cannot participate.
	“I don’t get all this pronoun stuff, so I’m just gonna call you what I call you.”	Diminishes the importance of gender identity; indicates a lack of empathy.
	“I can’t even tell you used to be a woman.”	Conflates identity with appearance, and assumes a person needs someone else’s validation.
	“You’re too good-looking to be so smart.”	Connects outward appearance to ability.
Sexual Orientation	“I support you; just don’t throw it in my face.”	Denies another person’s right to express their identity or point of view.
	“You seem so rugged for a gay guy.”	Stereotypes all gay people as being “not rugged,” and could likely offend the recipient.
	“I might try being a lesbian.”	May imply that sexual orientation is a choice.
	“I can’t even keep track of all these new categories.”	Bisexual, pansexual, asexual, and other sexual orientations are just as valid and deserving of respect as more binary orientations.
	“You can’t just love whomever you want; pick one.”	
Age	“Are you going to need help with the software?”	May stereotype an older person as lacking experience with the latest technology.
	“Young people have it so easy nowadays.”	Makes a false comparison between age and experience.
	“Okay, boomer.”	Dismisses an older generation as out of touch.
Size	“I bet no one messes with you.”	Projects a tendency to be aggressive onto a person of large stature.
	“You are so cute and tiny.”	Condescending to a person of small stature.
	“I wish I was thin and perfect like you.”	Equates a person’s size with character.
Ability	(To a person using a wheelchair) “I wish I could sit down wherever I went.”	Falsely assumes a wheelchair is a luxury; minimizes disabilities.

	Microaggressions	
	"You don't have to complete the whole test. Just do your best."	Assumes that a disability means limited intellectual potential.
	"I'm blind without my glasses."	Equating diminished capacity with a true disability.

Everyone Has a Problem: Implicit Bias

One reason we fall prey to stereotypes is our own implicit bias. Jo Handelsman and Natasha Sakraney, who developed science and technology policy during the Obama administration, defined implicit bias.

According to Handelsman and Sakraney, "A lifetime of experience and cultural history shapes people and their judgments of others. Research demonstrates that most people hold unconscious, implicit assumptions that influence their judgments and perceptions of others. Implicit bias manifests in expectations or assumptions about physical or social characteristics dictated by stereotypes that are based on a person's race, gender, age, or ethnicity. People who intend to be fair, and believe they are egalitarian, apply biases unintentionally. Some behaviors that result from implicit bias manifest in actions, and others are embodied in the absence of action; either can reduce the quality of the workforce and create an unfair and destructive environment."[2]

The notion of bias being "implicit," or unconsciously embedded in our thoughts and actions, is what makes this characteristic hard to recognize and evaluate. You may assume that you hold no racial bias, but messages from our upbringing, social groups, and media can feed us negative racial stereotypes no matter how carefully we select and consume information. Further, online environments have algorithms that reduce our exposure to diverse points of view. Psychologists generally agree that implicit bias affects the judgements we make about others.

Harvard University's Project Implicit website offers an interactive implicit association test that measures individual preference for characteristics such as weight, skin color, and gender. During the test, participants are asked to match a series of words and images with positive or negative associations. Test results, researchers suggest, can indicate the extent to which there is implicit bias in favor of or against a certain group. Completing a test like this might reveal unconscious feelings you were previously aware you had.

The researchers who developed the test make clear that there are limitations to its validity and that for some, the results of the test can be unsettling. The test makers advise not taking the test if you feel unprepared to receive unexpected results.

APPLICATION

Take the Project Implicit test and write a brief passage about your results.

Do you think the results accurately reflect your attitude toward the group you tested on? Can you point to any actions or thoughts you have about the group you tested on that are or are not reflected in the test results? Will you change any behaviors or try to think differently about the group you tested on based on your results? Why or why not?

Cultural Competency in the College Classroom

We carry our attitudes about gender, ethnicity, sexual orientation, age, and other diversity categories with us wherever we go. The college classroom is no different than any other place. Both educators and students maintain their implicit bias and are sometimes made uncomfortable by interacting with people different than themselves. Take for example a female freshman who has attended a school for girls for six years before college. She might find being in the classroom with her new male classmates a culture shock and dismiss male students' contributions to class discussions. Similarly, a homeschooled student may be surprised to find that no one on campus shares his religion. He may feel isolated in class until he finds other students of similar background and experience. Embedded in your classroom may be peers who are food insecure, undocumented, veterans, atheist, Muslim, or politically liberal or conservative. These identities may not be visible, but they still may separate and even marginalize these members of your community. If, in the context of classroom conversations, their perspectives are overlooked, they may also feel very isolated.

In each case, the students' assumptions, previous experience with diversity of any kind, and implicit bias surface. How each student reacts to the new situation can differ. One reaction might be to self-segregate, that is, locate people they believe are similar to them based on how they look, the assumption being that those people will share the same academic skills, cultural interests, and personal

values that make the student feel comfortable. The English instructor at the beginning of this chapter who assumed all of his students were the same demonstrated how this strategy could backfire.

You do not have to be enrolled in a course related to diversity, such as Asian American literature, to be concerned about diversity in the classroom. Diversity touches all aspects of our lives and can enter a curriculum or discussion at any time because each student and the instructor bring multiple identities and concerns into the classroom. Ignoring these concerns, which often reveal themselves as questions, makes for an unfulfilling educational experience.

In higher education, diversity includes not only the identities we have discussed such as race and gender, but also academic preparation and ability, learning differences, familiarity with technology, part-time status, language, and other factors students bring with them. Of course, the instructor, too, brings diversity into the classroom setting. They decide how to incorporate diverse perspectives into class discussions, maintain rules of civility, choose inclusive materials to study or reference, receive training on giving accommodations to students who need them, and acknowledge their own implicit bias. If they are culturally competent, both students and instructors are juggling many concerns.

How do you navigate diversity in the college classroom?

Academic Freedom Allows for Honest Conversations

Academic freedom applies to the permission instructors and students have to follow a line of intellectual inquiry without the fear of censorship or sanction. There are many heavily contested intellectual and cultural debates that, for some, are not resolved. A student who wants to argue against prevailing opinion has the right to do so based on academic freedom. Many point to a liberal bias on college campuses. Conservative points of view on immigration, education, and even science, are often not accepted on campus as readily as liberal viewpoints. An instructor or student who wants to posit a conservative idea, however, has the right to do so because of academic freedom.

Uncomfortable conversations about diversity are a part of the college classroom landscape. For example, a student might use statistical data to argue that disparities in degrees for men and women in chemistry reflect an advantage in analytical ability for men. While many would disagree with that theory, the student could pursue that topic in a discussion or paper as long as they use evidence and sound, logical reasoning.

“I’m just me.”

Remember the response to the “What are you?” question for people whose racial or gender identity was ambiguous? “I’m just me” also serves those who are undecided about diversity issues or those who do not fall into hard categories such as feminist, liberal, conservative, or religious. Ambiguity sometimes makes others feel uncomfortable. For example, if someone states she is a Catholic feminist unsure about abortion rights, another student may wonder how to compare her own strong pro-life position to her classmate’s uncertainty. It would be much easier to know exactly which side her classmate is on. Some people straddle the fence on big issues, and that is OK. You do not have to fit neatly into one school of thought. Answer your detractors with “I’m just me,” or tell them if you genuinely don’t know enough about an issue or are not ready to take a strong position.

Seek Resources and Projects That Contribute to Civility

A culturally responsive curriculum addresses cultural and ethnic differences of students. Even in classrooms full of minority students, the textbooks and topics may only reflect American cultural norms determined by the mainstream and tradition. Students may not relate to teaching that never makes reference to their socio-economic background, race, or their own way of thinking and expression. Educators widely believe that a culturally responsive curriculum, one that integrates relatable contexts for learning and reinforces cultural norms of the students receiving the information, makes a difference.

The K-12 classroom is different than the college classroom. Because of academic freedom, college instructors are not required to be culturally inclusive. (They *are* usually required to be respectful and civil, but there are different interpretations of those qualities.) Because American colleges are increasingly more sensitive to issues regarding diversity, faculty are compelled to be inclusive. Still, diversity is not always adequately addressed. In his TED “Talk Can Art Amend History?” the artist Titus Kaphar tells the story of the art history class that influenced him to become an artist and provides an example of this absence of diversity in the college classroom. Kaphar explains that his instructor led his class through important periods and artists throughout history, but failed to spend time on black artists, something that Kaphar was anxiously awaiting. The instructor stated that there was just not enough time to cover it. While the professor probably did not intend to be noninclusive, her choice resulted in just that. Kaphar let his disappointment fuel his passion and mission to amend the representation of black figures in historical paintings. His work brings to light the unnoticed black figures that are too often overlooked.



Figure 8.4.15 In *Twisted Tropes*, Titus Kaphar reworks a painting to bring a black figure to the forefront of an arrangement in which she had previously been marginalized. (Credit: smallcurio / Flickr / Attribution 2.0 Generic (CC-BY 2.0))

Any student can respond to a lack of diversity in a curriculum as Titus Kaphar did. Where you find diversity missing, when possible, fill in the gaps with research papers and projects that broaden your exposure to diverse perspectives. Take the time to research contributions in your field by underrepresented groups. Discover the diversity issues relevant to your major. Are women well-represented in your field? Is there equity when it comes to access to opportunities such as internships? Are veterans welcomed? Do the academic societies in your discipline have subgroups or boards focused on diversity and equity? (Most do.) Resources for expanding our understanding and inclusion of diversity issues are all around us.

Directly Confront Prejudice

To draw our attention to possible danger, the Department of Homeland Security has adopted the phrase, "If you see something, say something." That credo can easily be adopted to confront stereotypes and bias: "If you hear something, say something." Academic freedom protects students and instructors from reprisal for having unpopular opinions, but prejudice is never correct, nor should it be tolerated. Do not confuse hate speech, such as sexist language, anti-Semitism, xenophobia, and acts that reflect those points of view, with academic freedom. Yes, the classroom is a place to discuss these attitudes, but it is not a place to direct those sentiments toward fellow students, educators, or society in general.

Most higher education institutions have mission statements and codes of conduct that warn students about engaging in such behavior. The consequences for violators are usually probation and possibly dismissal. Further policies such as affirmative action and Title IX are instituted to evaluate and maintain racial and gender equity.

APPLICATION

No one knows when a racist or sexist attack is coming. The Barnard Center for Research on Women has created a video suggesting ways to be an ally to people victimized by intolerant behavior.

Affirmative Action and Higher Education

Affirmative action is a policy that began during the John F. Kennedy administration to eliminate discrimination in employment. Since that time, it has expanded as a policy to protect from discrimination in a number of contexts, including higher education. Most notably in higher education, affirmative action has been used to create equity in access. Institutions have used affirmative action as a mandate of sorts in admission policies to create diverse student bodies. Colleges sometimes overlook traditional admissions criteria and use socioeconomic and historical disparities in education equity as criteria to admit underrepresented groups. Affirmative action is a federal requirement to be met by entities that contract with the federal government; most colleges are federal government contractors and must adhere to the policy by stating a timeline by which its affirmative action goals are met.

Many interpret “goals” as quotas, meaning that a certain number of students from underrepresented groups would be admitted, presumably to meet affirmative action requirements. Opposition to affirmative action in college admissions has been pursued in several well-known court cases.

Regents of the University of California v. Bakke

This 1978 case resulted in a U.S. Supreme Court decision to allow race to be used as one of the criteria in higher education admission policies as long as quotas were not established and race was not the only criterion for admission. The case stemmed from Alan Bakke, an applicant to the University of California at Davis Medical School, suing the university because he was not admitted but had higher test scores and grades than minority students who had been accepted. Lawyers for Bakke referenced the same equal protection clause of the 14th Amendment used to desegregate public schools in *Brown v. Board of Education*. The “reverse discrimination” denied him equal protection under the law.

Fisher v. University of Texas

In 2016, the U.S. Supreme Court decided another affirmative action case regarding Fisher v. University of Texas. Abigail Fisher also argued that she had been denied college admission based on race. The case ended in favor of the university. Justice Kennedy, in the majority opinion, wrote:

> ***“A university is in large part defined by those intangible “qualities which are incapable of objective measurement but which make for greatness.” Considerable deference is owed to a university in defining those intangible characteristics, like student body diversity, that are central to its identity and educational mission.”***

In each of the above landmark cases, affirmative action in college admission policies were upheld. However, cases of reverse discrimination in college admission policies continue to be pursued.

ANALYSIS QUESTION

Examine your college’s code of conduct. You may find it in your student handbook, as part of an office of community standards or engagement, or by simply searching your college site. How does the code of conduct protect academic freedom but guard against hate speech, prejudice, and intolerance?

Title IX and Higher Education

Title IX of the Education Amendments of 1972 states, “No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance.” As with affirmative action, Title IX applies to institutions that receive federal funding, such as public and charter schools, for-profit schools, libraries, and museums in the United States and its territories.

According to the Office for Civil Rights, educational programs and activities receiving federal funds must operate in a nondiscriminatory manner. Title IX addresses recruitment, admissions, and counseling; financial assistance; athletics; sex-based harassment; treatment of pregnant and parenting students; discipline; single-sex education; and employment.

Before the enactment of Title IX, there were few if any protections provided for women college students. To give some perspective, consider this description of the circumstances:

“Young women were not admitted into many colleges and universities, athletic scholarships for women were rare, and math and science was a realm reserved for boys. Girls square danced instead of playing sports, studied home economics instead of training for 'male-oriented' (read: higher-paying) trades. Girls could become teachers and nurses, but not doctors or principals; women rarely were awarded tenure and even more rarely appointed college presidents. There was no such thing as sexual harassment because 'boys will be boys,' after all, and if a student got pregnant, her formal education ended. Graduate professional schools openly discriminated against women.”[3]

The protections of Title IX have been invoked in college athletics to ensure women’s athletic programs are sustained. In addition, schools must make efforts to prevent sexual harassment and violence. Gender discrimination under Title IX extends to the protection of transgender students so that they are treated as the gender they identify with.

ANALYSIS QUESTION

Based on the cases against affirmative action in higher education, are admissions policies that use race, along with other factors, as admissions criteria fair? What other options do you think would create equity in admissions?

Footnotes

1. Adapted from Sue, Derald Wing, Microaggressions in Everyday Life: Race, Gender and Sexual Orientation, Wiley & Sons, 2010
2. Handlesman, Jo and Sakraney, Natasha. White House Office of Science and Technology Policy. https://obamawhitehouse.archives.gov...4-15_final.pdf.
3. WInslow, Barbara. “The Impact of Title IX.” Gilder-Lerhman Institute. https://faculty.uml.edu/sgallagher/T...derLehrman.pdf

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8.5: Inclusivity and Civility- What Role Can I Play?

Questions to consider:

- Is it my fault that I have privilege?
- How long will diversity, equity, and inclusion efforts continue?
- What is to be gained by cultural competency?

Privilege Is Not Just for White People

Privilege is a right or exemption from liability or duty granted as a special benefit or advantage. Oppression is the result of the "use of institutional privilege and power, wherein one person or group benefits at the expense of another,"[1] according to the University of Southern California Suzanne Dworak Peck School of Social Work.

Just as everyone has implicit bias, everyone has a certain amount of privilege, too. For example, consider the privilege brought by being a certain height. If someone's height is close to the average height, they likely have a privilege of convenience when it comes to many day-to-day activities. A person of average height does not need assistance reaching items on high store shelves and does not need adjustments to their car to reach the brake pedal. There's nothing wrong with having this privilege, but recognizing it, especially when considering others who do not share it, can be eye-opening and empowering.

Wealthy people have privilege of not having to struggle economically. The wealthy can build retirement savings, can afford to live in the safest of neighborhoods, and can afford to pay out of pocket for their children's private education. People with a college education and advanced degrees are privileged because a college degree allows for a better choice of employment and earning potential. Their privilege doesn't erase the hard work and sacrifice necessary to earn those degrees, but the degrees often lead to advantages. And, yes, white people are privileged over racial minorities. Remember Malcolm Gladwell's explanation of how he was treated when people assumed he was white as opposed to how people treated him when they assumed he was black?

It is no one's fault that they may have privilege in any given situation. In pursuit of civility, diversity, equity, and inclusion, the goal is to not exploit privilege but to share it. What does that mean? It means that when given an opportunity to hire a new employee or even pick someone for your study group, you make an effort to be inclusive and not dismiss someone who has not had the same academic advantages as you. Perhaps you could mentor a student who might otherwise feel isolated. Sharing your privilege could also mean recognizing when diversity is absent, speaking out on issues others feel intimidated about supporting, and making donations to causes you find worthy.

> ***In pursuit of civility, diversity, equity, and inclusion, the goal is to not exploit privilege but to share it.***

When you are culturally competent, you become aware of how your privilege may put others at a disadvantage. With some effort, you can level the playing field without making yourself vulnerable to falling behind.

APPLICATION

Think about a regular activity such as going to a class. In what ways are you privileged in that situation? How can you share your privilege with others?

"Eternal vigilance is the price of civility."

The original statement reads, "Eternal vigilance is the price of liberty." History sometimes credits that statement to Thomas Jefferson and sometimes to Wendell Holmes. Ironically, no one was paying enough attention to document it accurately. Still, the meaning is clear—if we relax our standards, we may lose everything.

Civility is like liberty; it requires constant attention. We have to adjust diversity awareness, policies, and laws to accommodate the ever-changing needs of society. Without the vigilance of civil rights workers, society could have lapsed back into the Jim Crow era. Without activists such as Betty Friedan, Gloria Steinem, and Flo Kennedy remaining vigilant, women might not have made the gains they did in the 1970s. Constant attention is still needed because in the case of women's earning power, they only make about 80 cents for every dollar a man makes. Constant vigilance requires passion and persistence. The activism chronologies of Native Americans, African Americans, Asian Americans, the LGBTQ+ community, immigrants, students, labor, and other groups is full of

stops and starts, twists and turns that represent adjustments to their movements based on the shifting needs of younger generations. As long as there are new generations of these groups, we will need to pursue diversity, equity, and inclusion.

Your Future and Cultural Competency

Where will you be in five years? Will you own your own business? Will you be a stay-at-home parent? Will you be making your way up the corporate ladder of your dream job? Will you be pursuing an advanced degree? Maybe you will have settled into an entry-level job with good benefits and be willing to stay there for a while. Wherever life leads you in the future, you will need to be culturally competent. Your competency will be a valuable skill not only because of the increasing diversity and awareness in America, but also because we live in a world with increasing global connections.

If you do not speak a second language, try to learn one. If you can travel, do so, even if it's to another state or region of the United States. See how others live in order to understand their experience and yours. To quote Mark Twain, "Travel is fatal to prejudice, bigotry, and narrow-mindedness." The more we expose ourselves to different cultures and experiences, the more understanding and tolerance we tend to have.

The United States is not perfect in its practice of diversity, equity, and inclusion. Still, compared to much of the world, Americans are privileged on a number of fronts. Not everyone can pursue their dreams as freely as Americans do. Our democratic elections and representative government give us a role in our future.

Understanding diversity and being culturally competent will make for a better future for everyone.

Footnotes

1. Golbach, Jeremy. "A Guide to Discussion Identity, Power, and Priveledge." https://msw.usc.edu/mswusc-blog/dive...and-privilege/

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8.6: Summary

Understanding diversity, especially in the context of our country's history, is an important part of being an engaged citizen who can help us to adapt to a changing world. Diversity goes hand in hand with the concepts of equity and inclusion, which increase the chances of equal opportunity and representation. Sometimes creating inclusive communities upsets the social order with which people are familiar. Change can be difficult, and people are passionate. These passions can disrupt communities and communication with uncivil behavior, or people can "fight fair" and use strategies that allow for the smooth exchange of ideas.

Everyone has a personal identity made up of various aspects and experiences—intersectionality. Some elements of identity place people in a diversity category. Some categories are expansive and well understood; others are new and may face scrutiny. Policies and laws have been put in place to protect underrepresented citizens from discrimination. These standards are constantly being challenged to make sure that they allow for the shifting demographics of the United States and shifting values of its citizens.

Cultural competency, which includes our ability to adapt to diversity, is a valuable skill in our communities and workplaces. The more culturally competent we are, the more we can help safeguard diversity and make equitable and inclusive connections on a global scale.

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8.7: Career Connection

Keisha went to a temp agency to sign up for part-time work. The person in charge there gave her several tests on office skills. She checked Keisha's typing speed, her ability to handle phone calls, and her writing skills. Keisha also took a grammar test and a test about how to handle disputes in the office. The tester also had Keisha answer questions about whether it was OK to take home office supplies and other appropriate things to do and not to do.

The tester told Keisha that she scored very well on the evaluations, but she never called Keisha back for a job or even an interview. Keisha knows that she presented herself well, but wonders if she was not called back because she wears her hair in dreadlocks or because she has been told that her name sounds African American?

Reflection questions:

- Can this student say that she was discriminated against?
- What would you do to determine why you were not called back for a job?
- Should Keisha ask about how her name and appearance were received?

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8.8: Rethinking

Revisit the questions you answered at the beginning of the chapter, and consider one option you learned in this chapter that might make you rethink how you answered each one. Has this chapter prompted you to consider changing any of your feelings or practices?

Rank the following questions on a scale of 1–4. 1 = “least like me” and 4 = “most like me.”

1. I'm aware of the different categories of diversity and the various populations I may encounter.
2. I think we sometimes go too far in trying to be sensitive to different groups.
3. I think nearly everybody in our society has equal opportunity.
4. It’s not my role to ensure equity and inclusiveness among my peers or colleagues.

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8.9: Where do you go from here?

This chapter touched on many elements of civility and diversity, and mentioned a wide array of groups, identities, and populations. But the chapter certainly did not explore every concept or reflect every group you may encounter. In a similar way, you can't know everything about everyone, but you can build cultural competency and understanding to make people feel included and deepen your abilities and relationships.

Sometimes learning about one group or making one person feel comfortable can be as important as addressing a larger population. To that end, consider researching or discussing one of the following topics to increase your level of civility and understanding:

- Appropriate terminology and ways to address members of certain populations. For example, ways to properly describe people with certain disabilities, or discuss issues around racial or gender identity.
- Discussions or debates related to civility and intersectionality, such as whether "Latinx" should be used instead of "Latino/Latina," or whether certain sports team mascots can be considered offensive.
- Major historical figures or events related to a certain group.
- Academic majors and research centers/groups related to aspects of diversity.
- Historical events at your college or in your city related to civil rights.

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SUNY Genesee Community College

Foundations of Academic Success - Words of Wisdom

Thomas C. Priester

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9.1.1: The Student Experience

The Student Experience

Kristen Mruk

When thinking about college, what comes to mind? Perhaps stereotypical images or misconceptions of college life, a friend or sibling's story, or scenes from popular movies?



"The Student Experience" by Kristen Mruk

In popular culture, some movies depict college life as a party atmosphere in which students binge drink and waste their parents' money to have a good time without consequence. Films including *National Lampoon's Animal House* and *Van Wilder* as well as *Accepted*, to name a few, portray the student experience as a blatant disregard for education coupled with excessive drunken buffoonery. However, my *party* experience illustrates a side to college that is not generally in the limelight.

During my first weeks in college, I felt disconnected from the campus and feared that I would not make friends or find my niche. I was commuting from my family's home and wanted to do more on campus than just go to and from class. I was enrolled in a First-Year Experience (FYE) course that was intended to provide a framework for a successful undergraduate career and beyond. In the class, we learned about student support services on campus (tutoring, personal wellness, academic advisement, etc.) as well as personal success skills (time and financial management, values exploration, etc.).

Being a new student, and a commuter, I was overwhelmed by the amount of new information, new territory, campus culture, and unfamiliar processes. I asked my FYE instructor after class one day if there was something I could do to feel more connected to campus. She opened my eyes to a side of college that I was missing—this was my invitation to the *party*.

My FYE instructor promptly led me to her office, introduced me to the staff, and explained the variety of involvement opportunities available through her office. I was amazed that there was so much to do on campus! Because of that meeting, I decided to apply for a job in the Student Union working at the information desk. This position was a catalyst for all of the additional *parties* I would be invited to throughout my time as an undergraduate student. With so many possibilities, I had to be diligent in prioritizing my time and energy.

What My Friends Think I Do

Friends knew me to be much like the girl in the meme above. I was juggling extracurricular activities and two jobs all while maintaining a full course load. I had to be proactive and diligent to coordinate activities and assignments and make sure I had the time to do it all. Finding a system was a trial and error process, but ultimately I found a method that worked for me. I was an undergraduate student when apps didn't exist and Facebook was just becoming popular, so my organizational system included a

planner, a pen, and a lot of highlighters. Whatever that organizational system looks like for you does not matter as long as you use it.

There are a variety of organizational methods and tools you can use to stay on track with all aspects of your life as a student. Some of those are featured in the State University of New York (SUNY) blog: http://blog.suny.edu/tag/apps

What My Parents Think I Do

It may be difficult to discuss your studies and educational experience with a parent or someone that has a significant interest in your academic achievement. This was the case for me; I was the first kid in my house to enroll in college, and my parents were under the impression that grades would be sent home like they were in high school. During the New Student Orientation program, my Mom learned about FERPA (Federal Educational Rights and Privacy Act) and what that meant for my grades. “FERPA gives parents certain rights with respect to their children’s education records. These rights transfer to the student when he or she reaches the age of 18 or attends a school beyond the high school level.” In essence, parents cannot access grades or other restricted academic information unless you provide it to them (http://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html?src=ft).

I was fortunate enough to have my parents’ financial support toward tuition, so they felt entitled to reviewing my grades at the end of each semester. I did not want to give them direct access to my grade report by filing a FERPA waiver, so after much deliberation, I agreed to share my grades once released at the semester’s end. If their standards were not met, there would have to be a conversation about repercussions.

In the fall of my sophomore year I took my first online course—Introduction to Computers and Statistics. All of the lectures and assignments were available online at anytime and exams were administered in a computer lab on campus. I thought having the ability to view lectures on my own time would be more conducive to my schedule as I was becoming more involved on campus. For the first few weeks of classes I watched the lectures regularly and did the assignments on time. Slowly but surely I found myself prioritizing my time differently, ultimately putting my online class on the back burner, because (I told myself) the work could be done anytime! By the end of the semester I realized that I was going to fail the class. No amount of extra credit, crying, or pleading could save my grade; I had earned an F.

Seeing a failing grade on my transcript taught me two valuable lessons. First, I discovered that I needed the routine and accountability of an in-person class to ensure my participation in the material. Second, I was responsible for the grades I received. I probably could have come up with a million excuses for why I didn’t watch the lectures or do the assignments, but the reality was I just didn’t do it. I did not seek my professor’s help during their office hours when I started to fall behind, I did not go to the tutoring center on campus to get extra help, and I did not reach out to my classmates to form study groups.

Although the F that I received will never disappear from my transcript, it is an important reminder of the gruesome conversation I had with my parents and the feeling of failure in the pit of my stomach. Needless to say, that was the only online course I took during my collegiate career, but it was absolutely worth the lessons learned.

What My Professors Hope I Do

Professors do care about how you are doing in their class; they genuinely want you to succeed, but they will give you the grade you earn. There are people and resources on campus for you to utilize so you can earn the grade you want.

Your professors are one of those resources, and are perhaps the most important. Go see them during office hours, ask them questions about the material and get extra help if you need it. The caveat here is that you cannot wait until the last week of the semester to visit your professors to get help. Tears and pleading will not help you at the eleventh hour.

Another resource to utilize can be found in the campus learning center. I frequented my campus’ writing center for assistance with papers and research projects. Initially, I was scared to be critiqued, thinking my work would be perceived as inadequate. The first time I took a paper there, I recall standing outside the door for about ten minutes thinking of an excuse not to go in. Thankfully I saw a classmate walk in and I followed suit. The experience was less dramatic than I imagined it to be; no one ripped my paper to shreds and told me that I would never graduate. Instead I sat with an upper-class student who coached me through some pointers and suggestions for improvement. Thanks to that first visit, I received an A- on the paper!

What I Would Like to Do

I thought I knew exactly what I wanted to do when I started college, but that changed three times by the time I graduated. Initially I started as an International Business major but ended up receiving a degree in Communication and continued on to graduate school.

My greatest advice to you is to embrace feelings of uncertainty (if you have them) with regard to your academic, career, or life goals. Stop into the Career Services office on your campus to identify what it is that you really want to do when you graduate or to confirm your affinity to a career path. Make an appointment to see a counselor if you need to vent or get a new perspective. Do an internship in your field; this can give you a first-hand impression of what your life might look like in that role.

When I chose International Business, I did not do so as an informed student. I enjoyed and excelled in my business courses in high school and I had hopes of traveling the world, so International Business seemed to fit the bill. Little did I know, the major required a lot of accounting and economics which, as it turned out, were not my forte. Thinking this is what I wanted, I wasted time pursuing a major I didn't enjoy and academic courses I struggled through.

So I took a different approach. I began speaking to the professionals around me that had jobs that appealed to me: Student Unions/Activities, Leadership, Orientation, Alumni, etc. I found out I could have a similar career, and I would enjoy the required studies along the way. Making that discovery provided direction and purpose in my major and extracurricular activities. I felt like everything was falling into place.

What I Actually Do

I would like to pause for a moment and ask you to consider why you are in college? Why did you choose your institution? Have you declared a major yet? Why or why not? What are your plans post-graduation? By frequently reflecting in this way, you can assess whether or not your behaviors, affiliations, and activities align with your goals.

What you actually do with your student experience is completely up to you. You are the only person who can dictate your collegiate fate. Remind yourself of the reasons why you are in college and make sure your time is spent on achieving your goals. There are resources and people on your campus available to help you. You have the control—use it wisely.

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9.1.2: Practice, Practice, Practice

Dr. Kristine Duffy

Life in college will be like no other time in your life—I can guarantee you that! This is your time to explore who you are, who you want to become, and how you wish to play a part in this world. Don't squander this unique time in your life. I hope to share some thoughts that might help you avoid regrets when reflecting on your college years.

I want to be clear—there are many paths through college and we know that no one path is right for all. You may be starting at a community college, taking courses part-time, starting college again after an unsuccessful start, or returning to education after many years away, but no matter who you are or what path you've chosen, make the most of it.

I took the fairly traditional path. I graduated from high school and went directly to college (which was three hours away from home). Because I wasn't really sure what else I should do, I chose to be a business major by default. My parents thought it was a good route to take and would lead me to a *good job* (mainly to ensure I made some money and didn't live with them forever).

There are three things I learned quickly in college:

1. I had lived a very nice life, but in a very homogeneous environment.
2. There were people different from me.
3. Although I was a decent student, I had a ways to go to be a good student!

Learning to appreciate what you have is just as important as earning As on exams and papers. I share this because part of college is preparing for life, not just a job. Ask yourself some questions:

- What's important to me and why?
- What do you know about other people's lives, beliefs, and passions?
- Are you confident in your abilities to study, listen and learn, take notes, and be a learner?

What's Important to Me and Why?

Is it only to make money to buy things? If so, do you truly believe that money makes everything better? Don't be fooled by that. Yes, money certainly makes life more comfortable, but it absolutely doesn't buy happiness. I had friends in college that came from a significant amount of money and they would have traded it all to have a family they can depend upon and love in their homes. Consider this very carefully as you dream of the life ahead of you.

What Do You Know about Other People's Lives, Beliefs, and Passions?

You are not the center of the world. You should be confident and proud of who you are, but be humble and be open to others' experiences and worldviews. Take classes that stretch you, maybe even make you uncomfortable. In the end these types of classes will test your assumptions, beliefs, and make you a more well-rounded and interesting person. The roommate or classmate that is different from you can teach you about yourself. Be open to this.

Are You Confident in Your Abilities to Study, Listen and Learn, Take Notes, and Be a Learner?

Remember, if college were easy, everyone would do it! You have full control and responsibility for your learning. Yes, your professors have the responsibility of teaching well and helping you learn. But they cannot and should not do the work for you. Part of college is learning to learn: learning to study, listen better, take notes, and most importantly asking for help when you need it.

In my own research I have learned that students are confronted with a paradoxical situation. On the one hand, students in high school are warned that college will be hard—the professors won't care if you do the work or not, and you need to do it on your own. However in reality, college professors and support professionals do care and will tell you to come and see them if you need help.

So what is a student to do? You may feel bad in class if you just aren't getting it and are embarrassed to ask for help. Stop that thought in its tracks! Colleges offer many opportunities for help and in almost all cases, for free! Professors offer office hours specifically to address students' questions and tutoring is available to help you do better, not to punish you for not getting it. Remember you are paying a substantial amount of money for your tuition; find out what resources you have and take advantage of them. Be a mature learner, take advantage of everything your college offers, and hold your head high for doing so. There is no shame in asking for help. I always compare it to a job. When you start out on any job there is usually some type of training to teach

you how to do that job. College is no different. We are teaching you how to be a student—you've been practicing since Kindergarten, and doesn't end when you get to college.

Finally, here are some words of advice based on some of my regrets when I reflect on my college experience:

1. I didn't study abroad during my four years of college.
2. I didn't do any type of internship.
3. I didn't get involved with many clubs or organizations.
4. I didn't get involved with any type of research opportunities until graduate school.

Study Abroad

Whether it is a short-term experience (some are as short as three weeks) or a semester to a year—do it! This goes back to my point about understanding people different than you. The United States is a great nation, but we are not the only nation and our world is filled with amazing stories to share. One of my favorite quotes by Neale Walsch is: "Life begins at the end of your comfort zone" (2010). You will not miss much being gone from your college for a short period of time, and you will return from your adventure a changed person. How do I know this if I didn't study abroad myself? I know many who have and the end result is the same for all—no regrets, life changing moments, and better appreciation for the world we live in.

Internships

Going to college in the 80s was different than today. The job market was relatively strong and the push for an internship or co-op was not as strong. But if I had gotten some hands on experience and discovered my likes, dislikes, strengths, and weaknesses, I would had more direction for my career when I graduated. In addition, there is nothing more frustrating for a college graduate than to go on job interviews only to be told that you can't be hired because you have no *real* experience. So talk to your professors, academic advisors, counselors, and mentors about getting some internship experience while in school or during the summer. There are many companies that welcome interns, and you may find the direction you are seeking.

Clubs and Organizations

For years employers have been surveyed by colleges to ask them what type of skills they are seeking in college graduates. Although having discipline specific skills are important (in other words, the courses you take in your major), employers are very consistent in seeking out employees with what they call "soft skills," such as writing well, public speaking, getting along with others, and having leadership abilities. You'll develop these skills in your courses, but you can really hone and apply them by joining a club or organization on campus, where you will have opportunities to work with others, lead efforts, and have something to show for it—a campaign you ran, funds you raised, or an event you organized. Colleges offer many types of clubs to attract students in areas of interest. For example, if you are a business major, you could join the business club. More than likely the activities the club offers will allow you to meet business leaders, go on field trips to learn more about the business world, and meet people who have similar interests as yourself. I was a college athlete so my time was limited, and while I support athletics in college as an opportunity to continue your passion and to grow and learn, try to make time to join a special interest group. Take a leadership role in a group, and later, when you go on that job interview, talk about your leadership experience. The employer will be impressed and it may determine whether or not you get the job.

Research

Finally, develop your research skills. You may think that research is most important in the sciences and medicine. But research occurs in all fields of study, and much of what you do in college is research in some form. If you are a music major you may need to research how other musicians developed their talent, the history of genres, or new ways music is applied in our world. Problem solving through effective research and knowing how to test your ideas and hypotheses will make you a very valuable employee and citizen of your community. If your professor offers a chance to work on a special research project—sign up.

Question everything, and don't take the answers at face value. Question how people come to their conclusions, develop your own set of research questions, and be willing to dig to find the answers. This is not only important as a student but as an employee as well. Strive to be an engaged citizen in our world and don't believe what everyone tells you. An adult needs to make informed decisions to buy products, pay taxes, and vote for government leaders. Don't be complacent and put your life in the hands of others without fully researching the pros and cons—draw your own conclusions.

In conclusion, come to the classroom with an open mind and a willingness to exercise your right to take full advantage of all a college offers. Done correctly, college will be challenging and frustrating, and will test every part of you. Life will be the same way so use this time to practice, practice, practice.

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Walsch, N. D. (2010). *Neale Donald Walsch's little book of life: A user's manual.* Charlottesville, VA: Hampton Roads.

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9.1.3: Why So Many Questions?

Why So Many Questions?

Fatima Rodriguez Johnson

I chose to attend a small liberal arts college. The campus was predominately white and was nestled in a wealthy suburb among beautiful trees and landscaped lawns. My stepfather and I pulled into the parking lot and followed the path to my residence hall. The looks we received from most of the families made me feel like everyone knew we didn't belong. But, he and I greeted all we encountered, smiling and saying, "Hello." Once I was unpacked and settled into my residence hall, he gave me a hug and said, "Good luck." I wasn't sure if he meant good luck with classes or good luck with meeting new friends, but I heard a weight in his voice. He was worried. Had he and my mother prepared me for what was ahead?

With excitement, I greeted my roommate who I had already met through the summer Higher Educational Opportunity Program (HEOP). She and I were very happy to see each other. After decorating and organizing our room, we set out to meet new people. We went to every room introducing ourselves. We were pretty sure no one would forget us; it would be hard to miss the only Black and Latina girls whose room was next to the pay phone (yes, in my day each floor shared one pay phone).

Everyone on our floor was nice and we often hung out in each other's rooms. And like some of you, we answered some of those annoying questions:

- Why does your perm make your hair straight when ours makes our hair curly?
- How did your hair grow so long (whenever we had weave braids)?
- Why don't you wash your hair everyday (the most intriguing question of all)?

We were also asked questions that made us angry:

- Did you grow up with your father?
- Aren't you scared to take public transportation?
- Have you ever seen anyone get shot (because we both lived in the inner city)?

It was those questions that, depending on the day and what kind of mood we were in, made a fellow student either walk away with a better understanding of who we were as Black and Latina women or made a fellow student walk away red and confused. I guess that's why my stepfather said, "Good luck." He knew that I was living in a community where I would stand out—where I would have to explain who I was. Some days I was really good at answering those questions and some days I was not. I learned the questions were not the problem; it was not asking that was troubling.

My roommate and I put forth a lot of effort to fit in with the community—we spent time hanging out with our peers, we ate together almost every evening in the dining hall, and we participated in student organizations. We were invited to join the German Club, and were the only students of color there. In doing all these things we made ourselves approachable. Our peers became comfortable around us and trusted us.

Although my peers and I all had similar college stresses (tests, papers, projects, etc.) my roommate and I also had become a student resource for diversity. Not because we wanted to, but because we had too. There were very few students of color on campus, and I think students really wanted to learn about people different from themselves. It was a responsibility that we had accepted. The director of HEOP would often remind us that for many students, college was the first opportunity they had to ask these types of questions. He said we would learn to discern when people were really interested in learning about our differences or insulting us. If someone was interested in insulting us, there was no need to respond at all.

Although I transferred to another college at the end of my sophomore year, during those two years I learned a great deal about having honest conversations. Taking part in honest conversations challenged my notions of the world and how I viewed people from all walks of life (race, class, sexual orientation, ability, etc.). Those late nights studying or walks to the student center were when many of us listened to each other's stories.

My advice is to take time to examine your attitudes and perceptions of people different from yourself, put yourself in situations that will challenge your assumptions, and lastly, when you make a mistake do not get discouraged. Keep trying. It's easy to stay where we are comfortable. College is such a wonderful experience. Take it all in, and I am sure you will enjoy it!

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9.1.4: These Are the Best Years of Your Life

These Are the Best Years of Your Life

Sara Vacin

These are the best years of your life. I hope you've been told this a ridiculous amount of times and that you are finding this to be true! College provides an amazing opportunity to expand your mind, meet unique people you can deeply connect with, and discover new aspects of yourself. Being aware of this energy and taking full advantage of these opportunities can be life changing.

You learn a lot about yourself when living on your own for the first time or studying topics that are completely taboo at your home's kitchen table. When I transferred to a four-year institution, I found the strength to come out. Realizing I was gay led me to question where I belonged in the religion I was raised in and an enlightening journey ensued of exploring Buddhism, Native American beliefs, and even New Age mysticism. This process of questioning what I believed helped me to create a spiritual foundation that makes sense to me. I kept the best of what I was raised in and upgraded the rest!

I also discovered that the college I attended had amazing tools to help me be as healthy as possible. I used the free gym and knew the counseling center was there if anything became too tough. I also chose incredible electives (including Mountaineering and Modern Dance) that stretched my physical capabilities. Additionally, I made deep connections with my professors, many of whom remain friends. These smart, caring people validated my journey and were my safety net as I grew out of my old, comfortable self.

Another incredible lesson learned was the importance of balance. I couldn't party every night and neglect my schoolwork without consequences. I figured out the hard way that I really did need sleep and I couldn't nourish my body on coffee and pizza alone. In a moment of brilliance, I also figured out that if I used time with my friends as a reward for finishing my work, I would study and complete assignments more efficiently. Fun can be a great motivator—try this; it works!

In college, the emphasis is often on the mind. Do yourself a favor and remember to also nourish your spirit and take care of your body. Leave college brighter, healthier, and with a new understanding of yourself. Try that yoga or nutrition class. Join that new club. Trade in that soda for water. Jump into that drum circle or improvisation group. Who knows what you will discover—it just may be greatness!

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9.1.5: With a Little Help from My Friends

With a Little Help from My Friends

Paulo Fernandes

We often hear about the importance of relationships: a necessary aspect of integration in society. Unfortunately, we rarely follow that advice. Perhaps we live an excessively busy life or we already have a close group of friends and do not feel compelled to meet new people. I have come to learn through my time in college that neglecting to cultivate new relationships is detrimental to living a happy and successful life. I would like to offer this piece of advice: *no matter how difficult it seems at first, always try to make new friends*. College is not always easy. However, having friends makes it much easier. Friends are a vital part of your life that can expose you to new subjects, cultures, and experiences while giving you the opportunity to do the same for them.

At my college, there was a small space that the students called “the bat cave.” It was by no means a first-class lounge, but it was a place where friends could help others better understand their course material. We gave it this peculiar nickname because it was our place to get together and conquer villains one after another. These were not your everyday super villains, however. Sometimes they were complicated homework assignments and other times they were difficult exams. No matter the challenge, someone was always willing to help. I went to the bat cave several times and every visit I learned something new. Professors and teaching assistants could not relate to us like our friends could. That made a difference, because nothing was better than being taught by a friend.

Friends are not only an essential support for your time in school, but also can be integral in helping realize post-college aspirations. During a visit to New York City, I visited the offices of the company Spotify. After touring their facilities I had the opportunity to talk to some of the employees. One man I talked with was a senior employee who worked at Microsoft prior to joining Spotify’s team. Our conversation stuck in my head because he gave a very striking piece of advice: make friends. It never truly occurred to me that the friends you make in college could impact your future in the workforce. They could be partners in potential business ventures or help you land your dream job. In any case, having strong connections with friends can undoubtedly make a major difference in your career.

The best part of making new friends, however, is trading life experiences, skills, and interests with them. For a year and a half before my final semester of college, I studied abroad in the United States. My family was concerned because typically, students search for first jobs prior to graduation. I, on the other hand, had no trepidations about going because I knew that I would have countless, exciting learning experiences. I can say today, without a doubt, that my trip was a great decision. I met incredible people, and through knowing them, I grew and changed. I also know that I was a positive feature in the lives of my new friends. The greatest thing that I learned was that meeting different people with different backgrounds, histories, perspectives, or even different musical tastes, inevitably changes you and lets you see the world in an entirely different way. You no longer see the world as simply a big, blue sphere with freezing winters or sizzling summers (although that certainly seems to be the case up North!), but as a place in which people like you live, learn, and love.

Going to college may seem hard, but it does not need to be. I have learned that the way I perceive my life as a student completely relies upon my relationships with my friends. They are not only the people that I like to spend time with, but also are essential in my growth and development as a human being. The pages in this book include insights from others just like you and me. They want to help you get through the common struggles of college with confidence and perseverance. Consider them your most recent new friends. I truly hope that this inspires you in your quest for a great future.

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9.2.1: Can You Listen to Yourself?

Can You Listen to Yourself?

Yuki Sasao

It is almost impossible to find time away from information sources like TV, phone, advertisements, or even your friends and family in this modern society. Can you put yourself in a place that has no information at all—you alone, just yourself? If not, you should try—finding this quiet mental space will let you to practice listening to yourself. It is a wonderful way to find out who you truly are. Our society has become so loud that it is very difficult to listen to your own voice and extremely easy to lose it.

I am an international student from a very small town in Japan, and I am the first one among my family members to study abroad. When I told people that I decided to come to the United States to study, every single one of them was shocked and gave me their advice. Some said Americans are very bossy and tend to look down on people. Some said I would not be able to find any jobs there.

It does not matter who you are and what type of circumstances you are in. You will get some comments and advice no matter what you do.

Was the advice people gave me accurate? I'm sorry, but mostly, no. People I met in the United States were nice, and the advice I received really depended on whether or not the person looked down on others. Am I struggling with finding a job? No. My major in accounting provides me more opportunities than I can take. Looking back on the comments from my friends and family, I am very grateful that I was able to see what I truly wanted and stick with my decision.

