CONTEMPORARY HEALTH ISSUES I (LUMEN)



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Licensing

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CHAPTER OVERVIEW

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1.1: Basic Principles of Health Education

Basic Principles of Health Education

In this module, you will learn about the definition of health, health education, and health promotion. This will help you to understand then important components of health.

- **Physical**
- **Psychological**
- **Social**

Personal Views on Health

Think about your responses to the following questions:

- What does health mean to you?
- How important is health to you?
- What do you do (if anything) to stay healthy?

Definition and Concepts of Health

In the *Oxford English Dictionary* health is defined as: “the state of being free from sickness, injury, disease, bodily conditions; something indicating good bodily condition.”

Now stop for a minute and think about someone you think is healthy and someone else who you would consider not to be healthy.

- Look at the definition of health again.
- Is it similar to the what you thought about for a healthy or an unhealthy person?

This definition of health is a widely publicized one. But you may have thought of someone who has a disability or wondered about someone who looks OK but who you know does not exercise. Clearly health is not quite as simple as the definition implies.
The concept of health is wide, and the way we define health also depends on individual perception, religious beliefs, cultural values, norms, and social class. Generally, there are two different perspectives concerning people’s own definitions of health: a narrow perspective and a broader perspective.

1. Narrow Perspectives of Health

People with a narrow perspective consider health as the absence of disease, disability, or biological dysfunction. According to this view, to call someone unhealthy or sick means there should be evidence of a particular illness. Social, emotional, and psychological factors are not believed to cause unhealthy conditions. This view is narrow and limits the definition of health to the physical and physiological capabilities that are necessary to perform routine tasks.

According to this definition, the individual is healthy if all the body parts, cells, tissues, and organ systems are functioning well, and there is no apparent dysfunction of the body. Using this view, people view the human body in the same say as a computer or mechanical device. When something is wrong, the object is taken to experts who will maintain it. Hence, physicians often focus on treatment and clinical interventions with medication rather than health education to bring about behavior change.

Serena’s Story

- About two months ago Serena lost her six month old twins. She is grief stricken. She has always been slender, but now she looks very thin. She cannot sleep; she cannot eat, and she doesn’t want to talk to anyone.
- Do you think the view of health you have just read about applies to Serena?

This view of health ignores many of the social and psychological causes of ill health. Serena’s grief is not an illness, but it is certainly affecting her health.

2. Broader Perspectives of Health

In the previous section you read about a narrow definition of health. Now this section will help you understand the concept of health in a broader and more holistic way.

The most widely used broader definition of health is that within the constitution of the World Health Organization (1948), which defines health as: “Health is not only the absence of infirmity and disease but also a state of physical mental and social well-being.”

This classic definition is important, as it identifies the vital components of health. To more fully understand the meaning of health, it is important to understand each of its individual components.

- Think back to Serena.
- Describe her state of health.
- Serena is mentally distressed. She does not by any means have mental and social well-being.

Physical Health

Physical health, which is one of the components of the definition of health, could be defined as the absence of diseases or disability of the body parts. Physical health could be defined as the ability to perform routine tasks without any physical restriction

To understand physical health, one needs to know what is considered to be physically unhealthy.

The following examples can help to understand someone who is physically unhealthy:

- A person who has been harmed due to a car accident
- A farmer infected by malaria and unable to do their farming duties
- A person infected by tuberculosis and unable to perform his or her tasks.

According to the WHO definition, do you see any of the above unhealthy examples as healthy? Also think about someone in your community who you would consider to be physically disabled.

While both of these people may be restricted in their movement and ability to do routine tasks, they may still be in a state of physical and mental well-being.

Psychological Health

Health is not limited to the biological integrity and the physiological functioning of the human body. Psychological health is also an important aspect of a health definition.

- Think about people in the community who are showing behavior that may indicate they are going through a period of mental distress in their lives.
- Or think about Serena again.
- Do you think that everyone in distress shows the same sorts of symptoms?