The reason I could tune out those negative voices was not because I am lucky or intelligent. It is because I listened to myself—my own voice. However, this doesn't mean that I didn't listen to others. I considered what people said to me and I understood them. I just didn't agree with them, which was the most difficult part. In the process of building my own decisions, many pieces of advice actually helped me and I made some changes based on the advice from others combined with my own thoughts.

Why was I able to stick to my decision so tight and live the life I wanted? It's because I talked to myself and asked myself millions of questions.

"What do I want in my future?"

"Do I really need it or just want it?"

"Am I where I wanted to be? Yes? No? Why?"

"Where am I going?"

"What am I doing?"

"What would happen if I do this?"

"Why am I doing it?"

It is difficult, frustrating, and time-consuming to find your raw voice in this very noisy society, but in doing so you will get through life with minimal regret and confidence in who you are and what you are doing. Pull yourself away from the massive amount of information, talk to some people, understand them (never ignore them), and then talk with yourself. This is your life, and you cannot run away from yourself forever. You'd better learn how to listen to yourself and be able to stick with your own thoughts even after accepting what other say.

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9.2.2: Failure Is Not an Option

Failure Is Not an Option

Nathan Wallace

In the movie Apollo 13, Ed Harris portrays NASA flight director Gene Kranz as he successfully guides the crew of a damaged spacecraft to safety. In a famous scene during which Kranz and his staff are attempting to overcome some extremely daunting challenges, Harris shouts, “Failure is not an option!” This singular statement perfectly articulated the determination of Kranz to bring the Apollo astronauts back to Earth.

This “failure is not an option” credo was perfect for the life and death situation that NASA was facing. Failure meant that the astronauts on Apollo 13 would never come home, and that outcome was unacceptable. Attending college, on the other hand, shouldn’t be a life or death experience, though it sometimes might feel like one. Failure, though never the intended outcome, can and sometimes does happen. Sometimes failure manifests itself in election results for a student government post, in a test score, or even in a final grade.

Throughout my life I have had many failures. In high school I drove my parents and teachers crazy because of my lack of academic achievement. I even managed to get an F- in Spanish on my report card. When I told my mom that it was a typo she responded, “So you didn’t get an F?” “No,” I said, “I definitely earned the F, but there’s no such thing as an F-.” To this day I’m not so sure that my reply was accurate. I might have earned that minus after all.

My failures in high school led to only one acceptance from of all the colleges I applied to attend. Furthermore, I was not accepted to the school’s main campus, but to their branch campus. During my first semester there my effort wasn’t much better than in high school, but since my parents were now paying for my education I did enough work to avoid academic probation. It wasn’t until my second semester that I found my niche as a Religious Studies major and started getting good grades, moved to the main campus, and eventually graduated with honors.

Since graduating from college, my career path has taken me into higher education as a Student Affairs administrator. This career has exposed me to many great theories regarding student success, and many of them gave me insight into my own college experience. But it was Stanford psychologist Carol Dweck who appeared to be thinking of me when she wrote the following about fixed mindsets in the introduction to her book titled *Mindset: The New Psychology of Success*:

Believing that your qualities are carved in stone—the fixed mindset—creates an urgency to prove yourself over and over. If you have only a certain amount of intelligence, a certain personality, and a certain moral character—well, then you’d better prove that you have a healthy dose of them. It simply wouldn’t do to look or feel deficient in these most basic characteristics. (Dweck, 2006)

This statement was a revelation to me. I finally understood my problem throughout high school and even in college. I earned good grades because I liked Religious Studies but never really challenged myself inside or outside of the classroom. My problem was that I had a fixed mindset about academic success. I believed that a person is either smart or they’re not, and nothing could be done to significantly change that. I also believed that I was one of the fortunate ones to be “gifted” with an abundance of intelligence.

One might think that having confidence in your intelligence is a whole lot better than thinking that you’re stupid, but the result was the same. My fixed mindset was holding me back because it led to a paralyzing fear of failure. Since as far back as I could remember, my family, friends, and teachers were always telling me how smart I was, and I believed them. But that belief was a double-edged sword. High school and college offered many occasions when self-confidence in my inherent intelligence could be threatened. If I fail on this test or in this course it means that I’m not the smart person I thought I was. If I fail, my family and friends will find out that they were wrong about me.

However, there was a way to avoid all of the risks of academic rigor. I could just not try. If I don’t try I’ll get bad marks on my report card, but those won’t be true indicators of my intelligence. By not putting forth any effort, my intelligence would never be disproven. I would always be able to say to myself and others that, “I could do the work and be a straight A student, but I’m just not interested.” Looking back on this time in my life, it is clear to me that this wasn’t a conscious decision to save face. It was fear, not logic, which was guiding my behavior.

After reading *Mindset* I have made a conscious effort to identify and thwart any remaining fixed mindset thoughts that I continue to hold. Dweck’s book acts as a manual for rooting out fixed mindset thoughts, because she explains that the idea of fixed mindsets is only half of her mindset theory. There is another kind of mindset, and she calls it growth mindset. Dweck writes that, “This growth

mindset is based on the belief that your basic qualities are things you can cultivate through your efforts" (Dweck, 2006). Dweck goes on to explain that we can choose to have a growth mindset about any type of ability, whether it's math, art, athletics, or any other skill that one wishes to cultivate.

I put this theory to the test not long after reading the book. A few years ago I attended a meeting only to find out that it wasn't any ordinary meeting. During this meeting we would be brainstorming solutions to a specific problem. This was going to be a true brainstorming session, led by a facilitator trained in the science of soliciting uninhibited ideas from an audience. As soon as I heard the word *brainstorming* I froze. I have always hated brainstorming. I'm the type of person that likes to think things through two or three times before expressing an opinion. My fear of failing at this task in front of my coworkers paralyzed my mind. I couldn't think.

That's when it hit me. This was fixed mindset thinking. My belief in my brainstorming inadequacies was preventing me from even trying. So I flipped this thinking on its head and decided the best way to improve my brainstorming abilities was to clear my mind and start firing out ideas. I gave it a shot, and though the ideas didn't come out at the prolific rate of some of my colleagues, I had never before had such a positive outcome and experience while brainstorming. Through this experience I found that I really could choose to have a growth mindset, and that this choice produces a greater chance of success. With a greater chance of success comes a smaller chance of failure.

Nevertheless, when it comes to academic success and success in all phases of life, failure is always an option. Though it can be painful, failure can lead to great learning and progress when a specific failure is analyzed through the lens of a growth mindset. By focusing more on effort than on outcomes anyone can learn and grow, regardless of their skill level. Therefore, to make the most of their time in college, students must seek out challenges that will stretch their abilities. These challenges can take many forms and they can occur in a variety of settings, both inside and outside of the classroom. When seeking out challenges there is always the possibility of agonizing defeat, but out of that defeat can be the seeds of great success in the future.

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9.2.3: Thinking Critically and Creatively

Thinking Critically and Creatively

Dr. Andrew Robert Baker

Critical and creative thinking skills are perhaps the most fundamental skills involved in making judgments and solving problems. They are some of the most important skills I have ever developed. I use them everyday and continue to work to improve them both.

The ability to think critically about a matter—to analyze a question, situation, or problem down to its most basic parts—is what helps us evaluate the accuracy and truthfulness of statements, claims, and information we read and hear. It is the sharp knife that, when honed, separates fact from fiction, honesty from lies, and the accurate from the misleading. We all use this skill to one degree or another almost every day. For example, we use critical thinking every day as we consider the latest consumer products and why one particular product is the best among its peers. Is it a quality product because a celebrity endorses it? Because a lot of other people may have used it? Because it is made by one company versus another? Or perhaps because it is made in one country or another? These are questions representative of critical thinking.

The academic setting demands more of us in terms of critical thinking than everyday life. It demands that we evaluate information and analyze a myriad of issues. It is the environment where our critical thinking skills can be the difference between success and failure. In this environment we must consider information in an analytical, critical manner. We must ask questions—What is the source of this information? Is this source an expert one and what makes it so? Are there multiple perspectives to consider on an issue? Do multiple sources agree or disagree on an issue? Does quality research substantiate information or opinion? Do I have *any* personal biases that may affect my consideration of this information? It is only through purposeful, frequent, intentional questioning such as this that we can sharpen our critical thinking skills and improve as students, learners, and researchers. Developing my critical thinking skills over a twenty year period as a student in higher education enabled me to complete a quantitative dissertation, including analyzing research and completing statistical analysis, and earning my Ph.D. in 2014.

While critical thinking analyzes information and roots out the true nature and facets of problems, it is *creative* thinking that drives progress forward when it comes to solving these problems. Exceptional creative thinkers are people that invent new solutions to existing problems that do not rely on past or current solutions. They are the ones who invent solution C when everyone else is still arguing between A and B. Creative thinking skills involve using strategies to clear the mind so that our thoughts and ideas can transcend the current limitations of a problem and allow us to see beyond barriers that prevent new solutions from being found.

Brainstorming is the simplest example of intentional creative thinking that most people have tried at least once. With the quick generation of many ideas at once we can block-out our brain's natural tendency to limit our solution-generating abilities so we can access and combine many possible solutions/thoughts and invent new ones. It is sort of like sprinting through a race's finish line only to find there is new track on the other side and we can keep going, if we choose. As with critical thinking, higher education both demands creative thinking from us and is the perfect place to practice and develop the skill. Everything from word problems in a math class, to opinion or persuasive speeches and papers, call upon our creative thinking skills to generate new solutions and perspectives in response to our professor's demands. Creative thinking skills ask questions such as—What if? Why not? What else is out there? Can I combine perspectives/solutions? What is something no one else has brought-up? What is being forgotten/ignored? What about _____? It is the opening of doors and options that follows problem-identification.

Consider an assignment that required you to compare two different authors on the topic of education and select and defend one as better. Now add to this scenario that your professor clearly prefers one author over the other. While critical thinking can get you as far as identifying the similarities and differences between these authors and evaluating their merits, it is creative thinking that you must use if you wish to challenge your professor's opinion and invent new perspectives on the authors that have not previously been considered.

So, what can we do to develop our critical and creative thinking skills? Although many students may dislike it, group work is an excellent way to develop our thinking skills. Many times I have heard from students their disdain for working in groups based on scheduling, varied levels of commitment to the group or project, and personality conflicts too, of course. True—it's not always easy, but that is why it is so effective. When we work collaboratively on a project or problem we bring many brains to bear on a subject. These different brains will naturally develop varied ways of solving or explaining problems and examining information. To the observant individual we see that this places us in a constant state of back and forth critical/creative thinking modes.

For example, in group work we are simultaneously analyzing information and generating solutions on our own, while challenging other's analyses/ideas and responding to challenges to our own analyses/ideas. This is part of why students tend to avoid group work—it challenges us as thinkers and forces us to analyze others while defending ourselves, which is not something we are used to or comfortable with as most of our educational experiences involve solo work. Your professors know this—that's why we assign it—to help you grow as students, learners, and thinkers!

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9.2.4: Time Is on Your Side

Time Is on Your Side

Christopher L. Hockey

There I was, having just eaten dinner and realizing that I had less than twenty-four hours to go before my capstone paper was due for my History of Africa class. This paper was the only grade for the class and all I had done was some research. I still had thirty pages that needed to be written! How was I going to get this paper done?

I came to the realization that I was going to have to skip some classes and work through the night. I kept my roommate up with the click clack of the keyboard and worked through the night with breaks only to replenish the caffeine in my system. Morning came and I still had work to do.

I contacted my other professors letting them know that something came up and I wouldn't be in class. Thankfully, I was in good standing in my other classes and could afford to miss one class. I snuck in a twenty minute nap and kept working. I finally finished about thirty minutes before the deadline. Exhausted and not terribly proud of myself, I trudged my way to class to drop off the paper and committed to never working like this again. After all, there was a small likelihood that I would get a decent grade; I was hoping for just a C to keep my GPA respectable. I went back to my room and slept for a long time. Imagine my amazement when I received my grade for the paper (and ultimately the class) and there was an A- staring me back in the face! How could this be possible?

My experience illustrates a very important lesson. Best practices do not always yield the best results. Logic would tell us that to manage a thirty-page paper would require the student to spread out all the tasks over the semester and do a little bit of work over a long period of time as opposed to a lot of work over a short period of time. The problem is that time management is a personal thing. Everyone works differently and excels under different circumstances.

The important thing to remember about time management is that there is not one method. Everyone must find what works best for her or him. There are some strategies that have been used for years and others that are new. While there are multiple perspectives on how best to set personal and professional goals, there are three general themes that influence the development of personal time management plans: identifying priorities, managing time, and managing energy.

The concept of time management is actually personal management. Where you are going or what you are trying to accomplish is more important than how fast you get there. Personal management demands organizing and executing around priorities. One thing to watch out for on your college journey is something called *time famine*. Time famine is the feeling of having too much to do and not enough time to do it. This happens often to college students and without warning. This was certainly the case with my paper. I certainly felt overwhelmed with thirty pages to write and not a lot of time available to write it in. However, there's one really helpful aspect of time—you always know how much you have in a day. You know that in any given day, you have twenty-four hours to accomplish everything you need to do for that day. With that knowledge in hand it becomes an easy task to make smart choices when planning both the schedule for the day, as well as the energy needed to complete the tasks.

The objective of successful time management is to increase and optimize controllable time. Once you have a schedule made, don't change it unless something of some serious urgency comes up. However, while managing time is challenging enough, there's another concept out there about the management of your energy. Think of energy as money and time as what you'd like to buy. If you're too tired (or energy broke) to be productive, it's hard to accomplish (buy) everything on your schedule. Luckily, at the age of twenty-two, I had lots of energy and stamina to pull an all-nighter and finish the paper. If I tried to do that today at thirty-five, I would be asleep on my keyboard after a few hours. In order to always have enough of time currency, it's important that you are physically energized, emotionally connected, and mentally focused on your purpose.

While an understanding of these general principles is essential for the development of sound time and energy management strategies, it is also important to focus on practical strategies that can be implemented to improve the college experience. The first recommendation is to know who you are and how you work. In this step, you need to examine all aspects of your current time management skills. Take a look at personal practices such as where you work, how you organize information and course materials, how current and future assignments and projects are prioritized, how commitments are balanced, and lastly, how you prevent burnout. Once you have taken stock in your current practices, you'll have a better idea of what you need to do to improve.

Even today, I try to space out large projects and assignments and find that I am not as focused or motivated. I struggle to complete the task and when I do, it never feels like I did it well. However, when I revert back to that practice of waiting until the last minute,

I am focused, energized, and motivated and the results have been very positive. In my own doctoral program, I have begun assignments a little too close to the deadlines but they ultimately get completed and I continue to be amazed at the high marks I get back. What does that tell me? It tells me I thrive in high-pressure situations where I have to focus intensely on one thing and stay focused for a long period of time. Is that method for everyone? Certainly not, but it works for some and it may or may not work for you. You must examine your own work habits and practices and look back at times that you have done well and times you have done poorly and identify habits that led to those results.

The next strategy is to create a personal time management method to help prioritize projects and activities. Try to identify and eliminate activities that may detract from effectively balancing your roles and responsibilities. In any given day, what are the most important things that need to be completed? What can be eliminated from your schedule that provides you the time you need to be successful? I like to think of this as the “five-year-old plan.” My five-year-old loves to play in the morning as her Mom and I are getting ready for work. The problem is that we need her to get ready for school, too. We put a plan in place that allows her to play in the morning, only after she is completely ready for school. You need time to play, have fun, and socialize, but it should not come at the expense of higher priority tasks.

The next recommendation is to focus on the process of energy management. Create goals focused on physical, mental, spiritual, and emotional renewal. These goals can include, but are not limited to: getting seven to eight hours of sleep a night, taking small breaks during work sessions, eating healthy, exercising regularly, drinking lots of water, having a positive attitude, and practicing positive self-talk. Anytime I know I have a big work task or school task to complete, I am in the mindset of energy conversation—my energy. I make sure to get a good night sleep, eat my Wheaties, and think good vibes. These habits allow me to complete projects in a way that works for me.

Lastly, set up a reward system. One of the great things about creating prioritized lists of things that need to be done is the sense of accomplishment when you cross that item off the list. Once you’ve identified your major goals and tasks, identify a reward for each of these goals that provides an even greater sense of accomplishment. The reward should be personal and should encourage you to continue your good habits. What are the things you love to do? Write them down next to the major tasks and learn to practice delayed gratification by only doing those things once you’ve crossed the item off.

In conclusion, practical and tangible strategies for time and energy management can be the key to success for any undertaking. While each concept related to time and energy management is unique and provides a starting point for you to begin to develop strong personal management skills, these methods and ideas are not one-size-fits-all, and you need to explore the strategies and discover which components of each best fit your lifestyle and circumstances. Through this exercise, you can develop a personal management plan that is best suited to your needs and goals.

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9.2.5: What Do You Enjoy Studying?

What Do You Enjoy Studying?

Dr. Patricia Munsch

There is a tremendous amount of stress placed on college students regarding their choice of major. Everyday, I meet with students regarding their concern about choosing *right* major; the path that will lead to a fantastic, high-paying position in a growth industry. There is a hope that one decision, your college major, will have a huge impact on the rest of your life.

Students shy away from subject areas they enjoy due to fear that such coursework will not lead to a job. I am disappointed in this approach. As a counselor I always ask—what do you enjoy studying? Based on this answer it is generally easy to choose a major or a family of majors. I recognize the incredible pressure to secure employment after graduation, but forcing yourself to choose a major that you may not have any actual interest in because a book or website mentioned the area of growth may not lead to the happiness you predict.

Working in a college setting I have the opportunity to work with students through all walks of life, and I do believe based on my experience, that choosing a major because it is listed as a growth area alone is not a good idea. Use your time in college to explore all areas of interest and utilize your campus resources to help you make connections between your joy in a subject matter and the potential career paths. Realize that for most people, in most careers, the undergraduate major does not lead to a linear career path.

As an undergraduate student I majored in Political Science, an area that I had an interest in, but I added minors in Sociology and Women's Studies as my educational pursuits broadened. Today, as a counselor, I look back on my coursework with happy memories of exploring new ideas, critically analyzing my own assumptions, and developing an appreciation of social and behavioral sciences. So to impart my wisdom in regards to a student's college major, I will always ask, what do you enjoy studying?

Once you have determined what you enjoy studying, the real work begins. Students need to seek out academic advisement. Academic advisement means many different things; it can include course selection, course completion for graduation, mapping coursework to graduation, developing opportunities within your major and mentorship.

As a student I utilized a faculty member in my department for semester course selection, and I also went to the department chairperson to organize two different internships to explore different career paths. In addition, I sought mentorship from club advisors as I questioned my career path and future goals. In my mind I had a team of people providing me support and guidance, and as a result I had a great college experience and an easy transition from school to work.

I recommend to all students that I meet with to create their own team. As a counselor I can certainly be a part of their team, but I should not be the only resource. Connect with faculty in your department or in your favorite subject. Seek out internships as you think about the transition from college to workplace. Find mentors through faculty, club advisors, or college staff. We all want to see you succeed and are happy to be a part of your journey.

As a counselor I am always shocked when students do not understand what courses they need to take, what grade point average they need to maintain, and what requirements they must fulfill in order to reach their goal—graduation! Understand that as a college student it is your responsibility to read your college catalog and meet all of the requirements for graduation from your college. I always suggest that students, starting in their first semester, outline or map out all of the courses they need to take in order to graduate. Of course you may change your mind along the way, but by setting out your plan to graduation you are forcing yourself to learn what is required of you.

I do this exercise in my classes and it is by far the most frustrating for students. They want to live in the now and they don't want to worry about next semester or next year. However, for many students that I see, the consequence of this decision is a second semester senior year filled with courses that the student avoided during all the previous semesters. If you purposefully outline each semester and the coursework for each you can balance your schedule, understand your curriculum, and feel confident that you will reach your goal.

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9.3.1: Fighting for My Future Now

Fighting for My Future Now

Amie Bernstein

Instead of completing high school, I elected to obtain my GED due to an anxiety disorder that kept me from being successful in the traditional school setting. At sixteen years old, I thought I had it figured out. I was going to go to college before my high school class graduated, and I would be ahead of the curve. But I learned quickly that college coursework is tremendously different from high school. College requires a level of self-discipline that I had not yet developed. More importantly, college requires a substantial amount of courage and confidence that I was sorely lacking.

In the spring of 2005, I attempted to take my first two college classes. I withdrew from both within the first month. I made excuses as to why I could not complete the semester. I told people that it was the professor's fault for making the information too difficult or teaching the material too quickly. I told other people that the readings were too easy and I was wasting my time. The truth was that I was afraid to try. I was afraid that if I tried, the result would be failure.

After eight consecutive semesters, I had completed only five classes successfully, accrued seventeen withdrawals, and got three failing grades. In those four years, I was placed on academic probation five times because I neglected to withdraw from classes and just received a failing grade instead. I made the decision to find an entry-level job in an office so I could grow with a company to be successful instead of getting an education. Through a little bit of searching, I found what I was looking for. At the time, it seemed like the perfect place to be, and I was excited to start.

I was working at an HVAC company in the office part-time as a general office assistant. My duties included answering phones and taking messages. There wasn't a great amount of room for growth, however it had a better salary than any of the previous jobs I had at fast food restaurants and retail stores. I worked at the company for nearly two years before I asked for a raise. It took a month of contemplation, and the owner finally agreed to give me a raise. I waited for my next paycheck, excited to see the increase in pay even though I knew it wasn't going to be very big.

The raise meant that I had accomplished something, but when I received my next paycheck, the pay rate wasn't changed and it felt like I had accomplished nothing at all. When I questioned the owner about it, he said he forgot and he would change it for the next pay period. This same routine went on for two months until I made a big decision. The moment I received my paycheck, three months from when I originally asked for a raise, I walked out of the office and drove directly to the registrar on my local community college. I registered for classes again, but this time I promised myself it would be different; I was fighting for my future now.

I then started taking classes again in the fall of 2011 going part-time. I attended every class and studied as much as I could. I took every opportunity for extra credit assignments. I didn't stop to doubt myself. I just kept my thoughts focused on finishing the assignments—one at a time. Before I knew it, I had successfully completed the semester. I continued to take classes and try my best—taking every challenge head-on.

A year later, in the fall of 2012, I received a letter in the mail inviting me to join the honor society. Up until this point in my life I had let my anxiety disorder rule my life. This was proof that I was finally on the right track. I reluctantly joined and decided to continue to further push myself outside my comfort zone to challenge my anxiety.

Not only did I start going to meetings, but I participated in every event that the honor society had to offer. That included bake sales, volunteering for nonprofit organizations, and volunteering for the college itself. The opportunities came at me from every angle.

I then started to be recognized by the college. In addition to being recognized for my good grades, I was also recognized for my involvement with campus activities through the honor society. I received both a Distinguished Student Award from my college and a SUNY Chancellor's Award for Student Excellence. I joined everything I could after that, including two more honor societies, one for English and the other for Psychology. I enrolled in a non-credit bearing leadership class on campus so I could have even more experience that would help me with my future goals. I even went on to run for a regional officer position in my honor society and won. I was able to travel to California, Florida, and Missouri, all because of campus involvement in the honor society.

I still have anxiety, but now I am able to cope with it without letting it dictate my every move. I have confidence. I always thought that because I wasn't that cookie cutter all-American student, my opportunities would be limited, but getting involved on campus

opened so many doors for me. I learned so much about what it was to be a leader. I learned what it meant to be part of a team and the value in building relationships. I learned what it meant to be engaged both inside and outside of the classroom.

I developed a deeper sense of who I am through my campus involvement. Sometimes I think about what would have happened if I never had taken that step and joined the honor society or never attended any meetings. Honestly, I probably would have been okay. I would have been steadily gliding through my education. I would have shown up to class, taken notes, then gone home and studied. I would have probably then gone on and found a decent job with a regular amount of satisfaction. But who wants an okay, decent, or regular life? I don't; I need more. I want to love what I do and enjoy every moment I can.

Maybe the honor society isn't something that you are interested in and that's okay. Do something different and learn about all of the opportunities that your campus offers and pick one to try out. Make your life more than run of the mill—and start now.

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9.3.2: Something Was Different

Something Was Different

Jacqueline Tiermini

I have earned both a bachelor's and a master's degree and I have nearly twenty years of teaching experience. Would you ever guess that I contemplated not going to college at all? I originally thought about going to Beauty School and becoming a Cosmetologist. It was to me, honestly the easy way out since I was sick of all the drama after high school. The thought of college seemed overwhelming. Why did I really need to have a college degree when all I ever wanted was to get married and be a stay-at-home mom? My friends weren't going to college either, so I often wondered if going would complicate our friendship.

I decided to go anyway, and it *did* separate us a bit. While I was writing a ten-page paper for my summer class in Genetics and Heredity, my friends were swimming in *my* pool. They also had the chance to buy new cars and new clothes and to go on vacations. I just went to school, driving my used Nissan Sentra, without much more than gas money and a few extra bucks. Again, why was I doing this? It would have been easier to just do what my friends were doing.

Little by little, semesters went by and I graduated with my bachelor's degree in Education. I started substitute teaching immediately and within six months I was offered a full-time job. Just like that, I had more money and all kinds of new opportunities and I could now consider a new car or going on vacation just like my friends. At that point, I decided to continue my education and get my master's degree. Yes, it was a lot of hard work again, and yes, my friends wondered why I wanted to go back again, but I knew then that this was the best choice for me. The challenge wasn't knowing where I wanted my career to go, but rather overcoming the pull to settle into a lifestyle or career because it was easy, not because it was what I wanted.

By the time I graduated with my master's degree I realized that something was different. For all the years that I felt behind or unable to keep up with what my friends had, I was suddenly leaps and bounds ahead of them career-wise. I now had two degrees, a full-time teaching job, and a plan to keep my career moving forward. I was able to do all of the things that they had done all those years and more. None of them had careers, just jobs. None of them had long-term plans. None of them were as satisfied with their choices any longer and a few of them even mentioned that they were jealous of my opportunity to attend college.

Don't be fooled. Being a college student is a lot of work and, like me, most students have questioned what they are doing and why they are doing it. However, the rewards certainly outweigh all of the obstacles. I used to hear, "Attending college will make you a well-rounded person" or "It sets you apart from those that do not attend," yet it never felt true at the time. Eventually though, you will come to a point where you realize those quotes are true and you will be on your way to earning that degree!

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9.3.3: Transferable

Transferable

Vicki L. Brown

I was supposed to be a teacher. Growing up, I had a classroom in the basement. I had a chalkboard, chalk, desks, textbooks, homework assignments, pens, pencils, paper—you name it, I had it! My brother and sister called me “Miss Brown.” All I ever wanted to be was an elementary school teacher—until I went to college.

As an elementary education major in college, I participated in a variety of classes—classes on literacy, math and science, philosophies of teaching, child development theory, principles of education, foundations of classroom behavior, and a whole list of others. We learned how to write a lesson plan, manage a classroom, how to set up a classroom, and much, much more.

In addition to my studies, I got involved in campus life. I joined the swimming and diving team, participated in campus activities, and joined clubs. I served as a captain of the swimming and diving team, became an Orientation Leader and a Resident Assistant, and completely immersed myself in the college experience. It was through these co-curricular activities that I was introduced to the world of higher education and a potentially new career choice for myself.

Through my academic and co-curricular activities, I gained valuable knowledge from all those I came in contact with—my peers, professors, Residence Hall Directors, and many college administrators. They encouraged me to explore what it was that I *really* wanted to do with my life. The more I got involved in my college experience, the more I learned about myself: what I’m good at, what I’m not good at, what I wanted to, and what I didn’t want to do.

As I started to sort through my options, I continued my studies, receiving both a bachelor’s degree and a master’s degree in elementary education. While attending graduate school, I also worked as a Graduate Residence Hall Director. It was during that time when I finally made the decision to pursue a career in higher education administration/student affairs administration and leave my plans of being an elementary school teacher behind.

The decision wasn’t as difficult as one might think. When some listen to my story, I often hear “you’ve wasted all that time and money…” But, the truth is I gained valuable, lifelong skills from the people I met, the classes I took, the jobs I’ve had, and the activities I involved myself in. Each and every skill you acquire is transferable. This is perhaps the best lesson I’ve ever learned in college.

The countless lesson plans I had to write for my education classes and student teaching have helped me prepare practice plans as the head coach for the men’s and women’s swimming and diving team. The skills I learned while planning programs and activities for my residents as a Resident Assistant, Hall Director, and Area Coordinator have helped me plan campus events as the Director of Student Activities in the Center for Student Leadership & Involvement. The classroom management techniques I learned in college have helped me to manage my office, staff, team, committees, etc. The communication and development theories I’ve learned have taught me how to have meaningful conversations with others and how best to meet their needs.

Each and every skill you learn throughout your academic, personal, and professional career are valuable and transferable. Do not let your college degree define who you are but rather, let the knowledge and skills you’ve acquired define who you are.

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9.3.4: It's Like Online Dating

It's Like Online Dating

Jackie Vetrano

Searching for a job, especially your first job, is a lot like online dating. It begins as a time commitment, gets nerve-wracking towards the middle, but ends in success and happiness if you follow the right process.

Like many single people with access to current technology, I ventured into the world of online dating. I went for coffee with potential mates who were instant *no way*s, some who left me scratching my head, and a few who I found a connection with.

But hang on. We are here to talk about professional development, not my love life.

Being on the job hunt is not easy. Many spend hours preparing résumés, looking at open positions, and thinking about what career path to travel. Occasionally, it is overwhelming and intimidating, but when taken one step at a time, it can be a manageable and an exciting process.

Your Dating Profile—The Résumé

The first step of online dating is the most important: create your dating profile. Your profile is where you put your best foot forward and show off all of your attractive qualities through visuals and text. Online daters find their most flattering photos and then season the "about me" section of their profile with captivating and descriptive words to better display who they are and why other online daters should give them a shot.

Résumés follow this same logic. Your résumé should be clean, polished, and present you in your best light for future employers. Like dating profiles, they are detailed and should paint a picture for other prospective dates (or future employers) supporting why you deserve a chance at their love—an interview.

The unspoken rules of online dating profiles are very similar to the rules for writing a résumé. Whether you like it or not, your online dating profile and résumé both serve as a first impression. Profiles and résumés that are short, filled with spelling errors, or vague are usually passed over. Unless you are a supermodel and all you need is an enticing photo, your written description is very important to display who you are.

Your résumé should capture who you are, your skill set, education, past experiences, and anything else that is relevant to the job you hope to obtain. Knowing your audience is a key factor in crafting the perfect résumé. Logically, if my online dating profile presented studious and quiet personality traits, I would likely start receiving messages from potential mates who are looking for someone who is seeking those traits. By taking a similar approach while writing a résumé, you can easily determine the tone, language, and highlighted skills and experiences you should feature. The tone of your résumé is dictated by the nature of the position you hope to obtain in the future. For example, hospitality jobs or positions that require you to interact with many people on a daily basis should be warm and welcoming while analytical jobs, such as accounting or research positions, should reflect an astute attention to detail. Your choice in language follows similar logic—use appropriate terms for the position you are seeking.

Unlike online dating profiles, your résumé should include your important contact information, including email address, telephone number, and mailing address. Some advise refraining from listing a mailing address, as this could create a bias due to some organizations that are looking for a new employee who is already in the area. Unfortunately, this bias cannot be foreseen, which means you should use your best judgment when listing your contact information. If you include this contact information on your dating profile, you may have some very interesting text messages in the morning.

Finding Love—The Job Hunt

Simply crafting an online dating profile doesn't necessarily mean you will find your one true love, and the same applies to your career. Once your résumé is crafted, it is equally as important to search the job market to find what you think would be a good fit based on your skills and preferences.

An important part of online dating is setting the appropriate search filters. Sites allow users to search by gender, location, age, religious beliefs, or social practices. All these are small pieces that affect the overall compatibility between two people, with some factors being more important than others. By carefully choosing which filters are most important, you're sure to have better luck finding a perfect match that will make you happy and excited.

As you begin the job hunt, it is important to determine your filters when it comes to a career or first job. Some of these filters, like dating, may hold more weight to you than others. Many job search sites allow users to find job listings as defined by these filters, and they can include: location, type of organization, starting salary, potential for promotion, job responsibilities, etc.

Always establish filters. You may say, "I don't care what I find, as long as I find *something*." All of us have a preference in our love lives as well as our careers, and being honest with yourself about these filters will increase the likelihood for happiness in the end. These filters also allow you to more quickly read through job postings, because you will be focusing on positions with the qualities that you already determined are the most important to you.

When you are searching for a posted position using an online service, enter your filters and try a variety of search phrases to find as many postings as possible. Even changing "school counselor" to "guidance counselor" or only "counseling" may produce a different set of job postings, depending on the website.

It is also important to remember, like online dating sites, not every job posting will be on every employment site. Experiment with different search techniques and websites, and seek the advice of others for the best resource for recent postings. It's easy to save these filters and search results on most job search websites, allowing you to check back on a constant basis without resetting your filters. Most sites also allow you to create a free account, providing you a way to receive email alerts any time a new job is posted and fits in with your filters.

After the filters are set, it is time to start the exciting and nerve-wracking part: scrolling through profiles.

Scrolling through Profiles—The Job Postings

You will find attractive potentials with no description provided, others who exclusively take selfies, and a whole list of people who simply are not right for you based on their description. But then, it happens. You find someone who may be a match, and your heart starts to flutter.

Reading through a job description is equally as exciting. A good job posting provides a robust description of responsibilities, minimum qualifications, and desired qualifications for candidates. Knowing your own skill set, you can determine if you're a match or not. By having honest filters set before searching, it's likely that you are.

Sometimes, online dating simply doesn't work. Many will then turn to speed dating to meet new people in the area. This method allows for daters to quickly determine whether or not there's any chemistry, without spending time searching through online profiles. Similarly, job fairs provide this quick face-to-face advantage. If you're attending a job fair, be sure dress appropriately and have copies of your résumé or business cards on hand. Through job fairs, you'll be building your first impression right away, and may even be offered an interview on the spot.

Sending a Message—The Cover Letter

After searching through dozens of profiles, online daters generally find a handful of people they can picture themselves with. There's only one way to find out more about the person, and that's by sending the first message.

My personal rule for online dating is to always send a thoughtful first message to those I want to meet. It's easy enough to send a short, impersonal "hey," but it's important to make a good impression. It's obvious that the message I send, combined with my well-written profile, is going to continue to form a first impression of me. First impressions are very important in dating, job-hunting, and life overall.

The challenging part of the first message I send through online dating sites is determining what to say. I've never met these people before, but I do have access to their dating profiles filled with their hobbies, hometowns, and more. This is a perfect starting point for my message, especially if we both root for the same football team or if the other person likes to run as much as I do.

Your cover letter serves as an introduction to your future employer and should compliment your résumé to create a shining first impression. It is incredibly challenging to sit in front of a blank screen trying to find a good starting point, which means you should look at the job posting and organization's website for ideas about what to include.

Generally, these job postings provide a set of *hard* skills (such as proficiency with certain technology) and *soft* skills (such as public speaking, teamwork, or working in a flexible environment) required and desired for the posted position. This information provides you a list of what should be explained in your cover letter. Demonstrating your hard skills is a simple enough task by using examples or stating certifications, but describing your soft skills may require a little more thought. These soft skills can be

exhibited by discussing specific examples of past experiences in previous jobs you've held, volunteer work, or work you've done in college classes.

After you have crafted your cover letter, you should send it to a few people you trust for their opinion and overall proofreading along with the job posting for their reference. It's obvious that your cover letter should be free of spelling and grammar errors, but these trustworthy individuals will also be able to provide helpful insight about the examples you've used to display your soft skills.

The Hard Part—Waiting

You just sent your first message to the love of your life, but now what? You wait. You will undoubtedly feel anxious, especially if you sit refreshing your inbox for hours at a time, but if you made a good first impression and they like you as much as you like them, you will hear back.

While you wait, take the time to do a little research. Search for the organization online and view what information they provide. You will be storing up some good facts about your future partner, which is something you can bring up when you're on your first date. This research will also allow you to understand the company better. The organization displays their values, work ethic, and personality through online and print resources, which allows you to see if their values match with yours.

Unlike online dating, it is helpful to follow up with an organization you've applied to. Generally, the Human Resources department of an organization is the best place to start if you are unsure whom to call. This phone call is another piece of your first impression, which means you should be prepared to talk. Have any materials that you need ready, and be sure you are in a quiet place.

The First Date—The Job Interview

After what may feel like forever, you hear back from the love of your life. Congratulations! In the online dating world, you may chat about common interests (because you wrote a stunning first message), but in the world of work, you'll be asked to visit the organization for an interview.

I have been on many first dates, and whether it's in a coffee shop or over dinner, the first face-to-face meeting is tremendously important. If someone I am meeting for the first time looks like they just came from the gym or rolled out of bed, my impression instantly changes. This same theory can be directly applied to your first date with your future employer. You have worked hard on your cover letter and résumé, and you should not taint the sparkling first impression you have created with the wrong choice in dress.

What you wear to a job interview may change based on the position you have applied for, but there are a set of basic rules that everyone should follow. Similar to meeting someone on a first date for coffee, you want to be comfortable. Some interviews may take place with multiple people in an organization, meaning you will be walking to different locations, sitting down, and potentially sweating from a broken air conditioning unit. Consider these factors when choosing your outfit for your interview, and if you're concerned about being underdressed, remember to always dress a bit nicer than how you'd dress for the job itself.

There is nothing worse than sitting alone at a coffee shop waiting for a mystery date to show up. It's uncomfortable and affects my overall first impression of whom I'm about to meet. Avoid making your mystery employer annoyed and waiting for you by leaving at least ten minutes earlier than you need to, just in case you get stuck in traffic. Arrive at least ten minutes early. The interview will start out much better if you are early rather than nervous and running late. Arriving early also gives you the time to have some coffee and review materials you may need for the interview. Coming on time to an interview or a first date shows you respect the time of the person you plan to meet.

On a first date, it is all about communication. Sometimes, there may be silences that cannot be filled or the person I have just met discloses their entire life story to me in less than an hour. If we cannot achieve a proper balance, there will not be a second date. Communicating effectively in a job interview is equally as important, especially if you want a job offer!

All of the rules of dating apply to how you should behave in a job interview. The interviewer will ask you questions, which means that you should look at them and focus on what is being asked. Your phone should be on silent (not even on vibrate), and hidden, to show that you are fully attentive and engaged in the conversation you are having. Much like having a conversation on a date, the answers to your questions should be clear and concise and stay on topic. The stories I tell on my first dates are more personal than what would be disclosed in a job interview, but the mindset is the same. You are building the impression that the organization has of you, so put your best foot forward through the comments you make.

To make that great impression, it is really important to heavily prepare and practice, even before you have an interview scheduled. By brainstorming answers to typical interview questions in a typed document or out loud, later during the interview you will easily

remember the examples of your past experiences that demonstrate why you are best for the job. You can continue to update this list as you move through different jobs, finding better examples to each question to accurately describe your hard and soft skills.

This interview is as much a date for your future employer as it is for you. Come prepared with questions that you have about the company, the position, and anything else you are curious about. This is an opportunity for you to show off the research you've done on the organization and establish a better understanding of company culture, values, and work ethic. Without knowing these basics of the company or organization, what you thought was a match might only end in a tense breakup.

After your interview is over, you continue to have an opportunity to build on the positive impression that you've worked hard to form. Sending a follow up thank you note to each person you interviewed with will show your respect for the time the organization spent with you. These notes can be written and sent by mail or emailed, but either way should have a personal touch, commenting on a topic that was discussed in the interview. While sending a thank you note after a first date may sound a little strange, you might not get asked to a second interview without one!

It's Official—The Job Offer

In the online dating world, it takes a few dates to determine if two people are a match. In the corporate world, you may have a one or two interviews to build a relationship. If your impression was positive and the organization believes you're a match for the open position, you'll be offered a job.

With a job offer also comes the salary for the position. It is important to know what a reasonable salary is for the position and location, which can be answered with a bit of research. One good place to look is the Bureau of Labor Statistics website: http://stats.bls.gov/oes/current/oessrcst.htm. At this point, it is not uncommon to discuss your salary with your future employer, but be sure to do so in a polite way.

Online dating sites provide the means for millions of people to meet future partners, and the number of people who use online dating is so large that there are sure to be disappointments along the way. I have met people who I thought were compatible with me, but they did not feel the same, and vice versa. This happens frequently while searching for a job, which can be discouraging, but should not hinder you from continuing to search! There are a great number of opportunities, and sometimes all it takes is adjusting your filters or revising your résumé and cover letter. The cliché "there's plenty of fish in the sea" may be true, but there is definitely a way for each person to start their career off right.

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9.3.5: Learn What You Don’t Want

Learn What You Don’t Want

Jamie Edwards

For a long time, my plan had always been to be a kindergarten teacher. But when I began my undergraduate degree I fell into that ever-growing pool of college students who changed their major three times before graduation. I was swayed by family members, my peers, and the economy, but I eventually realized that I was investing my education in the wrong areas for the wrong reasons. It shouldn’t just be about salaries and job security. I needed to find that personal attachment.

At eighteen, it’s hard to see your entire life spread out before you. College may feel like a free-for-all at times, but the reality is that it’s one of the most defining times of our lives. It should never be squandered. I started to imagine my life beyond college—what I found important and the type of lifestyle I wanted in the end. I started thinking about the classes that I was actually interested in—the ones that I looked forward to each week and arrived early to just so I could get a seat up front.

A turning point for me was when I took the advice of a campus mentor and enrolled in a career exploration course. I learned more about myself in that class than I had in my entire three years at college prior to taking it. It showed me that my passion was something I had always thought about but never thought about as a career. In high school, I could sit in the Guidance Office for hours on end. I enjoyed listening to others—hearing and helping people work through their struggles.

I had seen firsthand how detrimental the absence of career classes can be to someone’s future. Through this realization and my participation in my career exploration class, I saw a viable future in the Higher Education Administration field. As I dove deeper, I was opened to an incredible amount of unique and diverse opportunities to work with students. My main approach was to get a taste anything to do with student services: I shadowed a career counselor in a career services office, attended graduate school fairs and informational sessions, discussed the Higher Education Administration Program with several staff at my college, and most importantly, I talked with my internship coordinator (my mentor). From there, I completed an internship in my prospective field, which gave me a wealth of insight and skills that directly related to my future career goals.

From where I sit now—my former personal and professional struggles in tow—I offer up some pieces of advice that were crucial to getting me where I am today. Whether you’re an undecided major who is looking for guidance or a student with a clearly defined career path, I suggest the following:

1. *Find a mentor*—For me, everything began there. Without my mentor, I wouldn’t have done any of the other items I’m about to suggest. Finding the right mentor is crucial. Look for someone who can complement your personality (typically someone who’s the opposite of you). My advice would be to look beyond your direct supervisor for mentorship. It’s important to create an open forum with your mentor, because there may be a conflict of interest as you discuss work issues and other job opportunities. Potential mentors to consider are an instructor on campus, your academic advisor, a professional currently working in your prospective field, someone you admire in your community, or anyone in your network of friends or family that you feel comfortable discussing your future goals with.
2. *Enroll in a Career Exploration/Planning course, or something similar*—Even if you do not see the effects of this course immediately (such as dramatically changing your major), you will notice the impact down the road. Making educated career choices and learning job readiness skills will always pay off in the end. Through my career exploration class, I learned how to relate my personality and values to potential career fields. These self-assessments changed my entire thought process, and I see that influence daily. Beyond changing the way you think, the knowledge you gain about effective job search strategies is invaluable. Learning how to write purposeful résumés and cover letters, finding the right approach to the interview process, and recognizing your strengths and weaknesses are just a few of the benefits you can gain from these type of courses.
3. *Complete a Job Shadow and/or Informational Interview*—No amount of online research is going to give you the same experience as seeing a job at the front line. In a job shadow or an informational interview, you’re able to explore options with no commitment and see how your in-class experience can carry over to a real world setting. Additionally, you’re expanding your professional network by having that personal involvement. You never know how the connections you make might benefit you in the future. My only regret about job shadowing in college is that I didn’t do it sooner.
4. *Do an Internship*—A main source of frustration for recent grads is the inability to secure an entry-level position without experience. “How do I get a job to gain experience when I can’t get a job without experience?” This is how: do an internship or two! Most colleges even have a course where you can obtain credit for doing it! Not only will you earn credits towards graduation, but you’ll gain the necessary experience to put on your résumé and discuss in future interviews. Having completed

four internships throughout my college career, I can't say they were all great. However, I don't regret a single one. The first one showed me the type of field I didn't want to work in. The second confirmed that I was heading in the right direction with my career. My third and fourth internships introduced me to completely different areas of higher education which broadened my knowledge and narrowed my search simultaneously.

My takeaway is that sometimes you have to learn what you don't want in order to find out what you do want. The more informed you are about career options through real life conversations and experiences, the better prepared you will be for your future and the more confident you will be in your career decisions. Always explore your options because even if you learn you hate it, at least you're one step close to finding what you love.