Sometimes it can be really difficult to tell if people are struggling with mental health issues, but at other times they may show symptoms that suggest a lack of self-awareness or personal identity, or an inability of rational and logical decision-making. At other times it might be apparent that they are not looking after themselves and are without a proper purpose in their lives. They may be drinking alcohol and have a non-logical response to any request. It may also be noticed that they have an inability to maintain their personal autonomy and are unable to maintain good relationships with people around them.

Social Health

The social component of health is considered to be the ability to make and maintain “acceptable” and “proper” interactions and to communicate with other people within the social environment. This component also includes being able to maintain satisfying interpersonal relationships and being able to fulfill a social role. Having a social role is the ability that people have to maintain their own identity while sharing, cooperating, communicating, and enjoying the company of others. This is really important when participating in friendships and taking a full part in family and community life.

Which of the following examples could be considered to contribute to social health? Explain and discuss your answers.

1. Mourning when a close family member dies
2. Going to a football game or involvement in a community meeting
3. Celebrating traditional cultural events within a community
4. Shopping in the market
5. Creating and maintaining friendships

In reality, all these events could have a social component and help towards building people’s social view of health. They all involve interacting with others and gaining support, friendship, and in many instances joy from being with other people.

The World Health Organization said that health promotion is defined as the process of enabling people to increase control over, and to improve, their health. The aim of health promotion is to reduce the underlying causes of ill-health so that there is a long-term reduction in many diseases.

Summary

When broadly defined, health is a state of complete physical, mental, and social well being not merely the absence of disease or infirmity. It contains several different aspects which can include physical and mental health issues often interrelated. According to this definition, physical, social, and psychological factors all contribute to health. Wellness is then expressed through the integration of the physical, intellectual, emotional, spiritual, social, and environmental components called the Six Dimensions of Health.

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1.2: Health Literacy

What is Health Literacy?

In the report, *Healthy People*, the U.S. Department of Health and Human Services included improved consumer health literacy and identified health literacy as an important component of health communication, medical product safety, and oral health. Health literacy is defined in *Healthy People* as: "The degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions."

Health literacy includes the ability to understand instructions on prescription drug bottles, appointment slips, medical education brochures, doctor's directions and consent forms, and the ability to negotiate complex health care systems. Health literacy is not simply the ability to read. It requires a complex group of reading, listening, analytical, and decision-making skills, and the ability to apply these skills to health situations.

Health literacy varies by context and setting and is not necessarily related to years of education or general reading ability. A person who functions adequately at home or work may have marginal or inadequate literacy in a health care environment. With the move towards a more "consumer-centric" health care system as part of an overall effort to improve the quality of health care and to reduce health care costs, individuals need to take an even more active role in health care related decisions. To accomplish this people need strong health information skills.

Why Does Health Literacy Matter?

Every day, people confront situations that involve life-changing decisions about their health. These decisions are made in places such as grocery and drug stores, workplaces, playgrounds, doctors' offices, clinics and hospitals, and around the kitchen table. Obtaining, communicating, processing, and understanding health information and services are essential steps in making appropriate health decisions; however, research indicates that today's health information is presented in ways that are not usable by most adults. "Limited health literacy" occurs when people can't find and use the health information and services they need.

- Nearly 9 out of 10 adults have difficulty using the everyday health information that is routinely available in our healthcare facilities, retail outlets, media, and communities.
- Without clear information and an understanding of the information's importance, people are more likely to skip necessary medical tests, end up in the emergency room more often, and have a harder time managing chronic diseases like diabetes or high blood pressure.

Whom Does Health Literacy Affect?

People of all ages, races, incomes, and educational levels can find it difficult to obtain, communicate, process, and understand health information and services. Literacy skills are only a part of health literacy. Even people with strong reading and writing skills can face health literacy challenges when they are not familiar with medical terms or how their bodies work. They have to interpret or calculate numbers or risks that could have immediate effects on their health and safety. They are diagnosed with a serious illness and are scared or confused. They have health conditions that require complicated self-care. Every organization involved in health information and services needs its own health literacy plan to improve its organizational practices to help everyone of all ages.