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CHAPTER OVERVIEW

10: Introduction to the Language of Algebra

You may not realize it, but you already use algebra every day. Perhaps you figure out how much to tip a server in a restaurant. Maybe you calculate the amount of change you should get when you pay for something. It could even be when you compare batting averages of your favorite players. You can describe the algebra you use in specific words, and follow an orderly process. In this chapter, you will explore the words used to describe algebra and start on your path to solving algebraic problems easily, both in class and in your everyday life.

10.1: Use the Language of Algebra (Part 1)
10.2: Use the Language of Algebra (Part 2)
10.3: Evaluate, Simplify, and Translate Expressions (Part 1)
10.4: Evaluate, Simplify, and Translate Expressions (Part 2)
10.5: Solving Equations Using the Subtraction and Addition Properties of Equality (Part 1)
10.6: Solving Equations Using the Subtraction and Addition Properties of Equality (Part 2)
10.7: Find Multiples and Factors (Part 1)
10.8: Find Multiples and Factors (Part 2)
10.9: Prime Factorization and the Least Common Multiple (Part 1)
10.10: Prime Factorization and the Least Common Multiple (Part 2)
10.E: Introduction to the Language of Algebra (Exercises)
10.S: Introduction to the Language of Algebra (Summary)

Figure 2.1 - Algebra has a language of its own. The picture shows just some of the words you may see and use in your study of Prealgebra.

Contributors

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10.1: Use the Language of Algebra (Part 1)

Learning Objectives

- Use variables and algebraic symbols
- Identify expressions and equations
- Simplify expressions with exponents
- Simplify expressions using the order of operations

Be Prepared!

Before you get started, take this readiness quiz.

a. Add: $43+69$. If you missed this problem, review Example 1.2.8.
b. Multiply: $(896)201$. If you missed this problem, review Example 1.4.11.
c. Divide: $7,263 \div 9$. If you missed this problem, review Example 1.5.8.

Use Variables and Algebraic Symbols

Greg and Alex have the same birthday, but they were born in different years. This year Greg is 20 years old and Alex is 23, so Alex is 3 years older than Greg. When Greg was 12, Alex was 15. When Greg is 35, Alex will be 38. No matter what Greg's age is, Alex's age will always be 3 years more, right?

In the language of algebra, we say that Greg's age and Alex's age are variable and the three is a constant. The ages change, or vary, so age is a variable. The 3 years between them always stays the same, so the age difference is the constant.

In algebra, letters of the alphabet are used to represent variables. Suppose we call Greg's age g. Then we could use $g+3$ to represent Alex's age. See Table 10.1.1.

Table 10.1.1

Greg's age	Alex's age
12	15
20	23
35	38
g	g + 3

Letters are used to represent variables. Letters often used for variables are $x, y, a, b,$ and c.

Definition: Variables and Constants

A variable is a letter that represents a number or quantity whose value may change.

A constant is a number whose value always stays the same.

To write algebraically, we need some symbols as well as numbers and variables. There are several types of symbols we will be using. In Whole Numbers, we introduced the symbols for the four basic arithmetic operations: addition, subtraction, multiplication, and division. We will summarize them here, along with words we use for the operations and the result.

Table 10.1.2

Operation	Notation	Say:	The result is...
Addition	a + b	a plus b	the sum of a and b
Subtraction	a − b	a minus b	the difference of a and b
Multiplication	a • b, (a)(b), (a)b, a(b)	a times b	the product of a and b

Operation	Notation	Say:	The result is...
Division	a ÷ b, a / b, $\frac{a}{b}$, $b\overline{)a}$	a divided by b	the quotient of a and b

In algebra, the cross symbol, $\times$, is not used to show multiplication because that symbol may cause confusion. Does $3xy$ mean $3 \times y$ (three times y) or $3 \bullet x \bullet y$ (three times x times y)? To make it clear, use $\bullet$ or parentheses for multiplication.

We perform these operations on two numbers. When translating from symbolic form to words, or from words to symbolic form, pay attention to the words *of* or *and* to help you find the numbers.

The *sum* ***of*** 5 ***and*** 3 means add 5 plus 3, which we write as $5+3$.

The *difference* ***of*** 9 ***and*** 2 means subtract 9 minus 2, which we write as $9-2$.

The *product* ***of*** 4 ***and*** 8 means multiply 4 times 8, which we can write as $4 \bullet 8$.

The *quotient* ***of*** 20 ***and*** 5 means divide 20 by 5, which we can write as $20 \div 5$.

Example 10.1.1: translate to words

Translate from algebra to words:

a. $12+14$
b. $(30)(5)$
c. $64 \div 8$
d. $x-y$

Solution

a.

12 + 14
12 plus 14
the sum of twelve and fourteen

b.

(30)(5)
30 times 5
the product of thirty and five

c.

64 ÷ 8
64 divided by 8
the quotient of sixty-four and eight

d.

x − y
x minus y
the difference of x and y

exercise 10.1.1

Translate from algebra to words.

a. $18+11$
b. $(27)(9)$
c. $84\div 7$
d. $p-q$

Answer a

18 plus 11; the sum of eighteen and eleven

Answer b

27 times 9; the product of twenty-seven and nine

Answer c

84 divided by 7; the quotient of eighty-four and seven

Answer d

p minus q; the difference of p and q

exercise 10.1.2

Translate from algebra to words.

a. $47-19$
b. $72\div 9$
c. $m+n$
d. $(13)(7)$

Answer a

47 minus 19; the difference of forty-seven and nineteen

Answer b

72 divided by 9; the quotient of seventy-two and nine

Answer c

m plus n; the sum of m and n

Answer d

13 times 7; the product of thirteen and seven

When two quantities have the same value, we say they are equal and connect them with an *equal sign*.

Definition: Equality Symbol

$a=b$ is read a is equal to b

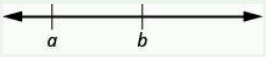
The symbol $=$ is called the equal sign.

An inequality is used in algebra to compare two quantities that may have different values. The number line can help you understand inequalities. Remember that on the number line the numbers get larger as they go from left to right. So if we know that b is greater than a, it means that b is to the right of a on the number line. We use the symbols "$<$" and "$>$" for inequalities.

Definition: Inequality

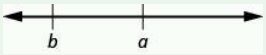
$a < b$ is read a is less than b

a is to the left of b on the number line



$a > b$ is read a is greater than b

a is to the right of b on the number line



The expressions $a < b$ and $a > b$ can be read from left-to-right or right-to-left, though in English we usually read from left-to-right. In general, $a < b$ is equivalent to $b > a$. For example, $7 < 11$ is equivalent to $11 > 7$. $a > b$ is equivalent to $b < a$. For example, $17 > 4$ is equivalent to $4 < 17$.

When we write an inequality symbol with a line under it, such as $a \leq b$, it means $a < b$ or $a = b$. We read this a is less than or equal to b. Also, if we put a slash through an equal sign, $\neq$, it means not equal.

We summarize the symbols of equality and inequality in Table 10.1.3.

Table 10.1.3

Algebraic Notation	Say
a = b	a is equal to b
a ≠ b	a is not equal to b
a < b	a is less than b
a > b	a is greater than b
a ≤ b	a is less than or equal to b
a ≥ b	a is greater than or equal to b

Definition: Symbols $<$ and $>$

The symbols $<$ and $>$ each have a smaller side and a larger side.

$$\text{smaller side} < \text{larger side}$$

$$\text{larger side} > \text{smaller side}$$

The smaller side of the symbol faces the smaller number and the larger faces the larger number.

Example 10.1.2: translate to words

Translate from algebra to words:

a. $20 \leq 35$
b. $11 \neq 15 - 3$
c. $9 > 10 \div 2$
d. $x + 2 < 10$

Solution

a.

$20 \leq 35$
20 is less than or equal to 35

b.

$11 \neq 15 - 3$
11 is not equal to 15 minus 3

c.

$9 > 10 \div 2$
9 is greater than 10 divided by 2

d.

$x + 2 < 10$
x plus 2 is less than 10

exercise 10.1.3

Translate from algebra to words.

a. $14 \leq 27$
b. $19 - 2 \neq 8$
c. $12 > 4 \div 2$
d. $x - 7 < 1$

Answer a

fourteen is less than or equal to twenty-seven

Answer b

nineteen minus two is not equal to eight

Answer c

twelve is greater than four divided by two

Answer d

x minus seven is less than one

exercise 10.1.4

Translate from algebra to words.

a. $19 \geq 15$
b. $7 = 12 - 5$
c. $15 \div 3 < 8$
d. $y - 3 > 6$

Answer a

nineteen is greater than or equal to fifteen

Answer b

seven is equal to twelve minus five

Answer c

fifteen divided by three is less than eight

Answer d

y minus three is greater than six

Example 10.1.3: translate

The information in Figure 10.1.1 compares the fuel economy in miles-per-gallon (mpg) of several cars. Write the appropriate symbol =, in each expression to compare the fuel economy of the cars.

Car	Prius	Mini Cooper	Toyota Corolla	Versa	Honda Fit
					
Fuel economy (mpg)	48	27	28	26	27

Figure 10.1.1: (credit: modification of work by Bernard Goldbach, Wikimedia Commons)

a. MPG of Prius _____ MPG of Mini Cooper
b. MPG of Versa _____ MPG of Fit
c. MPG of Mini Cooper _____ MPG of Fit
d. MPG of Corolla _____ MPG of Versa
e. MPG of Corolla_____ MPG of Prius

Solution

a.

	MPG of Prius____MPG of Mini Cooper
Find the values in the chart.	48____27
Compare.	48 > 27
	MPG of Prius > MPG of Mini Cooper

b.

	MPG of Versa____MPG of Fit
Find the values in the chart.	26____27
Compare.	26 < 27
	MPG of Versa < MPG of Fit

c.

	MPG of Mini Cooper____MPG of Fit
Find the values in the chart.	27____27
Compare.	27 = 27
	MPG of Mini Cooper = MPG of Fit

d.

	MPG of Corolla____MPG of Versa
Find the values in the chart.	28____26
Compare.	28 > 26

	MPG of Corolla > MPG of Versa

e.

	MPG of Corolla____MPG of Prius
Find the values in the chart.	28____48
Compare.	28 < 48
	MPG of Corolla < MPG of Prius

? exercise 10.1.5

Use Figure 10.1.1 to fill in the appropriate symbol, $=$, $<$, or $>$.

a. MPG of Prius_____MPG of Versa
b. MPG of Mini Cooper_____ MPG of Corolla

Answer a

$>$

Answer b

$<$

? exercise 10.1.6

Use Figure 10.1.1 to fill in the appropriate symbol, $=$, $<$, or $>$.

a. MPG of Fit_____ MPG of Prius
b. MPG of Corolla _____ MPG of Fit

Answer a

$<$

Answer b

$<$

Grouping symbols in algebra are much like the commas, colons, and other punctuation marks in written language. They indicate which expressions are to be kept together and separate from other expressions. Table 10.1.4 lists three of the most commonly used grouping symbols in algebra.

Table 10.1.4

Common Grouping Symbols	
parentheses	( )
brackets	[ ]
braces	{ }

Here are some examples of expressions that include grouping symbols. We will simplify expressions like these later in this section.

$$8(14-8) \qquad 21-3[2+4(9-8)] \qquad 24\div 13-2[1(6-5)+4]$$

Identify Expressions and Equations

What is the difference in English between a phrase and a sentence? A phrase expresses a single thought that is incomplete by itself, but a sentence makes a complete statement. “Running very fast” is a phrase, but “The football player was running very fast” is a sentence. A sentence has a subject and a verb.

In algebra, we have *expressions* and *equations*. An expression is like a phrase. Here are some examples of expressions and how they relate to word phrases:

Table 10.1.5

Expression	Words	Phrase
3 + 5	3 plus 5	the sum of three and five
n - 1	n minus one	the difference of n and one
6 • 7	6 times 7	the product of six and seven
$\frac{x}{y}$	x divided by y	the quotient of x and y

Notice that the phrases do not form a complete sentence because the phrase does not have a verb. An equation is two expressions linked with an equal sign. When you read the words the symbols represent in an equation, you have a complete sentence in English. The equal sign gives the verb. Here are some examples of equations:

Table 10.1.6

Equation	Sentence
3 + 5 = 8	The sum of three and five is equal to eight.
n − 1 = 14	n minus one equals fourteen.
6 • 7 = 42	The product of six and seven is equal to forty-two.
x = 53	x is equal to fifty-three.
y + 9 = 2y − 3	y plus nine is equal to two y minus three.

Definition: Expressions and Equations

An expression is a number, a variable, or a combination of numbers and variables and operation symbols.

An equation is made up of two expressions connected by an equal sign.

Example 10.1.4: expression or equation

Determine if each is an expression or an equation:

a. $16 - 6 = 10$
b. $4 \bullet 2 + 1$
c. $x \div 25$
d. $y + 8 = 40$

Solution

(a) 16 − 6 = 10	This is an equation—two expressions are connected with an equal sign.
(b) 4 • 2 + 1	This is an expression—no equal sign.
(c) x ÷ 25	This is an expression—no equal sign.

(d) y + 8 = 40	This is an equation—two expressions are connected with an equal sign.

? exercise 10.1.7

Determine if each is an expression or an equation:

a. $23+6=29$
b. $7 \bullet 3-7$

Answer a

equation

Answer b

expression

? exercise 10.1.8

Determine if each is an expression or an equation:

a. $y \div 14$
b. $x-6=21$

Answer a

expression

Answer b

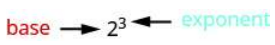
equation

Simplify Expressions with Exponents

To simplify a numerical expression means to do all the math possible. For example, to simplify $4 \bullet 2+1$ we'd first multiply $4 \bullet 2$ to get 8 and then add the 1 to get 9. A good habit to develop is to work down the page, writing each step of the process below the previous step. The example just described would look like this:

$$\begin{aligned} 4 \cdot 2+1 \\ 8+1 \\ 9 \end{aligned}$$

Suppose we have the expression $2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2$. We could write this more compactly using exponential notation. Exponential notation is used in algebra to represent a quantity multiplied by itself several times. We write $2 \bullet 2 \bullet 2$ as 2^3 and $2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2 \bullet 2$ as 2^9. In expressions such as 2^3, the 2 is called the **base** and the 3 is called the **exponent**. The exponent tells us how many factors of the base we have to multiply.

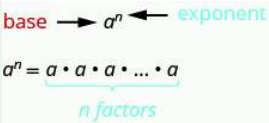


means multiply three factors of 2

We say 2^3 is in exponential notation and $2 \bullet 2 \bullet 2$ is in expanded notation.

Definition: Exponential Notation

For any expression a^n, a is a factor multiplied by itself n times if n is a positive integer.



The expression a^n is read a to the nth power.

For powers of $n = 2$ and $n = 3$, we have special names. a^2 is read as "a squared" a^3 is read as "a cubed" Table 10.1.7 lists some examples of expressions written in exponential notation.

Table 10.1.7

Exponential Notation	In Words
7^2	7 to the second power, or 7 squared
5^3	5 to the third power, or 5 cubed
9^4	9 to the fourth power
12^5	12 to the fifth power

Example 10.1.5: exponential form

Write each expression in exponential form:

a. $16 \bullet 16 \bullet 16 \bullet 16 \bullet 16 \bullet 16 \bullet 16$
b. $9 \bullet 9 \bullet 9 \bullet 9 \bullet 9$
c. $x \bullet x \bullet x \bullet x$
d. $a \bullet a \bullet a \bullet a \bullet a \bullet a \bullet a \bullet a$

Solution

(a) The base 16 is a factor 7 times.	16^7
(b) The base 9 is a factor 5 times.	9^5
(c) The base x is a factor 4 times.	x^4
(d) The base a is a factor 8 times.	a^8

exercise 10.1.9

Write each expression in exponential form: $41 \bullet 41 \bullet 41 \bullet 41 \bullet 41$

Answer

41^5

exercise 10.1.10

Write each expression in exponential form: $7 \bullet 7 \bullet 7 \bullet 7 \bullet 7 \bullet 7 \bullet 7 \bullet 7 \bullet 7$

Answer

7^9

Example 10.1.6: expanded form

Write each exponential expression in expanded form:

a. 8^6
b. x^5

Solution

a. The base is 8 and the exponent is 6, so 8^6 means $8 \bullet 8 \bullet 8 \bullet 8 \bullet 8 \bullet 8$
b. The base is x and the exponent is 5, so x^5 means $x \bullet x \bullet x \bullet x \bullet x$

exercise 10.1.11

Write each exponential expression in expanded form:

a. 4^8
b. a^7

Answer a

$4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$

Answer b

$a \cdot a \cdot a \cdot a \cdot a \cdot a \cdot a$

exercise 10.1.12

Write each exponential expression in expanded form:

a. 8^8
b. b^6

Answer a

$8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8 \cdot 8$

Answer b

$b \cdot b \cdot b \cdot b \cdot b \cdot b$

To simplify an exponential expression without using a calculator, we write it in expanded form and then multiply the factors.

Example 10.1.7: simplify

Simplify: 3^4.

Solution

Expand the expression.	$3^4 = 3 \cdot 3 \cdot 3 \cdot 3$
Multiply left to right.	$9 \cdot 3 \cdot 3 = 27 \cdot 3$
Multiply.	81

exercise 10.1.13

Simplify:

a. 5^3
b. 1^7

Answer a

125

Answer b

1

? exercise 10.1.14

Simplify:

a. 7^2
b. 0^5

Answer a

49

Answer b

0

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10.2: Use the Language of Algebra (Part 2)

Simplify Expressions Using the Order of Operations

We've introduced most of the symbols and notation used in algebra, but now we need to clarify the order of operations. Otherwise, expressions may have different meanings, and they may result in different values. For example, consider the expression:

$$4+3\cdot 7$$

Some students say it simplifies to	49	Some students say it simplifies to	25
Since 4 + 3 gives 7.	4 + 3 • 7 = 7 • 7	Since 3 • 7 is 21.	4 + 3 • 7 = 4 + 21
And 7 • 7 is 49.	7 • 7 = 49	And 21 + 4 makes 25.	4 + 21 = 25

Imagine the confusion that could result if every problem had several different correct answers. The same expression should give the same result. So mathematicians established some guidelines called the order of operations, which outlines the order in which parts of an expression must be simplified.

Definition: Order of Operations

When simplifying mathematical expressions perform the operations in the following order:

1. **P**arentheses and other Grouping Symbols
- Simplify all expressions inside the parentheses or other grouping symbols, working on the innermost parentheses first.
2. **E**xponents
- Simplify all expressions with exponents.
3. **M**ultiplication and **D**ivision
- Perform all multiplication and division in order from left to right. These operations have equal priority.
4. **A**ddition and **S**ubtraction
- Perform all addition and subtraction in order from left to right. These operations have equal priority.

Students often ask, "How will I remember the order?" Here is a way to help you remember: Take the first letter of each key word and substitute the silly phrase. **P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally.

Table 10.2.8

Order of Operations	
Please	**P**arentheses
Excuse	**E**xponents
My **D**ear	**M**ultiplication and **D**ivision
Aunt **S**ally	**A**ddition and **S**ubtraction

It's good that '**M**y **D**ear' goes together, as this reminds us that **m**ultiplication and **d**ivision have equal priority. We do not always do multiplication before division or always do division before multiplication. We do them in order from left to right.

Similarly, '**A**unt **S**ally' goes together and so reminds us that **a**ddition and **s**ubtraction also have equal priority and we do them in order from left to right.

Example 10.2.8: simplify

Simplify the expressions:

a. $4+3 \bullet 7$
b. $(4+3) \bullet 7$

Solution

a.

Are there any parentheses? No. Are there any exponents? No. Is there any multiplication or division? Yes.	$4+3 \cdot 7$
Multiply first.	$4+3 \cdot 7$
Add.	$4+21$
	25

b.

Are there any parentheses? Yes.	$(4+3) \cdot 7$
Simplify inside the parentheses.	$(4+3) \cdot 7$
Are there any exponents? No. Is there any multiplication or division? Yes.	$(7)7$
Multiply.	49

exercise 10.2.15

Simplify the expressions:

a. $12-5 \bullet 2$
b. $(12-5) \bullet 2$

Answer a

2

Answer b

14

exercise 10.2.16

Simplify the expressions:

a. $8+3 \bullet 9$
b. $(8+3) \bullet 9$

Answer a

35

Answer b

99

Example 10.2.9: simplify

Simplify:

a. $18 \div 9 \bullet 2$
b. $18 \bullet 9 \div 2$

Solution

a.

Are there any parentheses? No. Are there any exponents? No. Is there any multiplication or division? Yes.	$18 \div 9 \cdot 2$
Multiply and divide from left to right. Divide.	$2 \cdot 2$
Multiply.	4

b.

Are there any parentheses? No. Are there any exponents? No. Is there any multiplication or division? Yes.	$18 \cdot 9 \div 2$
Multiply and divide from left to right. Multiply.	$162 \div 2$
Divide.	81

exercise 10.2.17

Simplify: $42 \div 7 \bullet 3$

Answer

18

exercise 10.2.18

Simplify: $12 \bullet 3 \div 4$

Answer

9

Example 10.2.10: simplify

Simplify: $18 \div 6 + 4(5 - 2)$.

Solution

Parentheses? Yes, subtract first.	$18 \div 6 + 4(5 - 2)$
Exponents? No. Multiplication or division? Yes.	$18 \div 6 + 4(3)$
Divide first because we multiply and divide left to right.	$3 + 4(3)$
Any other multiplication or division? Yes. Multiply.	$3 + 12$
Any other multiplication or division? No. Any addition or subtraction? Yes	15

exercise 10.2.19

Simplify: $30 \div 5 + 10(3-2)$

Answer

16

exercise 10.2.20

Simplify: $70 \div 10 + 4(6-2)$

Answer

23

When there are multiple grouping symbols, we simplify the innermost parentheses first and work outward.

Example 10.2.11: simplify

Simplify: $5 + 2^3 + 3[6 - 3(4-2)]$.

Solution

Are there any parentheses (or other grouping symbol)? Yes.	$5 + 2^3 + 3[6 - 3(4-2)]$
Focus on the parentheses that are inside the brackets.	$5 + 2^3 + 3[6 - 3(4-2)]$
Subtract.	$5 + 2^3 + 3[6 - 3(2)]$
Continue inside the brackets and multiply.	$5 + 2^3 + 3[6 - 6]$
Continue inside the brackets and subtract.	$5 + 2^3 + 3[0]$
The expression inside the brackets requires no further simplification.	
Are there any exponents? Yes.	$5 + 2^3 + 3[0]$
Simplify exponents.	$5 + 8 + 3[0]$
Is there any multiplication or division? Yes.	$5 + 8 + 3[0]$
Multiply.	$5 + 8 + 0$
Is there any addition or subtraction? Yes.	$textcolorred5 + 8 + 0$
Add.	$13 + 0$
Add.	13

exercise 10.2.21

Simplify: $9 + 5^3 - [4(9+3)]$

Answer

86

exercise 10.2.22

Simplify: $7^2 - 2[4(5+1)]$

Answer

1

Example 10.2.12: simplify

Simplify: $2^3 + 34 \div 3 - 5^2$.

Solution

If an expression has several exponents, they may be simplified in the same step.	$2^3 + 3^4 \div 3 - 52$
Simplify exponents.	$2^3 + 3^4 \div 3 - 5^2$
Divide.	$8 + 81 \div 3 - 25$
Add.	$8 + 27 - 25$
Subtract.	$35 - 25$
	10

exercise 10.2.23

Simplify: $3^2 + 2^4 \div 2 + 4^3$

Answer

81

exercise 10.2.24

Simplify: $6^2 - 5^3 \div 5 + 8^2$

Answer

75

Access Additional Online Resources

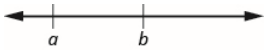
- Order of Operations
- Order of Operations – The Basics
- Ex: Evaluate an Expression Using the Order of Operations
- Example 3: Evaluate an Expression Using The Order of Operations

Key Concepts

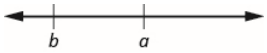
Operation	Notation	Say:	The result is…
Addition	a+b	a plus b	the sum of a and b
Multiplication	a·b,(a)(b),(a)b,a(b)	a times b	The product of a and b
Subtraction	a−b	a minus b	the difference of a and b

Operation	Notation	Say:	The result is…
Division	$a \div b, a/b, \frac{a}{b}, a\overline{)b}$	a divided by b	The quotient of a and b

- **Equality Symbol**
  - $a = b$ is read as a is equal to b
  - The symbol $=$ is called the equal sign.
- **Inequality**
  - $a < b$ is read a is less than b
  - a is to the left of b on the number line

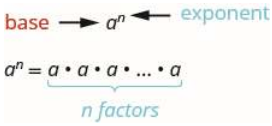


  - $a > b$ is read a is greater than b
  - a is to the right of b on the number line



Algebraic Notation	Say
a=b	a is equal to b
a≠b	a is not equal to b
a<b	a is less than b
a>b	a is greater than b
a≤b	a is less than or equal to b
a≥b	a is greater than or equal to b

- **Exponential Notation**
  - For any expression a^n is a factor multiplied by itself n times, if n is a positive integer.
  - a^n means multiply n factors of a



  - The expression of a^n is read a to the nth power.

Order of Operations When simplifying mathematical expressions perform the operations in the following order:

- Parentheses and other Grouping Symbols: Simplify all expressions inside the parentheses or other grouping symbols, working on the innermost parentheses first.
- Exponents: Simplify all expressions with exponents.
- Multiplication and Division: Perform all multiplication and division in order from left to right. These operations have equal priority.
- Addition and Subtraction: Perform all addition and subtraction in order from left to right. These operations have equal priority.

Glossary

expressions

An expression is a number, a variable, or a combination of numbers and variables and operation symbols.

equation

An equation is made up of two expressions connected by an equal sign.

Practice Makes Perfect

Use Variables and Algebraic Symbols

In the following exercises, translate from algebraic notation to words.

1. $16 - 9$
2. $25 - 7$
3. $5 \cdot 6$
4. $3 \cdot 9$
5. $28 \div 4$
6. $45 \div 5$
7. $x + 8$
8. $x + 11$
9. $(2)(7)$
10. $(4)(8)$
11. $14 < 21$
12. $17 < 35$
13. $36 \geq 19$
14. $42 \geq 27$
15. $3n = 24$
16. $6n = 36$
17. $y - 1 > 6$
18. $y - 4 > 8$
19. $2 \leq 18 \div 6$
20. $3 \leq 20 \div 4$
21. $a \neq 7 \cdot 4$
22. $a \neq 1 \cdot 12$

Identify Expressions and Equations

In the following exercises, determine if each is an expression or an equation.

23. $9 \cdot 6 = 54$
24. $7 \cdot 9 = 63$
25. $5 \cdot 4 + 3$
26. $6 \cdot 3 + 5$
27. $x + 7$
28. $x + 9$
29. $y - 5 = 25$
30. $y - 8 = 32$

Simplify Expressions with Exponents

In the following exercises, write in exponential form.

31. $3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3 \cdot 3$
32. $4 \cdot 4 \cdot 4 \cdot 4 \cdot 4 \cdot 4$
33. $x \cdot x \cdot x \cdot x \cdot x$
34. $y \cdot y \cdot y \cdot y \cdot y \cdot y$

In the following exercises, write in expanded form.

35. 5^3
36. 8^3
37. 2^8
38. 10^5

Simplify Expressions Using the Order of Operations

In the following exercises, simplify.

39. (a) 3 + 8 • 5 (b) (3+8) • 5
40. (a) 2 + 6 • 3 (b) (2+6) • 3
41. $2^3 - 12 \div (9 - 5)$
42. $3^2 - 18 \div (11 - 5)$
43. 3 • 8 + 5 • 2
44. 4 • 7 + 3 • 5
45. 2 + 8(6 + 1)
46. 4 + 6(3 + 6)
47. 4 • 12 / 8
48. 2 • 36 / 6
49. 6 + 10 / 2 + 2
50. 9 + 12 / 3 + 4
51. (6 + 10) ÷ (2 + 2)
52. (9 + 12) ÷ (3 + 4)
53. 20 ÷ 4 + 6 • 5
54. 33 ÷ 3 + 8 • 2
55. 20 ÷ (4 + 6) • 5
56. 33 ÷ (3 + 8) • 2
57. $4^2 + 5^2$
58. $3^2 + 7^2$
59. $(4 + 5)^2$
60. $(3 + 7)^2$
61. $3(1 + 9 \cdot 6) - 4^2$
62. $5(2 + 8 \cdot 4) - 7^2$
63. $2[1 + 3(10 - 2)]$
64. $5[2 + 4(3 - 2)]$

Everyday Math

65. **Basketball** In the 2014 NBA playoffs, the San Antonio Spurs beat the Miami Heat. The table below shows the heights of the starters on each team. Use this table to fill in the appropriate symbol (=, <, >).

Spurs	Height	Heat	Height
Tim Duncan	83″	Rashard Lewis	82"
Boris Diaw	80"	LeBron James	80"
Kawhi Leonard	79"	Chris Bosh	83"
Tony Parker	74"	Dwyane Wade	76"
Danny Green	78"	Ray Allen	77"

a. Height of Tim Duncan____Height of Rashard Lewis
b. Height of Boris Diaw____Height of LeBron James
c. Height of Kawhi Leonard____Height of Chris Bosh
d. Height of Tony Parker____Height of Dwyane Wade
e. Height of Danny Green____Height of Ray Allen

66. **Elevation** In Colorado there are more than 50 mountains with an elevation of over 14,000 feet. The table shows the ten tallest. Use this table to fill in the appropriate inequality symbol.

Mountain	Elevation

Mountain	Elevation
Mt. Elbert	14,433′
Mt. Massive	14,421′
Mt. Harvard	14,420′
Blanca Peak	14,345′
La Plata Peak	14,336′
Uncompahgre Peak	14,309′
Crestone Peak	14,294′
Mt. Lincoln	14,286′
Grays Peak	14,270′
Mt. Antero	14,269′

a. Elevation of La Plata Peak____Elevation of Mt. Antero
b. Elevation of Blanca Peak____Elevation of Mt. Elbert
c. Elevation of Gray's Peak____Elevation of Mt. Lincoln
d. Elevation of Mt. Massive____Elevation of Crestone Peak
e. Elevation of Mt. Harvard____Elevation of Uncompahgre Peak

Writing Exercises

67. Explain the difference between an expression and an equation.
68. Why is it important to use the order of operations to simplify an expression?

Self Check

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

I can...	Confidently	With some help	No-I don't get it!
use variables and algebraic symbols.			
identify expressions and equations.			
simplify expressions with exponents.			
simplify expressions using the order of operations.			

(b) If most of your checks were:

…confidently. Congratulations! You have achieved the objectives in this section. Reflect on the study skills you used so that you can continue to use them. What did you do to become confident of your ability to do these things? Be specific.

…with some help. This must be addressed quickly because topics you do not master become potholes in your road to success. In math, every topic builds upon previous work. It is important to make sure you have a strong foundation before you move on. Who can you ask for help? Your fellow classmates and instructor are good resources. Is there a place on campus where math tutors are available? Can your study skills be improved?

…no—I don't get it! This is a warning sign and you must not ignore it. You should get help right away or you will quickly be overwhelmed. See your instructor as soon as you can to discuss your situation. Together you can come up with a plan to get you the help you need.

Contributors and Attributions

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10.3: Evaluate, Simplify, and Translate Expressions (Part 1)

Learning Objectives

- Evaluate algebraic expressions
- Identify terms, coefficients, and like terms
- Simplify expressions by combining like terms
- Translate word phrases to algebraic expressions

Be prepared!

Before you get started, take this readiness quiz.

1. Is $n \div 5$ an expression or an equation? If you missed this problem, review Example 2.1.4.
2. Simplify 4^5. If you missed this problem, review Example 2.1.6.
3. Simplify $1 + 8 \bullet 9$. If you missed this problem, review Example 2.1.8.

Evaluate Algebraic Expressions

In the last section, we simplified expressions using the order of operations. In this section, we'll evaluate expressions—again following the order of operations.

To **evaluate** an algebraic expression means to find the value of the expression when the variable is replaced by a given number. To evaluate an expression, we substitute the given number for the variable in the expression and then simplify the expression using the order of operations.

Example 10.3.1: evaluate

Evaluate $x + 7$ when

a. $x = 3$
b. $x = 12$

Solution

a. To evaluate, substitute 3 for x in the expression, and then simplify.

	$x + 7$
Substitute.	$3 + 7$
Add.	10

When $x = 3$, the expression $x + 7$ has a value of 10.

b. To evaluate, substitute 12 for x in the expression, and then simplify.

	$x + 7$
Substitute.	$12 + 7$
Add.	19

When $x = 12$, the expression $x + 7$ has a value of 19. Notice that we got different results for parts (a) and (b) even though we started with the same expression. This is because the values used for x were different. When we evaluate an expression, the value varies depending on the value used for the variable.

exercise 10.3.1

Evaluate: $y+4$ when

a. $y=6$
b. $y=15$

Answer a

10

Answer b

19

exercise 10.3.2

Evaluate: $a-5$ when

a. $a=9$
b. $a=17$

Answer a

4

Answer b

12

Example 10.3.2

Evaluate $9x-2$, when

a. $x=5$
b. $x=1$

Solution

Remember ab means a times b, so $9x$ means 9 times x.

a. To evaluate the expression when $x=5$, we substitute 5 for x, and then simplify.

	$9x-2$
Substitute 5 for x.	$9\cdot 5-2$
Multiply.	$45-2$
Subtract.	43

b. To evaluate the expression when $x=1$, we substitute 1 for x, and then simplify.

	$9x-2$
Substitute 1 for x.	$9\cdot 1-2$
Multiply.	$9-2$
Subtract.	7

Notice that in part (a) that we wrote $9\bullet 5$ and in part (b) we wrote $9(1)$. Both the dot and the parentheses tell us to multiply.

exercise 10.3.3

Evaluate: $8x - 3$, when

a. $x = 2$
b. $x = 1$

Answer a

13

Answer b

5

exercise 10.3.4

Evaluate: $4y - 4$, when

a. $y = 3$
b. $y = 5$

Answer a

8

Answer b

16

Example 10.3.3: evaluate

Evaluate x^2 when $x = 10$.

Solution

We substitute 10 for x, and then simplify the expression.

	x^2
Substitute 10 for x.	10^2
Use the definition of exponent.	$10 \cdot 10$
Multiply	100

When $x = 10$, the expression x^2 has a value of 100.

exercise 10.3.5

Evaluate: x^2 when $x = 8$.

Answer

64

exercise 10.3.6

Evaluate: x^3 when $x = 6$.

Answer

216

Example 10.3.4: evaluate

Evaluate 2^x when $x = 5$.

Solution

In this expression, the variable is an exponent.

	2^x
Substitute 5 for x.	2^5
Use the definition of exponent.	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 2$
Multiply	32

When $x = 5$, the expression 2^x has a value of 32.

exercise 10.3.7

Evaluate: 2^x when $x = 6$.

Answer

64

exercise 10.3.8

Evaluate: 3^x when $x = 4$.

Answer

81

Example 10.3.5: evaluate

Evaluate $3x + 4y - 6$ when $x = 10$ and $y = 2$.

Solution

This expression contains two variables, so we must make two substitutions.

	$3x + 4y - 6$
Substitute 10 for x and 2 for y.	$3(10) + 4(2) - 6$
Multiply.	$30 + 8 - 6$
Add and subtract left to right.	32

When $x = 10$ and $y = 2$, the expression $3x + 4y - 6$ has a value of 32.

exercise 10.3.9

Evaluate: $2x + 5y - 4$ when $x = 11$ and $y = 3$

Answer

33

exercise 10.3.10

Evaluate: $5x - 2y - 9$ when $x = 7$ and $y = 8$

Answer

10

Example 10.3.6: evaluate

Evaluate $2x^2 + 3x + 8$ when $x = 4$.

Solution

We need to be careful when an expression has a variable with an exponent. In this expression, $2x^2$ means $2 \bullet x \bullet x$ and is different from the expression $(2x)^2$, which means $2x \bullet 2x$.

	$2x^2 + 3x + 8$
Substitute 4 for each x.	$2(4)^2 + 3(4) + 8$
Simplify 4^2.	$2(16) + 3(4) + 8$
Multiply.	$32 + 12 + 8$
Add.	52

exercise 10.3.11

Evaluate: $3x^2 + 4x + 1$ when $x = 3$.

Answer

40

exercise 10.3.12

Evaluate: $6x^2 - 4x - 7$ when $x = 2$.

Answer

9

Identify Terms, Coefficients, and Like Terms

Algebraic expressions are made up of *terms*. A **term** is a constant or the product of a constant and one or more variables. Some examples of terms are 7, y, $5x^2$, $9a$, and $13xy$.

The constant that multiplies the variable(s) in a term is called the **coefficient**. We can think of the coefficient as the number *in front of* the variable. The coefficient of the term $3x$ is 3. When we write x, the coefficient is 1, since $x = 1 \bullet x$. Table 10.3.1 gives the coefficients for each of the terms in the left column.

Table 10.3.1

Term	Coefficient
7	7
9a	9
y	1

Term	Coefficient
$5x^2$	5

An algebraic expression may consist of one or more terms added or subtracted. In this chapter, we will only work with terms that are added together. Table $10.3.2$ gives some examples of algebraic expressions with various numbers of terms. Notice that we include the operation before a term with it.

Table 10.3.2

Expression	Terms
7	7
y	y
x + 7	x, 7
2x + 7y + 4	2x, 7y, 4
$3x^2 + 4x^2 + 5y + 3$	$3x^2$, $4x^2$, 5y, 3

Example 10.3.7:

Identify each term in the expression $9b+15x^2+a+6$. Then identify the coefficient of each term.

Solution

The expression has four terms. They are $9b$, $15x^2$, a, and 6.

The coefficient of $9b$ is 9.

The coefficient of $15x^2$ is 15.

Remember that if no number is written before a variable, the coefficient is 1. So the coefficient of a is 1.

The coefficient of a constant is the constant, so the coefficient of 6 is 6.

? exercise 10.3.13

Identify all terms in the given expression, and their coefficients: $4x+3b+2$

Answer

The terms are $4x, 3b,$ and 2. The coefficients are $4, 3,$ and 2.

? exercise 10.3.14

Identify all terms in the given expression, and their coefficients: $9a+13a^2+a^3$

Answer

The terms are $9a, 13a^2,$ and a^3, The coefficients are $9, 13,$ and 1.

Some terms share common traits. Look at the following terms. Which ones seem to have traits in common?

$5x, 7, n^2, 4, 3x, 9n^2$

Which of these terms are like terms?

- The terms 7 and 4 are both constant terms.
- The terms $5x$ and $3x$ are both terms with x.
- The terms n^2 and $9n^2$ both have n^2.

Terms are called like terms if they have the same variables and exponents. All constant terms are also like terms. So among the terms $5x, 7, n^2, 4, 3x, 9n^2, 7$and 4 are like terms, $5x$ and $3x$ are like terms, and n^2 and $9n^2$ are like terms.

Definition: Like terms

Terms that are either constants or have the same variables with the same exponents are like terms.

Example 10.3.8: identify

Identify the like terms:

a. $y^3, 7x^2, 14, 23, 4y^3, 9x, 5x^2$
b. $4x^2 + 2x + 5x^2 + 6x + 40x + 8xy$

Solution

a. $y^3, 7x^2, 14, 23, 4y^3, 9x, 5x^2$

Look at the variables and exponents. The expression contains y^3, x^2, x, and constants. The terms y^3 and $4y^3$ are like terms because they both have y^3. The terms $7x^2$ and $5x^2$ are like terms because they both have x^2. The terms 14 and 23 are like terms because they are both constants. The term $9x$ does not have any like terms in this list since no other terms have the variable x raised to the power of 1.

b. $4x^2 + 2x + 5x^2 + 6x + 40x + 8xy$

Look at the variables and exponents. The expression contains the terms $4x^2, 2x, 5x^2, 6x, 40x$and $8xy$The terms $4x^2$ and $5x^2$ are like terms because they both have x^2. The terms $2x, 6x$, and $40x$ are like terms because they all have x. The term $8xy$ has no like terms in the given expression because no other terms contain the two variables xy.

exercise 10.3.15

Identify the like terms in the list or the expression: $9, 2x^3, y^2, 8x^3, 15, 9y, 11y^2$

Answer

$9, 15$; $2x^3$ and $8x^3$, y^2, and $11y^2$

exercise 10.3.16

Identify the like terms in the list or the expression: $4x^3 + 8x^2 + 19 + 3x^2 + 24 + 6x^3$

Answer

$4x^3$ and $6x^3$; $8x^2$ and $3x^2$; 19 and 24

Simplify Expressions by Combining Like Terms

We can simplify an expression by combining the like terms. What do you think $3x + 6x$ would simplify to? If you thought $9x$, you would be right!

We can see why this works by writing both terms as addition problems.

$$\overbrace{x+x+x}^{3x} + \overbrace{x+x+x+x+x+x}^{6x}$$
$$+$$
$$9x$$

Add the coefficients and keep the same variable. It doesn't matter what x is. If you have 3 of something and add 6 more of the same thing, the result is 9 of them. For example, 3 oranges plus 6 oranges is 9 oranges. We will discuss the mathematical properties behind this later.

The expression $3x + 6x$ has only two terms. When an expression contains more terms, it may be helpful to rearrange the terms so that like terms are together. The Commutative Property of Addition says that we can change the order of addends without changing the sum. So we could rearrange the following expression before combining like terms.

$$3x + 4y - 2x + 6y$$
$$3x - 2x + 4y + 6y$$

Now it is easier to see the like terms to be combined.

HOW TO: COMBINE LIKE TERMS

Step 1. Identify like terms.

Step 2. Rearrange the expression so like terms are together.

Step 3. Add the coefficients of the like terms.

Example 10.3.9: simplify

Simplify the expression: $3x + 7 + 4x + 5$.

Solution

	$3x + 7 + 4x + 5$
Identify the like terms	$3x + 7 + 4x + 5$
Rearrange the expression, so the like terms are together.	$3x + 4x + 7 + 5$
Add the coefficients of the like terms.	$7x + 12$
The original expression is simplified to...	$7x + 12$

exercise 10.3.17

Simplify: $7x + 9 + 9x + 8$

Answer

$16x + 17$

exercise 10.3.18

Simplify: $5y + 2 + 8y + 4y + 5$

Answer

$17y + 7$

Example 10.3.10: simplify

Simplify the expression: $7x^2 + 8x + x^2 + 4x$.

Solution

	$7x^2 + 8x + x^2 + 4x$
Identify the like terms.	$7x^2 + 8x + x^2 + 4x$
Rearrange the expression so like terms are together.	$7x^2 + x^2 + 8x + 4x$

Add the coefficients of the like terms.	$8x^2+12x$

These are not like terms and cannot be combined. So $8x^2+12x$ is in simplest form.

exercise 10.3.19

Simplify: $3x^2+9x+x^2+5x$

Answer

$4x^2+14x$

exercise 10.3.20

Simplify: $11y^2+8y+y^2+7y$

Answer

$12y^2+15y$

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10.4: Evaluate, Simplify, and Translate Expressions (Part 2)

Translate Words to Algebraic Expressions

In the previous section, we listed many operation symbols that are used in algebra, and then we translated expressions and equations into word phrases and sentences. Now we'll reverse the process and translate word phrases into algebraic expressions. The symbols and variables we've talked about will help us do that. They are summarized in Table 10.4.3.

Table 10.4.3

Operation	Phrase	Expression
Addition	a plus b the sum of a and b a increased by b b more than a the total of a and b b added to a	a + b
Subtraction	a minus b the difference of a and b b subtracted from a a decreased by b b less than a	a - b
Multiplication	a times b the product of a and b	a • b, ab, a(b), (a)(b)
Division	a divided by b the quotient of a and b the ratio of a and b b divided into a	a ÷ b, a / b, $\frac{a}{b}$, $b\overline{)a}$

Look closely at these phrases using the four operations:

- the sum of a and b
- the difference of a and b
- the product of a and b
- the quotient of a and b

Each phrase tells you to operate on two numbers. Look for the words ***of*** and ***and*** to find the numbers.

Example 10.4.11: translate

Translate each word phrase into an algebraic expression:

a. the difference of 20 and 4
b. the quotient of $10x$ and 3

Solution

a. The key word is *difference*, which tells us the operation is subtraction. Look for the words *of* and *and* to find the numbers to subtract.

$$\text{the difference of } 20 \text{ and } 4$$

$$20 \text{ minus } 4$$

$$20 - 4$$

b. The key word is *quotient*, which tells us the operation is division.

the quotient of $10x$ and 3

divide $10x$ by 3

$$10x \div 3$$

This can also be written as $10x/3$ or $\frac{10x}{3}$

? exercise 10.4.21

Translate the given word phrase into an algebraic expression:

a. the difference of 47 and 41
b. the quotient of $5x$ and 2

Answer a

$47 - 41$

Answer b

$5x \div 2$

? exercise 10.4.22

Translate the given word phrase into an algebraic expression:

a. the sum of 17 and 19
b. the product of 7 and x

Answer a

$17 + 19$

Answer b

$7x$

How old will you be in eight years? What age is eight more years than your age now? Did you add 8 to your present age? Eight *more than* means eight added to your present age.

How old were you seven years ago? This is seven years less than your age now. You subtract 7 from your present age. Seven *less than* means seven subtracted from your present age.