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1.3: Well-Being Concepts

Well-being Concepts

Well-being is a positive outcome that is meaningful for people and for many sectors of society because it shows that people perceive that their lives are going well. Good living conditions (e.g., housing, employment) are fundamental to well-being. Tracking these conditions is important. However, many indicators that measure living conditions fail to measure what people think and feel about their lives such as the quality of their relationships, their positive emotions and resilience, the realization of their potential, or their overall satisfaction with life—i.e., their "well-being." Well-being generally includes global judgments of life satisfaction and feelings ranging from depression to joy.

Why is well-being useful?

- Well-being integrates mental health (mind) and physical health (body) resulting in more holistic approaches to disease prevention and health promotion.
- Well-being is a valid population outcome measure beyond morbidity, mortality, and economic status that tells how people perceive their lives are going from their own perspective.
- Well-being is an outcome that is meaningful to the public.
- Results from cross-sectional, longitudinal, and experimental studies find that well-being is associated with:
  - Self-perceived health
  - Longevity
  - Healthy behaviors
  - Mental and physical illness
  - Social connectedness
  - Productivity
  - Factors in the physical and social environment

Measuring, tracking, and promoting well-being can be useful in disease prevention and health promotion. Well-being is associated with numerous health-, job-,family-,and economically-related benefits. For example, higher levels of well-being are associated with decreased risk of disease, illness, and injury; better immune functioning; speedier recovery; and increased longevity. Individuals with high levels of well-being are more productive at work and are more likely to contribute to their communities.

How does well-being relate to health promotion?

Health is more than the absence of disease; it is a resource that allows people to realize their aspirations, satisfy their needs, and to cope with the environment in order to live a long, productive, and fruitful life. In this sense, health enables social, economic, and personal development fundamental to well-being. Health promotion is the process of enabling people to increase control over, and to improve their health. Environmental and social resources for health can include: peace, economic security, a stable ecosystem, and safe housing. Individual resources for health can include: physical activity, healthful diet, social ties, resiliency, positive emotions, and autonomy. Health promotion activities aimed at strengthening such individual, environmental, and social resources may ultimately improve well-being.

How is well-being defined?

There is no consensus around a single definition of well-being, but there is general agreement that at minimum, well-being includes the presence of positive emotions and moods (e.g., contentment, happiness), the absence of negative emotions (e.g., depression, anxiety), satisfaction with life, fulfillment and positive functioning, (e.g., feeling very healthy and full of energy). In simple terms, well-being can be described as judging life positively and feeling good. The following areas have been examined by different disciplines and include six of the dimensional wellness categories:

- Physical well-being
- Economic well-being
- Social well-being
- Development and activity
- Emotional well-being
- Psychological well-being
- Life satisfaction

- Domain specific satisfaction
- Engaging activities and work

What are some determinants of individual-level well-being?

There is no sole determinant of individual well-being, but in general, well-being is dependent upon good health, positive social relationships, and availability and access to basic resources (e.g., shelter, income). Life satisfaction is dependent more closely on the availability of basic needs being met (food, shelter, income) as well as access to modern conveniences (e.g., electricity). Pleasant emotions are more closely associated with having supportive relationships. Having supportive relationships is one of the strongest predictors of well-being, having a notably positive effect.

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1.4: Risk Factors

What is a risk factor?

Risk factors are things in one's life that increase the chances of developing a condition or disease. They can include things like family history, exposures to things in the environment, being a certain age or sex, being from a certain ethnic group, or already having a health condition.

Understanding Risk Factors

Part of learning how to take charge of one's health requires understanding the risk factors for different diseases. Risk factors increase the chances of getting a certain disease. Some risk factors are beyond control such as being born with them or exposed to them.

Some risk factors that one has little or no control over include:

- Family history of a disease
- Sex/gender — male or female
- Ancestry

Some risk factors that can be controlled include:

- Diet
- Physical activity
- Tobacco use
- Alcohol use
- Drug use
- Safety in an automobile

In fact, it has been estimated that almost 35 percent of all U.S. early deaths in 2000 could have been avoided by changing just three behaviors:

- Stopping smoking
- Eating a healthy diet (for example, eating more fruits and vegetables and less red meat)
- Getting more physical activity

Personal Assessment

Find out about your own health risks by completing the questionnaire at Keep Me Well. Email yourself the results of the assessment.

FYI:
You can have one risk factor for a disease or you can have many. The more risk factors you have, the more likely you are to get the disease. For example, if you eat healthy, exercise on a regular basis, and control your blood pressure, your chances of getting heart disease are less than if you are diabetic, a smoker, and inactive. To lower your risks, take small steps toward engaging in a healthy lifestyle, and you'll see big rewards.
Rarely, you can inherit a mutated gene that alone causes you to get a disease. Genes control chemical reactions in our bodies. If you inherit a faulty gene, your body may not be able to carry out an important chemical reaction. For instance, a faulty gene may make your blood unable to clot. This problem is at the root of a rare bleeding disorder. More often, you can inherit genes from one or both of your parents that put you at higher risk of certain diseases. But having a gene for a certain disease does not always mean you will get it. There are many unknown factors that may raise or lower your chances of getting the disease. People with a family health history of chronic disease may have the most to gain from making lifestyle changes. You can't change your genes, but you can change behaviors that affect your health such as smoking, inactivity, and poor eating habits. In many cases, making these changes can reduce your risk of disease even if the disease runs in your family. Another change you can make is to have screening tests such as mammograms and colorectal cancer screening. These screening tests help detect disease early.

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1.5: Personal Safety

When I first moved to Tacoma several years ago, a colleague from my small community college in Walla Walla told me that I should be careful of violent crime because Tacoma was such a dangerous place. Of course, I knew that a greater population meant that there was more likely to be more crime than the much smaller city of Walla Walla, but I also knew that I could protect myself by following a few simple rules.

The National Crime Prevention Council provides a list of rules that adults should follow to protect themselves from violent crime.

It's also important to know that violent crime in the United States has actually decreased in the past few years. The NCPC provides more information about that as well.

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CHAPTER OVERVIEW

2: Nutritional Health

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2.2: Essential Nutrients
2.3: Food Energy, Calories
2.4: Importance of Food Groups

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2.1: Nutritional Health

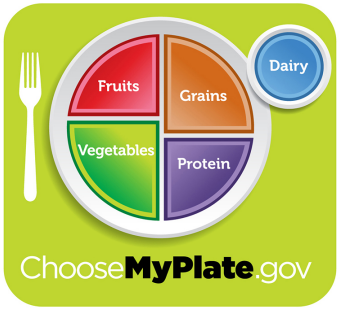
Tell me what you eat: I will tell you what you are.

Jean-Anthelme Brillat-Savarin, *The Philosopher in the Kitchen*, Aphorism IV, 1825

Brillat-Savarin's aphorism may not be entirely true, but it holds a grain of truth. Given the diversity of animal life on our planet, it is not surprising that the animal diet would also vary substantially. The animal diet is the source of materials needed for building DNA and other complex molecules needed for growth, maintenance, and reproduction; collectively these processes are called biosynthesis. The diet is also the source of materials for ATP production in the cells. The diet must be balanced to provide the minerals and vitamins that are required for cellular function.

Food Requirements

What are the fundamental requirements of the animal diet? The animal diet should be well balanced and provide nutrients required for bodily function and the minerals and vitamins required for maintaining structure and regulation necessary for good health and reproductive capability. These requirements for a human are illustrated graphically in this picture.



For humans, a balanced diet includes fruits, vegetables, grains, and protein. (credit: USDA)

Let's Move! Campaign

Obesity is a growing epidemic and the rate of obesity among children is rapidly rising in the United States. To combat childhood obesity and ensure that children get a healthy start in life, First Lady Michelle Obama has launched the Let's Move! campaign. The goal of this campaign is to educate parents and caregivers on providing healthy nutrition and encouraging active lifestyles to future generations. This program aims to involve the entire community, including parents, teachers, and healthcare providers to ensure that children have access to healthy foods—more fruits, vegetables, and whole grains—and consume fewer calories from processed foods. Another goal is to ensure that children get physical activity. With the increase in television viewing and stationary pursuits such as video games, sedentary lifestyles have become the norm.

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2.2: Essential Nutrients

Nutrition can be defined as the science of food, beverages, and their components in biological systems. A nutrient is a compound that provides a needed function in the body. Nutrients can be further classified based on the amount needed in the body.