✓ Example 10.4.12: translate

Translate each word phrase into an algebraic expression:

a. Eight more than y
b. Seven less than $9z$

Solution

a. The key words are more than. They tell us the operation is addition. More than means "added to".

Eight more than y

Eight added to y

$$y + 8$$

b. The key words are less than. They tell us the operation is subtraction. Less than means "subtracted from".

Seven less than $9z$

Seven subtracted from $9z$

$$9z-7$$

exercise 10.4.23

Translate each word phrase into an algebraic expression:

a. Eleven more than x
b. Fourteen less than $11a$

Answer a

$x+11$

Answer b

$11a-14$

exercise 10.4.24

Translate each word phrase into an algebraic expression:

a. 19 more than j
b. 21 less than $2x$

Answer a

$j+19$

Answer b

$2x-21$

Example 10.4.13: translate

Translate each word phrase into an algebraic expression:

a. five times the sum of m and n
b. the sum of five times m and n

Solution

a. There are two operation words: times tells us to multiply and sum tells us to add. Because we are multiplying 5 times the sum, we need parentheses around the sum of m and n.

$$\text{five times the sum of } m \text{ and } n$$
$$5(m+n)$$

b. To take a sum, we look for the words of and and to see what is being added. Here we are taking the sum of five times m and n.

$$\text{the sum of five times } m \text{ and } n$$
$$5m+n$$

Notice how the use of parentheses changes the result. In part (a), we add first and in part (b), we multiply first.

exercise 10.4.25

Translate the word phrase into an algebraic expression:

a. four times the sum of p and q
b. the sum of four times p and q

Answer a

$4(p+q)$

Answer b

$4p+q$

exercise 10.4.26

Translate the word phrase into an algebraic expression:

a. the difference of two times x and 8
b. two times the difference of x and 8

Answer a

$2x-8$

Answer b

$2(x-8)$

Later in this course, we'll apply our skills in algebra to solving equations. We'll usually start by translating a word phrase to an algebraic expression. We'll need to be clear about what the expression will represent. We'll see how to do this in the next two examples.

Example 10.4.14: write an expression

The height of a rectangular window is 6 inches less than the width. Let w represent the width of the window. Write an expression for the height of the window.

Solution

Write a phrase about the height.	6 less than the width
Substitute w for the width.	6 less than w
Rewrite 'less than' as 'subtracted from'.	6 subtracted from w
Translate the phrase into algebra.	w - 6

exercise 10.4.27

The length of a rectangle is 5 inches less than the width. Let w represent the width of the rectangle. Write an expression for the length of the rectangle.

Answer

$w-5$

exercise 10.4.28

The width of a rectangle is 2 meters greater than the length. Let l represent the length of the rectangle. Write an expression for the width of the rectangle.

Answer

$l+2$

Example 10.4.15: write an expression

Blanca has dimes and quarters in her purse. The number of dimes is 2 less than 5 times the number of quarters. Let q represent the number of quarters. Write an expression for the number of dimes.

Solution

Write a phrase about the number of dimes.	two less than five times the number of quarters
Substitute q for the number of quarters.	2 less than five times q
Translate 5 *times* q.	2 less than 5q
Translate the phrase into algebra.	5q - 2

exercise 10.4.29

Geoffrey has dimes and quarters in his pocket. The number of dimes is seven less than six times the number of quarters. Let q represent the number of quarters. Write an expression for the number of dimes.

Answer

$6q-7$

exercise 10.4.30

Lauren has dimes and nickels in her purse. The number of dimes is eight more than four times the number of nickels. Let n represent the number of nickels. Write an expression for the number of dimes.

Answer

$4n+8$

Access Additional Online Resources

- Algebraic Expression Vocabulary

Key Concepts

- Combine like terms.
  - Identify like terms.
  - Rearrange the expression so like terms are together.
  - Add the coefficients of the like terms

Glossary

term

A term is a constant or the product of a constant and one or more variables.

coefficient

The constant that multiplies the variable(s) in a term is called the coefficient.

like terms

Terms that are either constants or have the same variables with the same exponents are like terms.

evaluate

To evaluate an algebraic expression means to find the value of the expression when the variable is replaced by a given number.

Practice Makes Perfect

Evaluate Algebraic Expressions

In the following exercises, evaluate the expression for the given value.

69. $7x + 8$ when $x = 2$
70. $9x + 7$ when $x = 3$
71. $5x - 4$ when $x = 6$
72. $8x - 6$ when $x = 7$
73. x^2 when $x = 12$
74. x^3 when $x = 5$
75. x^5 when $x = 2$
76. x^4 when $x = 3$
77. 3^x when $x = 3$
78. 4^x when $x = 2$
79. $x^2 + 3x - 7$ when $x = 4$
80. $x^2 + 5x - 8$ when $x = 6$
81. $2x + 4y - 5$ when $x = 7, y = 8$
82. $6x + 3y - 9$ when $x = 6, y = 9$
83. $(x - y)^2$ when $x = 10, y = 7$
84. $(x + y)^2$ when $x = 6, y = 9$
85. $a^2 + b^2$ when $a = 3, b = 8$
86. $r^2 - s^2$ when $r = 12, s = 5$
87. $2l + 2w$ when $l = 15, w = 12$
88. $2l + 2w$ when $l = 18, w = 14$

Identify Terms, Coefficients, and Like Terms

In the following exercises, list the terms in the given expression.

89. $15x^2 + 6x + 2$
90. $11x^2 + 8x + 5$
91. $10y^3 + y + 2$
92. $9y^3 + y + 5$

In the following exercises, identify the coefficient of the given term.

93. $8a$
94. $13m$
95. $5r^2$
96. $6x^3$

In the following exercises, identify all sets of like terms.

97. x^3, $8x$, 14, $8y$, 5, $8x^3$
98. $6z$, $3w^2$, 1, $6z^2$, $4z$, w^2
99. $9a$, a^2, $16ab$, $16b^2$, $4ab$, $9b^2$
100. 3, $25r^2$, $10s$, $10r$, $4r^2$, $3s$

Simplify Expressions by Combining Like Terms

In the following exercises, simplify the given expression by combining like terms.

101. $10x + 3x$
102. $15x + 4x$
103. $17a + 9a$
104. $18z + 9z$
105. $4c + 2c + c$
106. $6y + 4y + y$

107. $9x + 3x + 8$
108. $8a + 5a + 9$
109. $7u + 2 + 3u + 1$
110. $8d + 6 + 2d + 5$
111. $7p + 6 + 5p + 4$
112. $8x + 7 + 4x - 5$
113. $10a + 7 + 5a - 2 + 7a - 4$
114. $7c + 4 + 6c - 3 + 9c - 1$
115. $3x^2 + 12x + 11 + 14x^2 + 8x + 5$
116. $5b^2 + 9b + 10 + 2b^2 + 3b - 4$

Translate English Phrases into Algebraic Expressions

In the following exercises, translate the given word phrase into an algebraic expression.

117. The sum of 8 and 12
118. The sum of 9 and 1
119. The difference of 14 and 9
120. 8 less than 19
121. The product of 9 and 7
122. The product of 8 and 7
123. The quotient of 36 and 9
124. The quotient of 42 and 7
125. The difference of x and 4
126. 3 less than x
127. The product of 6 and y
128. The product of 9 and y
129. The sum of 8x and 3x
130. The sum of 13x and 3x
131. The quotient of y and 3
132. The quotient of y and 8
133. Eight times the difference of y and nine
134. Seven times the difference of y and one
135. Five times the sum of x and y
136. Nine times five less than twice x

In the following exercises, write an algebraic expression.

137. Adele bought a skirt and a blouse. The skirt cost $15 more than the blouse. Let b represent the cost of the blouse. Write an expression for the cost of the skirt.
138. Eric has rock and classical CDs in his car. The number of rock CDs is 3 more than the number of classical CDs. Let c represent the number of classical CDs. Write an expression for the number of rock CDs.
139. The number of girls in a second-grade class is 4 less than the number of boys. Let b represent the number of boys. Write an expression for the number of girls.
140. Marcella has 6 fewer male cousins than female cousins. Let f represent the number of female cousins. Write an expression for the number of boy cousins.
141. Greg has nickels and pennies in his pocket. The number of pennies is seven less than twice the number of nickels. Let n represent the number of nickels. Write an expression for the number of pennies.
142. Jeannette has $5 and $10 bills in her wallet. The number of fives is three more than six times the number of tens. Let t represent the number of tens. Write an expression for the number of fives.

Everyday Math

In the following exercises, use algebraic expressions to solve the problem.

143. **Car insurance** Justin's car insurance has a $750 deductible per incident. This means that he pays $750 and his insurance company will pay all costs beyond $750. If Justin files a claim for $2,100, how much will he pay, and how much will his

insurance company pay?

144. **Home insurance** Pam and Armando's home insurance has a $2,500 deductible per incident. This means that they pay $2,500 and their insurance company will pay all costs beyond $2,500. If Pam and Armando file a claim for $19,400, how much will they pay, and how much will their insurance company pay?

Writing Exercises

145. Explain why "the sum of x and y" is the same as "the sum of y and x," but "the difference of x and y" is not the same as "the difference of y and x." Try substituting two random numbers for x and y to help you explain. 146. Explain the difference between "4 times the sum of x and y" and "the sum of 4 times x and y."

Self Check

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

I can...	Confidently	With some help	No-I don't get it!
evaluate algebraic expressions.			
identify terms, coefficients, and like terms.			
simplify expressions by combining like terms.			
translate word phrases to algebraic expressions.			

(b) After reviewing this checklist, what will you do to become confident for all objectives?

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10.5: Solving Equations Using the Subtraction and Addition Properties of Equality (Part 1)

Learning Objectives

- Determine whether a number is a solution of an equation
- Model the Subtraction Property of Equality
- Solve equations using the Subtraction Property of Equality
- Solve equations using the Addition Property of Equality
- Translate word phrases to algebraic equations
- Translate to an equation and solve

Be Prepared!

Before you get started, take this readiness quiz.

1. Evaluate $x+8$ when $x=11$. If you missed this problem, review Example 2..2.1.
2. Evaluate $5x-3$ when $x=9$. If you missed this problem, review Example 2.2.2.
3. Translate into algebra: the difference of x and 8. If you missed this problem, review Example 2.2.11.

When some people hear the word *algebra*, they think of solving equations. The applications of solving equations are limitless and extend to all careers and fields. In this section, we will begin solving equations. We will start by solving basic equations, and then as we proceed through the course we will build up our skills to cover many different forms of equations.

Determine Whether a Number is a Solution of an Equation

Solving an equation is like discovering the answer to a puzzle. An algebraic equation states that two algebraic expressions are equal. To solve an equation is to determine the values of the variable that make the equation a true statement. Any number that makes the equation true is called a **solution** of the equation. It is the answer to the puzzle!

Definition: Solution of an Equation

A solution to an equation is a value of a variable that makes a true statement when substituted into the equation. The process of finding the solution to an equation is called solving the equation.

To find the solution to an equation means to find the value of the variable that makes the equation true. Can you recognize the solution of $x+2=7$? If you said 5, you're right! We say 5 is a solution to the equation $x+2=7$ because when we substitute 5 for x the resulting statement is true.

$$\begin{aligned} x+2 &= 7 \\ 5+2 &\stackrel{?}{=} 7 \\ 7 &= 7 \checkmark \end{aligned}$$

Since $5+2=7$ is a true statement, we know that 5 is indeed a solution to the equation. The symbol $\stackrel{?}{=}$ asks whether the left side of the equation is equal to the right side. Once we know, we can change to an equal sign ($=$) or not-equal sign ($\neq$).

HOW TO: DETERMINE WHETHER A NUMBER IS A Solution TO AN EQUATION

Step 1. Substitute the number for the variable in the equation.

Step 2. Simplify the expressions on both sides of the equation.

Step 3. Determine whether the resulting equation is true.

- If it is true, the number is a solution.
- If it is not true, the number is not a solution.

Example 10.5.1

Determine whether $x = 5$ is a solution of $6x - 17 = 16$.

Solution

	$6x - 17 = 16$
Substitute 5 for x.	$6 \cdot 5 - 17 \stackrel{?}{=} 16$
Multiply.	$30 - 17 \stackrel{?}{=} 16$
Subtract	$13 \neq 16$

So $x = 5$ is not a solution to the equation $6x - 17 = 16$.

exercise 10.5.1

Is $x = 3$ a solution of $4x - 7 = 16$?

Answer

no

exercise 10.5.2

Is $x = 2$ a solution of $6x - 2 = 10$?

Answer

yes

Example 10.5.2

Determine whether $y = 2$ is a solution of $6y - 4 = 5y - 2$.

Solution

Here, the variable appears on both sides of the equation. We must substitute 2 for each y.

	$6y - 4 = 5y - 2$
Substitute 2 for y.	$6(2) - 4 \stackrel{?}{=} 5(2) - 2$
Multiply.	$12 - 4 \stackrel{?}{=} 10 - 2$
Subtract	$8 = 8$ ✓

Since $y = 2$ results in a true equation, we know that 2 is a solution to the equation $6y - 4 = 5y - 2$.

exercise 10.5.3

Is $y = 3$ a solution of $9y - 2 = 8y + 1$?

Answer

yes

exercise 10.5.4

Is $y = 4$ a solution of $5y - 3 = 3y + 5$?

Answer

yes

Model the Subtraction Property of Equality

We will use a model to help you understand how the process of solving an equation is like solving a puzzle. An envelope represents the variable – since its contents are unknown – and each counter represents one.

Suppose a desk has an imaginary line dividing it in half. We place three counters and an envelope on the left side of desk, and eight counters on the right side of the desk as in Figure 10.5.1. Both sides of the desk have the same number of counters, but some counters are hidden in the envelope. Can you tell how many counters are in the envelope?

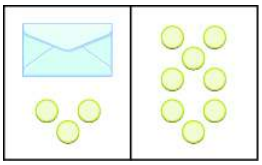


Figure 10.5.1

What steps are you taking in your mind to figure out how many counters are in the envelope? Perhaps you are thinking "I need to remove the 3 counters from the left side to get the envelope by itself. Those 3 counters on the left match with 3 on the right, so I can take them away from both sides. That leaves five counters on the right, so there must be 5 counters in the envelope." Figure 10.5.2 shows this process.

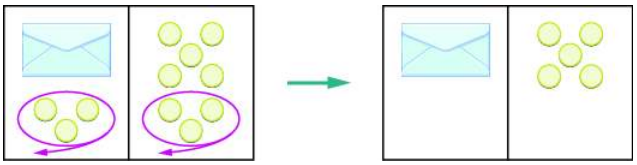


Figure 10.5.2

What algebraic equation is modeled by this situation? Each side of the desk represents an expression and the center line takes the place of the equal sign. We will call the contents of the envelope x, so the number of counters on the left side of the desk is $x + 3$. On the right side of the desk are 8 counters. We are told that $x + 3$ is equal to 8 so our equation is $x + 3 = 8$.

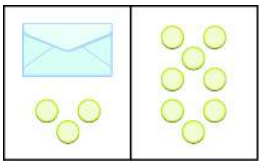


Figure 10.5.3

$x + 3 = 8$

Let's write algebraically the steps we took to discover how many counters were in the envelope.

	$x + 3 = 8$
First, we took away three from each side.	$x + 3 - 3 = 8 - 3$
Then we were left with five.	$x = 5$

Now let's check our solution. We substitute 5 for x in the original equation and see if we get a true statement.

$$x+3=8$$
$$5+3\stackrel{?}{=}8$$
$$8=8\ \checkmark$$

Our solution is correct. Five counters in the envelope plus three more equals eight

Example 10.5.3

Write an equation modeled by the envelopes and counters, and then solve the equation:

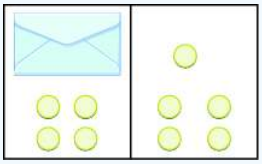


Figure 10.5.4

Solution

On the left, write x for the contents of the envelope, add the 4 counters, so we have x + 4.	x + 4
On the right, there are 5 counters.	5
The two sides are equal.	x + 4 = 5
Solve the equation by subtracting 4 counters from each side.	

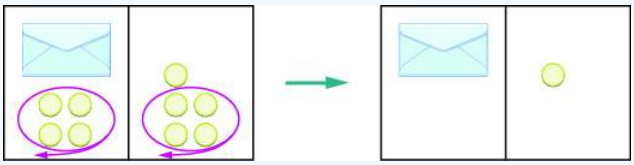


Figure 10.5.5

We can see that there is one counter in the envelope. This can be shown algebraically as:

$$x+4=5$$
$$x+4-4=5-4$$
$$x=1$$

Substitute 1 for x in the equation to check.

$$x+4=5$$
$$1+4\stackrel{?}{=}5$$
$$5=5\ \checkmark$$

Since $x=1$ makes the statement true, we know that 1 is indeed a solution.

Exercise 10.5.5

Write the equation modeled by the envelopes and counters, and then solve the equation:

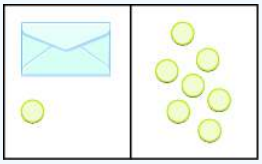


Figure 10.5.6

Answer

$x+1=7; x=6$

Exercise 10.5.6

Write the equation modeled by the envelopes and counters, and then solve the equation:

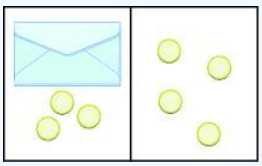


Figure 10.5.7

Answer

$x+3=4; x=1$

Solve Equations Using the Subtraction Property of Equality

Our puzzle has given us an idea of what we need to do to solve an equation. The goal is to isolate the variable by itself on one side of the equations. In the previous examples, we used the Subtraction Property of Equality, which states that when we subtract the same quantity from both sides of an equation, we still have equality.

Definition: Subtraction Property of Equality

For any numbers a, b, and c, if $a=b$ then $a-c=b-c$

Think about twin brothers Andy and Bobby. They are 17 years old. How old was Andy 3 years ago? He was 3 years less than 17, so his age was $17-3$, or 14. What about Bobby's age 3 years ago? Of course, he was 14 also. Their ages are equal now, and subtracting the same quantity from both of them resulted in equal ages 3 years ago.

$$\begin{aligned} a &= b \\ a-3 &= b-3 \end{aligned}$$

HOW TO: SOLVE AN EQUATION USING THE SUBTRACTION PROPERTY OF EQUALITY

Step 1. Use the Subtraction Property of Equality to isolate the variable.

Step 2. Simplify the expressions on both sides of the equation.

Step 3. Check the solution.

Example 10.5.4: solve

Solve: $x+8=17$.

Solution

We will use the Subtraction Property of Equality to isolate x.

	$x+8=17$
Subtract 8 from both sides.	$x+8-8=17-8$
Simplify.	$x=9$

Check the solution.	$9+8=17$
	$17=17$ ✓

Since $x=9$ makes $x+8=17$ a true statement, we know 9 is the solution to the equation.

Exercise 10.5.7

Solve: $x+6=19$

Answer

$x=13$

Exercise 10.5.8

Solve: $x+9=14$

Answer

$x=5$

Example 10.5.5: solve

Solve: $100=y+74$.

Solution

To solve an equation, we must always isolate the variable—it doesn't matter which side it is on. To isolate y, we will subtract 74 from both sides.

	$100=y+74$
Subtract 74 from both sides.	$100-74=y+74-74$
Simplify.	$26=y$
Substitute 26 for y to check	$100\stackrel{?}{=}26+74$
	$100=100$ ✓

Since $y=26$ makes $100=y+74$ a true statement, we have found the solution to this equation.

Exercise 10.5.9

Solve: $95=y+67$

Answer

$y=28$

Exercise 10.5.10

Solve: $91=y+45$

Answer

$y=46$

Solve Equations Using the Addition Property of Equality

In all the equations we have solved so far, a number was added to the variable on one side of the equation. We used subtraction to "undo" the addition in order to isolate the variable.

But suppose we have an equation with a number subtracted from the variable, such as $x-5=8$. We want to isolate the variable, so to "undo" the subtraction we will add the number to both sides.

We use the Addition Property of Equality, which says we can add the same number to both sides of the equation without changing the equality. Notice how it mirrors the Subtraction Property of Equality.

Definition: Addition Property of Equality

For any numbers a, b, and c, if $a=b$ then $a+c=b+c$

Remember the 17-year-old twins, Andy and Bobby? In ten years, Andy's age will still equal Bobby's age. They will both be 27.

$$\begin{aligned} a &= b \\ a+10 &= b+10 \end{aligned}$$

We can add the same number to both sides and still keep the equality.

HOW TO: SOLVE AN EQUATION USING THE ADDITION PROPERTY OF EQUALITY

Step 1. Use the Addition Property of Equality to isolate the variable.

Step 2. Simplify the expressions on both sides of the equation.

Step 3. Check the solution.

Example 10.5.6: solve

Solve: $x-5=8$.

Solution

We will use the Addition Property of Equality to isolate the variable.

	$x-5=8$
Add 5 to both sides.	$x-5+5=8+5$
Simplify	$x=13$
Now we can check. Let x = 13.	$13-5\stackrel{?}{=}8$
	$8=8$ ✓

Exercise 10.5.11

Solve: $x-9=13$

Answer

$x=22$

Exercise 10.5.12

Solve: $y-1=3$

Answer

$y = 4$

Example 10.5.7: solve

Solve: $27 = a - 16$.

Solution

We will add 16 to each side to isolate the variable.

	$27 = a - 16$
Add 16 to each side.	$27 + 16 = a - 16 + 16$
Simplify.	$43 = a$
Now we can check. Let a = 43.	$27 \stackrel{?}{=} 43 - 16$
	$27 = 27$ ✓

The solution to $27 = a - 16$ is $a = 43$.

Exercise 10.5.13

Solve: $19 = a - 18$

Answer

$a = 37$

Exercise 10.5.14

Solve: $27 = n - 14$

Answer

$n = 41$

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10.6: Solving Equations Using the Subtraction and Addition Properties of Equality (Part 2)

Translate Word Phrases to Algebraic Equations

Remember, an equation has an equal sign (=) between two algebraic expressions. So if we have a sentence that tells us that two phrases are equal, we can translate it into an equation. We look for clue words that mean equals. Some words that translate to the equal sign are:

- is equal to
- is the same as
- is
- gives
- was
- will be

It may be helpful to put a box around the equals word(s) in the sentence to help you focus separately on each phrase. Then translate each phrase into an expression, and write them on each side of the equal sign.

We will practice translating word sentences into algebraic equations. Some of the sentences will be basic number facts with no variables to solve for. Some sentences will translate into equations with variables. The focus right now is just to translate the words into algebra.

Example 10.6.8: translate

Translate the sentence into an algebraic equation: The sum of 6 and 9 is 15.

Solution

The word is tells us the equal sign goes between 9 and 15.

Locate the “equals” word(s).	The sum of 6 and 9 is 15
Write the = sign.	The sum of 6 and 9 = 15
Translate the words to the left of the *equals* word into an algebraic expression.	6 + 9 = _____
Translate the words to the right of the *equals* word into an algebraic expression.	6 + 9 = 15

Exercise 10.6.15

Translate the sentence into an algebraic equation: The sum of 7 and 6 gives 13.

Answer

$7+6=13$

Exercise 10.6.16

Translate the sentence into an algebraic equation: The sum of 8 and 6 is 14.

Answer

$8+6=14$

Example 10.6.9: translate

Translate the sentence into an algebraic equation: The product of 8 and 7 is 56.

Solution

The location of the word is tells us that the equal sign goes between 7 and 56.

Locate the “equals” word(s).	The product of 8 and 7 is 56
Write the = sign.	The product of 8 and 7 = 56
Translate the words to the left of the *equals* word into an algebraic expression.	8 • 7 = _____
Translate the words to the right of the *equals* word into an algebraic expression.	8 • 7 = 56

Exercise 10.6.17

Translate the sentence into an algebraic equation: The product of 6 and 9 is 54.

Answer

$6 \cdot 9 = 54$

Exercise 10.6.18

Translate the sentence into an algebraic equation: The product of 21 and 3 gives 63.

Answer

$21 \cdot 3 = 63$

Example 10.6.10: translate

Translate the sentence into an algebraic equation: Twice the difference of x and 3 gives 18.

Solution

Locate the “equals” word(s).	Twice the difference of x and 3 gives 18.
Recognize the key words: *twice*; *difference of … and …*	*Twice* means two times.
Translate.	Twice the difference of x and 3 gives 18. 2 $(x-3)$ = 18

Exercise 10.6.19

Translate the given sentence into an algebraic equation: Twice the difference of x and 5 gives 30.

Answer

$2(x-5) = 30$

Exercise 10.6.20

Translate the given sentence into an algebraic equation: Twice the difference of y and 4 gives 16.

Answer

$2(y-4)=16$

Translate to an Equation and Solve

Now let's practice translating sentences into algebraic equations and then solving them. We will solve the equations by using the Subtraction and Addition Properties of Equality.

Example 10.6.11: translate and solve

Translate and solve: Three more than x is equal to 47.

Solution

	Three more than x is equal to 47.
Translate.	$x+3=47$
Subtract 3 from both sides of the equation.	$x+3-3=47-3$
Simplify	$x=44$
We can check. Let x = 44.	$44+3\stackrel{?}{=}47$
	$47=47$ ✓

So $x=44$ is the solution.

Exercise 10.6.21

Translate and solve: Seven more than x is equal to 37.

Answer

$x+7=37; x=30$

Exercise 10.6.22

Translate and solve: Eleven more than y is equal to 28.

Answer

$y+11=28; y=17$

Example 10.6.12: translate and solve

Translate and solve: The difference of y and 14 is 18.

Solution

	The difference of y and 14 is 18.
Translate.	$y-14=18$
Add 14 to both sides.	$y-14+14=18+14$

Simplify.	$y = 32$
We can check. Let y = 32.	$32 - 14 \stackrel{?}{=} 18$
	$18 = 18$ ✓

So $y = 32$ is the solution.

Exercise 10.6.23

Translate and solve: The difference of z and 17 is equal to 37.

Answer

$z - 17 = 37; z = 54$

Exercise 10.6.24

Translate and solve: The difference of x and 19 is equal to 45.

Answer

$x - 19 = 45; x = 64$

Access Additional Online Resources

- Solving One Step Equations By Addition and Subtraction

Key Concepts

- Determine whether a number is a solution to an equation.
  1. Substitute the number for the variable in the equation.
  2. Simplify the expressions on both sides of the equation.
  3. Determine whether the resulting equation is true. If it is true, the number is a solution.

  If it is not true, the number is not a solution.
- Subtraction Property of Equality
  - For any numbers a, b, and c,

if	a=b
then	a−c=b−c

- Solve an equation using the Subtraction Property of Equality.
  1. Use the Subtraction Property of Equality to isolate the variable.
  2. Simplify the expressions on both sides of the equation.
  3. Check the solution.
- Addition Property of Equality
  - For any numbers a, b, and c,

if	a=b
then	a+c=b+c

- Solve an equation using the Addition Property of Equality.
  1. Use the Addition Property of Equality to isolate the variable.
  2. Simplify the expressions on both sides of the equation.

3. Check the solution.

Glossary

solution of an equation

A solution to an equation is a value of a variable that makes a true statement when substituted into the equation. The process of finding the solution to an equation is called solving the equation.

Practice Makes Perfect

Determine Whether a Number is a Solution of an Equation

In the following exercises, determine whether each given value is a solution to the equation.

147. $x + 13 = 21$
   a. $x = 8$
   b. $x = 34$

148. $y + 18 = 25$
   a. $y = 7$
   b. $y = 43$

149. $m - 4 = 13$
   a. $m = 9$
   b. $m = 17$

150. $n - 9 = 6$
   a. $n = 3$
   b. $n = 15$

151. $3p + 6 = 15$
   a. $p = 3$
   b. $p = 7$

152. $8q + 4 = 20$
   a. $q = 2$
   b. $q = 3$

153. $18d - 9 = 27$
   a. $d = 1$
   b. $d = 2$

154. $24\,f - 12 = 60$
   a. $f = 2$
   b. $f = 3$

155. $8u - 4 = 4u + 40$
   a. $u = 3$
   b. $u = 11$

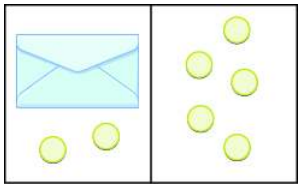
156. $7v - 3 = 4v + 36$
   a. $v = 3$
   b. $v = 11$

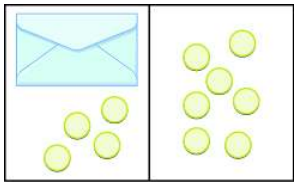
157. $20h - 5 = 15h + 35$
   a. $h = 6$
   b. $h = 8$

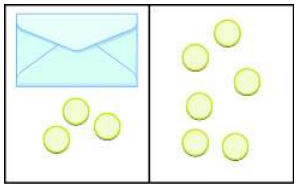
158. $18k - 3 = 12k + 33$
   a. $k = 1$
   b. $k = 6$

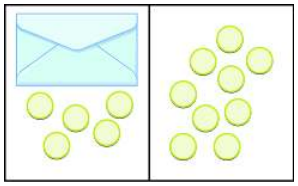
Model the Subtraction Property of Equality

In the following exercises, write the equation modeled by the envelopes and counters and then solve using the subtraction property of equality.

159. 

160. 

161. 

162. 

Solve Equations using the Subtraction Property of Equality

In the following exercises, solve each equation using the subtraction property of equality.

163. $a + 2 = 18$
164. $b + 5 = 13$
165. $p + 18 = 23$
166. $q + 14 = 31$
167. $r + 76 = 100$
168. $s + 62 = 95$
169. $16 = x + 9$
170. $17 = y + 6$
171. $93 = p + 24$
172. $116 = q + 79$
173. $465 = d + 398$
174. $932 = c + 641$

Solve Equations using the Addition Property of Equality

In the following exercises, solve each equation using the addition property of equality.

175. $y - 3 = 19$
176. $x - 4 = 12$
177. $u - 6 = 24$
178. $v - 7 = 35$
179. $f - 55 = 123$
180. $g - 39 = 117$
181. $19 = n - 13$
182. $18 = m - 15$

183. $10 = p - 38$
184. $18 = q - 72$
185. $268 = y - 199$
186. $204 = z - 149$

Translate Word Phrase to Algebraic Equations

In the following exercises, translate the given sentence into an algebraic equation.

187. The sum of 8 and 9 is equal to 17.
188. The sum of 7 and 9 is equal to 16.
189. The difference of 23 and 19 is equal to 4.
190. The difference of 29 and 12 is equal to 17.
191. The product of 3 and 9 is equal to 27.
192. The product of 6 and 8 is equal to 48.
193. The quotient of 54 and 6 is equal to 9.
194. The quotient of 42 and 7 is equal to 6.
195. Twice the difference of n and 10 gives 52.
196. Twice the difference of m and 14 gives 64.
197. The sum of three times y and 10 is 100.
198. The sum of eight times x and 4 is 68.

Translate to an Equation and Solve

In the following exercises, translate the given sentence into an algebraic equation and then solve it.

199. Five more than p is equal to 21.
200. Nine more than q is equal to 40.
201. The sum of r and 18 is 73.
202. The sum of s and 13 is 68.
203. The difference of d and 30 is equal to 52.
204. The difference of c and 25 is equal to 75.
205. 12 less than u is 89.
206. 19 less than w is 56.
207. 325 less than c gives 799.
208. 299 less than d gives 850.

Everyday Math

209. **Insurance** Vince's car insurance has a $500 deductible. Find the amount the insurance company will pay, p, for an $1800 claim by solving the equation $500 + p = 1800$.
210. **Insurance** Marta's homeowner's insurance policy has a $750 deductible. The insurance company paid $5800 to repair damages caused by a storm. Find the total cost of the storm damage, d, by solving the equation $d - 750 = 5800$.
211. **Sale purchase** Arthur bought a suit that was on sale for $120 off. He paid $340 for the suit. Find the original price, p, of the suit by solving the equation $p - 120 = 340$.
212. **Sale purchase** Rita bought a sofa that was on sale for $1299. She paid a total of $1409, including sales tax. Find the amount of the sales tax, t, by solving the equation $1299 + t = 1409$.

Writing Exercises

213. Is $x = 1$ a solution to the equation $8x - 2 = 16 - 6x$? How do you know?
214. Write the equation $y - 5 = 21$ in words. Then make up a word problem for this equation.

Self Check

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

I can...	Confidently	With some help	No-I don't get it!
determine whether a number is a solution of an equation.			
model the subtraction property of equality.			
solve equations using the subtraction property of equality.			
solve equations using the addition property of equality.			
translate word phrases to algebraic equations.			
translate to an equation and solve.			

(b) What does this checklist tell you about your mastery of this section? What steps will you take to improve?

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10.7: Find Multiples and Factors (Part 1)

Learning Objectives

- Identify multiples of numbers
- Use common divisibility tests
- Find all the factors of a number
- Identify prime and composite numbers

Be prepared!

Before you get started, take this readiness quiz.

1. Which of the following numbers are counting numbers (natural numbers)? $0, 4, 215$ If you missed this problem, review Example 1.1.1.
2. Find the sum of 3, 5, and 7. If you missed the problem, review Section 2.1.

Identify Multiples of Numbers

Annie is counting the shoes in her closet. The shoes are matched in pairs, so she doesn't have to count each one. She counts by twos: $2, 4, 6, 8, 10, 12$ She has 12 shoes in her closet.

The numbers $2, 4, 6, 8, 10, 12$ are called multiples of 2. Multiples of 2 can be written as the product of a counting number and 2. The first six multiples of 2 are given below.

$$\begin{aligned} 1 \cdot 2 &= 2 \\ 2 \cdot 2 &= 4 \\ 3 \cdot 2 &= 6 \\ 4 \cdot 2 &= 8 \\ 5 \cdot 2 &= 10 \\ 6 \cdot 2 &= 12 \end{aligned}$$

A **multiple of a number** is the product of the number and a counting number. So a multiple of 3 would be the product of a counting number and 3. Below are the first six multiples of 3.

$$\begin{aligned} 1 \cdot 3 &= 3 \\ 2 \cdot 3 &= 6 \\ 3 \cdot 3 &= 9 \\ 4 \cdot 3 &= 12 \\ 5 \cdot 3 &= 15 \\ 6 \cdot 3 &= 18 \end{aligned}$$

We can find the multiples of any number by continuing this process. Table $10.7.1$ shows the multiples of 2 through 9 for the first twelve counting numbers.

Table 10.7.1

Counting Number	1	2	3	4	5	6	7	8	9	10	11	12
Multiples of 2	2	4	6	8	10	12	14	16	18	20	22	24
Multiples of 3	3	6	9	12	15	18	21	24	27	30	33	36
Multiples of 4	4	8	12	16	20	24	28	32	36	40	44	48

Counting Number	1	2	3	4	5	6	7	8	9	10	11	12
Multiples of 5	5	10	15	20	25	30	35	40	45	50	55	60
Multiples of 6	6	12	18	24	30	36	42	48	54	60	66	72
Multiples of 7	7	14	21	28	35	42	49	56	63	70	77	84
Multiples of 8	8	16	24	32	40	48	56	64	72	80	88	96
Multiples of 9	9	18	27	36	45	54	63	72	81	90	99	108

Definition: Multiple of a Number

A number is a multiple of n if it is the product of a counting number and n.

Recognizing the patterns for multiples of 2, 5, 10, and 3 will be helpful to you as you continue in this course.

Figure $10.7.1$ shows the counting numbers from 1 to 50. Multiples of 2 are highlighted. Do you notice a pattern?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Figure $10.7.1$: Multiples of 2 between 1 and 50

The last digit of each highlighted number in Figure $10.7.1$ is either 0, 2, 4, 6, or 8. This is true for the product of 2 and any counting number. So, to tell if any number is a multiple of 2 look at the last digit. If it is 0, 2, 4, 6, or 8, then the number is a multiple of 2.

Example 10.7.1: multiples of 2

Determine whether each of the following is a multiple of 2:

a. 489
b. $3,714$

Solution

a.

Is 489 a multiple of 2?	
Is the last digit 0, 2, 4, 6, or 8?	No.
	489 is not a multiple of 2.

b.

Is 3,714 a multiple of 2?	
Is the last digit 0, 2, 4, 6, or 8?	Yes.
	3,714 is a multiple of 2.

Exercise 10.7.1

Determine whether each number is a multiple of 2:

a. 678
b. 21,493

Answer a

yes

Answer b

no

Exercise 10.7.2

Determine whether each number is a multiple of 2:

a. 979
b. 17,780

Answer a

no

Answer b

yes

Now let's look at multiples of 5. Figure 10.7.2 highlights all of the multiples of 5 between 1 and 50. What do you notice about the multiples of 5?

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Figure 10.7.2: Multiples of 5 between 1 and 50

All multiples of 5 end with either 5 or 0. Just like we identify multiples of 2 by looking at the last digit, we can identify multiples of 5 by looking at the last digit.

Example 10.7.2: multiples of 5

Determine whether each of the following is a multiple of 5:

a. 579
b. 880

Solution

a.

Is 579 a multiple of 5?	
Is the last digit 5 or 0?	No.
	579 is not a multiple of 5.

b.

Is 880 a multiple of 5?	

Is the last digit 5 or 0?	Yes.
	880 is not a multiple of 5.

Exercise 10.7.3

Determine whether each number is a multiple of 5.

a. 675
b. 1,578

Answer a

yes

Answer b

no

Exercise 10.7.4

Determine whether each number is a multiple of 5.

a. 421
b. 2,690

Answer a

no

Answer b

yes

Figure 10.7.3 highlights the multiples of 10 between 1 and 50. All multiples of 10 all end with a zero.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Figure 10.7.3 Multiples of 10 between 1 and 50

Example 10.7.3: multiples of 10

Determine whether each of the following is a multiple of 10:

a. 425
b. 350

Solution

a.

Is 425 a multiple of 10?	
Is the last digit zero?	No.
	425 is not a multiple of 10.

b.

Is 350 a multiple of 10?	
Is the last digit zero?	Yes.
	350 is a multiple of 10.

Exercise 10.7.5

Determine whether each number is a multiple of 10:

a. 179
b. 3,540

Answer a

no

Answer b

yes

Exercise 10.7.6

Determine whether each number is a multiple of 10:

a. 110
b. 7,595

Answer a

yes

Answer b

no

Figure 10.7.4highlights multiples of 3. The pattern for multiples of 3 is not as obvious as the patterns for multiples of 2, 5, and 10.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50

Figure 10.7.4: Multiples of 3 between 1 and 50

Unlike the other patterns we've examined so far, this pattern does not involve the last digit. The pattern for multiples of 3 is based on the sum of the digits. If the sum of the digits of a number is a multiple of 3, then the number itself is a multiple of 3. See Table 10.7.2

Table 10.7.2

Multiple of 3	3	6	9	12	15	18	21	24
Sum of digits	3	6	9	1 + 2 3	1 + 5 6	1 + 8 9	2 + 1 3	2 + 4 6

Consider the number 42. The digits are 4 and 2, and their sum is $4+2=6$. Since 6 is a multiple of 3, we know that 42 is also a multiple of 3.

Example 10.7.4: multiples of 3

Determine whether each of the given numbers is a multiple of 3:

a. 645
b. 10,519

Solution

a. Is 645 a multiple of 3?

Find the sum of the digits.	6 + 4 + 5 = 15
Is 15 a multiple of 3?	Yes.
If we're not sure, we could add its digits to find out. We can check it by dividing 645 by 3.	645 ÷ 3
The quotient is 215.	3 • 215 = 645

b. Is 10,519 a multiple of 3?

Find the sum of the digits.	1 + 0 + 5 + 1 + 9 = 16
Is 15 a multiple of 3?	No.
So 10,519 is not a multiple of 3 either..	645 ÷ 3
We can check this by dividing by 10,519 by 3.	$3\overline{)10{,}519}$ 3,506R1

When we divide 10,519 by 3, we do not get a counting number, so 10,519 is not the product of a counting number and 3. It is not a multiple of 3.

Exercise 10.7.7

Determine whether each number is a multiple of 3:

a. 954
b. 3,742

Answer a

yes

Answer b

no

Exercise 10.7.8

Determine whether each number is a multiple of 3:

a. 643
b. 8,379

Answer a

no

Answer b

yes

Look back at the charts where you highlighted the multiples of 2, of 5, and of 10. Notice that the multiples of 10 are the numbers that are multiples of both 2 and 5. That is because $10 = 2 \cdot 5$. Likewise, since $6 = 2 \cdot 3$, the multiples of 6 are the numbers that are multiples of both 2 and 3.

Use Common Divisibility Tests

Another way to say that 375 is a multiple of 5 is to say that 375 is divisible by 5. In fact, $375 \div 5$ is 75, so 375 is $5 \cdot 75$. Notice in Example 10.7.4 that 10,519 is not a multiple 3. When we divided 10,519 by 3 we did not get a counting number, so 10,519 is not divisible by 3.

Definition: Divisibility

If a number m is a multiple of n, then we say that m is divisible by n.

Since multiplication and division are inverse operations, the patterns of multiples that we found can be used as divisibility tests. Table 10.7.3 summarizes divisibility tests for some of the counting numbers between one and ten.

Table 10.7.3: Divisibility tests

A number is divisible by	
2	if the last digit is 0, 2, 4, 6, or 8
3	if the sum of the digits is divisible by 3
5	if the last digit is 5 or 0
6	if divisible by both 2 and 3
10	if the last digit is 0

Example 10.7.5: divisibility

Determine whether 1,290 is divisible by 2, 3, 5, and 10.

Solution

Table 10.7.4 applies the divisibility tests to 1,290. In the far right column, we check the results of the divisibility tests by seeing if the quotient is a whole number.

Table 10.7.4

Divisible by…?	Test	Divisible?	Check
2	Is last digit 0, 2, 4, 6, or 8?	yes	1290 ÷ 2 = 645
3	Is sum of digits divisible by 3? 1 + 2 + 9 + 0 = 12	yes	1290 ÷ 3 = 430
5	Is last digit 5 or 0?	yes	1290 ÷ 5 = 258
10	Is last digit 0?	yes	1290 ÷ 10 = 129

Thus, 1,290 is divisible by 2, 3, 5, and 10.

Exercise 10.7.9

Determine whether the given number is divisible by 2, 3, 5, and 10.

6240

Answer

Divisible by 2, 3, 5, and 10

Exercise 10.7.10

Determine whether the given number is divisible by 2, 3, 5, and 10.

7248

Answer

Divisible by 2 and 3, not 5 or 10

Example 10.7.6: divisibility

Determine whether 5,625 is divisible by 2, 3, 5, and 10.

Solution

Table 10.7.5 applies the divisibility tests to 5,625 and tests the results by finding the quotients.

Table 10.7.5

Divisible by…?	Test	Divisible?	Check
2	Is last digit 0, 2, 4, 6, or 8?	no	5625 ÷ 2 = 2812.5
3	Is sum of digits divisible by 3? 5 + 6 + 2 + 5 = 18	yes	5625 ÷ 3 = 1875
5	Is last digit 5 or 0?	yes	5625 ÷ 5 = 1125
10	Is last digit 0?	no	5625 ÷ 10 = 562.5

Thus, 5,625 is divisible by 3 and 5, but not 2, or 10.

Exercise 10.7.11

Determine whether the given number is divisible by 2, 3, 5, and 10.

4962

Answer

Divisible by 2, 3, not 5 or 10

Exercise 10.7.12

Determine whether the given number is divisible by 2, 3, 5, and 10.

3765

Answer

Divisible by 3 and 5

Find All the Factors of a Number

There are often several ways to talk about the same idea. So far, we've seen that if m is a multiple of n, we can say that m is divisible by n. We know that 72 is the product of 8 and 9, so we can say 72 is a multiple of 8 and 72 is a multiple of 9. We can also

say 72 is divisible by 8 and by 9. Another way to talk about this is to say that 8 and 9 are factors of 72. When we write $72 = 8 \cdot 9$ we can say that we have factored 72.

$$\underbrace{8 \cdot 9}_{\text{factors}} = \underbrace{72}_{\text{product}}$$

Definition: Factors

If $a \bullet b = m$, then a and b are factors of m, and m is the product of a and b.

In algebra, it can be useful to determine all of the factors of a number. This is called factoring a number, and it can help us solve many kinds of problems.

For example, suppose a choreographer is planning a dance for a ballet recital. There are 24 dancers, and for a certain scene, the choreographer wants to arrange the dancers in groups of equal sizes on stage.

In how many ways can the dancers be put into groups of equal size? Answering this question is the same as identifying the factors of 24. Table $10.7.6$ summarizes the different ways that the choreographer can arrange the dancers.

Table 10.7.6

Number of Groups	Dancers per Group	Total Dancers
1	24	1 • 24 = 24
2	12	2 • 12= 24
3	8	3 • 8= 24
4	6	4 • 6= 24
6	4	6 • 4= 24
8	3	8 • 3= 24
12	2	12 • 2= 24
24	1	24 • 1= 24

What patterns do you see in Table $10.7.6$? Did you notice that the number of groups times the number of dancers per group is always 24? This makes sense, since there are always 24 dancers.