Essential Nutrients

The six Essential Nutrients are the nutrients that our bodies need in order to survive. They can be broken into two categories: macronutrients and micronutrients. Throughout this class we will go into more detail about each of the essential nutrients.

Macronutrients are nutrients needed in larger amounts. There are four macronutrients which include:

- carbohydrates
- lipids
- protein
- water

Micronutrients are nutrients needed in smaller amounts, but they are still considered essential. There are two groups of micronutrients which are:

- vitamins
- minerals

Carbohydrates

Carbohydrates are the primary form of energy. The name carbohydrate means “hydrated carbon” or carbon with water. Thus, it isn’t a surprise that carbohydrates are made up of carbon, hydrogen, and oxygen. Sucrose (table sugar) is an example of a commonly consumed carbohydrate. Some dietary examples of carbohydrates are whole-wheat bread, oatmeal, rice, sugary snacks/drinks, and pasta.



Grains, such as those in this whole wheat bread, are carbohydrates.

Lipids (Fats)

Lipids consist of fatty acids, triglycerides, phospholipids, and sterols (i.e. cholesterol). Lipids are also composed of carbon, hydrogen, and oxygen. Some dietary sources of lipids include oils, butter, and egg yolks.



Butter is a food source of lipids.

Proteins

Proteins are also made up of carbon, hydrogen, and oxygen, but they also contain nitrogen. Several dietary sources of proteins include nuts, beans/legumes, skim milk, egg whites, and meat.



Eggs are a source of protein.

Water

Water is made up of hydrogen and oxygen (H2O) and is the only macronutrient that doesn't provide energy.



Thirsty? There is a reason.

Vitamins

Vitamins are compounds that are essential for normal physiologic processes in the body.



Oranges are a food source for Vitamin C.

Minerals

Minerals are elements (think periodic table) that are essential for normal physiologic processes in the body.



Table salt is a food source for sodium, a mineral.

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2.3: Food Energy, Calories

Food energy is measured in calories, also known as kilocalories (kcals). Food labels use the term calorie to describe the amount of energy in the individual foods described. The term calorie is used in this textbook to describe food energy.



Fruit, vegetables and dairy products provide calories.

FYI

A kilocalorie is the amount of energy needed to raise 1 kilogram of water 1 degree Celsius.

Three of the macronutrients provide energy (calories).

Carbohydrate : 4 calories per gram

Protein: 4 calories per gram

Fats: 9 calories per gram

As can be seen, carbohydrates, protein, and fats provide energy. However, there is another energy source in the diet that is not a nutrient…..alcohol.

Alcohol is NOT a nutrient! But it does provide energy. Alcohol has 7 calories per gram.

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2.4: Importance of Food Groups

Explore this interactive United States Department of Agriculture website to learn more about each food group and the recommended daily amounts.

The organic molecules required for building cellular material and tissues must come from food. During digestion, digestible carbohydrates are ultimately broken down into glucose and used to provide energy within the cells of the body. Complex carbohydrates, including polysaccharides, can be broken down into glucose through biochemical modification; however, humans do not produce the enzyme necessary to digest cellulose (fiber). The intestinal flora in the human gut are able to extract some nutrition from these plant fibers. These plant fibers are known as dietary fiber and are an important component of the diet. The excess sugars in the body are converted into glycogen and stored for later use in the liver and muscle tissue. Glycogen stores are used to fuel prolonged exertions, such as long-distance running, and to provide energy during food shortage. Fats are stored under the skin of mammals for insulation and energy reserves.

Proteins in food are broken down during digestion and the resulting amino acids are absorbed. All of the proteins in the body must be formed from these amino-acid constituents; no proteins are obtained directly from food.

Fats add flavor to food and promote a sense of satiety or fullness. Fatty foods are also significant sources of energy, and fatty acids are required for the construction of lipid membranes. Fats are also required in the diet to aid the absorption of fat-soluble vitamins and the production of fat-soluble hormones.

While the animal body can synthesize many of the molecules required for function from precursors, there are some nutrients that must be obtained from food. These nutrients are termed essential nutrients, meaning they must be eaten, because the body cannot produce them.