You may notice another pattern if you look carefully at the first two columns. These two columns contain the exact same set of numbers—but in reverse order. They are mirrors of one another, and in fact, both columns list all of the factors of 24, which are:

$$1, 2, 3, 4, 6, 8, 12, 24$$

We can find all the factors of any counting number by systematically dividing the number by each counting number, starting with 1. If the quotient is also a counting number, then the divisor and the quotient are factors of the number. We can stop when the quotient becomes smaller than the divisor.

HOW TO: FIND ALL THE FACTORS OF A COUNTING NUMBER.

Step 1. Divide the number by each of the counting numbers, in order, until the quotient is smaller than the divisor.

- If the quotient is a counting number, the divisor and quotient are a pair of factors.
- If the quotient is not a counting number, the divisor is not a factor.

Step 2. List all the factor pairs.

Step 3. Write all the factors in order from smallest to largest.

Example 10.7.7: factors

Find all the factors of 72.

Solution

Divide 72 by each of the counting numbers starting with 1. If the quotient is a whole number, the divisor and quotient are a pair of factors.

Dividend	Divisor	Quotient	Factors
72	1	72	1, 72
72	2	36	2, 36
72	3	24	3, 24
72	4	18	4, 18
72	5	14.4	–
72	6	12	6, 12
72	7	~10.29	–
72	8	9	8, 9

The next line would have a divisor of 9 and a quotient of 8. The quotient would be smaller than the divisor, so we stop. If we continued, we would end up only listing the same factors again in reverse order. Listing all the factors from smallest to greatest, we have 1, 2, 3, 4, 6, 8, 9, 12, 18, 24, 36, and 72.

Exercise 10.7.13

Find all the factors of the given number: 96

Answer

$1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96$

Exercise 10.7.14

Find all the factors of the given number: 80

Answer

$1, 2, 4, 5, 8, 10, 16, 20, 40, 80$

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10.8: Find Multiples and Factors (Part 2)

Identify Prime and Composite Numbers

Some numbers, like 72, have many factors. Other numbers, such as 7, have only two factors: 1 and the number. A number with only two factors is called a **prime number**. A number with more than two factors is called a **composite number**. The number 1 is neither prime nor composite. It has only one factor, itself.

Definition: Prime Numbers and Composite Numbers

A prime number is a counting number greater than 1 whose only factors are 1 and itself.

A composite number is a counting number that is not prime.

Figure 10.8.5 lists the counting numbers from 2 through 20 along with their factors. The highlighted numbers are prime, since each has only two factors.

Number	Factors	Prime or Composite?		Number	Factor	Prime or Composite?
2	1,2	Prime		12	1,2,3,4,6,12	Composite
3	1,3	Prime		13	1,13	Prime
4	1,2,4	Composite		14	1,2,7,14	Composite
5	1,5	Prime		15	1,3,5,15	Composite
6	1,2,3,6	Composite		16	1,2,4,8,16	Composite
7	1,7	Prime		17	1,17	Prime
8	1,2,4,8	Composite		18	1,2,3,6,9,18	Composite
9	1,3,9	Composite		19	1,19	Prime
10	1,2,5,10	Composite		20	1,2,4,5,10,20	Composite
11	1,11	Prime				

Figure 10.8.5: Factors of the counting numbers from 2 through 20, with prime numbers highlighted

The prime numbers less than 20 are 2, 3, 5, 7, 11, 13, 17, and 19. There are many larger prime numbers too. In order to determine whether a number is prime or composite, we need to see if the number has any factors other than 1 and itself. To do this, we can test each of the smaller prime numbers in order to see if it is a factor of the number. If none of the prime numbers are factors, then that number is also prime.

HOW TO: DETERMINE IF A NUMBER IS PRIME.

- Step 1. Test each of the primes, in order, to see if it is a factor of the number.
- Step 2. Start with 2 and stop when the quotient is smaller than the divisor or when a prime factor is found.
- Step 3. If the number has a prime factor, then it is a composite number. If it has no prime factors, then the number is prime.

Example 10.8.8: prime or composite

Identify each number as prime or composite:

a. 83
b. 77

Solution

a. Test each prime, in order, to see if it is a factor of 83, starting with 2, as shown. We will stop when the quotient is smaller than the divisor.

Prime	Test	Factor of 83?
2	Last digit of 83 is not 0, 2, 4, 6, or 8.	No.
3	8 + 3 = 11, and 11 is not divisible by 3.	No.

Prime	Test	Factor of 83?
5	The last digit of 83 is not 5 or 0.	No.
7	$83 \div 7 = 11.857\ldots$.	No.
11	$83 \div 11 = 7.545\ldots$	No.

We can stop when we get to 11 because the quotient ($7.545\ldots$) is less than the divisor. We did not find any prime numbers that are factors of 83, so we know 83 is prime.

b. Test each prime, in order, to see if it is a factor of 77.

Prime	Test	Factor of 77?
2	Last digit is not 0, 2, 4, 6, or 8.	No.
3	7 + 7 = 14, and 14 is not divisible by 3.	No.
5	The last digit is not 5 or 0.	No.
7	$77 \div 7 = 11$	Yes.

Since 77 is divisible by 7, we know it is not a prime number. It is composite.

? Exercise 10.8.15

Identify the number as prime or composite: 91

Answer

composite

? Exercise 10.8.16

Identify the number as prime or composite: 137

Answer

prime

Access Additional Online Resources

- Divisibility Rules
- Factors
- Ex 1: Determine Factors of a Number
- Ex 2: Determine Factors of a Number
- Ex 3: Determine Factors of a Number

Key Concepts

Divisibility Tests	
A number is divisible by	
2	if the last digit is 0, 2, 4, 6, or 8
3	if the sum of the digits is divisible by 3
5	if the last digit is 5 or 0

Divisibility Tests	
6	if divisible by both 2 and 3
10	if the last digit is 0

- Factors If $a \cdot b = m$, then a and b are factors of m, and m is the product of a and b.
- Find all the factors of a counting number.
  - Divide the number by each of the counting numbers, in order, until the quotient is smaller than the divisor.
    - If the quotient is a counting number, the divisor and quotient are a pair of factors.
    - If the quotient is not a counting number, the divisor is not a factor.
  - List all the factor pairs.
  - Write all the factors in order from smallest to largest.
- Determine if a number is prime.
  - Test each of the primes, in order, to see if it is a factor of the number.
  - Start with 2 and stop when the quotient is smaller than the divisor or when a prime factor is found.
  - If the number has a prime factor, then it is a composite number. If it has no prime factors, then the number is prime.

Glossary

multiple of a number

A number is a multiple of n if it is the product of a counting number and n.

divisibility

If a number m is a multiple of n, then we say that m is divisible by n.

prime number

A prime number is a counting number greater than 1 whose only factors are 1 and itself.

composite number

A composite number is a counting number that is not prime.

Practice Makes Perfect

Identify Multiples of Numbers

In the following exercises, list all the multiples less than 50 for the given number.

215. 2
216. 3
217. 4
218. 5
219. 6
220. 7
221. 8
222. 9
223. 10
224. 12

Use Common Divisibility Tests

In the following exercises, use the divisibility tests to determine whether each number is divisible by 2, 3, 4, 5, 6, and 10.

225. 84
226. 96
227. 75
228. 78

229. 168
230. 264
231. 900
232. 800
233. 896
234. 942
235. 375
236. 750
237. 350
238. 550
239. 1430
240. 1080
241. 22,335
242. 39,075

Find All the Factors of a Number

In the following exercises, find all the factors of the given number.

243. 36
244. 42
245. 60
246. 48
247. 144
248. 200
249. 588
250. 576

Identify Prime and Composite Numbers

In the following exercises, determine if the given number is prime or composite.

251. 43
252. 67
253. 39
254. 53
255. 71
256. 119
257. 481
258. 221
259. 209
260. 359
261. 667
262. 1771

Everyday Math

263. **Banking** Frank's grandmother gave him $100 at his high school graduation. Instead of spending it, Frank opened a bank account. Every week, he added $15 to the account. The table shows how much money Frank had put in the account by the end of each week. Complete the table by filling in the blanks.

Weeks after graduation	Total number of dollars Frank put in the account	Simplified Total
0	100	100
1	100 + 15	115
2	100 + 15 • 2	130

Weeks after graduation	Total number of dollars Frank put in the account	Simplified Total
3	100 + 15 • 3	
4	100 + 15 • []	
5	100 + []	
6		
20		
x		

264. **Banking** In March, Gina opened a Christmas club savings account at her bank. She deposited $75 to open the account. Every week, she added $20 to the account. The table shows how much money Gina had put in the account by the end of each week. Complete the table by filling in the blanks.

Weeks after opening the account	Total number of dollars Gina put in the account	Simplified Total
0	75	75
1	75 + 20	95
2	75 + 20 • 2	115
3	75 + 20 • 3	
4	75 + 20 • []	
5	75 + []	
6		
20		
x		

Writing Exercises

265. If a number is divisible by 2 and by 3, why is it also divisible by 6?
266. What is the difference between prime numbers and composite numbers?

Self Check

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

I can...	Confidently	With some help	No-I don't get it!
identify multiples of numbers.			
use common divisibility tests.			
find all the factors of a number.			
identify prime and composite numbers.			

(b) On a scale of 1–10, how would you rate your mastery of this section in light of your responses on the checklist? How can you improve this?

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10.9: Prime Factorization and the Least Common Multiple (Part 1)

Learning Objectives

- Find the prime factorization of a composite number
- Find the least common multiple (LCM) of two numbers

be prepared!

Before you get started, take this readiness quiz.

1. Is 810 divisible by $2, 3, 5, 6,$ or 10? If you missed this problem, review Example 2.4.5.
2. Is 127 prime or composite? If you missed this problem, review Example 2.4.8.
3. Write $2 \cdot 2 \cdot 2 \cdot 2$ in exponential notation. If you missed this problem, review Example 2.1.5.

Find the Prime Factorization of a Composite Number

In the previous section, we found the factors of a number. Prime numbers have only two factors, the number 1 and the prime number itself. Composite numbers have more than two factors, and every composite number can be written as a unique product of primes. This is called the **prime factorization** of a number. When we write the prime factorization of a number, we are rewriting the number as a product of primes. Finding the prime factorization of a composite number will help you later in this course.

Definition: Prime Factorization

The prime factorization of a number is the product of prime numbers that equals the number.

You may want to refer to the following list of prime numbers less than 50 as you work through this section.

$$2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47$$

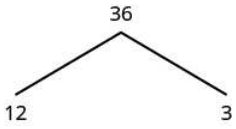
Prime Factorization Using the Factor Tree Method

One way to find the prime factorization of a number is to make a factor tree. We start by writing the number, and then writing it as the product of two factors. We write the factors below the number and connect them to the number with a small line segment—a "branch" of the factor tree.

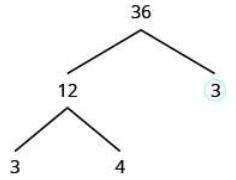
If a factor is prime, we circle it (like a bud on a tree), and do not factor that "branch" any further. If a factor is not prime, we repeat this process, writing it as the product of two factors and adding new branches to the tree.

We continue until all the branches end with a prime. When the factor tree is complete, the circled primes give us the prime factorization.

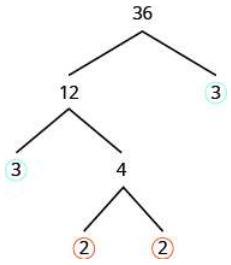
For example, let's find the prime factorization of 36. We can start with any factor pair such as 3 and 12. We write 3 and 12 below 36 with branches connecting them.



The factor 3 is prime, so we circle it. The factor 12 is composite, so we need to find its factors. Let's use 3 and 4. We write these factors on the tree under the 12.



The factor 3 is prime, so we circle it. The factor 4 is composite, and it factors into $2 \bullet 2$. We write these factors under the 4. Since 2 is prime, we circle both $2s$.



The prime factorization is the product of the circled primes. We generally write the prime factorization in order from least to greatest.

$$2 \cdot 2 \cdot 3 \cdot 3$$

In cases like this, where some of the prime factors are repeated, we can write prime factorization in exponential form.

$$2 \cdot 2 \cdot 3 \cdot 3$$

$$2^2 \cdot 3^2$$

Note that we could have started our factor tree with any factor pair of 36. We chose 12 and 3, but the same result would have been the same if we had started with 2 and 18, 4 and 9, or 6 and 6.

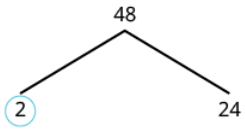
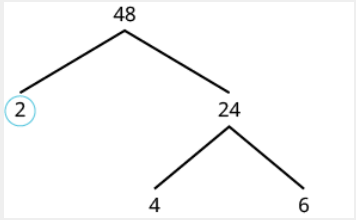
HOW TO: FIND THE PRIME FACTORIZATION OF A COMPOSITE NUMBER USING THE TREE METHOD

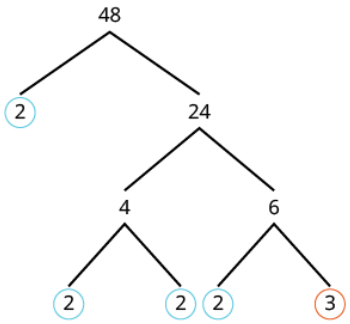
- Step 1. Find any factor pair of the given number, and use these numbers to create two branches.
- Step 2. If a factor is prime, that branch is complete. Circle the prime.
- Step 3. If a factor is not prime, write it as the product of a factor pair and continue the process.
- Step 4. Write the composite number as the product of all the circled primes.

Example 10.9.1: prime factors

Find the prime factorization of 48 using the factor tree method.

Solution

We can start our tree using any factor pair of 48. Let's use 2 and 24. We circle the 2 because it is prime and so that branch is complete.	
Now we will factor 24. Let's use 4 and 6.	

Neither factor is prime, so we do not circle either. We factor the 4, using 2 and 2. We factor 6, using 2 and 3. We circle the 2s and the 3 since they are prime. Now all of the branches end in a prime.	
Write the product of the circled numbers.	$2 \cdot 2 \cdot 2 \cdot 2 \cdot 3$
Write in exponential form.	$2^4 \cdot 3$

Check this on your own by multiplying all the factors together. The result should be 48.

Exercise 10.9.1

Find the prime factorization using the factor tree method: 80

Answer

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$, or $2^4 \cdot 5$

Exercise 10.9.2

Find the prime factorization using the factor tree method: 60

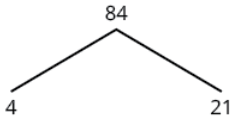
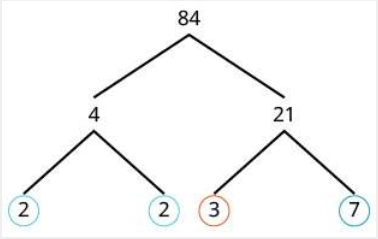
Answer

$2 \cdot 2 \cdot 3 \cdot 5$, or $2^2 \cdot 3 \cdot 5$

Example 10.9.2: prime factors

Find the prime factorization of 84 using the factor tree method.

Solution

We start with the factor pair 4 and 21. Neither factor is prime so we factor them further.	
Now the factors are all prime, so we circle them.	
Then we write 84 as the product of all circled primes.	$2 \cdot 2 \cdot 3 \cdot 7 = 2^2 \cdot 3 \cdot 7$

Draw a factor tree of 84.

Exercise 10.9.3

Find the prime factorization using the factor tree method: 126

Answer

$2 \cdot 3 \cdot 3 \cdot 7$, or $2 \cdot 3^2 \cdot 7$

Exercise 10.9.4

Find the prime factorization using the factor tree method: 294

Answer

$2 \cdot 3 \cdot 7 \cdot 7$, or $2 \cdot 3 \cdot 7^2$

Prime Factorization Using the Ladder Method

The ladder method is another way to find the prime factors of a composite number. It leads to the same result as the factor tree method. Some people prefer the ladder method to the factor tree method, and vice versa.

To begin building the "ladder," divide the given number by its smallest prime factor. For example, to start the ladder for 36, we divide 36 by 2, the smallest prime factor of 36.

$$2\overline{)36}\quad 18$$

To add a "step" to the ladder, we continue dividing by the same prime until it no longer divides evenly.

$$\begin{array}{r} 9 \\ 2\overline{)18} \\ 2\overline{)\ 36} \end{array}$$

Then we divide by the next prime; so we divide 9 by 3.

$$\begin{array}{r} 3 \\ 3\overline{)9} \\ 2\overline{)18} \\ 2\overline{)\ 36} \end{array}$$

We continue dividing up the ladder in this way until the quotient is prime. Since the quotient, 3, is prime, we stop here. Do you see why the ladder method is sometimes called stacked division?

The prime factorization is the product of all the primes on the sides and top of the ladder.

$$2 \cdot 2 \cdot 3 \cdot 3$$

$$2^2 \cdot 3^2$$

Notice that the result is the same as we obtained with the factor tree method.

HOW TO: FIND THE PRIME FACTORIZATION OF A COMPOSITE NUMBER USING THE LADDER METHOD

Step 1. Divide the number by the smallest prime.

Step 2. Continue dividing by that prime until it no longer divides evenly.

Step 3. Divide by the next prime until it no longer divides evenly.

Step 4. Continue until the quotient is a prime.

Step 5. Write the composite number as the product of all the primes on the sides and top of the ladder.

Example 10.9.3: prime factors

Find the prime factorization of 120 using the ladder method.

Solution

Divide the number by the smallest prime, which is 2.	$2\overline{)120}\quad 60$
Continue dividing by 2 until it no longer divides evenly.	$2\overline{)120}\quad 60$ $2\overline{)60}\quad 30$ $2\overline{)30}\quad 15$ $3\overline{)15}\quad 5$
Divide by the next prime, 3.	$2\overline{)120}\quad 60$ $2\overline{)60}\quad 30$ $2\overline{)30}\quad 15$
The quotient, 5, is prime, so the ladder is complete. Write the prime factorization of 120.	$2 \cdot 2 \cdot 2 \cdot 3 \cdot 5$ $2^3 \cdot 3 \cdot 5$

Check this yourself by multiplying the factors. The result should be 120.

Exercise 10.9.5

Find the prime factorization using the ladder method: 80

Answer

$2 \cdot 2 \cdot 2 \cdot 2 \cdot 5$, or $2^4 \cdot 5$

Exercise 10.9.6

Find the prime factorization using the ladder method: 60

Answer

$2 \cdot 2 \cdot 3 \cdot 5$, or $2^2 \cdot 3 \cdot 5$

Example 10.9.4: prime factors

Find the prime factorization of 48 using the ladder method.

Solution

Divide the number by the smallest prime, 2.	$2\overline{)48}\quad 24$
Continue dividing by 2 until it no longer divides evenly.	$2\overline{)48}\quad 24$ $2\overline{)24}\quad 12$ $2\overline{)12}\quad 6$ $2\overline{)6}\quad 3$
The quotient, 3, is prime, so the ladder is complete. Write the prime factorization of 48.	$2 \bullet 2 \bullet 2 \bullet 2 \bullet 3$ $2^4 \bullet 3$

Exercise 10.9.7

Find the prime factorization using the ladder method: 126

Answer

$2 \cdot 3 \cdot 3 \cdot 7$, or $2 \cdot 3^2 \cdot 7$

Exercise 10.9.8

Find the prime factorization using the ladder method: 294

Answer

$2 \cdot 3 \cdot 7 \cdot 7$, or $2 \cdot 3 \cdot 7^2$

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10.10: Prime Factorization and the Least Common Multiple (Part 2)

Find the Least Common Multiple (LCM) of Two Numbers

One of the reasons we look at multiples and primes is to use these techniques to find the least common multiple of two numbers. This will be useful when we add and subtract fractions with different denominators.

Listing Multiples Method

A common multiple of two numbers is a number that is a multiple of both numbers. Suppose we want to find common multiples of 10 and 25. We can list the first several multiples of each number. Then we look for multiples that are common to both lists—these are the common multiples.

$$10\colon\ 10, 20, 30, 40, \mathbf{50}, 60, 70, 80, 90, \mathbf{100}, 110, \ldots$$
$$25\colon\ 25, \mathbf{50}, 75, \mathbf{100}, 125, \ldots$$

We see that 50 and 100 appear in both lists. They are common multiples of 10 and 25. We would find more common multiples if we continued the list of multiples for each.

The smallest number that is a multiple of two numbers is called the **least common multiple** (LCM). So the least LCM of 10 and 25 is 50.

HOW TO: FIND THE LEAST COMMON MULTIPLE (LCM) OF TWO NUMBERS BY LISTING MULTIPLES

Step 1. List the first several multiples of each number.

Step 2. Look for multiples common to both lists. If there are no common multiples in the lists, write out additional multiples for each number.

Step 3. Look for the smallest number that is common to both lists.

Step 4. This number is the LCM.

Example 10.10.5: lcm

Find the LCM of 15 and 20 by listing multiples.

Solution

List the first several multiples of 15 and of 20. Identify the first common multiple.

$$15\colon\ 15, 30, 45, \mathbf{60}, 75, 90, 105, 120$$
$$20\colon\ 20, 40, \mathbf{60}, 80, 100, 120, 140, 160$$

The smallest number to appear on both lists is 60, so 60 is the least common multiple of 15 and 20. Notice that 120 is on both lists, too. It is a common multiple, but it is not the least common multiple.

Exercise 10.10.9

Find the least common multiple (LCM) of the given numbers: 9 and 12

Answer

36

Exercise 10.10.10

Find the least common multiple (LCM) of the given numbers: 18 and 24

Answer

72

Prime Factors Method

Another way to find the least common multiple of two numbers is to use their prime factors. We'll use this method to find the LCM of 12 and 18.

We start by finding the prime factorization of each number.

$$12 = 2 \cdot 2 \cdot 3 \qquad 18 = 2 \cdot 3 \cdot 3$$

Then we write each number as a product of primes, matching primes vertically when possible.

$$\begin{aligned} 12 &= 2 \cdot 2 \cdot 3 \\ 18 &= 2 \cdot \quad 3 \cdot 3 \end{aligned}$$

Now we bring down the primes in each column. The LCM is the product of these factors.

$$\begin{aligned} 12 &= 2 \cdot 2 \cdot 3 \\ 18 &= 2 \cdot \quad 3 \cdot 3 \\ \hline \text{LCM} &= 2 \cdot 2 \cdot 3 \cdot 3 \\ \text{LCM} &= 2 \cdot 2 \cdot 3 \cdot 3 = 36 \end{aligned}$$

Notice that the prime factors of 12 and the prime factors of 18 are included in the LCM. By matching up the common primes, each common prime factor is used only once. This ensures that 36 is the least common multiple.

HOW TO: FIND THE LCM USING THE PRIME FACTORS METHOD

Step 1. Find the prime factorization of each number.

Step 2. Write each number as a product of primes, matching primes vertically when possible.

Step 3. Bring down the primes in each column.

Step 4. Multiply the factors to get the LCM.

Example 10.10.6: lcm

Find the LCM of 15 and 18 using the prime factors method.

Solution

Write each number as a product of primes.	$15 = 3 \cdot 5 \qquad 18 = 2 \cdot 3 \cdot 3$
Write each number as a product of primes, matching primes vertically when possible.	$\begin{aligned} 15 &= \quad 3 \cdot \quad 5 \\ 18 &= 2 \cdot 3 \cdot 3 \end{aligned}$
Bring down the primes in each column.	$\begin{aligned} 15 &= \quad 3 \cdot \quad 5 \\ 18 &= 2 \cdot 3 \cdot 3 \\ \hline \text{LCM} &= 2 \cdot 3 \cdot 3 \cdot 5 \end{aligned}$
Multiply the factors to get the LCM.	LCM = 2 • 3 • 3 • 5 The LCM of 15 and 18 is 90.

Exercise 10.10.11

Find the LCM using the prime factors method: 15 and 20

Answer

60

Exercise 10.10.12

Find the LCM using the prime factors method: 15 and 35

Answer

105

Example 10.10.7: lcm

Find the LCM of 50 and 100 using the prime factors method.

Solution

Write the prime factorization of each number.	$50 = 2 \cdot 5 \cdot 5 \qquad 100 = 2 \cdot 2 \cdot 5 \cdot 5$
Write each number as a product of primes, matching primes vertically when possible.	$50 = \quad 2 \cdot 5 \cdot 5$ $100 = 2 \cdot 2 \cdot 5 \cdot 5$
Bring down the primes in each column.	$50 = \quad 2 \cdot 5 \cdot 5$ $100 = 2 \cdot 2 \cdot 5 \cdot 5$ $\text{LCM} = 2 \cdot 2 \cdot 5 \cdot 5$
Multiply the factors to get the LCM.	$\text{LCM} = 2 \cdot 2 \cdot 5 \cdot 5$ The LCM of 50 and 100 is 100.

Exercise 10.10.13

Find the LCM using the prime factors method: $55, 88$

Answer

440

Exercise 10.10.14

Find the LCM using the prime factors method: $60, 72$

Answer

360

Access Additional Online Resources

- Ex 1: Prime Factorization
- Ex 2: Prime Factorization
- Ex 3: Prime Factorization
- Ex 1: Prime Factorization Using Stacked Division
- Ex 2: Prime Factorization Using Stacked Division
- The Least Common Multiple
- Example: Determining the Least Common Multiple Using a List of Multiples
- Example: Determining the Least Common Multiple Using Prime Factorization

Key Concepts

- Find the prime factorization of a composite number using the tree method.
  - Find any factor pair of the given number, and use these numbers to create two branches.
  - If a factor is prime, that branch is complete. Circle the prime.
  - If a factor is not prime, write it as the product of a factor pair and continue the process.
  - Write the composite number as the product of all the circled primes.
- Find the prime factorization of a composite number using the ladder method.
  - Divide the number by the smallest prime.
  - Continue dividing by that prime until it no longer divides evenly.
  - Divide by the next prime until it no longer divides evenly.
  - Continue until the quotient is a prime.
  - Write the composite number as the product of all the primes on the sides and top of the ladder.
- Find the LCM by listing multiples.
  - List the first several multiples of each number.
  - Look for multiples common to both lists. If there are no common multiples in the lists, write out additional multiples for each number.
  - Look for the smallest number that is common to both lists.
  - This number is the LCM.
- Find the LCM using the prime factors method.
  - Find the prime factorization of each number.
  - Write each number as a product of primes, matching primes vertically when possible.
  - Bring down the primes in each column.
  - Multiply the factors to get the LCM.

Glossary

least common multiple

The smallest number that is a multiple of two numbers is called the least common multiple (LCM).

prime factorization

The prime factorization of a number is the product of prime numbers that equals the number.

Practice Makes Perfect

Find the Prime Factorization of a Composite Number

In the following exercises, find the prime factorization of each number using the factor tree method.

267. 86
268. 78
269. 132
270. 455
271. 693
272. 420
273. 115
274. 225
275. 2475
276. 1560

In the following exercises, find the prime factorization of each number using the ladder method.

277. 56
278. 72
279. 168
280. 252

281. 391
282. 400
283. 432
284. 627
285. 2160
286. 2520

In the following exercises, find the prime factorization of each number using any method.

287. 150
288. 180
289. 525
290. 444
291. 36
292. 50
293. 350
294. 144

Find the Least Common Multiple (LCM) of Two Numbers

In the following exercises, find the least common multiple (LCM) by listing multiples.

295. 8, 12
296. 4, 3
297. 6, 15
298. 12, 16
299. 30, 40
300. 20, 30
301. 60, 75
302. 44, 55

In the following exercises, find the least common multiple (LCM) by using the prime factors method.

303. 8, 12
304. 12, 16
305. 24, 30
306. 28, 40
307. 70, 84
308. 84, 90

In the following exercises, find the least common multiple (LCM) using any method.

309. 6, 21
310. 9, 15
311. 24, 30
312. 32, 40

Everyday Math

313. **Grocery shopping** Hot dogs are sold in packages of ten, but hot dog buns come in packs of eight. What is the smallest number of hot dogs and buns that can be purchased if you want to have the same number of hot dogs and buns? (Hint: it is the LCM!)
314. **Grocery shopping** Paper plates are sold in packages of 12 and party cups come in packs of 8. What is the smallest number of plates and cups you can purchase if you want to have the same number of each? (Hint: it is the LCM!)

Writing Exercises

315. Do you prefer to find the prime factorization of a composite number by using the factor tree method or the ladder method? Why?
316. Do you prefer to find the LCM by listing multiples or by using the prime factors method? Why?

Self Check

(a) After completing the exercises, use this checklist to evaluate your mastery of the objectives of this section.

I can...	Confidently	With some help	No-I don't get it!
find the prime factorization of a composite number.			
find the least common multiple (LCM) of two numbers.			

(b) Overall, after looking at the checklist, do you think you are well-prepared for the next Chapter? Why or why not?

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10.E: Introduction to the Language of Algebra (Exercises)

2.1 - Use the Language of Algebra

Use Variables and Algebraic Symbols

In the following exercises, translate from algebra to English.

317. $3 \cdot 8$
318. $12 - x$
319. $24 \div 6$
320. $9 + 2a$
321. $50 \geq 47$
322. $3y < 15$
323. $n + 4 = 13$
324. $32 - k = 7$

Identify Expressions and Equations

In the following exercises, determine if each is an expression or equation.

325. $5 + u = 84$
326. $36 - 6s$
327. $4y - 11$
328. $10x = 120$

Simplify Expressions with Exponents

In the following exercises, write in exponential form.

329. $2 \cdot 2 \cdot 2$
330. $a \cdot a \cdot a \cdot a \cdot a$
331. $x \cdot x \cdot x \cdot x \cdot x \cdot x$
332. $10 \cdot 10 \cdot 10$

In the following exercises, write in expanded form.

333. 8^4
334. 3^6
335. y^5
336. n^4

In the following exercises, simplify each expression.

337. 3^4
338. 10^6
339. 2^7
340. 4^3

Simplify Expressions Using the Order of Operations

In the following exercises, simplify.

341. $10 + 2 \cdot 5$
342. $(10 + 2) \cdot 5$
343. $(30 + 6) \div 2$
344. $30 + 6 \div 2$
345. $7^2 + 5^2$
346. $(7 + 5)^2$
347. $4 + 3(10 - 1)$
348. $(4 + 3)(10 - 1)$

2.2 - Evaluate, Simplify, and Translate Expressions

Evaluate an Expression

In the following exercises, evaluate the following expressions.

349. $9x - 5$ when $x = 7$
350. y^3 when $y = 5$
351. $3a - 4b$ when $a = 10, b = 1$
352. bh when $b = 7, h = 8$

Identify Terms, Coefficients and Like Terms

In the following exercises, identify the terms in each expression.

353. $12n^2 + 3n + 1$
354. $4x^3 + 11x + 3$

In the following exercises, identify the coefficient of each term.

355. $6y$
356. $13x^2$

In the following exercises, identify the like terms.

357. $5x^2$, 3, $5y^2$, $3x$, x, 4
358. 8, $8r^2$, $8r$, $3r$, r^2, $3s$

Simplify Expressions by Combining Like Terms

In the following exercises, simplify the following expressions by combining like terms.

359. $15a + 9a$
360. $12y + 3y + y$
361. $4x + 7x + 3x$
362. $6 + 5c + 3$
363. $8n + 2 + 4n + 9$
364. $19p + 5 + 4p - 1 + 3p$
365. $7y^2 + 2y + 11 + 3y^2 - 8$
366. $13x^2 - x + 6 + 5x^2 + 9x$

Translate English Phrases to Algebraic Expressions

In the following exercises, translate the following phrases into algebraic expressions.

367. the difference of x and 6
368. the sum of 10 and twice a
369. the product of $3n$ and 9
370. the quotient of s and 4
371. 5 times the sum of y and 1
372. 10 less than the product of 5 and z
373. Jack bought a sandwich and a coffee. The cost of the sandwich was $3 more than the cost of the coffee. Call the cost of the coffee c. Write an expression for the cost of the sandwich.
374. The number of poetry books on Brianna's bookshelf is 5 less than twice the number of novels. Call the number of novels n. Write an expression for the number of poetry books.

2.3 - Solve Equations Using the Subtraction and Addition Properties of Equality

Determine Whether a Number is a Solution of an Equation

In the following exercises, determine whether each number is a solution to the equation.

375. $y + 16 = 40$

    a. 24

b. 56

376. d − 6 = 21

a. 15
b. 27

377. 4n + 12 = 36

a. 6
b. 12

378. 20q − 10 = 70

a. 3
b. 4

379. 15x − 5 = 10x + 45

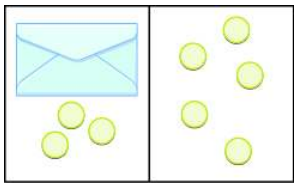
a. 2
b. 10

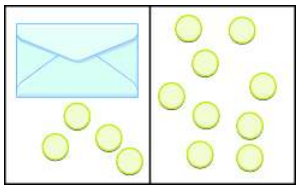
380. 22p − 6 = 18p + 86

a. 4
b. 23

Model the Subtraction Property of Equality

In the following exercises, write the equation modeled by the envelopes and counters and then solve the equation using the subtraction property of equality

381. 

382. 

Solve Equations using the Subtraction Property of Equality

In the following exercises, solve each equation using the subtraction property of equality.

383. c + 8 = 14
384. v + 8 = 150
385. 23 = x + 12
386. 376 = n + 265

Solve Equations using the Addition Property of Equality

In the following exercises, solve each equation using the addition property of equality.

387. y − 7 = 16
388. k − 42 = 113
389. 19 = p − 15
390. 501 = u − 399

Translate English Sentences to Algebraic Equations

In the following exercises, translate each English sentence into an algebraic equation.

391. The sum of 7 and 33 is equal to 40.

392. The difference of 15 and 3 is equal to 12.
393. The product of 4 and 8 is equal to 32.
394. The quotient of 63 and 9 is equal to 7.
395. Twice the difference of n and 3 gives 76.
396. The sum of five times y and 4 is 89.

Translate to an Equation and Solve

In the following exercises, translate each English sentence into an algebraic equation and then solve it.

397. Eight more than x is equal to 35.
398. 21 less than a is 11.
399. The difference of q and 18 is 57.
400. The sum of m and 125 is 240.

Mixed Practice

In the following exercises, solve each equation.

401. $h - 15 = 27$
402. $k - 11 = 34$
403. $z + 52 = 85$
404. $x + 93 = 114$
405. $27 = q + 19$
406. $38 = p + 19$
407. $31 = v - 25$
408. $38 = u - 16$

2.4 - Find Multiples and Factors

Identify Multiples of Numbers

In the following exercises, list all the multiples less than 50 for each of the following.

409. 3
410. 2
411. 8
412. 10

Use Common Divisibility Tests

In the following exercises, using the divisibility tests, determine whether each number is divisible by 2, by 3, by 5, by 6, and by 10.

413. 96
414. 250
415. 420
416. 625

Find All the Factors of a Number

In the following exercises, find all the factors of each number.

417. 30
418. 70
419. 180
420. 378

Identify Prime and Composite Numbers

In the following exercises, identify each number as prime or composite.

421. 19
422. 51

423. 121

2.5 - Prime Factorization and the Least Common Multiple

Find the Prime Factorization of a Composite Number

In the following exercises, find the prime factorization of each number.

425. 84
426. 165
427. 350
428. 572

Find the Least Common Multiple of Two Numbers

In the following exercises, find the least common multiple of each pair of numbers.

429. 9, 15
430. 12, 20
431. 25, 35
432. 18, 40

Everyday Math

433. Describe how you have used two topics from The Language of Algebra chapter in your life outside of your math class during the past month.

PRACTICE TEST

In the following exercises, translate from an algebraic equation to English phrases.

434. $6 \cdot 4$
435. $15 - x$

In the following exercises, identify each as an expression or equation.

436. $5 \cdot 8 + 10$
437. $x + 6 = 9$
438. $3 \cdot 11 = 33$
439. (a) Write $n \cdot n \cdot n \cdot n \cdot n \cdot n$ in exponential form. (b) Write 3^5 in expanded form and then simplify.

In the following exercises, simplify, using the order of operations.

440. $4 + 3 \cdot 5$
441. $(8 + 1) \cdot 4$
442. $1 + 6(3 - 1)$
443. $(8 + 4) \div 3 + 1$
444. $(1 + 4)^2$
445. $5[2 + 7(9 - 8)]$

In the following exercises, evaluate each expression.

446. $8x - 3$ when $x = 4$
447. y^3 when $y = 5$
448. $6a - 2b$ when $a = 5, b = 7$
449. hw when $h = 12, w = 3$
450. Simplify by combining like terms.
    a. $6x + 8x$
    b. $9m + 10 + m + 3$

In the following exercises, translate each phrase into an algebraic expression.

451. 5 more than x

452. the quotient of 12 and y
453. three times the difference of a and b
454. Caroline has 3 fewer earrings on her left ear than on her right ear. Call the number of earrings on her right ear, r. Write an expression for the number of earrings on her left ear.

In the following exercises, solve each equation.

455. n − 6 = 25
456. x + 58 = 71

In the following exercises, translate each English sentence into an algebraic equation and then solve it.

457. 15 less than y is 32.
458. the sum of a and 129 is 164.
459. List all the multiples of 4, that are less than 50.
460. Find all the factors of 90.
461. Find the prime factorization of 1080.
462. Find the LCM (Least Common Multiple) of 24 and 40.

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10.S: Introduction to the Language of Algebra (Summary)

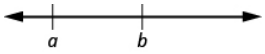
Key Terms

coefficient	The constant that multiplies the variable(s) in a term.
composite number	A composite number is a counting number that is not prime.
divisibility	If a number m is a multiple of n, then we say that m is divisible by n.
equation	An equation is made up of two expressions connected by an equal sign.
evaluate	To evaluate an algebraic expression means to find the value of the expression when the variable is replaced by a given number.
expression	An expression is a number, a variable, or a combination of numbers and variables and operation symbols.
least common multiple (LCM)	The smallest number that is a multiple of two numbers.
like terms	Terms that are either constants or have the same variables with the same exponents.
multiple of a number	A number is a multiple of n if it is the product of a counting number and n.
prime factorization	The product of prime numbers that equals the number.
prime number	A counting number greater than 1 whose only factors are 1 and itself.
solution of an equation	A value of a variable that makes a true statement when substituted into the equation. The process of finding the solution to an equation is called solving the equation.
term	A constant or the product of a constant and one or more variables.

Key Concepts

2.1 - Use the Language of Algebra

Operation	Notation	Say:	The result is…
Addition	a + b	a plus b	The sum of a and b
Multiplication	a • b, (a)(b), (a)b, a(b)	a times b	The product of a and b
Subtraction	a - b	a minus b	The difference of a and b
Division	a ÷ b, a / b, $\frac{a}{b}$, $b\overline{)a}$	a divided by b	The quotient of a and b

- **Equality Symbol**
  - a = b is read as a is equal to b
  - The symbol = is called the equal sign.
- **Inequality**
  - a < b is read a is less than b
  - a is to the left of b on the number line: 

  - a > b is read a is greater than b

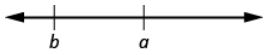
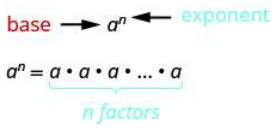
- a is to the right of b on the number line: 

Table 2.77

Algebraic Notation	Say
a = b	a is equal to b
a ≠ b	a is not equal to b
a < b	a is less than b
a > b	a is greater than b
a ≤ b	a is less than or equal to b
a ≥ b	a is greater than or equal to b

- **Exponential Notation**
  - For any expression a n is a factor multiplied by itself n times, if n is a positive integer.
  - a^n means multiply n factors of a
  - The expression of a^n is read a to the nth power



- **Order of Operations**: When simplifying mathematical expressions perform the operations in the following order:

1. Parentheses and other Grouping Symbols: Simplify all expressions inside the parentheses or other grouping symbols, working on the innermost parentheses first.
2. Exponents: Simplify all expressions with exponents.
3. Multiplication and Division: Perform all multiplication and division in order from left to right. These operations have equal priority.
4. Addition and Subtraction: Perform all addition and subtraction in order from left to right. These operations have equal priority.

2.2 - Evaluate, Simplify, and Translate Expressions

- **Combine like terms**.

1. Identify like terms.
2. Rearrange the expression so like terms are together.
3. Add the coefficients of the like terms

2.3 - Solving Equations Using the Subtraction and Addition Properties of Equality

- **Determine whether a number is a solution to an equation.**

1. Substitute the number for the variable in the equation.
2. Simplify the expressions on both sides of the equation.
3. Determine whether the resulting equation is true. If it is true, the number is a solution. If it is not true, the number is not a solution.

- **Subtraction Property of Equality**
  - For any numbers a, b, and c, if a = b, then a - c = b - c.
- Solve an equation using the Subtraction Property of Equality.

1. Use the Subtraction Property of Equality to isolate the variable.
2. Simplify the expressions on both sides of the equation.
3. Check the solution.

- **Addition Property of Equality**

- For any numbers a, b, and c, if a = b, then a + c = b + c.

- Solve an equation using the Addition Property of Equality.

1. Use the Addition Property of Equality to isolate the variable.
2. Simplify the expressions on both sides of the equation.
3. Check the solution.

2.4 - Find Multiples and Factors

Divisibility Tests	
A number is divisible by	
2	if the last digit is 0, 2, 4, 6, or 8
3	if the sum of the digits is divisible by 3
5	if the last digit is 5 or 0
6	if divisible by both 2 and 3
10	if the last digit is 0

- **Factors:** If a • b = m, then a and b are factors of m, and m is the product of a and b.
- **Find all the factors of a counting number.**

1. Divide the number by each of the counting numbers, in order, until the quotient is smaller than the divisor.
   a. If the quotient is a counting number, the divisor and quotient are a pair of factors.
   b. If the quotient is not a counting number, the divisor is not a factor.
2. List all the factor pairs.
3. Write all the factors in order from smallest to largest.

- **Determine if a number is prime**.

1. Test each of the primes, in order, to see if it is a factor of the number.
2. Start with 2 and stop when the quotient is smaller than the divisor or when a prime factor is found.
3. If the number has a prime factor, then it is a composite number. If it has no prime factors, then the number is prime.

2.5 - Prime Factorization and the Least Common Multiple

- **Find the prime factorization of a composite number using the tree method**.

1. Find any factor pair of the given number, and use these numbers to create two branches.
2. If a factor is prime, that branch is complete. Circle the prime.
3. If a factor is not prime, write it as the product of a factor pair and continue the process.
4. Write the composite number as the product of all the circled primes.

- **Find the prime factorization of a composite number using the ladder method**.

1. Divide the number by the smallest prime.
2. Continue dividing by that prime until it no longer divides evenly.
3. Divide by the next prime until it no longer divides evenly.
4. Continue until the quotient is a prime.
5. Write the composite number as the product of all the primes on the sides and top of the ladder.

- **Find the LCM by listing multiples**

1. List the first several multiples of each number.
2. Look for multiples common to both lists. If there are no common multiples in the lists, write out additional multiples for each number.
3. Look for the smallest number that is common to both lists.
4. This number is the LCM.

- **Find the LCM using the prime factors method**.

1. Find the prime factorization of each number.
2. Write each number as a product of primes, matching primes vertically when possible.
3. Bring down the primes in each column.
4. Multiply the factors to get the LCM.

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00: Front Matter

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Lake Tahoe Community College
Support Course for Elementary Statistics

Larry Green

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11.1.1: Comparing Fractions, Decimals, and Percents

Learning Outcomes

1. Compare two fractions
2. Compare two numbers given in different forms

In this section, we will go over techniques to compare two numbers. These numbers could be presented as fractions, decimals or percents and may not be in the same form. For example, when we look at a histogram, we can compute the fraction of the group that occurs the most frequently. We might be interested in whether that fraction is greater than 25% of the population. By the end of this section we will know how to make this comparison.

Comparing Two Fractions

Whether you like fractions or not, they come up frequently in statistics. For example, a probability is defined as the number of ways a sought after event can occur over the total number of possible outcomes. It is commonly asked to compare two such probabilities to see if they are equal, and if not, which is larger. There are two main approaches to comparing fractions.

Approach 1: Change the fractions to equivalent fractions with a common denominator and then compare the numerators

The procedure of approach 1 is to first find the common denominator and then multiply the numerator and the denominator by the same whole number to make the denominators common.

Example 11.1.1.1

Compare: $\frac{2}{3}$ and $\frac{5}{7}$

Solution

A common denominator is the product of the two: $3 \times 7 = 21$. We convert:

$$\frac{2}{3}\frac{7}{7} = \frac{14}{21}$$

and

$$\frac{5}{7}\frac{3}{3} = \frac{15}{21}$$

Next we compare the numerators and see that $14 < 15$, hence

$\frac{2}{3} < \frac{5}{7}$

Example 11.1.1.2

In statistics, we say that two events are independent if the probability of the second occurring is equal to the probability of the second occurring given that the first occurs. The probability of rolling two dice and having the sum equal to 7 is $\frac{6}{36}$. If you know that the first die lands on a 4, then the probability that the sum of the two dice is a 7 is $\frac{1}{6}$. Are these events independent?

Solution

We need to compare $\frac{6}{36}$ and $\frac{1}{6}$. The common denominator is 36. We convert the second fraction to

$$\frac{1}{6}\frac{6}{6} = \frac{6}{36}$$

Now we can see that the two fractions are equal, so the events are independent.

Approach 2: Use a calculator or computer to convert the fractions to decimals and then compare the decimals

If it is easy to build up the fractions so that we have a common denominator, then Approach 1 works well, but often the fractions are not simple, so it is easier to make use of the calculator or computer.

Example 11.1.1.3

In computing probabilities for a uniform distribution, fractions come up. Given that the number of ounces in a medium sized drink is uniformly distributed between 15 and 26 ounces, the probability that a randomly selected medium sized drink is less than 22 ounces is $\frac{7}{11}$. Given that the weight of in a medium sized American is uniformly distributed between 155 and 212 pounds, the probability that a randomly selected medium sized American is less than 195 pounds is $\frac{40}{57}$. Is it more likely to select a medium sized drink that is less than 22 ounces or to select a medium sized American who is less than 195 pounds?

Solution

We could get a common denominator and build the fractions, but it is much easier to just turn both fractions into decimal numbers and then compare. We have:

$$\frac{7}{11} \approx 0.6364$$

and

$$\frac{40}{57} \approx 0.7018$$

Notice that

$$0.6364 < 0.7018$$

Hence, we can conclude that it is less likely to pick the medium sized 22 ounce or less drink than to pick the 195 pound or lighter medium sized person.

Exercise

If you guess on 10 true or false questions, the probability of getting at least 9 correct is $\frac{11}{1024}$. If you guess on six multiple choice questions with three choices each, then the probability of getting at least five of the six correct is $\frac{7}{729}$. Which of these is more likely?

Comparing Fractions, Decimals and Percents

When you want to compare a fraction to a decimal or a percent, it is usually easiest to convert to a decimal number first, and then compare the decimal numbers.

Example 11.1.1.4

Compare 0.52 and $\frac{7}{13}$.

Solution

We first convert $\frac{7}{13}$ to a decimal by dividing to get 0.5385. Now notice that

$$0.52 < 0.5385$$

Thus

$$0.52 < \frac{7}{13}$$

Example 11.1.1.5

When we preform a hypothesis test in statistics, We have to compare a number called the p-value to another number called the level of significance. Suppose that the p-value is calculated as 0.0641 and the level of significance is 5%. Compare these two numbers.

Solution

We first convert the level of significance, 5%, to a decimal number. Recall that to convert a percent to a decimal, we move the decimal over two places to the right. This gives us 0.05. Now we can compare the two decimals:

$$0.0641 > 0.05$$

Therefore, the p-value is greater than the level of significance.



This is an application of comparing fractions to probability.

- Example: Comparing Fractions with Different Denominators using Inequality Symbols
- Ex: Compare Fractions and Decimals using Inequality Symbols
- https://youtu.be/lSzNkQjcfEU

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11.1.2: Converting Between Fractions, Decimals and Percents

Learning Outcomes

1. Given a decimal, convert it to a percent
2. Given a percent, convert it to a decimal
3. Convert a fraction to a decimal and percent

In this section, we will convert from decimals to percents and back. We will also start with a fraction and convert it to a decimal and a percent. In statistics we are often given a number as a percent and have to do calculations on it. To do so, we must first convert it to a percent. Also, the computer or calculator shows numbers as decimals, but for presentations, percents are friendlier. It is also much easier to compare decimals than fractions, thus converting to a decimal is helpful.

For example, we often want to see if a probability is greater than 5%. A computer will display the probability as a decimal such as 0.04836. To make the comparison we will first change it to a percent and then compare it to 5%.

Transforming a Decimal to a Percent

We have all heard of percents before. "You only have a 20% chance of winning the game", "Just 38% of all Americans approve of Congress", and "I am 95% confident that my answer is correct" are just a few of the countless examples of percents as they come up in statistics.

Defintion: Percent

Percent means Parts Per Hundred

Thus if we are given a decimal and want to convert it to a percent, we multiply the decimal by 100. In practice, this means we move the decimal point two places to the right.

Example 11.1.2.1

Convert the number 0.1738 to a percent.

Solution

We move the decimal over two to the right as shown below.



We get: 17.38% for the answer.

Example 11.1.2.2

Convert 0.7 to a percent.

Solution

We want to move the decimal two places to the right, but there is only one digit to the right of the decimal place. The good news is that we can always add a 0 to the right of the last digit. We write:

$$0.7 = 0.70$$

Now move the decimal place two digits to the right to get 70%.

Example 11.1.2.3

In regression analysis, an important number that is calculated is called R-Squared. It helps us determine how helpful one variable is in predicting another variable. The computer and calculator always display it as a decimal, but it is more meaningful

as a percent. Suppose that the R-Squared value that relates the amount of studying students do to prepare for a final exam and the score on the exam is: $r^2 = 0.8971$. Convert this to a percent rounded to the nearest whole number percent.

Solution

We move the decimal 0.8971 two places to the right to get 89.71%

Now round to the nearest whole number percent. Note that the digit to the left of the whole number is $7 \geq 5$. Thus we add 1 to the whole number, 89. This gives us 90%.

Exercise

A standard goal in statistics is to come up with a range of values that a population proportion is likely to lie. This range is called a confidence interval. Suppose that we want to interpret a confidence interval for the percent of patients who experience side effects from an experimental cancer treatment. The computer calculates it as the decimal range: [0.023,0.029]. What is the likely range for the percent of patients who experience side effects from the experimental cancer treatment?

Transforming a Percent to a Decimal

To convert a decimal to a percent, we multiply the decimal by 100 which is equivalent to moving the decimal two places to the right. Not surprisingly, to convert a percent to a decimal, we do exactly the opposite. We divide the number by 100 which is equivalent to moving the decimal two places to the left.

Example 11.1.2.4

Convert the percent 89.4% to a decimal.

Solution

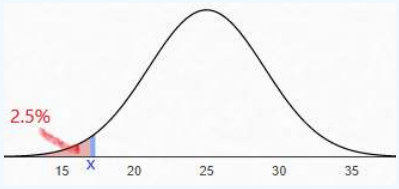
We move the decimal over two to the left as shown below.



We get: 0.894 for the answer.

Example 11.1.2.5

Suppose that you want to find the value of x such that 2.5% of the entire area under the Normal curve lies to the left of x. The first step will be to convert the 2.5% to a decimal. What decimal is equivalent to 2.5%?



Solution

We want to move the decimal 2.5 two places to the left, but since there is only one digit to the left of the decimal, we add a zero first: 02.5. Now move the decimal two places to the left to get 0.025.

Converting a Fraction to a Decimal and a Percent

Often in probability it is natural to represent probabilities as fractions, but it is easier to make comparisons as decimals. Thus, we need to be able to convert fractions to decimals. To do so we just divide.

Example 11.1.2.6

Convert the fraction $\frac{4}{7}$ to a decimal, rounding to the nearest hundredth.

Solution

We use long division:

$$\begin{array}{r} .571 \\ \hline 7)4.000 \\ \underline{35} \\ 50 \\ \underline{49} \\ 10 \end{array} \tag{11.1.2.1}$$

Next round to the nearest hundredth to get 0.57.

Although everyone's favorite thing to do is to perform long division by hand, in most statistics classes you will have a calculator or computer to use. Thus you just have to remember to perform the division with the calculator or computer and then round.

Example 11.1.2.7

In statistics we need to find basic probabilities and create a table for them. Suppose that you roll two six-sided dice, what percent of the time will the sum equal to a 4? Round to the nearest whole number percent.

Solution

First, notice that there are 36 total possibilities for rolling the dice, since there are 6 faces on the first die and for each value of the first die roll, there are 6 possibilities for the second die roll. Multiplying: 6 x 6 = 36. This will be the denominator. To find the numerator, we list all the possible outcome where the sum is 4:

(1,3), (2,2), and (3,1)

There are three possible outcomes with the sum equaling a 4. Thus:

$$P(\text{sum} = 4) = 3/36$$

Now we divide:

$$\frac{3}{36} = 0.08333...$$

Next to convert this decimal to a percent, we move the decimal two places to the right to get: 8.333...%

We are asked to round to the nearest whole number percent. The digit to the right or the whole number (8) is a 3. Since 3 < 5, we can just erase everything to the left of the 8 and leave the 8 unchanged to get 8%. Thus there is an 8% chance of getting a sum of 4 if you roll two six sided dice.

- Convert Percentages to Decimals
- Relating Fractions, Decimals, and Percents
- Statistics Application of Converting Decimals to Percents

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11.1.3: Decimals- Rounding and Scientific Notation

Learning Outcomes

1. Understand what it means to have a number rounded to a certain number of decimal places.
2. Round a number to a fixed number of digits.
3. Convert from scientific notation to decimal notation and back.

In this section, we will go over how to round decimals to the nearest whole number, nearest tenth, nearest hundredth, etc. In most statistics applications that you will encounter, the numbers will not come out evenly, and you will need to round the decimal. We will also look at how to read scientific notation. A very common error that statistics students make is not noticing that the calculator is giving an answer in scientific notation.

For example, suppose that you used a calculator to find the probability that a randomly selected day in July will have a high temperature of over 90 degrees. Your calculator gives the answer: 0.4987230156. This is far too many digits for practical use, so it makes sense to round to just a few digits. By the end of this section you will be able to perform the rounding that is necessary to make unmanageable numbers manageable.

Brief Review of Decimal Language

Consider the decimal number: 62.5739. There is a defined way to refer to each of the digits.

- The digit 6 is in the "Tens Place"
- The digit 2 is in the "Ones Place"
- The digit 5 is in the "Tenths Place"
- The digit 7 is in the "Hundredths Place"
- The digit 3 is in the "Thousandths Place"
- The digit 9 is in the "Ten-thousandths Place"
- We also say that 62 is the "Whole Number" part.



Keeping this example in mind will help you when you are asked to round to a specific place value.

Example 11.1.3.1

It is reported that the mean number of classes that college students take each semester is 3.2541. Then the digit in the *hundredths place* is 5.

Rules of Rounding

Now that we have reviewed place values of numbers, we are ready to go over the process of rounding to a specified place value. When asked to round to a specified place value, the answer will erase all the digits after the specified digit. The process to deal with the other digits is best shown by examples.

Example 11.1.3.2: Case 1 - The Test Digit is Less Than 5

Round 3.741 to the nearest tenth.

Solution



Since the test digit (4) is less than 5, we just erase everything to the right of the tenths digit, 7. The answer is: 3.7.

Example 11.1.3.3: Case 2 - The Test Digit is 5 or Greater

Round 8.53792 to the nearest hundredth.

Solution



Since the test digit (6) is 5 or greater, we add one to the hundredths digit and erase everything to the right of the hundredths digit, 3. Thus the 3 becomes a 4. The answer is: 8.54.

Example 11.1.3.4: Case 3 - The Test Digit is 5 or Greater and the rounding position digit is a 9

Round 0.014952 to four decimal places.

Solution



The test digit is 5, so we must round up. The rounding position is a 9 and adding 1 gives 10, which is not a single digit number. Instead look at the two digits to the left of the test digit: 49. If we add 1 to 49, we get 50. Thus the answer is 0.0150.

Applications

Rounding is used in most areas of statistics, since the calculator or computer will produce numerical answers with far more digits than are useful. If you are not told how many decimal places to round to, then you often want to think about the smallest number of decimals to keep so that no important information is lost. For example suppose you conducted a sample to find the proportion of college students who receive financial aid and the calculator presented 0.568429314. You could turn this into a percent at 56.8429314%. There are no applications where keeping this many decimal places is useful. If, for example, you wanted to present this finding to the student government, you might want to round to the nearest whole number. In this case the ones digit is 6 and the test digit is 8. Since $8 \geq 5$, you add 1 to the ones digit. You can tell the student government that 57% of all college students receive financial aid.

Example 11.1.3.5

Suppose that you found out that the probability that a randomly selected person with who has misused prescription opioids will transition to heroin is 0.04998713. Round this number to four decimal places.

Solution

The first four decimal places are 0.0499 and the test digit is 8. Since $8 \geq 5$, we would like to add 1 to the fourth digit. Since this is a 9, we go to the next digit to the left. This is also a 9, so we go to the next one which is a 4. We can think of adding 0499 +

1 = 0500. Thus the answer is 0.0500. Note that we keep the last two 0's after the 5 to emphasize that this is accurate to the fourth decimal place.

Rounding and Arithmetic

Many times, we have to do arithmetic on numbers with several decimal places and want the answer rounded to a smaller number of decimal places. One question you might ask is should you round before you perform the arithmetic or after. For the most accurate result, you should always round after you preform the arithmetic if possible.

> *When asked to do arithmetic and present you answer rounded to a fixed number of decimal places, only round after performing the arithmetic.*

Example 11.1.3.6

Suppose you pick three cards from a 52 card deck with replacement and want to find the probability of the event, A, that none of the three cards will be a 2 through 7 of hearts. This probability is:

$$P(A) = (0.8846)^3$$

Round the answer to 2 decimal places.

Solution

Note that we have to first perform the arithmetic. With a computer or calculator we get:

$$0.8846^3 = 0.69221467973$$

Now we round to two decimal places. Notice that the hundredths digit is a 9 and the test digit is a 2. Thus the 9 remains unchanged and everything to the right of the 9 goes away. the result is

$$P(A) \approx 0.69$$

If we mistakenly rounded 0.8846 to two decimal places (0.88) and then cubed the answer we would have gotten 0.68 which is not the correct answer.

Scientific Notation

When a calculator presents a number in scientific notation, we must pay attention to what this represents. The standard way of writing a number in scientific notation is writing the number as a product of a number greater than or equal 1 but less than 10 followed by a power of 10. For example:

$$602,000,000,000,000,000,000,000 = 6.02 \times 10^{23}$$

The main purpose of scientific notation is to allow us to write very large numbers or numbers very close to 0 without having to use so many digits. Most calculators and computers use a different notation for scientific notation, most likely because the superscript is difficult to render on a screen. For example, with a calculator:

$$0.00000032 = 3.2E-7$$

Notice that to arrive at 3.2, the decimal needed to be moved 7 places to the right.

Example 11.1.3.7

A calculator displays:

$$2.0541E6$$

Write this number in decimal form.

Solution

Notice that the number following E is 6. This means move the decimal over 6 places to the right. The first 4 moves is natural, but for the last 2 moves, there are no numbers to move the decimal place past. We can always add extra zeros after the last

number to the right of the decimal place:

$$2.0541E6 = 2.054100E6$$

Now we can move the decimal place to the right 6 places to get

$$2.0541E6 = 2.054100E6 = 2,054,100$$

Example 11.1.3.8

If you use a calculator or computer to find the probability of flipping a coin 27 times and getting all heads, then it will display:

$$7.45E-9$$

Write this number in decimal form.

Solution

Many students will forget to look for the "E" and just write that the probability is 7.45, but probabilities can never be bigger than 1. You can not have a 745% chance of it occurring. Notice that the number following E is −9. Since the power is negative, this means move the decimal to the left, and in particular 9 places to the left. There is only one digit to the left of the decimal place, so we need to insert 8 zeros:

$$7.45E-9 = 000000007.45E-9$$

Now we can move the decimal place to the right 9 places to the left to get

$$7.45E-9 = 000000007.45E-9 = 0.00000000745$$

- Application of Rounding Decimal Numbers
- Here is a video that explains rounding.

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11.1.4: Using Fractions, Decimals and Percents to Describe Charts

Learning Outcomes

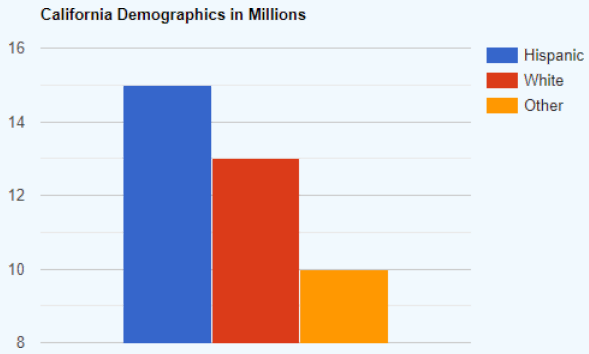
1. Interpret bar charts using fractions, decimals and percents
2. Interpret pie charts using fractions, decimals and percents

Charts, such as bar charts and pie charts are visual ways of presenting data. You can think of each slice of the pie or each bar as a part of the whole. The numerical versions of this are a list of fractions, decimals and percents. By the end of this section we will be able to look at one of these charts and produce the corresponding fractions, decimals, and percents.

Reading a Bar Chart

Bar charts occur frequently and it is definitely required to understand how to read them and interpret them in statistics. Often we want to convert the information of a bar chart to information shown numerically. We need fractions and/or percents to do this.

Example 11.1.4.1



The above bar chart shows the demographics of California in 2019 where the numbers represent millions of people. Here are some questions that might come up in a statistics class.

A. What fraction of Californians was Hispanic in 2019?
B. What proportion of all Californians was White in 2019? Write your answer as a decimal number rounded to four decimal places.
C. What percent of Californians who were neither Hispanic nor White in 2019? Round your answer to the nearest percent.

Solution

A. To find the fraction of California that was Hispanic in 2019, the numerator will be the total number of Hispanics and the denominator will be the total number of people in California in 2019. The height of the bar that represents Hispanics is 15. Therefore the numerator is 15. To find the total number of people in California, we add up the heights of the three bars:

$$15+13+10 = 38$$

Now we can just write down the fraction:

$$\frac{15}{38}$$

To find the proportion of Californians who were White in 2019, we start in the same way. The numerator will be the number of Whites: 13. The denominator will be the total number of Californians which we already computed as 38. Therefore the fraction of Californians who were White is:

$$\frac{13}{38}$$

To convert this to a decimal, we use a calculator to get:

$$\frac{13}{38} \approx 0.342105$$

Next round to four decimal places. Since the digit to the right of the fourth decimal place is $0 < 5$, we round down to:

$$0.3421$$

B. To find the percent of Californians who were neither Hispanic nor White in 2019, we first find the fraction who were neither. The numerator will be the number of "Other" which is: 10. The denominator will be the total which is 38. Thus the fraction is:

$$\frac{10}{38}$$

Next, use a calculator to divide these numbers to get:

$$\frac{10}{38} \approx 0.263158$$

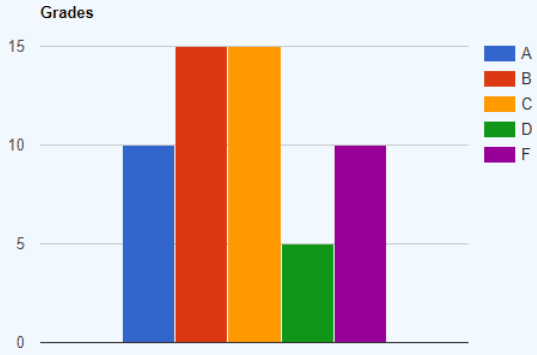
To convert this to a percent we multiply by 100% by moving the decimal two places to the right:

$$0.263158 \times 100\% = 26.3158\%$$

Finally we round to the nearest whole number. Noting that $3 < 5$, we round down to get: 26%

Exercise

The bar chart below shows the grade distribution for a math class.



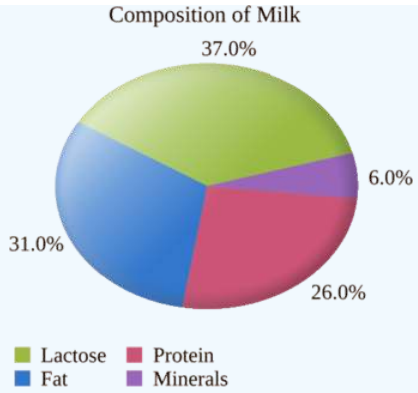
A. Find the fraction of students who received a "C" grade.
B. Find the proportion of grades below a "C". Write your answer as a decimal number rounded to the nearest hundredth.
C. What percent of the students received an "A" grade? Round your answer to the nearest whole number percent.

Reading a Pie Chart

Another important chart that is used to display the components of a whole is a pie chart. With a pie chart, it is very easy to determine the percent of each item.

Example 11.1.4.2

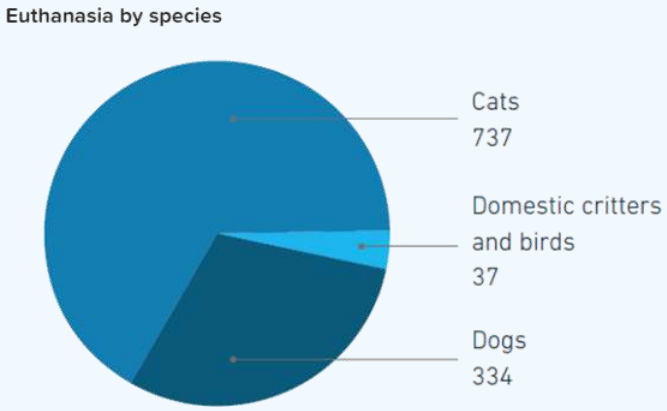
The pie chart below shows the makeup of milk. Write the proportion of fat contained in milk as a decimal.



Solution

We see that 31% of milk is fat. To convert a percent to a decimal, we just move the decimal over two places to the left. Thus, 31% becomes 0.31.

Example 11.1.4.3



The pie chart above shows the number of pets of each type that had to be euthanized by the humane society due to incurable illnesses.

A. What fraction of the euthanized pets were dogs?
B. What percent of the euthanized pets were cats? Round to the nearest whole number percent.

Solution

A. We take the number of dogs over the total. There were 334 euthanized dogs. To find the total we add:

$$737 + 37 + 334 = 1108$$

Therefore, the fraction of euthanized dogs is

$$\frac{334}{1108}$$

B. To find the percent of euthanized cats, we first find the fraction. There were 737 cats over a total of 1108 pets. The fraction is

$$\frac{737}{1108}$$

Next use a calculator to get the decimal number: 0.66516. Now multiply by 100% by moving the decimal place two digits to the right to get: 66.516%. Finally, we need to round to the nearest whole number percent. Since $5 \geq 5$, we round up.

> Thus the percent of euthanized cats is 67%.

- Finding Fractions, Decimals and Percents from a Bar Chart
- Ex: Find the a Percent of a Total Using an Amount in Pie Chart

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SECTION OVERVIEW

11.2: The Number Line

11.2.1: Distance between Two Points on a Number Line

11.2.2: Plotting Points and Intervals on the Number Line

11.2.3: Represent an Inequality as an Interval on a Number Line

11.2.4: The Midpoint

Thumbnail: Demonstration the addition on the line number. Image used with permission (CC BY 3.0 unported; Stephan Kulla).

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11.2.1: Distance between Two Points on a Number Line

Learning Outcomes

1. Calculate the distance between two points on a number line when both are non-negative.
2. Calculate the distance between two points on a number line when at least one is negative.

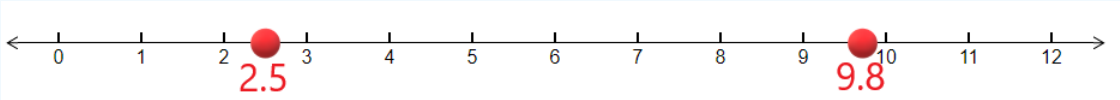
The number line is the main visual base in statistics and we often want to look at two points on the number line and determine the distance between them. This is used to find the base of a rectangle or another figure that lies above the number line. By the end of this section, you will be able to determine the distance between any two points on a number line that comes from a statistics application.

Finding the Distance Between Two Points with Positive Coordinates on a Number Line

The key to finding the distance between two points is to remember that the geometric definition of subtraction is the distance between the two numbers as long as we subtract the smaller number from the larger.

Example 11.2.1.1

Find the distance between the points 2.5 and 9.8 as shown below on the number line.



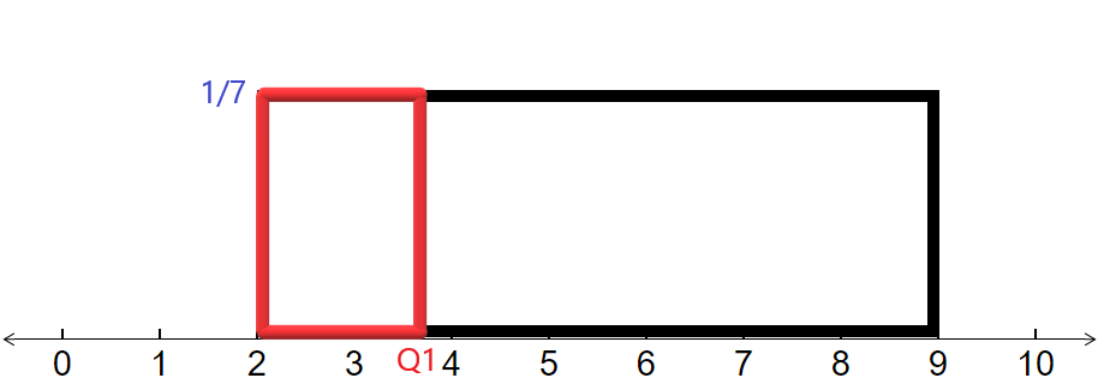
Solution

To find the distance, we just subtract:

$$9.8 - 2.5 = 7.3$$

Example 11.2.1.2

When finding probabilities involving a uniform distribution, we have to find the base of a rectangle that lies on a number line. Find the base of the rectangle shown below that represents a uniform distribution from 2 to 9.



Solution

We just subtract:

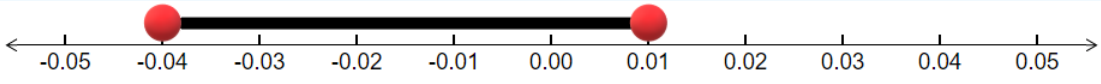
$$9 - 2 = 7$$

Finding the Distance Between Two Points on a Number Line When the Coordinates Are Not Both Positive

In statistics, it is common to have points on a number line where the points are not both positive and we need to find the distance between them.

Example 11.2.1.3

The diagram below shows the confidence interval for the difference between the proportion of men who are planning on going into the health care profession and the proportion of women. What is the width of the confidence interval?



Solution

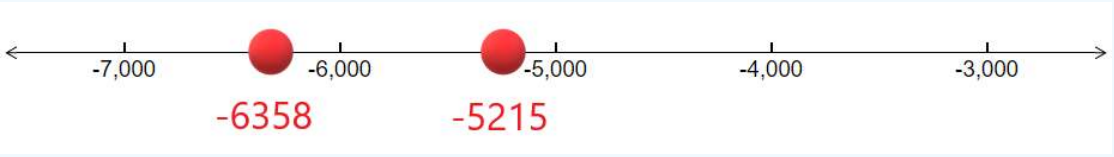
Whenever we want want to find the distance between two numbers, we always subtract. Recall that subtracting a negative number is adding.

$$0.01 - (-0.04) = 0.01 + 0.04 = 0.05$$

Therefore the width of the confidence interval is 0.05.

Example 11.2.1.4

The mean value of credit card accounts is -6358 dollars. A study was done of recent college graduates and found their mean value for their credit card accounts was -5215 dollars. The number line below shows this situation. How far apart are these values?



Solution

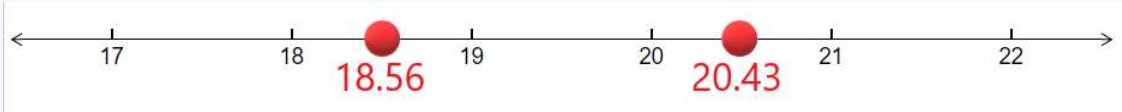
We subtract the two numbers and recall that when we subtract two negative numbers when we are looking at the right minus the left, we make them positive and subtract the positive numbers.

$$-5215 - (-6358) = 6358 - 5215 = 1143$$

Thus the mean credit card balances are $1143 apart.

Exercise

In statistics, we are asked to find a z-score, which tells us how unusual an event is. The first step in finding a z-score is to calculate the distance a value is from the mean. The number line below depicts the mean of 18.56 and the value of 20.43. Find the distance between these two points.



- Finding the Distance Between Points on a Number Line
- Integer Subtracton Using the Number Line

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11.2.2: Plotting Points and Intervals on the Number Line

Learning Outcomes

1. Plot a point on the number line
2. Plot an interval on the number line

The number line is of fundamental importance and is used repeatedly in statistics. It is a tool to visualize all of the possible outcomes of a study and to organize the results of the study. Often a diagram is placed above the number line to provide us with a picture of the results. By the end of this section, you will be able to plot points and intervals on a number line and use these plots to understand the possible outcomes and actual outcomes of studies.

Drawing Points on a Number Line

A number line is just a horizontal line that is used to display all the possible outcomes. It is similar to a ruler in that it helps us describe and compare numbers. Similar to a ruler that can be marked with many different scales such as inches or centimeters, we get to choose the scale of the number line and where the center is.

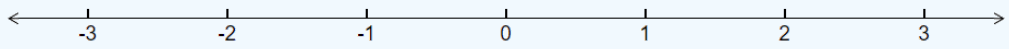
Example 11.2.2.1

The standard normal distribution is plotted above a number line. The most important values are the integers between -3 and 3. The number 0 is both the mean (average) and median (center).

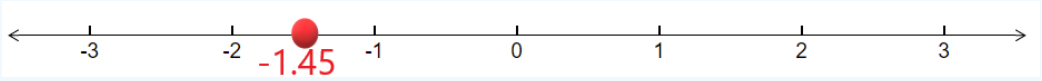
1. Plot the number line that best displays this information.
2. Plot the value -1.45 on this number line.

Solution

1. We sketch a line, mark 0 as the center, and label the numbers -3, -2, -1, 0, 1, 2, 3 from left to right.



2. To plot the point -1.45, we first have to understand that this number is between -1 and -2. It is close to half way between -1 and -2. We put a circle on the number line that is close to halfway between these values as shown below.

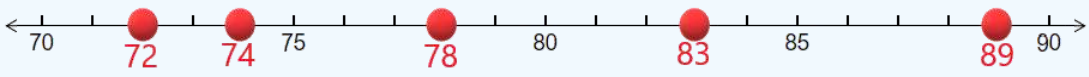


Example 11.2.2.2

When working with box plots, we need to first set up a number line that labels what is called the five point summary: Minimum, First Quartile, Median, Third Quartile, and Maximum. Suppose the five point summary for height in inches for a basketball team is: 72,74,78,83,89. Plot these points on a number line

Solution

When plotting points on a number line, we first have to decide what range of the line we want to show in order to best display the points that appear. Technically all numbers are on every number line, but that does not mean we show all numbers. In this example, the numbers are all between 70 and 90, so we certainly don't need to display the number 0. A good idea is to let 70 be on the far left and 90 be on the far right and then plot the points between them. We also have to decide on the spacing of the tick marks. Since the range from 70 to 90 is 20, this may be too many numbers to display. Instead we might want to count by 5's. Below is the number line that shows the numbers 70 to 90 and counts by 5's. The five point summary is plotted on this line.



Exercise

A histogram will be drawn to display the annual income that experienced registered nurses make. The boundaries of the bars of the histogram are: $81,000, $108,000, $135,000, $162,000, and $189,000. Plot these points on a number line.

Plotting an Interval on a Number Line

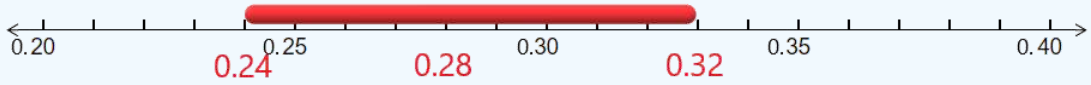
Often in statistics, instead of just having to plot a few points on a number line, we need to instead plot a whole interval on the number line. This is especially useful when we want to exhibit a range of values between two numbers, to the left of a number or to the right of a number.

Example 11.2.2.3

A 95% confidence interval for the proportion of Americans who work on weekends is found to be 0.24 to 0.32, with the center at 0.28. Use a number line to display this information.

Solution

We just draw a number line, include the three key numbers: 0.24, 0.32, and 0.28 and highlight the part of the interval between 0.23 and 0.31.

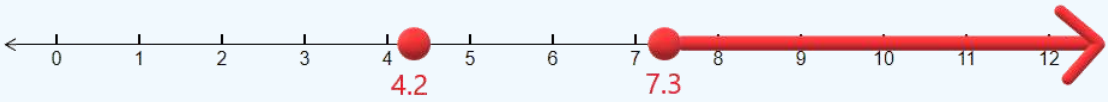


Example 11.2.2.4: rejection region

In Hypothesis testing, we sketch something called the rejection region which is an interval that goes off to infinity or to negative infinity. Suppose that the mean number of hours to work on the week's homework is 4.2. The rejection region for the hypothesis test is all numbers larger than 7.3 hours. Plot the mean and sketch the rejection region on a number line.

Solution

We plot the point 4.2 on the number line and shade everything to the right of 7.3 on the number line.



- Plot Integers on the Number Line
- Intervals: Given an Inequality, Graph the Interval and State Using Interval Notation
- Plotting Points on a Number Line Application

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11.2.3: Represent an Inequality as an Interval on a Number Line

Learning Outcomes

1. Graph and inequality on a number line.
2. Graph the complement on a number line for both continuous and discrete variables.

Inequalities come up frequently in statistics and it is often helpful to plot the inequality on the number line in order to visualize the inequality. This helps both for inequalities that involve real numbers and for inequalities that refer to just integer values. As an extension of this idea, we often want to look at the complement of an inequality, that is all numbers that make the inequality false. In this section we will look at examples that accomplish this task.

Sketching an Inequality on a number line where the possible values are real numbers.

There are four different inequalities: $<$, $\leq$, $>$, $\geq$. What makes this the most challenging is when they are expressed in words. Here are some of the words that are used for each:

- $<$: "Less Than", "Smaller", "Lower", "Younger"
- $\leq$: "Less Than or Equal to", "At Most", "No More Than", "Not to Exceed"
- $>$: "Greater Than", "Larger", "Higher", "Bigger", "Older", "More Than"
- $\geq$: "Greater Than or Equal to", "At Least", "No Less than"

These are the most common words that correspond to the inequalities, but there are others that come up less frequently.

Example 11.2.3.1

Graph the inequality: $3 < x \leq 5$ on a number line

Solution

First notice that the interval does not include the number 3, but does include the number 5. We can represent not including a number with an open circle and including a number with a closed circle. The number line representation of the inequality is shown below.

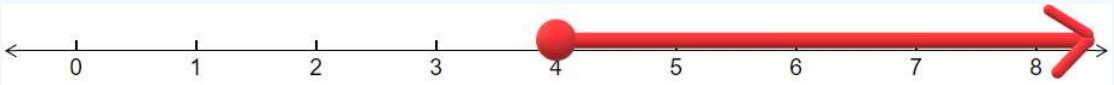


Example 11.2.3.2

In statistics, we often want to find probabilities of an event being at least as large or no more than a given value. It helps to first plot the interval on a number line. Suppose you want to find the probability that you will have to wait in line for at least 4minutes. Sketch this inequality on a number line.

Solution

First, notice that "At Least" has the symbol $\geq$. Thus, we have a closed circle on the number 4. There is no upper bound, so we draw a long arrow from 4 to the right of 4. The solution is shown below

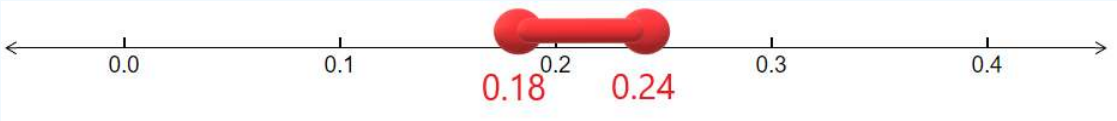


Example 11.2.3.3

Another main topic that comes up in statistics is confidence intervals. For example in recent poll to see the percent of Americans who think that Congress is doing a good job found that a 95% confidence interval had lower bound of 0.18 and an upper bound of 0.24. This can be written as [0.18,0,24]. Sketch this interval on the number line.

Solution

The first thing we need to do is decide on the tick marks to put on the number line. If we counted by 1's, then the interval of interest would be too small to stand out. Instead we will count by 0.1's. The number line is shown below.

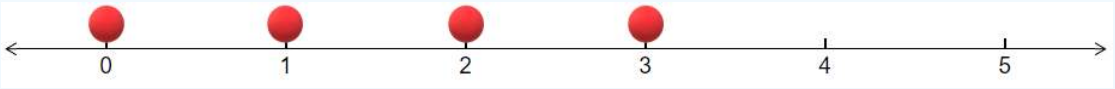


Example 11.2.3.4

Often in statistics, we deal with discrete variables. Most of the time this will mean that only whole number values can occur. For example, you want to find out the probability that a college student is taking at most three classes. Graph this on a number line.

Solution

First note that the outcomes can only be whole numbers. Second, note that "at most" means $\leq$. Thus the possible outcomes are: 0, 1, 2, and 3. The number line below displays these outcomes.



Graphing the Complement

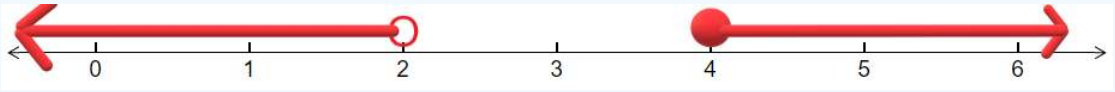
In statistics, we often want to graph the complement of an interval. The complement means everything that is not in the interval.

Example 11.2.3.5

Graph the complement of the interval [2,4).

Solution

Notice that the complement of numbers inside the interval between 2 and 4 is the numbers outside that interval. This will consist of the numbers to the left of 2 and to the right of 4. Since the number 2 is included in the original interval, it will not be included in the complement. Since the number 4 is not included in the original interval, it will be included in the complement. The complement is shown on the number line below.

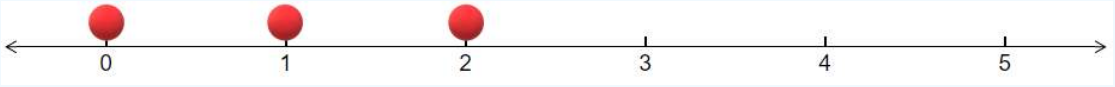


Example 11.2.3.6

Some calculators can only find probabilities for values less than a certain number. If we want the probability of an interval greater than a number, we need to use the complement. Suppose that you want to find the probability that a person will have traveled to more than two foreign countries in the last twelve months. Find the complement of this and graph it on a number line.

Solution

First notice that only whole numbers are possible since it does not make sense to go to a fractional number of countries. Second note that the lowest number that is more than 2 is 3. If 3 is included in the original list, then 3 will not be included in the complement. Thus, the highest number that is in the complement of "more than 2" is 2. The number line below shows the complement of more than 2.



Exercise

Suppose you want to find the probability that at least 4 people in your class have a last name that contains the letter "W". To make this calculation you will need to first find the complement of "at least 4". Sketch this complement on the number line.

- Intervals: Given an Inequality, Graph the Interval and State Using Interval Notation
- Express Inequalities as a Graph and Interval Notation
- Sketching the Complement of an Interval on a Number Line

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11.2.4: The Midpoint

Learning Outcomes

1. Find the midpoint between two numbers.
2. Sketch the midpoint of two numbers on a number line.

As the word sounds, "midpoint" means "the point in the middle". Finding a midpoint is not too difficult and has applications in many areas of statistics, from confidence intervals to sketching distributions, to means.

Finding the Midpoint Between Two Numbers

If we are given two numbers, then the midpoint is just the average of the two numbers. To calculate the midpoint, we add them up and then divide the result by 2. The formula is as follows:

Definition: the Midpoint

Let a and b be two numbers. Then the midpoint, M of these two numbers is

$$M = \frac{a+b}{2} \tag{11.2.4.1}$$

Example 11.2.4.1

Find the midpoint of the numbers 3.5 and 7.2.

Solution

The most important thing about finding the midpoint is that the addition of the two numbers must occur before the division by 2. We can either do this one step at a time in our calculator or we can enclose the sum in parentheses. In this example we will perform the addition first:

$$3.5+7.2 = 10.7$$

Now we are ready to divide by 2:

$$\frac{10.7}{2} = 5.35$$

Thus the midpoint of 3.5 and 7.2 is 5.35.

Example 11.2.4.2

A major topic in statistics is the confidence interval which tells us the most likely interval that the mean or the proportion will lie in. Often the lower and upper bound of the confidence interval are given, but the midpoint of these two numbers is the best guess for what we are looking for. Suppose a 95% confidence interval for the difference between two means is -1.34 and 2.79. Find the midpoint of these numbers, which is the best guess for the difference between the two means.

Solution

We use the formula for the midpoint (Equation 11.2.4.1):

$$M = \frac{a+b}{2} = \frac{-1.34+2.79}{2}$$

Now let's use a calculator. We will need parentheses around the numerator:

$$(-1.34+2.79) \div 2 = 0.725$$

Thus, the midpoint of the numbers -1.34 and 2.79 is 0.725.

Sketching the Midpoint on a Number Line

Visualizing the midpoint can often reveal it much better than just writing down its value. The diagrams are of fundamental importance in statistics.

Example 11.2.4.3

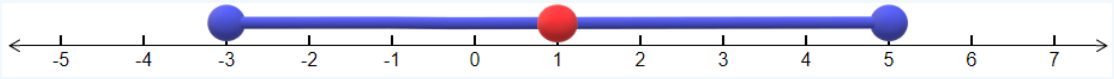
Sketch the points -3, 5 and the midpoint of these two numbers on a number line.

Solution

We start by finding the midpoint using the midpoint formula (Equation 11.2.4.1):

$$M = \frac{-3+5}{2} = (-3+5) \div 2 = 1$$

Now we sketch these three points on the number line:

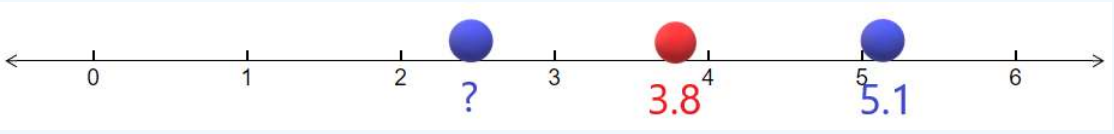


Example 11.2.4.4: hypothesis testing

Another application of the midpoint involves hypothesis testing. Sometimes we are given the hypothesized mean, which is the midpoint. We are also given the sample mean, which is either the left or right endpoint. The goal is to find the other endpoint. Suppose that the midpoint (hypothesized mean) is at 3.8 and the right endpoint (sample mean) is at 5.1. Find the value of the left endpoint.

Solution

It helps to sketch the diagram on the number line as shown below.



Now since 3.8 is the midpoint, the distance from the left endpoint to the midpoint is equal to the distance from 3.8 to 5.1. The distance from 3.8 to 5.1 is:

$$5.1 - 3.8 = 1.3$$

Therefore the left endpoint is 1.3 to the left of 3.8. This can be found by subtracting the two numbers:

$$3.8 - 1.3 = 2.5$$

Therefore the left endpoint is at 2.5.

Exercise

Suppose that the midpoint (hypothesized proportion) is at 0.31 and the left endpoint (sample proportion) is at 0.28. Find the value of the right endpoint.

- Midpoint on the Number line
- Finding the Right Endpoint Given the Left Endpoint and Midpoint

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SECTION OVERVIEW

11.3: Operations on Numbers

11.3.1: Area of a Rectangle

11.3.2: Factorials and Combination Notation

11.3.3: Order of Operations

11.3.4: Order of Operations in Expressions and Formulas

11.3.5: Perform Signed Number Arithmetic

11.3.6: Powers and Roots

11.3.7: Using Summation Notation

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11.3.1: Area of a Rectangle

Learning Outcomes

- Find the area of a rectangle.
- Find the height of a rectangle given that the area is equal to 1.

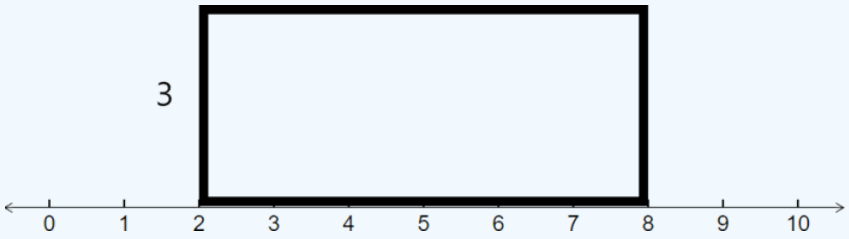
Rectangles are of fundamental importance in the portion of statistics that involves the uniform distribution. Every rectangle has a base and a height and an area. The formula for the area of a rectangle is:

$$\text{Area} = \text{Base} \times \text{Height} \tag{11.3.1.1}$$

When working with the uniform distribution, the area represents the probability of an event being within the bounds of the base.

Example 11.3.1.1

Consider the rectangle shown below.



Find the area of this rectangle.