The fatty acids omega-3 alpha-linolenic acid and omega-6 linoleic acid are essential fatty acids needed to make some membrane phospholipids. Vitamins are another class of essential organic molecules that are required in small quantities. Many of these assist enzymes in their function and, for this reason, are called coenzymes. Absence or low levels of vitamins can have a dramatic effect on health. Minerals are another set of inorganic essential nutrients that must be obtained from food. Minerals perform many functions, from muscle and nerve function, to acting as enzyme cofactors. Certain amino acids also must be procured from food and cannot be synthesized by the body. These amino acids are the “essential” amino acids. The human body can synthesize only 11 of the 20 required amino acids; the rest must be obtained from food.

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CHAPTER OVERVIEW

3: Cardiovascular System

3.1: Cardiovascular System
3.2: Shape and Size of the Heart
3.3: Heart Chambers and Circulation through the Heart
3.4: External picture of the Heart
3.5: Internal Structure of the Heart
3.6: Right Atrium
3.7: Right Ventricle
3.8: Left Atrium
3.9: Left Ventricle
3.10: Importance of the Human Heart

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3.1: Cardiovascular System

The vital importance of the heart is obvious. If one assumes an average rate of contraction of 75 contractions per minute, a human heart would contract approximately 108,000 times in one day, more than 39 million times in one year, and nearly 3 billion times during a 75-year lifespan. Mind boggling isn't it?

Each of the major pumping chambers of the heart ejects approximately 70 mL blood per contraction in a resting adult. This would be equal to 5.25 liters of fluid per minute and approximately 14,000 liters per day. Over one year, that would equal 10,000,000 liters or 2.6 million gallons of blood sent through roughly 60,000 miles of vessels. In order to understand how that happens, it is necessary to understand the anatomy and physiology of the heart. So let's delve into the inner makings of the heart to see how fascinating it is.

Location of the Heart

The human heart is located within the thoracic cavity. Figure shows the position of the heart within the thoracic cavity. The great veins, the superior and inferior venae cavae, and the great arteries, the aorta and pulmonary trunk, are attached to the superior surface of the heart, called the base. Figure. The inferior tip of the heart is called the apex.

Position of the Heart in the Thorax

This diagram shows the location of the heart in the thorax.

The heart is located within the thoracic cavity. It is about the size of a fist, is broad at the top, and tapers toward the base.

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3.2: Shape and Size of the Heart

Shape and Size of the Heart

The shape of the heart is similar to a triangle, rather broad at the superior surface and tapering to the apex (see Figure). A typical heart is approximately the size of your fist. Given the size difference between most members of the sexes, the weight of a female heart is smaller on average than the male's heart. The heart of a well-trained athlete, especially one specializing in aerobic sports, can be considerably larger than this. Cardiac muscle responds to exercise in a manner similar to that of skeletal muscle. Hearts of athletes can pump blood more effectively at lower rates than those of nonathletes.

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3.3: Heart Chambers and Circulation through the Heart

Heart Chambers and Circulation through the Heart

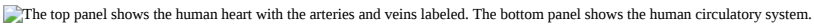
The human heart consists of four chambers: The left side and the right side each have one atrium and one ventricle. Each of the upper chambers, the right atrium (plural = atria) and the left atrium, acts as a receiving chamber and contracts to push blood into the lower chambers, the right ventricle and the left ventricle. The ventricles serve as the primary pumping chambers of the heart propelling blood to the lungs or to the rest of the body.

There are two distinct but linked circuits in the human circulation called the pulmonary and systemic circuits. The pulmonary circuit transports blood to and from the lungs, where it picks up oxygen and delivers carbon dioxide for exhalation. The systemic circuit transports oxygenated blood to virtually all of the tissues of the body and returns to the heart.