Solution

We use the Area formula (Equation 11.3.1.1). To find the base, we notice that it runs from 2 to 8, so we subtract these numbers to get the base:

$$Base = 8 - 2 = 6$$

Next multiply by the height, 3, to get

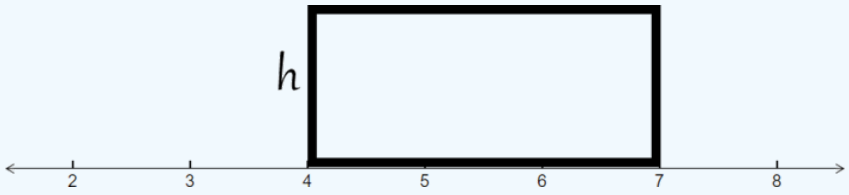
$$Area = Base \times Height = 6 \times 3 = 18$$

Example 11.3.1.2

It turns out that the area of the rectangles that equal to 1 will occur the most often for a uniform distribution. Suppose that we know that the area of a rectangle that depicts a uniform distribution is equal to 1 and that the base of the rectangle goes from 4 to 7. Find the height of the rectangle.

Solution

First sketch the rectangle below, labeling the height as h.



Next, find the base of the rectangle that goes from 4 to 7 by subtracting:

$$Base = 7 - 4 = 3$$

Next, plug in what we know into the area equation:

$$1 = Area = Base \times Height = 3 \times h$$

This tell us that 3 times a number is equal to 1. To find out what the number is, we just divide both sides by 3 to get:

$$h = \frac{1}{3}$$

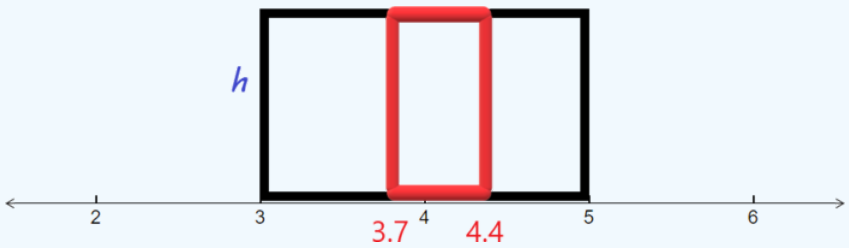
Therefore the height of an area 1 rectangle with base from 4 to 7 is $\frac{1}{3}$.

Example 11.3.1.3

Suppose that we know that the area of a rectangle that depicts a uniform distribution is equal to 1 and that the base of the rectangle goes from 3 to 5. There is a smaller rectangle within the larger one with the same height, but whose base goes from 3.7 to 4.4. Find the area of the smaller rectangle.

Solution

First, sketch the larger rectangle with the smaller rectangle shaded in.



Next, we find the height of the rectangle. We know that the area of the larger rectangle is 1. The base goes from 3 to 5, so the base is $5 - 3 = 2$ Hence:

$$1 = Area = Base \times Height = 2h$$

Dividing by 2, gives us that the height is $\frac{1}{2}$ or 0.5. Now we are ready to find the area of the smaller rectangle. We first find the base by subtracting:

$$\text{Base} = 4.4 - 3.7 = 0.7$$

Next, use the area formula:

$$Area = Base \times Height = 0.7 \times 0.5 = 0.35$$

Exercise 11.3.1.1

Suppose that elementary students' ages are uniformly distributed from 5 to 11 years old. The rectangle that depicts this has base from 5 to 11 and area 1. The rectangle that depicts the probability that a randomly selected child will be between 6.5 and 8.6 years old has base from 6.5 to 8.6 and the same height as the larger rectangle. Find the area of the smaller rectangle

- Ex: Determine the Area of a Rectangle Involving Whole Numbers
- Area of a Rectangle and the Uniform Distribution

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11.3.2: Factorials and Combination Notation

Learning Outcomes

1. Evaluate a factorial.
2. Use combination notation for statistics applications.

When we need to compute probabilities, we often need to multiple descending numbers. For example, if there is a deck of 52 cards and we want to pick five of them without replacement, then there are 52 choices for the first pick, 51 choices for the second pick since one card has already been picked, 50 choices for the third, 49 choices for the fourth, and 48 for the fifth. If we want to find out how many different outcomes there are, we can use what we call the multiplication principle and multiple them: $52 \times 51 \times 50 \times 49 \times 48$. If we wanted to pick all 52 of the cards one at a time, then this list would be excessively long. Instead there is a notation that describes multiplying all the way down to 1, called the factorial. It must be exciting, since we use the symbol "!" for the factorial.

Example 11.3.2.1

Calculate $4!$

Solution

We use the definition which says start at 4 and multiply until we get to 1:

$$4! = 4 \times 3 \times 2 \times 1 = 24$$

Example 11.3.2.2

If we pick 5 cards from a 52 card deck without replacement and the same two sets of 5 cards, but in different orders, are considered different, how many sets of 5 cards are there?

Solution

From the introduction, the number of sets is just:

$$52 \times 51 \times 50 \times 49 \times 48$$

This is not quite a factorial since it stops at 48; however, we can think of this as $52!$ with $47!$ removed from it. In other words we need to find

$$\frac{52!}{47!}$$

We could just multiply the numbers from the original list, but it is a good idea to practice with your calculator or computer to find this using the ! symbol. When you do use technology, you should get:

$$\frac{52!}{47!} = 311,875,200$$

Combinations

One of the most important applications of factorials is combinations which count the number of ways of selecting a smaller collection from a larger collection when order is not important. For example if there are 12 people in a room and you want to select a team of 4 of them, then the number of possibilities uses combinations. Here is the definition:

Definition: Combinations

The number of ways of selecting k items without replacement from a collection of n items when order does not matter is:

$$\binom{n}{r} = {}_nC_r = \frac{n!}{r!\,(n-r)!} \tag{11.3.2.1}$$

Notice that there are a few notations. The first is more of a mathematical notation while the second is the notation that a calculator uses. For example, in the TI 84+ calculator, the notation for the number of combinations when selecting 4 from a collection of 12 is:

$$12\ {}_nC_r\ 4$$

There are many internet sites that will perform combinations. For example the math is fun site asks you to put in n and r and also state whether order is important and repetition is allowed. If you click to make both "no" then you will get the combinations.

Example 11.3.2.3

Calculate

$$\binom{15}{11} = {}_{15}C_{11}$$

Solution

Whether you use a hand calculator or a computer you should get the number: 1365

Example 11.3.2.4

The probability of winning the Powerball lottery if you buy one ticket is:

$$P(win) = \frac{1}{{}_{69}C_5 \times 26}$$

Calculate this probability.

Solution

First, let's calculate ${}_{69}C_5$. Using a calculator or computer, you should get 11,238,513. Next, multiply by 26 to get

$$11,238,513 \times 26 = 292,201,338$$

Thus, there is a one in 292,201,338 chance of winning the Powerball lottery if you buy a ticket. We can also write this as a decimal by dividing:

$$P\left(win\right) = \frac{1}{292,201,338} = 0.000000003422$$

As you can see, your chances of winning the Powerball are very small.

Exercise

A classroom is full of 28 students and there will be one president of the class and a "Congress" of 4 others selected. The number of different leadership group possibilities is:

$$28 \times {}_{27}C_4$$

Calculate this number to find out how many different leadership group possibilities there are.

Ex 1: Simplify Expressions with Factorials

Combinations

Combinations

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11.3.3: Order of Operations

Learning Outcomes

1. Use the order of operations to correctly perform multi-step arithmetic
2. Apply the order of operations to statistics related complex questions.

When we are given multiple arithmetic operations within a calculation, there is a, established order that we must do them in based on how the expression is written. Understanding these rules is especially important when using a calculator, since calculators are programmed to strictly follow the order of operations. This comes up in every topic in statistics, so knowing the order of operations is an essential skill for all successful statistics students to have.

PEMDAS

The order of operations are as follows:

1. **P**arentheses
2. **E**xponents
3. **M**ultiplication and **D**ivision
4. **A**ddition and **S**ubtraction

When there is a tie, the rule is to go from left to right.

Notice that Multiplication and division are listed together as item 3. If you see multiplication and division in the same expression the rule is to go from left to right. Similarly, if you see addition and subtraction in the same expression the rule is to from go left to right. The same goes for two of the same arithmetic operators.

Example 11.3.3.1

Evaluate: $20-6\div 3+\left(2\times 3^2\right)$

Solution

We start with what is inside the parentheses: $2+3^2$. Since exponents comes before addition, we find $3^2=9$ first. We now have

$$20-6\div 3+(2\times 9)$$

We continue inside the parentheses and perform the multiplication: $2\times 9=18$.

This gives

$$20-6\div 3+18$$

Since division comes before addition and subtraction, we next calculate $6\div 3=2$ to get

$$20-2+18$$

Since subtraction and addition are tied, we go from left to right. We calculate: $20-2=18$ to get

$$18+18\ =36$$

The key to arriving at the correct answer is to go slow and write down each step in the arithmetic.

Hidden Parentheses

You may think that since you always have a calculator or computer at hand, that you don't need to worry about order of operations. Unfortunately, the way that expressions are written is not the same as the way that they are entered into a computer or calculator. In particular, exponents need to be treated with care as do fractions bars.

Example 11.3.3.3

Evaluate 2.1^{6-2}

Solution

First, note that we use the symbol "^" to tell a computer or calculator to exponentiate. If you were to enter 2.1^6-2 into a computer, it would give you the answer of 83.766121 which is not correct, since the computer will first expontiate and then subtract. Since the subtraction is within the exponent, it must be performed first. To tell a calculator or computer to perform the subtraction first, we use parentheses:

2.1^(6 - 2) = 19.4481

Example 11.3.3.4: z-scores

The "z-score" is defined by:

$$z = \frac{x - \mu}{\sigma}$$

Find the z-score rounded to one decimal place if:

$$x = 2.323,\ \mu = 1.297,\ \sigma = 0.241$$

Solution

Once again, if we put these numbers into the z-score formula and use a computer or calculator by entering $3.323 - 1.297 \div 0.241$ we will get -0.259 which is the wrong answer. Instead, we need to know that the fraction bar separates the numerator and the denominator, so the subtraction must be done first. We compute

$$\frac{2.323 - 1.297}{0.241} = (2.323 - 1.297) \div 0.241 = 4.25726141$$

Now round to one decimal place to get 4.3. Notice that if you rounded before you did the arithmetic, you would get exactly 5 which is very different. 4.3 is more accurate.

Exercise

Suppose the equation of the regression line for the number of pairs of socks a person owns, y, based on the number of pairs of shoes, x, the person owns is

$$\hat{y} = 6 + 2x$$

Use this regression line to predict the number of pairs of socks a person owns for a person who owns 4 pairs of shoes.

- Order of Operations - The Basics
- Order of Operations

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11.3.4: Order of Operations in Expressions and Formulas

Learning Outcomes

- Use Order of Operations in Statistics Formulas.

We have already encountered the order of operations: Parentheses, Exponents, Multiplication and Division, Addition and Subtraction. In this section, we will give some additional examples where the order of operations must be used properly to evaluate statistics.

Example 11.3.4.1

The sample standard deviation asks us to add up the squared deviations, take the square root and divide by one less than the sample size. For example, suppose that there are three data values: 3, 5, 10. The mean of these values is 6. Then the standard deviation is:

$$s = \sqrt{\frac{(3-6)^2 + (5-6)^2 + (10-6)^2}{3-1}}$$

Evaluate this number rounded to the nearest hundredth.

Solution

The first thing in the order of operations is to do what is in the parentheses. We must subtract:

$$3-6 = -3, \quad 5-6 = -1, \quad 10-6 = 4$$

We can substitute the numbers in to get:

$$= \sqrt{\frac{(-3)^2 + (-1)^2 + (4)^2}{3-1}}$$

Next, we exponentiate:

$$(-3)^2 = 9, \quad (-1)^2 = 1, \quad 4^2 = 16$$

Substitute these in to get:

$$\sqrt{\frac{9+1+16}{3-1}}$$

We can now perform the addition inside the square root to get:

$$\sqrt{\frac{26}{3-1}}$$

Next, perform the subtraction of the denominator to get:

$$\sqrt{\frac{26}{2}}$$

We can divide to get:

$$\sqrt{13}$$

We don't want to do this by hand, so in a calculator or computer type in:

$$13^{0.5} = 3.61$$

Example 11.3.4.2

When calculating the probability that a value will be less than 4.6 if the value is taken randomly from a uniform distribution between 3 and 7, we have to calculate:

$$(4.6-3)\times\frac{1}{7-3}$$

Find this probability.

Solution

We can use a calculator or computer, but we must be very careful about the order of operations. Notice that there are implied parentheses due to the fraction bar. The answer is:

$$\frac{(4.6-3)\times 1}{7-3}$$

Using technology, we get:

$$(4.6-3)\times\frac{1}{7-3}=0.4$$

Exercise

When finding the upper bound, U, of a confidence interval given the lower bound, L, and the margin of error, E, we use the formula

$$U=L+2E$$

Find the upper bound of the confidence interval for the proportion of babies that are born preterm if the lower bound is 0.085 and the margin of error is 0.03.

- Ex: Evaluate an Expression Using the Order of Operations
- Order of Operations and Confidence Intervals

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11.3.5: Perform Signed Number Arithmetic

Learning Outcomes

1. Add signed numbers.
2. Subtract signed numbers.
3. Multiply signed numbers.
4. Divide signed numbers.

Even though negative numbers seem not that common in the real world, they do come up often when doing comparisons. For example, a common question is how much bigger is one number than another, which involves subtraction. In statistics we don't know the means until we collect the data and do the calculations. This often results in subtracting a larger number from a smaller number which yields a negative number. Because of this and for many other reasons, we need to be able to perform arithmetic on both positive and negative numbers.

Adding Signed Numbers

We will assume that you are very familiar with adding positive numbers, but when there are negative numbers involved, there are some rules to follow:

1. When adding two negative numbers, ignore the negative signs, add the positive numbers and then make the result negative.
2. When adding two numbers such that one is positive and the other is negative, ignore the sign, subtract the smaller from the larger. If the larger of the positive numbers was originally negative, then make the result negative. Otherwise keep the result positive.

Example 11.3.5.1

Add:

$$-4+(-3)$$

Solution

First we ignore the signs and add the positive numbers.

$$4+3=7$$

Next we make the result negative.

$$-4+(-3)=-7$$

Example 11.3.5.2

Add:

$$-2+5$$

Solution

Since one of the numbers is positive and the other is negative, we subtract:

$$5-2=3$$

Of the two numbers, 2 and 5, 5 is the larger one and started positive. Hence we keep the result positive:

$$-2+5=3$$

Subtracting Numbers

Subtraction comes up often when we want to find the width of an interval in statistics. Here are the cases for subtracting: $a-b$:

1. If $a \geq b \geq 0$, then this is just ordinary subtraction.
2. If $b \geq a \geq 0$, then find $b - a$ and make the result negative.
3. If $a < 0,\ b \geq 0$, then make both positive, add the two positive numbers and make the result negative.
4. If $b < 0$ then you use the rule that subtracting a negative number is the same as adding the positive number.

Example 11.3.5.3

Evaluate $5 - 9$

Solution

Since 9 is bigger than 5, we subtract:

$$9 - 5 = 4$$

Next, we make the result negative to get:

$$5 - 9 = -4$$

Example 11.3.5.4

Evaluate $-9 - 4$

Solution

We are in the case $a < 0,\ b \geq 0$. Therefore, we first make both positive and add the positive numbers.

$$9 + 4 = 13$$

The final step is to make the answer negative to get

$$-9 - 4 = -13$$

Example 11.3.5.5: Uniform distributions

In statistics, we call a *distribution Uniform* if an event is just as likely to be in any given interval within the bounds as any other interval within the bounds as long as the intervals are both of the same width. Finding the width of a given interval is usually the first step in solving a question involving uniform distributions. Suppose that the temperature on a winter day has a Uniform distribution on [-8,4]. Find the width of this interval

Solution

To find the width of an interval, we subtract the left endpoint from the right endpoint:

$$4 - (-8)$$

Since we are subtracting a negative number, the "-" signs become addition:

$$4 - (-8) = 4 + 8 = 12$$

Thus the width of the interval is 12.

Multiplying and Dividing Signed Numbers

When we have a multiplication or division problem, we just remember that two negatives make a positive. So if there are an even number of negative numbers that are multiplied or divided, the result is negative. If there are an odd number of negative numbers that are multiplied or divided, the result is positive.

Example 11.3.5.6

Perform the arithmetic:

$$\frac{(-6)(-10)}{(-4)(-5)}$$

Solution

First, just ignore all of the negative signs and multiply the numerator and denominator separately:

$$\frac{(6)(10)}{(4)(5)} = \frac{60}{20}$$

Now divide:

$$\frac{60}{20} = \frac{6}{2} = 3$$

Finally, notice that there are four negative numbers in the original multiplication and division problem. Four is an even number, so the answer is positive:

$$\frac{(-6)(-10)}{(-4)(-5)} = 3$$

Example 11.3.5.7

A confidence interval for the population mean difference in books read per year by men and women was was found to be [-4,1]. Find the midpoint of this interval.

Solution

First recall that to find the midpoint of two numbers, we add then and then divide by 2. Hence, our first step is to add -4 and 1. Since 1 is positive and -4 is negative, we first subtract the two numbers:

$$4-1=3$$

Of the two numbers, 4 and 1, 4 is the larger one and started negative. Hence we change the sign to negative::

$$-4+1=-3$$

The final step in finding the midpoint is to divide by 2. First we divide them as positive numbers:

$$\frac{3}{2}=1.5$$

Since the original quotient has a single negative number (an odd number of negative numbers), the answer is negative. Thus the midpoint of -4 and 1 is -1.5.

Exercise

The difference between the observed value and the expected value in linear regression is called the residual. Suppose that the three observed values are: -4, 2, and 5. The expected values are -3, 7, and -1. First find the residuals and then find the sum of the residuals.

- Signed Number Operations (L1.4)
- signed arithmetic

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11.3.6: Powers and Roots

Learning Outcomes

1. Raise a number to a power using technology.
2. Take the square root of a number using technology.
3. Apply the order of operations when there is root or a power.

It can be a challenge when we first try to use technology to raise a number to a power or take a square root of a number. In this section, we will go over some pointers on how to successfully take powers and roots of a number. We will also continue our practice with the order of operations, remembering that as long as there are no parentheses, exponents always come before all other operations. We will see that taking a power of a number comes up in probability and taking a root comes up in finding standard deviations.

Powers

Just about every calculator, computer, and smartphone can take powers of a number. We just need to remember that the symbol "^" is used to mean "to the power of". We also need to remember to use parentheses if we need to force other arithmetic to come before the exponentiation.

Example 11.3.6.1

Evaluate: 1.04^5 and round to two decimal places.

Solution

This definitely calls for the use of technology. Most calculators, whether hand calculators or computer calculators, use the symbol "^" (shift 6 on the keyboard) for exponentiation. We type in:

$$1.04^5 = 1.2166529$$

We are asked to round to two decimal places. Since the third decimal place is a 6 which is 5 or greater, we round up to get:

$$1.04^5 \approx 1.22$$

Example 11.3.6.2

Evaluate: $2.8^{5.3\times 0.17}$ and round to two decimal places.

Solution

First note that on a computer we use "*" (shift 8) to represent multiplication. If we were to put in 2.8 ^ 5.3 * 0.17 into the calculator, we would get the wrong answer, since it will perform the exponentiation before the multiplication. Since the original question has the multiplication inside the exponent, we have to force the calculator to perform the multiplication first. We can ensure that multiplication occurs first by including parentheses:

$$2.8^{5.3\times 0.17} = 2.52865$$

Now round to decimal places to get:

$$2.8^{5.3\times 0.17} \approx 2.53$$

Example 11.3.6.3

If we want to find the probability that if we toss a six sided die five times that the first two rolls will each be a 1 or a 2 and the last three die rolls will be even, then the probability is:

$$\left(\frac{1}{3}\right)^2 \times \left(\frac{1}{2}\right)^3$$

What is this probability rounded to three decimal places?

Solution

We find:

$$(1/3)^2(1/2)^3 \approx 0.013888889$$

Now round to three decimal places to get

$$\left(\frac{1}{3}\right)^2 \times \left(\frac{1}{2}\right)^3 \approx 0.014$$

Square Roots

Square roots come up often in statistics, especially when we are looking at standard deviations. We need to be able to use a calculator or computer to compute a square root of a number. There are two approaches that usually work. The first approach is to use the $\sqrt{\ }$ symbol on the calculator if there is one. For a computer, using sqrt() usually works. For example if you put 10*sqrt(2) in the Google search bar, it will show you 14.1421356. A second way that works for pretty much any calculator, whether it is a hand held calculator or a computer calculator, is to realize that the square root of a number is the same thing as the number to the 1/2 power. In order to not have to wrap 1/2 in parentheses, it is easier to type in the number to the 0.5 power.

Example 11.3.6.3

Evaluate $\sqrt{42}$ and round your answer to two decimal places.

Solution

Depending on the technology you are using you will either enter the square root symbol and then the number 42 and then close the parentheses if they are presented and then hit enter. If you are using a computer, you can use sqrt(42). The third way that will work for both is to enter:

$$42^{0.5} \approx 6.4807407$$

You must then round to two decimal places. Since 0 is less than 5, we round down to get:

$$\sqrt{42} \approx 6.48$$

Example 11.3.6.4

The "z-score" is for the value of 28 for a sampling distribution with sample size 60 coming from a population with mean 28.3 and standard deviation 5 is defined by:

$$z = \frac{28 - 28.3}{\frac{5}{\sqrt{60}}}$$

Find the z-score rounded to two decimal places.

Solution

We have to be careful about the order of operations when putting it into the calculator. We enter:

$$(28 - 28.3)/(5/60\text{^}0.5) = -0.464758$$

Finally, we round to 2 decimal places. Since 4 is smaller than 5, we round down to get:

$$z = \frac{28 - 28.3}{\frac{5}{\sqrt{60}}} = -0.46$$

Exercise

The standard error, which is an average of how far sample means are from the population mean is defined by:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

where $\sigma_{\bar{x}}$ is the standard error, σ is the standard deviation, and n is the sample size. Find the standard error if the population standard deviation, σ, is 14 and the sample size, n, is 11.

- Square Root on the TI-83plus and TI-84 family of Calculators
- Square Roots with a Computer

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11.3.7: Using Summation Notation

Learning Outcomes

1. Evaluate an expression that includes summation notation.
2. Apply summation notation to calculate statistics.

This notation is called summation notation and appears as:

$$\sum_{i=1}^{n} a_i$$

In this notation, the a_i is an expression that contains the index i and you plug in 1 and then 2 and then 3 all the way to the last number n and then add up all of the results.

Example 11.3.7.1

Calculate

$$\sum_{i=1}^{4} 3i$$

Solution

First notice that i = 1, then 2, then 3 and finally 4. We are supposed to multiply each of these by 3 and add them up:

$$\begin{aligned}\sum_{i=1}^{4} 3i &= 3(1)+3(2)+3(3)+3(4)\\ &= 3+6+9+12 = 30\end{aligned}$$

Example 11.3.7.2

The formula for the sample mean, sometimes called the average, is

$$\bar{x} = \frac{\sum_{i-1}^{n} x_i}{n}$$

A survey was conducted asking 8 older adults how many sexual partners they have had in their lifetime. Their answers were {4,12,1,3,4,9,24,7}. Use the formula to find the sample mean.

Solution

Notice that the numerator of the formula just tells us to add the numbers up. Computing the numerator first gives:

$$\sum_{i=1}^{8} x_i = 4+12+1+3+4+9+24+7 = 64$$

Now that we have the numerator calculated, the formula tells us to divide by *n*, which is just 8. We have:

$$\bar{x} = \frac{64}{8} = 8$$

Thus, the sample mean number of sexual partners this group had in their lifetimes is 8.

Example 11.3.7.3

The next most important statistic is the standard deviation. The formula for the sample standard deviation is:

$$s = \sqrt{\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1}}$$

Let's consider the data in the previous example. Find the standard deviation.

Solution

The formula is quite complicated, but if tackle it one piece at a time using the order of operations properly, we can succeed in finding the sample standard deviation for the data. Notice that there are parentheses, so based on the order of operations, we must do the subtraction within the parentheses first. Since this is all part of the sum, we have eight different subtractions to do. From our calculations in the previous example, the sample mean was $\bar{x} = 8$. We compute the 8 subtractions:

$$4 - 8 = -4,\ 12 - 8 = 4,\ 1 - 8 = -7,\ 3 - 8 = -5,$$

$$4 - 8 = -4,\ 9 - 8 = 1,\ 24 - 8 = 16,\ 7 - 8 = -1$$

The next arithmetic to do is to square each of the differences to get:

$$(-4)^2 = 16,\ (4)^2 = 16, (-7)^2 = 49,\ (-5)^2 = 25,$$

$$(-4)^2 = 16,\ 1^2 = 1,\ 16^2 = 256,\ (-1)^2 = 1$$

Now we have all the entries in the summation, so we add them all up:

$$16 + 16 + 49 + 25 + 16 + 1 + 256 + 1 = 380$$

Now we can write

$$s = \sqrt{\frac{380}{8-1}} = \sqrt{\frac{380}{7}}$$

We can put this into the calculator or computer to get:

$$s = \sqrt{\frac{380}{7}} = 7.3679$$

Exercise: expected value

The expected value, EV, is defined by the formula

$$EV = \sum_{i=1}^{n} x_i\, P(x_i)$$

Where x_i are the possible outcomes and $P(x_i)$ are the probabilities of the outcomes occurring. Suppose the table below shows the number of eggs in a bald eagle clutch and the probabilities of that number occurring.

Probability Distribution Table with Outcomes, x, and probabilities, P(x)

x	1	2	3	4
P(x)	0.2	0.4	0.3	0.1

Find the expected value.

Ex 1: Find a Sum Written in Summation / Sigma Notation

Summation Notation and Expected Value

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SECTION OVERVIEW

11.4: Sets

11.4.1: Set Notation

11.4.2: The Complement of a Set

11.4.3: The Union and Intersection of Two Sets

11.4.4: Venn Diagrams

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11.4.1: Set Notation

Learning Outcomes

1. Read set notation.
2. Describe sets using set notation.

A set is just a collection of items and there are different ways of representing a set. We want to be able to both read the various ways and be able to write down the representation ourselves in order to best display the set. We have already seen how to represent a set on a number line, but that can be cumbersome, especially if we want to just use a keyboard. Imagine how difficult it would be to text a friend about a cool set if the only way to do this was with a number line. Fortunately, mathematicians have agreed on notation to describe a set.

Example 11.4.1.1

If we just have a few items to list, we enclose them in curly brackets "{" and "}" and separate the items with commas. For example,

$$\{\text{Miguel}, \text{Kristin}, \text{Leo}, \text{Shanice}\}$$

means the set the contains these four names.

Example 11.4.1.2

If we just have a long collection of numbers that have a clear pattern, we use the "..." notation to mean "start here, keep going, and end there". For example,

$$\{3, 6, 9, 12, \ldots, 90\}$$

This set contains more than just the five numbers that are shown. It is clear that the numbers are separated by three each. After the 12, even though it is not explicitly shown, is a 15 which is part of this set. It also contains 18, 21 and keeps going including all the multiples of 3 until it gets to its largest number 90.

Example 11.4.1.3

If we just have a collection of numbers that have a clear pattern, but never ends, we use the "..." without a number at the end. For example,

$$\left\{\frac{1}{2}, \frac{2}{3}, \frac{3}{4}, \frac{4}{5}, \cdots\right\}$$

This set contains an infinite number of fractions, since there is no number followed by the "...".

Example 11.4.1.4

Sometimes we have a set that it best described by stating a rule. For example, if you want to describe the set of all people who are over 18 years old but not 30 years old, you announce the conditions by putting them to the left of a vertical line segment. We read the line segment as "such that".

$$\{x \mid x > 18 \; and \; x \neq 30\}$$

This can be read as "the set of all numbers x such that x is greater than 18 and x is not equal to 30".

Exercise

Describe using set notation the collection of all positive even whole numbers that are not equal to 20 or 50.

- Set-Builder Notation

- https://youtu.be/VGphtczN0-c

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11.4.2: The Complement of a Set

Learning Outcomes

1. Determine the complement of a set.
2. Write the complement of a set using set notation.

We saw in the section "Represent an Inequality as an Interval on a Number Line" how to graph the complement for a set defined by an inequality. Complements come up very often in statistics, so it is worth revisiting this, but instead of graphically we will focus on set notation. Recall that the complement of a set is everything that is not in that set. Sometimes it is much easier to find the probability of a complement than of the original set, and there is an easy relationship between the probability of an event happening and the probability of the complement of that event happening.

$$P(A) = 1 - P(not\ A)$$

Example 11.4.2.1

Find the complement of the set:

$$A = \{x \mid x < 4\}$$

Solution

The complement of the set of all numbers that are less than 4 is the set of all numbers that are at least as big as 4. Notice that the number 4 is not in the set A, since the inequality is strict (does not have an "="). Therefore the number 4 is in the complement of the set A. In set notation:

$$A^c = \{x \mid x \geq 4\}$$

Example 11.4.2.2

When computing probabilities the complement is sometimes much easier than the original set. For example suppose you roll a die 6 times and want to find the probability that the number 3 comes up at least once. Find the complement of this event.

Solution

First note that the event of at least once means that there could be one 3, two 3's, three 3's, four 3's, five 3's, or six 3's. It turns out that this would be a burden to deal with each of these possibilities. However the complement is quite easy. The complement of getting at least one 3 is that you go no 3's.

Example 11.4.2.3

Suppose that we want to find the probability that at least 20 people in the class have done their homework. Find the complement of this event.

Solution

Sometimes it is easiest to list nearby outcomes and then determine the outcomes that satisfy the event. Finally, to find the complement, you select the rest. First list numbers near 20:

$$\ldots, 17, 18, 19, 20, 21, 22, \ldots$$

Now, the ones that are at least 20 are all the ones including 20 and to the right of 20:

$$20, 21, 22, \ldots$$

These are the large numbers. The complement includes all the small numbers.

$$\ldots, 17, 18, 19$$

We can write this in set notation as:

$$\{x \mid x \leq 19\}$$

or equivalently

$$\{x \mid x < 20\}$$

Example 11.4.2.4

Suppose a number is picked at random from the whole numbers from 1 to 10. Let A be the event that a number is both even and less than 8. Find the complement of A.

Solution

First, the set of numbers that are both even and less than 8 is:

$$A = \{2, 4, 6\}$$

The complement of this set is all the numbers from 1 to 10 that are not in A:

$$A^c = \{1, 3, 5, 7, 8, 9, 10\}$$

Exercise

Suppose that two six sided dice are rolled. Let the A be the event that either the first die is even or the sum of the dice is greater than 5 or both have occurred. Find the complement of A.

- Ex: Find the Intersection of a Set and A Complement Using a Venn Diagram
- https://youtu.be/ek3QwY2gw4w

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11.4.3: The Union and Intersection of Two Sets

Learning Outcomes

1. Find the union of two sets.
2. Find the intersection of two sets.
3. Combine unions intersections and complements.

All statistics classes include questions about probabilities involving the union and intersections of sets. In English, we use the words "Or", and "And" to describe these concepts. For example, "Find the probability that a student is taking a mathematics class or a science class." That is expressing the union of the two sets in words. "What is the probability that a nurse has a bachelor's degree and more than five years of experience working in a hospital." That is expressing the intersection of two sets. In this section we will learn how to decipher these types of sentences and will learn about the meaning of unions and intersections.

Unions

An element is in the union of two sets if it is in the first set, the second set, or both. The symbol we use for the union is $\cup$. The word that you will often see that indicates a union is "or".

Example 11.4.3.1: Union of Two sets

Let:

$$A = \{2, 5, 7, 8\}$$

and

$$B = \{1, 4, 5, 7, 9\}$$

Find $A \cup B$

Solution

We include in the union every number that is in A or is in B:

$$A \cup B = \{1, 2, 4, 5, 7, 8, 9\}$$

Example 11.4.3.2: Union of Two sets

Consider the following sentence, "Find the probability that a household has fewer than 6 windows or has a dozen windows." Write this in set notation as the union of two sets and then write out this union.

Solution

First, let A be the set of the number of windows that represents "fewer than 6 windows". This set includes all the numbers from 0 through 5:

$$A = \{0, 1, 2, 3, 4, 5\}$$

Next, let B be the set of the number of windows that represents "has a dozen windows". This is just the set that contains the single number 12:

$$B = \{12\}$$

We can now find the union of these two sets:

$$A \cup B = \{0, 1, 2, 3, 4, 5, 12\}$$

Intersections

An element is in the intersection of two sets if it is in the first set and it is in the second set. The symbol we use for the intersection is $\cap$. The word that you will often see that indicates an intersection is "and".

Example 11.4.3.3: Intersection of Two sets

Let:

$$A = \{3, 4, 5, 8, 9, 10, 11, 12\}$$

and

$$B = \{5, 6, 7, 8, 9\}$$

Find $A \cap B$.

Solution

We only include in the intersection that numbers that are in both A and B:

$$A \cap B = \{5, 8, 9\}$$

Example 11.4.3.4: Intersection of Two sets

Consider the following sentence, "Find the probability that the number of units that a student is taking is more than 12 units and less than 18 units." Assuming that students only take a whole number of units, write this in set notation as the intersection of two sets and then write out this intersection.

Solution

First, let A be the set of numbers of units that represents "more than 12 units". This set includes all the numbers starting at 13 and continuing forever:

$$A = \{13,\ 14,\ 15,\ \ldots\}$$

Next, let B be the set of the number of units that represents "less than 18 units". This is the set that contains the numbers from 1 through 17:

$$B = \{1,\ 2,\ 3,\ \ldots,\ 17\}$$

We can now find the intersection of these two sets:

$$A \cap B = \{13,\ 14,\ 15,\ 16,\ 17\}$$

Combining Unions, Intersections, and Complements

One of the biggest challenges in statistics is deciphering a sentence and turning it into symbols. This can be particularly difficult when there is a sentence that does not have the words "union", "intersection", or "complement", but it does implicitly refer to these words. The best way to become proficient in this skill is to practice, practice, and practice more.

Example 11.4.3.5

Consider the following sentence, "If you roll a six sided die, find the probability that it is not even and it is not a 3." Write this in set notation.

Solution

First, let A be the set of even numbers and B be the set that contains just 3. We can write:

$$A = \{2, 4, 6\}, \quad B = \{3\}$$

Next, since we want "not even" we need to consider the complement of A:

$$A^c = \{1, 3, 5\}$$

Similarly since we want "not a 3", we need to consider the complement of B:

$$B^c = \{1, 2, 4, 5, 6\}$$

Finally, we notice the key word "and". Thus, we are asked to find:

$$A^c \cap B^c = \{1, 3, 5\} \cap \{1, 2, 4, 5, 6\} = \{1, 5\}$$

Example 11.4.3.6

Consider the following sentence, "If you randomly select a person, find the probability that the person is older than 8 or is both younger than 6 and is not younger than 3." Write this in set notation.

Solution

First, let A be the set of people older than 8, B be the set of people younger than 6, and C be the set of people younger than 3. We can write:

$$A = \{x \mid x > 8\}, \quad B = \{x \mid x < 6\}, \; C = \{x \mid x < 3\}$$

We are asked to find

$$A \cup (B \cap C^c)$$

Notice that the complement of "$<$" is "$\geq$". Thus:

$$C^c = \{x \mid x \geq 3\}$$

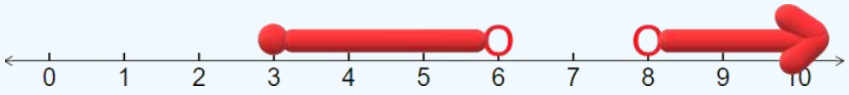
Next we find:

$$B \cap C^c = \{x \mid x < 6\} \cap \{x \mid x \geq 3\} = \{x \mid 3 \leq x < 6\}$$

Finally, we find:

$$A \cup (B \cap C^c) = \{x \mid x > 8\} \cup \{x \mid 3 \leq x < 6\}$$

The clearest way to display this union is on a number line. The number line below displays the answer:



Exercise

Suppose that we pick a person at random and are interested in finding the probability that the person's birth month came after July and did not come after September. Write this event using set notation.

- Ex: Find the Intersection of a Set and A Complement Using a Venn Diagram
- Intersection and Complements of Sets

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11.4.4: Venn Diagrams

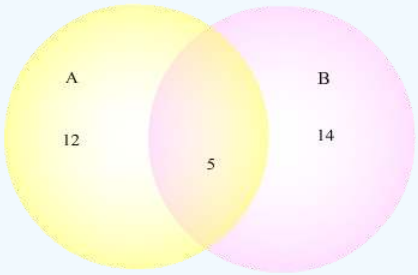
Learning Outcomes

1. Read a Venn Diagram to extract information.
2. Draw a Venn Diagram.

Venn Diagrams are a simple way of visualizing how sets interact. Many times we will see a long wordy sentence that describes a numerical situation, but it is a challenge to understand. As the saying goes, "A picture is worth a thousand words." In particular, a Venn Diagram describes how many elements are in each set displayed and how many elements are in their intersections and complements.

Example 11.4.4.1

Consider the Venn Diagram shown below.



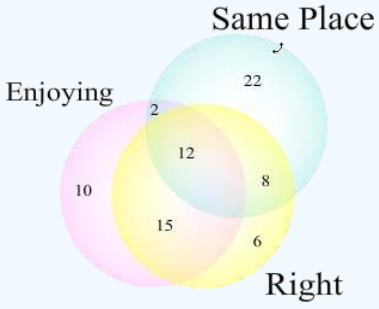
Describe how many elements are in each of the sets.

Solution

Once we understand how to read the Venn Diagram we can use it in many applications. For the Venn Diagram above, there are 12 from A that are not in B, there are 5 in both A and B, and there are 14 in B that are not in A. If we wanted to find the total in A, we would just add 12 and 5 to get 17 total in A. Similarly, there are 19 total in B.

Example 11.4.4.2

Consider the Venn Diagram below that shows the results of a study asking students whether their first college class was at the same place they are at now, whether they are right handed, and whether they are enjoying their experience at their college.



Determine how many students are:

1. Right handed and enjoy college.
2. At the same place but not right handed.
3. Enjoy college.

Solution

1. To be right handed and enjoy college they must be in both the Right circle and the Enjoying circle. Notice that the numbers 12 and 15 are in both these circles. Thus, there are 12 + 15 = 27 total students who are right handed and enjoy college.

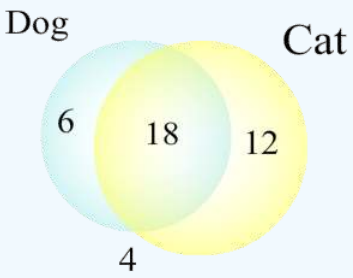
2. To be in the same place and not be right handed, the number must be in the same place circle but not in the right circle. We see that 2 and 22 are the numbers in the same place circle but not in the right circle. Adding these gives 2 + 22 = 24 total students who are at the same place but not right handed.
3. We must count all the numbers in the Enjoying circle. These are 2, 10, 12, and 15. Adding these up gives: 2 + 10 + 12 + 15 = 39. Thus, 39 students enjoy college.

Example 11.4.4.3

Suppose that a group of 40 households was looked at. 24 of them housed dogs, 30 of them housed cats, and 18 of them housed both cats and dogs. Sketch a Venn Diagram that displays this information.

Solution

To get ready to sketch the Venn Diagram, we first plan on what it will look like. There are two main groups here: houses with dogs and houses with cats. Therefore we will have two circles. The intersection will have the number 18. Since there are 24 houses with dogs and 18 also have cats, we subtract 24 - 18 = 6 to find the houses with dogs but no cats. Similarly, we subtract 30 - 18 = 12 houses with cats and no dogs. If we add 18 + 6 + 12 = 36, we find the total number of houses with a dog, cat or both. Therefore there are 40 - 36 = 4 houses without any pets. Now we are ready to put in the numbers into the Venn Diagram. It is shown below.



Exercise

Suppose that a group of 55 businesses was researched. 29 of them were open on the weekends, 25 of them paid more than minimum wage for everyone , 17 of them were both open on the weekends and paid more than minimum wage for everyone, and 4 of them were government consulting businesses. None of the government consulting businesses were open on the weekend nor did they pay more than minimum wage for everyone. Sketch a Venn Diagram that displays this information.

- **Solving Problems with Venn Diagrams**
- https://youtu.be/t67RMAWGMdY

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SECTION OVERVIEW

11.5: Expressions, Equations and Inequalities

11.5.1: Evaluate Algebraic Expressions

11.5.2: Inequalities and Midpoints

11.5.3: Solve Equations with Roots

11.5.4: Solving Linear Equations in One Variable

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11.5.1: Evaluate Algebraic Expressions

Learning Outcomes

1. Evaluate an algebraic expression given values for the variables.
2. Recognize given values in a word problem and evaluate an expression using these values.

There are many formulas that are encountered in a statistics class and the values of each variable will be given. It will be your task to carefully evaluate the expression after plugging in each of the given values into the formula. In order to be successful you should not rush through the process and you need to be aware of the order of operations and use parentheses when necessary.

Example 11.5.1.1

Suppose that equation of the regression line for the number of days a week, x, a person exercises and the number of days, $\hat{y}$, a year a person is sick is:

$$\hat{y} = 12.5 - 1.6x$$

We use $\hat{y}$ instead of y since this is a prediction instead of an actual data value's y-coordinate. Use this regression line to predict the number of times a person who exercises 4 days a week will be sick this year.

Solution

The first step is always to identify the variable or variables that are given. In this case, we have 4 days of exercise a week, so:

$$x = 4$$

Next, we plug in to get:

$$\hat{y} = 12.5 - 1.6(4) = 6.1$$

Since we are predicting the number of days a year being sick, it is a good idea to round to the nearest whole number. We get that the best prediction for the number of sick days for a person who exercises 4 days per week is that they will be sick 6 days this year.

Example 11.5.1.2

For a yes/no question, a sample size is considered large enough to use a Normal distribution if

$np > 5$ and $nq > 5$

where n is the sample size, p is the proportion of Yes answers, and q is the proportion of No answers. A survey was given to 59 American adults asking them if they were food insecure today. 6.8% of them said they were food insecure today. Was the sample size large enough to use the Normal distribution?

Solution

Our first task is to list out each of the needed variables. Let's start with n, the sample size. We are given that 59 Americans were surveyed. Thus

$$n = 59$$

Next, we will find p, the proportion of Yes answers. We are given that 6.8% said Yes. Since this is a percent and not a proportion, we must convert the percent to a proportion by moving the decimal place two places to the right. It helps to place a 0 to the left of the 6, so that the decimal point has a place to go. A common error is to rush through this and wrongly write down 0.68. Instead, the proportion is:

$$p = 0.068$$

Our next task is to find q, the proportion of No answers. For a Yes/No question, the proportion of Yes answers and the proportion of No answers must always add up to 1. Thus:

$$q = 1 - 0.068 \ = \ 0.932$$

Now we are ready to plug into the two inequalities:

$$np = 59 \times 0.068 = 4.012$$

and

$$nq = 59 \times 0.932 = 54.988$$

Although $nq \ = \ 54.988 > 5$, we have $np \ = \ 4.012 < 5$, so the sample size was not large enough to use the Normal distribution.

Example 11.5.1.3

For a quantitative study, the sample size, n, needed in order to produce a confidence interval with a margin of error no more than $\pm E$, is

$$n = \left(\frac{z\sigma}{E}\right)^2$$

where z is a value that is determined from the confidence level and σ is the population standard deviation. You want to conduct a survey to estimate the population mean amount of years it takes psychologists to get through college and you require a margin of error of no more than ± 0.1 years. Suppose that you know that the population standard deviation is 1.3 years. If you want a 95% confidence interval that comes with a $z = 1.96$, at least how many psychologists must you survey? Round your answer up.

Solution

We start out by identifying the given values for each variable. Since we want a margin of error of no more than ± 0.1, we have:

$$E \ = \ 0.1$$

We are told that the population standard is 1.3, so:

$$\sigma = 1.3$$

We are also given the value of z:

$$z = 1.96$$

Now put this into the formula to get:

$$n = \left(\frac{1.96 \times 1.3}{0.1}\right)^2$$

We put this into a calculator or computer to get:

$$(1.96 \times 1.3 \div 0.1)^2 = 649.2304$$

We round up and can conclude that we need to survey 650 psychologists.

Example 11.5.1.4

Based on the Central Limit Theorem, the standard deviation of the sampling distribution when samples of size n are taken from a population with standard deviation, σ, is given by:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

If the population standard deviation for the number of customers who walk into a fast food restaurant is 12, what is the standard deviation of the sampling distribution for samples of size 35? Round your answer to two decimal places.

Solution

First we identify each of the given variables. Since the population standard deviation was 12, we have:

$$\sigma = 12$$

We are told that the sample size is 35, so:

$$n = 35$$

Now we put these numbers into the formula for the standard deviation of the sampling distribution to get:

$$\sigma_{\bar{x}} = \frac{12}{\sqrt{35}}$$

We are now ready to put this into our calculator or computer. We put in:

$$\sigma_x = \frac{12}{\sqrt{35}} = 12 \div (35 \text{^} 0.5) = 2.02837$$

Rounded to two decimal places, we can say that the standard deviation of the sampling distribution is 2.03.

Example 11.5.1.5: Z score

The z-score for a given sample mean $\bar{x}$ for a sampling distribution with population mean μ, population standard deviation σ, and sample size n is given by:

$$z = \frac{\bar{x} - \mu}{\frac{\sigma}{\sqrt{n}}}$$

An environmental scientist collected data on the amount of glacier retreat. She measured 45 glaciers. The population mean retreat is 22 meters and the population standard deviation is 16 meters. The sample mean for her data was 27 meters and the sample standard deviation for her data was 18 meters. What was the z-score?

Solution

First we identify each of the given variables. Since the sample mean was 27, we have:

$$\bar{x} = 27$$

We are told that the population mean is 22 meters, so:

$$\mu = 22$$

We are also given that the population standard deviation is 16 meters, hence:

$$\sigma = 16$$

Finally, since she measured 45 glaciers, we have:

$$n = 45$$

Now we put the numbers into the formula for the z-score to get:

$$z = \frac{27 - 22}{\frac{16}{\sqrt{45}}}$$

We are now ready to put this into our calculator or computer. We must pay attention to the order of operations and put parentheses around the numerator, since the subtraction happens for this expression before the division. We also must put parentheses around the denominator. We put in:

$$z = (27 - 22) \div \left(16 \div \sqrt{45}\right) = 2.0963$$

Exercise

You want to come up with a 90% confidence interval for the proportion of people in your community who are obese and require a margin of error of no more than $\pm 3\%$. According to the Journal of the American Medical Association (JAMA) 34% of all Americans are obese. The equation to find the sample size, n, needed in order to come up with a confidence interval is:

$n = p\,(1-p)\left(\frac{z}{E}\right)^2$

where p is the preliminary estimate for the population proportion. Based on calculations, $z = 1.645$. How many people in your community must you survey?

Evaluating Algebraic Expressions (L2.1)

https://youtu.be/HLjUT8Kvc5U

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11.5.2: Inequalities and Midpoints

Learning Objectives

- Write out an inequality from words.
- Go from a midpoint and error to an inequality.
- Go from inequality to a midpoint and error.

Inequalities are an essential component of statistics. One very important use of inequalities is when we have found a mean or proportion from a sample and want to write out an inequality that gives where the population mean or proportion is likely to lie. Another application is in probability where we want to find the probability of a value being more than a number, less than a number, or between two numbers.

Converting Words to Inequalities

Example 11.5.2.1

You want to find the probability that it will a patient will "take at least three hours to wake up after surgery". Write an inequality for this situation.

Solution

The key words here are "at least". These words can be written symbolically as "≤". Therefore we can write "take at least three hours to wake up after surgery" as:

$$x \leq 3$$

Example 11.5.2.2

Suppose you want to find the probability that a relationship will last "more than 1 week and at most 8 weeks". Write an inequality for this situation.

Solution

Let's first translate the words "more than". This is equivalent to ">". Next translate the words "at most". This is equivalent to "≤". Now we can put this together to get:

$$1 < x \leq 8$$

Midpoints and Inequalities

There are two ways of thinking about an interval. The first is that x is greater than the lower bound and less than the upper bound. The second is that the center or midpoint of the interval is a given value and the interval goes no more than a certain distance from that value. In statistics, this is important when we look at confidence intervals. Both ways of presenting the interval are commonly used, so we need to be able to go from one way to the other.

Example 11.5.2.3

A researcher observed 45 startup companies to find a 95% confidence interval for the population mean amount of time it takes to make a profit. The sample mean was 14 months and the margin of error was plus or minus 8 months. In symbols the confidence interval can be written as:

$$14 \pm 8$$

Express this as a trilinear inequality.

Solution

We first find the lower bound by subtracting:

$$14-8=6$$

Next, we find the upper bound by adding:

$$14+8=22$$

We can now put this together as a trilinear inequality:

$$6 \leq x \leq 22$$

Example 11.5.2.4

A researcher interviewed 1000 Americans to asking them if they thought abortion should be against the law. The following 95% confidence interval was given for the population proportion of all Americans who are against abortion:

$$(0.41, 0.47)$$

Find the midpoint and the margin or error. That is write this interval in the form:

$$a \pm b \tag{11.5.2.1}$$

Solution

Let's first find the midpoint. This is the average of the left and right endpoints:

$$a = \frac{0.41+0.47}{2} = 0.44$$

Next, find the distance from the midpoint to either boundary:

$$b = 0.47 - 0.44 = 0.3$$

Finally we can put these two together to get:

$$0.44 \pm 0.03$$

Exercise 11.5.2.1

A study was done to see how many years longer it takes low income students to finish college compared to high income students. The confidence interval for the population mean difference was found to be:

$$[0.67, 0.84]$$

Find the midpoint and the margin of error. That is write this interval as in the form:

$$a \pm b$$

Converting an Inequality from Interval Notation to Midpoint and Error Notation (Links to an external site.)

Writing Equations and Inequalities for Scenarios

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11.5.3: Solve Equations with Roots

Learning Outcomes

- Solve equations that include square roots.

Square roots occur frequently in a statistics course, especially when dealing with standard deviations and sample sizes. In this section we will learn how to solve for a variable when that variable lies under the square root sign. The key thing to remember is that the square of a square root is what lies inside. In other words, squaring a square root cancels the square root.

Example 11.5.3.1

Solve the following equation for x.

$$2+\sqrt{x-3} = 6$$

Solution

What makes this a challenge is the square root. The strategy for solving is to isolate the square root on the left side of the equation and then square both sides. First subtract 2 from both sides:

$$\sqrt{x-3}=4$$

Now that the square root is isolated, we can square both sides of the equation:

$$\left(\sqrt{x-3}\right)^2=4^2$$

Since the square and the square root cancel we get:

$$x-3=16$$

Finally add 3 to both sides to arrive at:

$$x=19$$

It's always a good idea to check your work. We do this by plugging the answer back in and seeing if it works. We plug in $x=19$ to get

$$\begin{aligned} 2+\sqrt{19-3} &= 2+\sqrt{16} \\ &= 2+4 \\ &= 6 \end{aligned}$$

Yes, the solution is correct.

Example 11.5.3.2

The standard deviation, $\sigma_{\hat{p}}$, of the sampling distribution for a proportion follows the formula:

$$\sigma_{\hat{p}}=\sqrt{\frac{p\left(1-p\right)}{n}}$$

Where p is the population proportion and n is the sample size. If the population proportion is 0.24 and you need the standard deviation of the sampling distribution to be 0.03, how large a sample do you need?

Solution

We are given that $p=0.24$ and $\sigma_{\hat{p}}=0.03$

Plug in to get:

$$0.03=\sqrt{\frac{0.24\left(1-0.24\right)}{n}}$$

We want to solve for n, so we want n on the left hand side of the equation. Just switch to get:

$$\sqrt{\frac{0.24\,(1-0.24)}{n}} \;=\; 0.03$$

Next, we subtract:

$$1-0.24 \;=\; 0.76$$

And them multiply:

$$0.24\,(0.76) = 0.1824$$

This gives us

$$\sqrt{\frac{0.1824}{n}} \;=\; 0.03$$

To get rid of the square root, square both sides:

$$\left(\sqrt{\frac{0.1824}{n}}\right)^2 \;=\; 0.03^2$$

The square cancels the square root, and squaring the right hand side gives:

$$\frac{0.1824}{n} \;=\; 0.0009$$

We can write:

$$\frac{0.1824}{n} \;=\; \frac{0.0009}{1}$$

Cross multiply to get:

$$0.0009\,n \;=\; 0.1824$$

Finally, divide both sides by 0.0009:

$$n \;=\; \frac{0.1824}{0.0009} = 202.66667$$

Round up and we can conclude that we need a sample size of 203 to get a standard error that is 0.03. We can check to see if this is reasonable by plugging $n = 203$ back into the equation. We use a calculator to get:

$$\sqrt{\frac{0.24\,(1-0.24)}{203}} \;=\; 0.029975$$

Since this is very close to 0.03, the answer is reasonable.

Exercise

The standard deviation, $\sigma_{\bar{x}}$, of the sampling distribution for a mean follows the formula:

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Where σ is the population standard deviation and n is the sample size. If the population standard deviation is 3.8 and you need the standard deviation of the sampling distribution to be 0.5, how large a sample do you need?

- Ex 1: Solve a Basic Radical Equation - Square Roots
- https://youtu.be/u1aGMkJIlMI

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11.5.4: Solving Linear Equations in One Variable

Learning Outcomes

- Solve linear equations for the variable.

It is a common task in algebra to solve an equation for a variable. The goal will be to get the variable on one side of the equation all by itself and have the other side of the equation just be a number. The process will involve identifying the operations that are done on the variable and apply the inverse operation to both sides of the equation. This will be managed in the reverse of the order of operations.

Example 11.5.4.1

Solve the following equation for x.

$$3x+4=11 \tag{11.5.4.1}$$

Solution

We begin by looking at the operations that are done to x, keeping track the order. The first operation is "multiply by 3" and the second is "add 4". We now do everything backwards. Since the last operation is "add 4", our first step is to subtract 4 from both sides of Equation 11.5.4.1.

$$3x \cancel{+4} \cancel{-4} = 11-4$$

which simplifies the equation

$$3x = 7$$

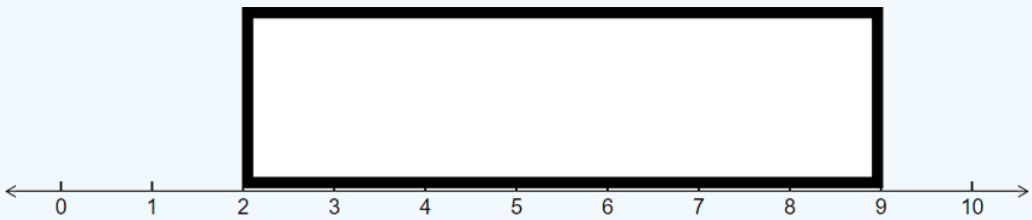
Next, the way to undo "multiply by 3" is to divide both sides by 3. We get

$$\frac{\cancel{3}x}{\cancel{3}} = \frac{7}{3}$$

or

$$x = \frac{7}{3}$$

Example 11.5.4.2



The rectangle above is a diagram for a uniform distribution from 2 to 9 that asks for the first quartile. The area of the smaller red rectangle that has base from 2 to Q1 and height 1/7 is 1/4. Find Q1.

Solution

We start by using the area formula for a rectangle:

$$\text{Area} = \text{Base} \times \text{Height} \tag{11.5.4.2}$$

We have:

- Area = $\frac{1}{4}$
- Base = $Q1-2$

- Height = $\frac{1}{7}$

Plug this into Equation 11.5.4.2to get:

$$\frac{1}{4} = (Q1 - 2)\left(\frac{1}{7}\right) \tag{11.5.4.3}$$

We need to solve for $Q1$. First multiple both sides of Equation 11.5.4.3by 7 to get:

$$7\left(\frac{1}{4}\right) = 7(Q1 - 2)\left(\frac{1}{7}\right)$$

$$\frac{7}{4} = Q1 - 2 \tag{11.5.4.4}$$

Now add 2 to both sides of Equation 11.5.4.4to get:

$$\frac{7}{4} + 2 = Q1 - 2 + 2$$

$$\frac{7}{4} + 2 = Q1$$

or

$$Q1 = \frac{7}{4} + 2$$

Putting this into a calculator gives:

$$Q1 = 3.75$$

Example 11.5.4.3: z-score

The z-score for a given value x for a distribution with population mean μ and population standard deviation σ is given by:

$$z = \frac{x - \mu}{\sigma}$$

An online retailer has found that the population mean sales per day is \$2,841 and the population standard deviation is \$895. A value of x is considered an outlier if the z-score is less than -2 or greater than 2. How many sales must be made to have a z-score of 2?

Solution

First we identify each of the given variables. Since the population mean is 2,841, we have:

$$\mu = 2841$$

We are told that the population standard deviation is 895 meters, so:

$$\sigma = 895$$

We are also given that the z-score is 2, hence:

$$z = 2$$

Now we put the numbers into the formula for the z-score to get:

$$2 = \frac{x - 2841}{895}$$

We can next switch the order of the equation so that the x is on the left hand side of the equation:

$$\frac{x - 2841}{895} = 2$$

Next, we solve for x. First multiply both sides of the equation by 895 to get

$$x - 2841 = 2\,(895) = 1790$$

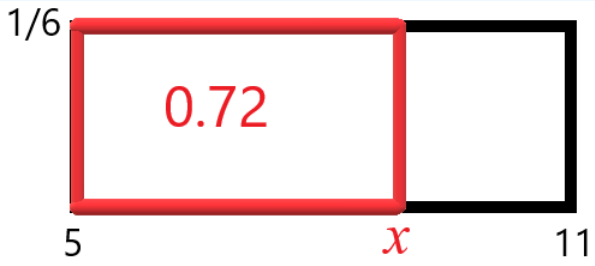
Finally, we can add 2841 to both sides of the equation to get x by itself:

$$x = 1790 + 2841 = 4631$$

We can conclude that if the day's sales is at $4631, the z-score is 2.

Exercise

The rectangle below is a diagram for a uniform distribution from 5 to 11 that asks for the 72nd percentile. The area of the smaller red rectangle that has base from 5 to the 72nd percentile, x, and height 1/6 is 0.72. Find x.



- Solving Two Step Equations: The Basics
- Solving Linear Equations

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SECTION OVERVIEW

11.6: Graphing Points and Lines in Two Dimensions

11.6.1: Finding Residuals

11.6.2: Find the Equation of a Line given its Graph

11.6.3: Find y given x and the Equation of a Line

11.6.4: Graph a Line given its Equation

11.6.5: Interpreting the Slope of a Line

11.6.6: Interpreting the y-intercept of a Line

11.6.7: Plot an Ordered Pair

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11.6.1: Finding Residuals

Learning Outcomes

- Given a Regression line and a data point, find the residual

In the linear regression part of statistics we are often asked to find the residuals. Given a data point and the regression line, the residual is defined by the vertical difference between the observed value of y and the computed value of $\hat{y}$ based on the equation of the regression line:

$$\text{Residual} = y - \hat{y}$$

Example 11.6.1.1

A study was conducted asking female college students how tall they are and how tall their mother is. The results are show in the table below:

Table of Mother and Daughter Heights

Mother's Height	63	67	64	60	65	67	59	60
Daughter's Height	58	64	65	61	65	67	61	64

The equation of the regression line is

$$\hat{y} = 30.28 + 0.52x$$

Find the residual for the mother who is 59 inches tall.

Solution

First note that the Daughter's Height associated with the mother who is 59 inches tall is 61 inches. This is y. Next we use the equation of the regression line to find $\hat{y}$. Since $x = 59$, we have

$$\hat{y} = 30.28 + 0.52(59)$$

We can use a calculator to get:

$$\hat{y} = 60.96$$

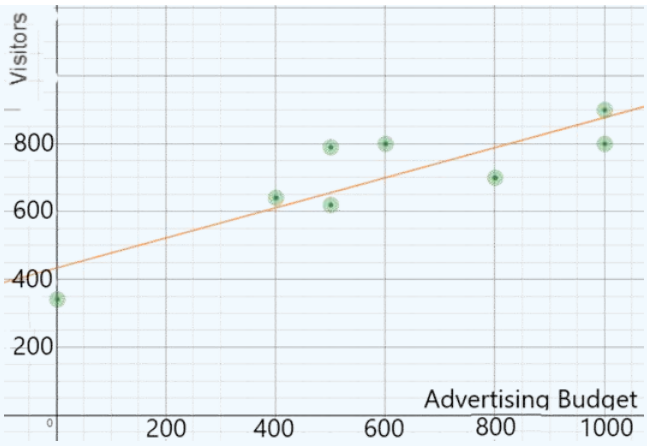
Now we are ready to put the values into the residual formula:

$$\text{Residual} = y - \hat{y} = 61 - 60.96 = 0.04$$

Therefore the residual for the 59 inch tall mother is 0.04. Since this residual is very close to 0, this means that the regression line was an accurate predictor of the daughter's height.

Example 11.6.1.2

An online retailer wanted to see how much bang for the buck was obtained from online advertising. The retailer experimented with different weekly advertising budgets and logged the number of visitors who came to the retailer's online site. The regression line for this is shown below.



Find the residual for the week when the retailer spent $600 on advertising.

Solution

First notice that the point of the scatterplot with x-coordinate of 600 has y-coordinate 800. Thus $y = 800$. Next note that the point on the line with x-coordinate 600 has y-coordinate 700. Thus $\hat{y} = 700$. Now we are ready to put the values into the residual formula:

$$\text{Residual} = y - \hat{y} = 800 - 700 = 100$$

Therefore the residual for the $600 advertising budget is -100.

Exercise

Data was taken from the recent Olympics on the GDP in trillions of dollars of 8 of the countries that competed and the number of gold medals that they won. The equation of the regression line is:

$$\hat{y} = 7.55 + 1.57x$$

The table below shows the data:

GDP	21	1.6	16	1.8	4	5.4	3.1	2.3
Medals	46	8	26	19	17	12	10	9

Find the residual for the country with a GDP of 4 trillion dollars.

- Calculating residual example | Exploring bivariate numerical data | AP Statistics | Khan Academy
- Finding a Residual

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11.6.2: Find the Equation of a Line given its Graph

Learning Outcomes

1. Find the slope of a line given its graph.
2. Find the y-intercept of a line given its graph.
3. Find the equation of a line given its graph.

There are two main ways of representing a line: the first is with its graph, and the second is with its equation. In this section, we will practice how to find the equation of the line if we are given the graph of the line. The two key numbers in the equation of a line are the slope and the y-intercept. Thus the main steps in finding the equation of a line are finding the slope and finding the y-intercept. In statistics we are often presented with a **scatterplot** where we can eyeball the line. Once we have the graph of the line, getting the equation is helpful for making predictions based on the line.

Finding the Slope of a Line Given Its Graph

The steps to follow to fine the slope of the line given its graph are the following.

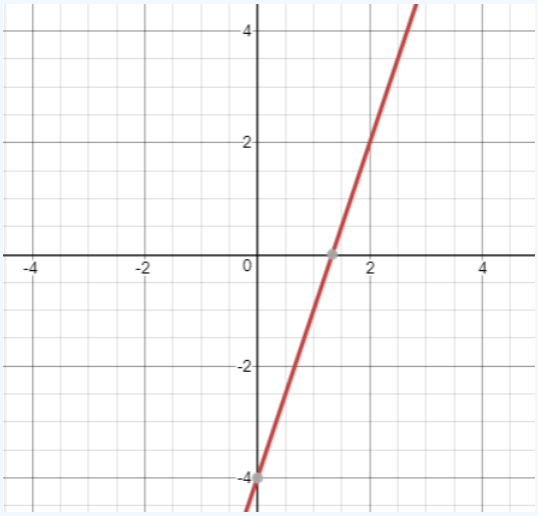
Step 1: Identify two points on the line. Any two points will do, but it is recommended to find points with nice x and y coordinates.

Step 2: The slope is the rise over the run. Thus if the points have coordinates (x_1, y_1) and $(x_2,\ y_2)$, then the slope is:

$$Slope\ =\ \frac{Rise}{Run} = \frac{y_2 - y_1}{x_2 - x_1}$$

Example 11.6.2.1

Find the slope of the line shown below.



Solution

First, we locate points on the line that are as easy as possible to work with. The points with integer coordinates are (0,-4) and (2,2).

Next, we use the rise over run formula to find the slope of the line.

$$Slope\ =\ \frac{y_2 - y_1}{x_2 - x_1} = \frac{2-(-4)}{2-0} = \frac{6}{2} = 3$$

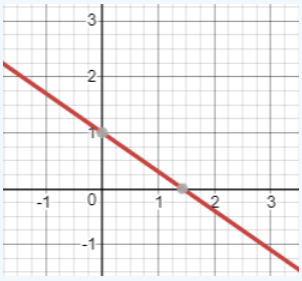
Finding the y-intercept from the graph

If the portion of the graph that is in view includes the y-axis, then the y-intercept is very easy to spot. You just see where it crosses the y-axis. On the other hand, if the portion of the graph in view does not contain the y-axis, then it is best to first find the equation

of the line and then use the equation to find the y-intercept.

Example 11.6.2.2

Find the y-intercept of the line shown below.



Solution

We just look at the line and notice that it crosses the y-axis at $y = 1$. Therefore, the y-intercept is 1 or (0,1).

Finding the equation of the line given its graph

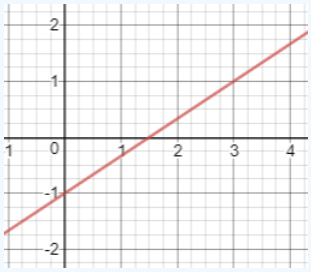
If you are given the graph of a line and want to find its equation, then you first find the slope as in Example 11.6.2.1 Then you use one of the points you found $(x_1,\ y_1)$ when you computed the slope, m, and put it into the **point slope equation**:

$$y - y_1 = m\,(x - x_1)$$

Then you multiply the slope through and add y_1 to both sides to get y by itself.

Example 11.6.2.3

Find the equation of the line shown below.



Solution

First we find the slope by identifying two nice points. Notice that the line passes through (0,-1) and (3,1). Now compute the slope using the rise over run formula:

$$Slope = \frac{rise}{run} = \frac{1-(-1)}{3-0} = \frac{2}{3}$$

Next use the point slope equation with the point (0,-1).

$$y-(-1) = \frac{2}{3}(x-0)$$

Now simplify:

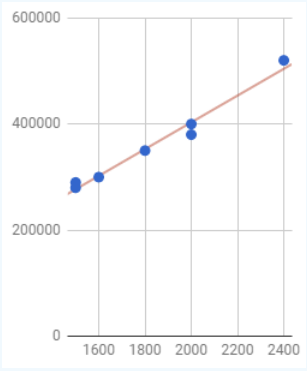
$$y+1 = \frac{2}{3}x$$

Finally subtract 1 from both sides to get:

$$y = \frac{2}{3}x - 1$$

Example 11.6.2.4

A study was done to look at the relationship between the square footage of a house and the price of the house. The scatter plot and regression line are shown below. Find the equation of the regression line.



Solution

First we find the slope by identifying two nice points. You will have to eyeball it and notice that the line passes through (1600, 300000) and (2000,400000). Now compute the slope using the rise over run formula:

$$\frac{rise}{run} = \frac{400000 - 300000}{2000 - 1600} = \frac{100000}{400} = 250$$

Next use the point slope equation with the point (2000,400000).

$$y - (400000) = 250\,(x - 2000)$$

Now simplify:

$$y - 400000 = 250x - 500000$$

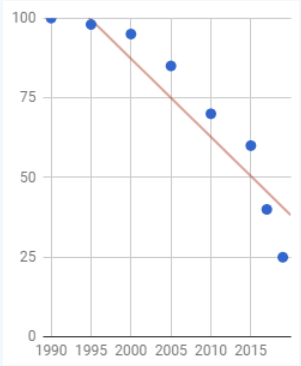
Finally add 400000 to both sides to get:

$$y = 250x - 100000$$

Notice that although the y-intercept is not visible from the graph of the line, we can see from the equation of the line that the y-intercept is -100000 or (0,-100000).

Exercise

The regression line and scatterplot below show the result of surveys that were taken in multiple years to find out the percent of households that had a landline telephone.



Find the equation of this regression line.

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11.6.3: Find y given x and the Equation of a Line

Learning Outcomes

1. Find the value of y given x and the equation of a line.
2. Use a line to make predictions.

A line can be thought of as a function, which means that if a value of x is given, the equation of the line produces exactly one value of y; This is particularly useful in regression analysis where the line is used to make a prediction of one variable given the value of the other variable.

Example 11.6.3.1

Consider the line with equation:

$$y = 3x - 4$$

Find the value of y when x is 5.

Solution

Just replace the variable x with the number 5 in the equation and perform the arithmetic:

$$y \ = \ 3\,(5) - 4 = 15 - 4 \ = 11$$

Example 11.6.3.2

A survey was done to look at the relationship between a woman's height, x and the woman's weight, y. The equation of the regression line was found to be:

$$y = -220 + 5.5x$$

Use this equation to estimate the weight in pounds of a woman who is 5' 2" (62 inches) tall.

Solution

Just replace the variable x with the number 62 in the equation and perform the arithmetic:

$$y \ = \ -220 + 5.5\,(62)$$

We can put this into a calculator or computer to get:

$$y \ = \ 121$$

Therefore, our best prediction for the weight of a woman who is 5' 2" tall is that she is 121 lbs.

Exercise

A biologist has collected data on the girth (how far around) of pine trees and the pine tree's height. She found the equation of the regression line to be:

$$y = 1.3 + 2.7x$$

Where the girth, x, is measured in inches and the height, y, is measured in feet. Use the regression line to predict the height of a tree with girth 28 inches.



https://youtu.be/cS95PlUKZ6I

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11.6.4: Graph a Line given its Equation

Learning Outcomes

1. Identify the slope and y-intercept from the equation of a line.
2. Plot the y-intercept of a line given its equation.
3. Plot a second point on a line given the y-intercept and the slope.
4. Graph a line given its equation in slope y-intercept form.

Often we are given an equation of a line and we want to visualize it. For this reason, it is important to be able to graph a line given its equation. We will look at lines that are in slope intercept form: $y = a + bx$ where a is the y-intercept of the line and b is the slope of the line. The y-intercept is the value of y where the line crosses the y-axis. The slope is the rise over run. If we write the slope as a fraction, then the numerator tells us how far to move up (or down if it is negative) and the denominator tells us how far to the right we need to go. the main application to statistics is in regression analysis which is the study of how to use a line to make a prediction about one variable based on the value of the other variable.

Example 11.6.4.1

Graph the line given by the equation:

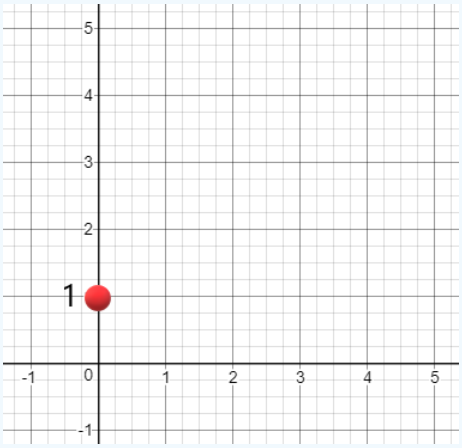
$$y = 1 + \frac{3}{2}x$$

Solution

We follow the three step process:

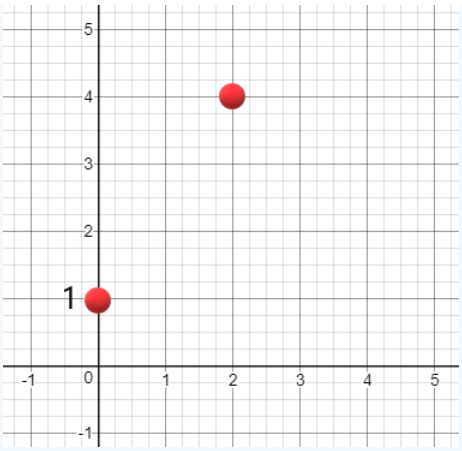
Step 1: Plot the y-intercept

The y-intercept is the number that is not associated with the x. For this example, it is 1. The x-coordinate of the y-intercept is always 0. So the coordinates of the y-intercept are (0,1). Thus start at the origin and move up 1:



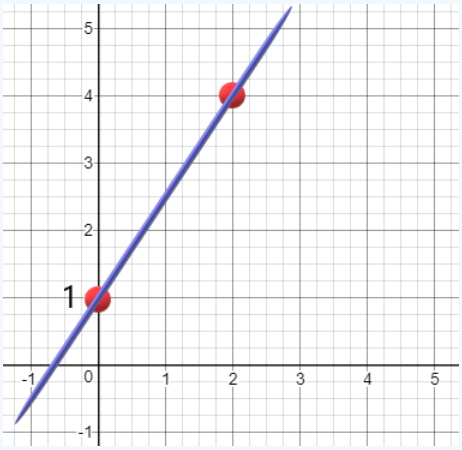
Step 2: Plot the Slope.

The slope of a line is the coefficient of the x term. Here it is $\frac{3}{2}$. What this means is that we rise 3 and run to the right 2. Rising 3 from an original y-coordinate of 1 gives a new y-coordinate of 4. Running 2 to the right from an initial x-coordinate of 0gives a new x-coordinate of 2. Thus we next plot the point (2,4).



Step 3: Connect the Dots

The last thing we need to do is connect the dots with a line:



Example 11.6.4.2

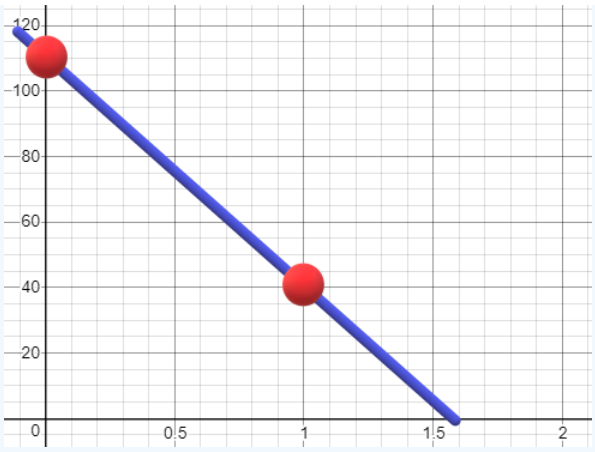
A study was done to look at the relationship between the weight of a car, x, in tons and its gas mileage in mpg, y. The equation of the regression line was found to be:

$$y = 110 - 70x \tag{11.6.4.1}$$

Graph this line.

Solution

The fist step is to note that the y-intercept is 110, hence the graph goes through the point (0,110). The next step is to see that the slope is -70. We can always put a number over 1 in order to make it a fraction. The slope of $-\frac{70}{1}$ tells us that y goes down by 70 if x goes up by 1. We use this to find the second point. The y-coordinate is: $110 - 70 = 40$. The x-coordinate is 1. Thus, a second point is (1,40). We can now plot the two points and connect the dots with a line.



Exercise

The regression line that relates the ounces of beer consumed just before a test, x, and the score on the test, y, is given by

$y = 93 - 1.2x$

Graph this line.

Graphing a Line in Slope-Intercept Form

https://youtu.be/z3rM-ZidXaw

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11.6.5: Interpreting the Slope of a Line

Learning Outcomes

1. Interpret the slope of a line as the change in y when x changes by 1.

Template for Interpreting the Slope of a Line

For every increase in the x-variable by 1, the y-variable tends to change by (xxx the slope).

A common issue when we learn about the equation of a line in algebra is to state the slope as a number, but have no idea what it represents in the real world. The slope of a line is the rise over the run. If the slope is given by an integer or decimal value we can always put it over the number 1. In this case, the line rises by the slope when it runs 1. "Runs 1" means that the x value increases by 1 unit. Therefore the slope represents how much the y value changes when the x value changes by 1 unit. In statistics, especially regression analysis, the x value has real life meaning and so does the y value.

Example 11.6.5.1

A study was done to see the relationship between the time it takes, x, to complete a college degree and the student loan debt incurred, y. The equation of the regression line was found to be:

$$y = 25142 + 14329x \tag{11.6.5.1}$$

Interpret the slope of the regression line in the context of the study.

Solution

First, note that the slope is the coefficient in front of the x. Thus, the slope is 14,329. Next, the slope is the rise over the run, so it helps to write the slope as a fraction:

$$Slope = \frac{rise}{run} = \frac{14,329}{1} \tag{11.6.5.2}$$

The rise is the change in y and y represents student loan debt. Thus, the numerator represents an increase of $14,329 of student loan debt. The run is the change in x and x represents the time it takes to complete a college degree. Thus, the denominator represents an increase of 1 year to complete a college degree. We can put this all together and interpret the slope as telling us that

For every additional year it takes to complete a college degree, on average the student loan debt tends to increase by $14,329.

Example 11.6.5.2

Suppose that a research group tested the cholesterol level of a sample of 40 year old women and then waited many years to see the relationship between a woman's HDL cholesterol level in mg/dl, x, and her age of death, y. The equation of the regression line was found to be:

$$y = 103 - 0.3x \tag{11.6.5.3}$$

Interpret the slope of the regression line in the context of the study.

Solution

The slope of the regression line is -0.3. The slope as a fraction is:

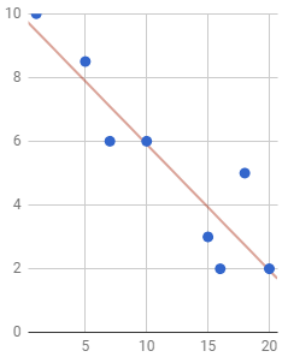
$Slope = \frac{rise}{run} = \frac{-0.3}{1}$ ” $width =$” 233

The rise is the change in y and y represents age of death. Since the slope is negative, the numerator indicates a decrease in lifespan. Thus, the numerator represents a decrease in lifespan of 0.3 years. The run is the change in x and x represents the HDL cholesterol level. Thus, the denominator represents an HDL cholesterol level increase of 1 mg/dl. Now, put this all together and interpret the slope as telling us that

For every additional 1 mg/dl of HDL cholesterol, on average women are predicted to die 0.3 years younger.

Example 11.6.5.3

A researcher asked several employees who worked overtime "How many hours of overtime did you work last week?" and "On a scale from 1 to 10 how satisfied are you with your job?". The scatterplot and the regression line from this study are shown below.



Interpret the slope of the regression line in the context of the study.

Solution

We first need to determine the slope of the regression line. To find the slope, we get two points that have as nice coordinates as possible. From the graph, we see that the line goes through the points (10,6) and (15,4). The slope of the regression line can now be found using the rise over the run formula:

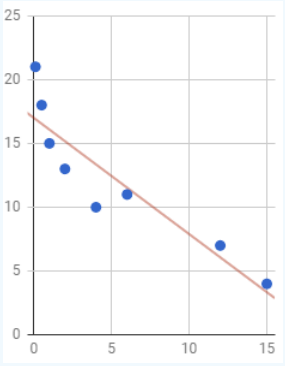
$$Slope = \frac{rise}{run} = \frac{4-6}{15-10} = \frac{-2}{5} \tag{11.6.5.4}$$

The rise is the change in y and y represents job satisfaction rating. Since the slope is negative, the numerator indicates a decrease in job satisfaction. Thus, the numerator represents a decrease in job satisfaction of 2 on the scale from 1 to 10. The run is the change in x and x represents the overtime work hours. Thus, the denominator represents an increase of 5 hours of overtime work. Now, put this all together and interpret the slope as telling us that

For every additional 5 hours of overtime work that employees are asked to do, their job satisfaction tends to go down an average of 2 points.

Exercise

The scatterplot and regression line below are from a study that collected data on the population (in hundred thousands) of cities and the average number of hours per week the city's residents spend outdoors.



Interpret the slope of this regression line in the context of the study.

Interpret the Meaning of the Slope of a Linear Equation - Smokers

Interpreting the Slope of a Regression Line

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11.6.6: Interpreting the y-intercept of a Line

Learning Outcomes

1. Interpret the y-intercept of a line as the value of y when x equals to 0.
2. Determine whether the y-intercept is useful for interpreting the relationship between x and y

Just like the slope of a line, many algebra classes go over the y-intercept of a line without explaining how to use it in the real world. The y-intercept of a line is the value of y where the line crosses the y-axis. In other words, it is the value of y when the value of x is equal to 0. Sometimes this has true meaning for the model that the line provides, but other times it is meaningless. We will encounter examples of both types in this section.

Template for the y-Intercept Interpretation

When the value for the x-variable is 0, the best prediction for the value of the y-variable is (xxx the y-intercept).

Example 11.6.6.1

A study was done to see the relationship between the ounces of meat, x, that people eat each day on average and the hours per week, y they watch sports. The equation of the regression line was found to be:

$$y = 1.3 + 0.4x$$

Interpret the y-intercept of the regression line in the context of the study or explain why it has no practical meaning.

Solution

First, note that the y-intercept is the number that is not in front of the x. Thus, the y-intercept is 1.3. Next, the y-intercept is the value of y when x equals zero. For this example, x represents the ounces of meat consumed each day.

When the consumption of meat is 0, the best prediction for the value of the hours of sports each week is 1.3.

If x is equal to 0, this means the person does not consume any meat. Since there are people, called vegetarians, who consume no meat, it is meaningful to have an x-value of 0. The y-value of 1.3 represents the hours of sports the person watches. Putting this all together we can state:

A vegetarian is predicted to watch 1.3 hours of sports each week.

Example 11.6.6.2

A neonatal nurse at Children's Hospital has collected data on the birth weight, x, in pounds the number of days, y, that the newborns stay in the hospital. The equation of the regression line was found to be

$$y = 45 - 3.9x$$

Interpret the y-intercept of the regression line in the context of the study or explain why it has no practical meaning.

Solution

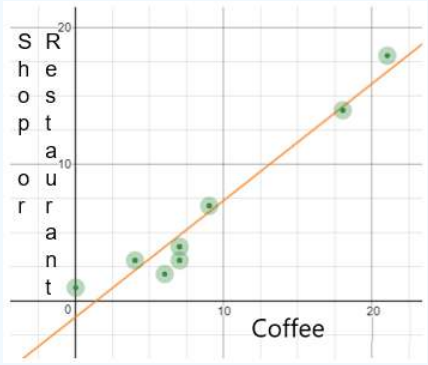
Again, we note that the y-intercept is the number that is not in front of the x. Thus, the y-intercept is 45. Next, the y-intercept is the value of y when x equals zero.

When the birth weight in pounds is 0, the best prediction for the value of the number of days the newborn is predicted to stay in the hospital is 45 days.

For this example, x represents the new born baby's birth weight in pounds. If x is equal to 0, this means the baby was born with a weight of 0 pounds. Since it makes no sense for a baby to weigh 0 pounds, we can say that the y-intercept of this regression line has no practical meaning.

Example 11.6.6.3

A researcher asked several people "How many cups of coffee did you drink last week?" and "How many times did you go to a shop or restaurant for a meal or a drink last week?" The scatterplot and the regression line from this study are shown below.



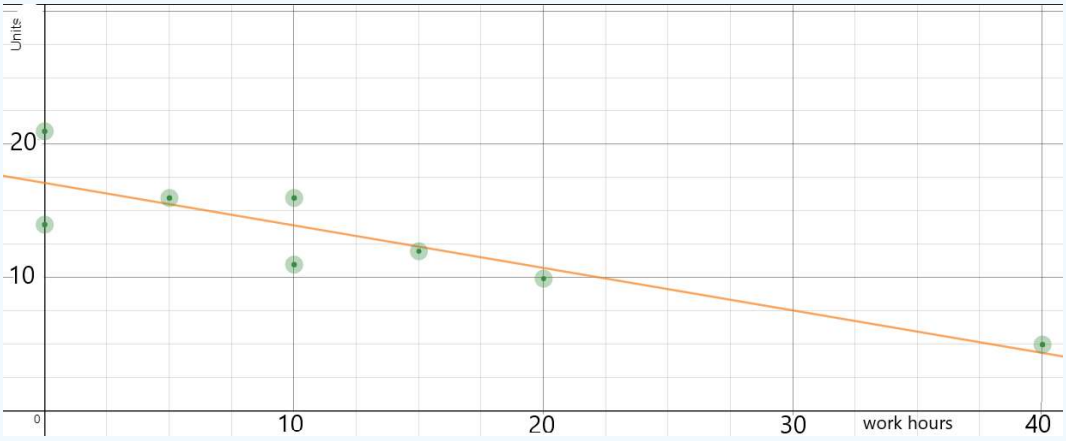
Interpret the y-intercept of the regression line in the context of the study or explain why it has no practical meaning.

Solution

The y-intercept of a line is where it crosses the y-axis. In this case, the line crosses at around y = -1. The value of x, by definition is 0 and the x-axis represents the number of cups of coffee a person drank last week. Since there are people who don't drink coffee, it does male sense to have an x-value of 0. The y-axis represents the number of times the person went to a shop or restaurant last week to purchase a meal or a drink. It makes no sense to say that a person went -1 times to a shop or restaurant last week to purchase a meal or a drink. Therefore the y-intercept of this regression line has no practical meaning.

Exercise

The scatterplot and regression line below are from a study that collected data from a group of college students on the number of hours per week during the school year they work at a paid job and the number of units they are taking. Interpret the y-intercept of the regression line or explain why it has no practical meaning.



- Interpret the Meaning of the y-intercept Given a Linear Equation
- Interpreting the y-Intercept

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11.6.7: Plot an Ordered Pair

Learning Outcomes

1. Draw x and y axes.
2. Plot a point in the xy-plane

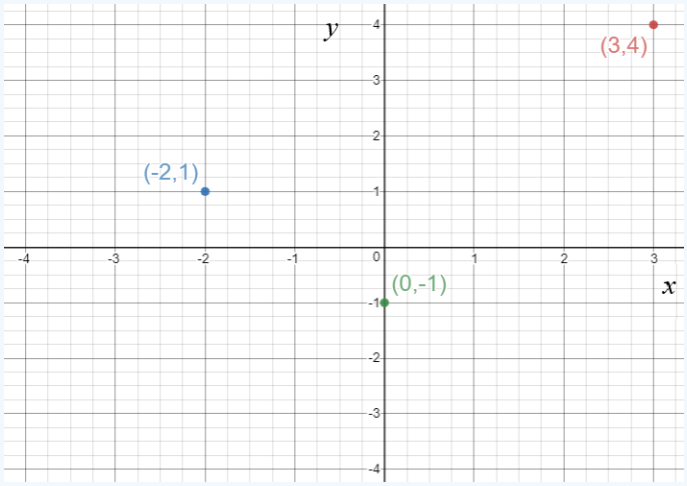
We have already gone into detail about how to plot points on a number line, and that is very useful for single variable presentations. Now we will move to questions that involve comparing two variables. Working with two variables is frequently encountered in statistical studies and we would like to be able to display the results graphically. This is best done by plotting points in the xy-plane.

Example 11.6.7.1

Plot the points: $(3,4)$,$(-2,1)$, and $(0,-1)$

Solution

The first thing to do when plotting points is to sketch the x-axis and y-axis and decide on the tick marks. Here the numbers are all less than 5, so it is reasonable to count by 1's. Next, we plot the first point, $(3,4)$. This means to start at the origin, where the axes intersect. Then move 3 units to the right and 4 units up. After arriving there, we just draw a dot. For the next point, $(-2,1)$, we start at the origin, move 2 units to the left and 1 unit up and draw the dot. For the third point, $(0,-1)$, we don't move left or right at all since the x-coordinate is 0, but we do move 1 unit down and draw the dot. The plot is shown below.



Example 11.6.7.2

A survey was done to look at the relationship between a person's age and their income. The first three answers are shown in the table below:

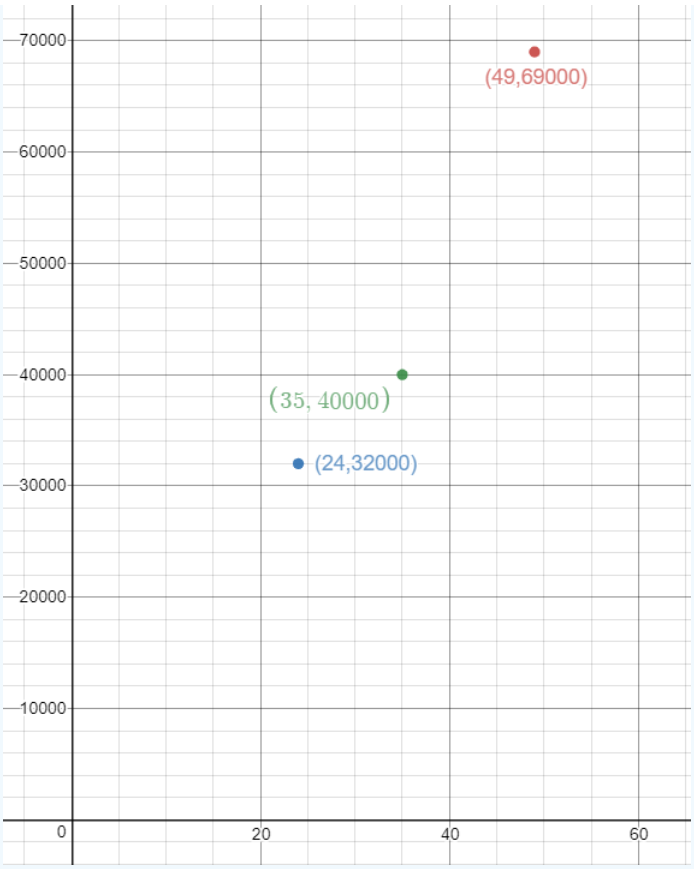
Table of ages and income

Age	49	24	35
Income	69,000	32,000	40,000

Graph the three points on the xy-plane.

Solution

Notice that the numbers are all relatively large. Therefore counting by 1's would not make sense. Instead, it makes better sense to count the Age axis, x, by 10's and the Income axis, y, by 1000's. The points are plotted below.



Exercise

A hotel manager was interested in seeing the relationship between the price per night, x, that the hotel charged and the number of occupied rooms, y. The results were (75,83), (100,60), (110,55), and (125,40). Plot these points in the xy-plane.

Ex: Plotting Points on the Coordinate Plane

Plotting Points

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