The right ventricle pumps **deoxygenated** blood into the pulmonary trunk which leads toward the lungs and splits into the left and right pulmonary arteries. These vessels in turn branch many times before reaching the pulmonary capillaries where gas exchange occurs: Carbon dioxide exits the blood and oxygen enters. The pulmonary trunk arteries and their branches are the **only** arteries in the body that carry relatively **deoxygenated** blood (blue blood). Highly oxygenated blood returning from the pulmonary capillaries in the lungs passes through a series of vessels that join together to form the pulmonary veins—the **only** veins (red) in the body that carry **highly oxygenated** blood. The pulmonary veins (red) bring blood into the left atrium which delivers the blood into the left ventricle which in turn pumps oxygenated blood into the aorta and on to the many branches of the systemic circuit. Eventually, these vessels will lead to the systemic capillaries where exchange with the tissue fluid and cells of the body occurs. In this case, oxygen and nutrients exit the systemic capillaries to be used by the cells in their metabolic processes, and carbon dioxide and waste products will enter the blood.

The blood that has traveled throughout the body is lower in oxygen concentration than when it entered. The superior vena cava and the inferior vena cava return blood to the right atrium. The blood in the superior and inferior venae cavae flows into the right atrium, which delivers blood into the right ventricle. This process of blood circulation continues as long as the individual remains alive. (Figure).

Dual System of the Human Blood Circulation


The top panel shows the human heart with the arteries and veins labeled. The bottom panel shows the human circulatory system.

Blood flows from the right atrium to the right ventricle where it is pumped into the pulmonary circuit. The blood in the pulmonary artery branches is low in oxygen but relatively high in carbon dioxide. Gas exchange occurs in the pulmonary capillaries (oxygen into the blood, carbon dioxide out), and blood high in oxygen and low in carbon dioxide is returned to the left atrium. From here, blood enters the left ventricle which pumps it into the systemic circuit. Following exchange in the systemic capillaries (oxygen and nutrients out of the capillaries and carbon dioxide and wastes in), blood returns to the right atrium and the cycle is repeated.

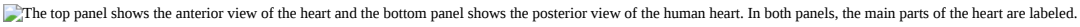
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3.4: External picture of the Heart

External Anatomy of the Heart


The top panel shows the anterior view of the heart and the bottom panel shows the posterior view of the human heart. In both panels, the main parts of the heart are labeled.

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3.5: Internal Structure of the Heart

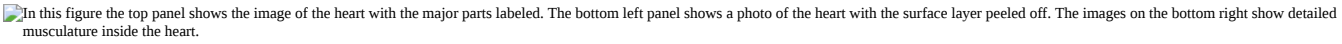
Internal Structure of the Heart

Recall that the heart's contraction cycle follows a dual pattern of circulation—the pulmonary (lungs)and systemic (body) circuits—because of the pairs of chambers that pump blood into the circulation. In order to develop a more precise understanding of cardiac function, it is first necessary to explore the internal anatomical structures in more detail.

The word septum is derived from the Latin for "something that encloses;" in this case, a septum (plural = septa) refers to a wall or partition that divides the heart into chambers.

Valves of the Heart: the septum between the atria and ventricles is known as the atrioventricular septum. It is marked by the presence of four openings that allow blood to move from the atria into the ventricles and from the ventricles into the pulmonary trunk and aorta. Located in each of these openings between the atria and ventricles is a valve, a specialized structure that ensures **one-way flow** of blood. The valves between the atria and ventricles are known generically as the tricuspid (right side)and the bicuspid (left side**) va**lve. The valves at the openings that lead to the pulmonary trunk and aorta are known generically as the pulmonary and the aortic valve.

Structures of the Heart


In this figure the top panel shows the image of the heart with the major parts labeled. The bottom left panel shows a photo of the heart with the surface layer peeled off. The images on the bottom right show detailed musculature inside the heart.

This anterior view of the heart shows the four chambers, the major vessels, and their early branches as well as the valves.
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3.6: Right Atrium

Right Atrium

The right atrium serves as the receiving chamber for blood **returning** to the heart from the systemic circulation. The two major systemic veins are the superior and inferior venae cavae. The **superior vena cava** drains blood from regions **superior** to the diaphragm: the head, neck, upper limbs, and the thoracic region. It empties into the superior and posterior portions of the right atrium. The **inferior vena cava** drains blood from areas inferior to the diaphragm: the lower limbs and abdominopelvic region of the body. It, too, empties into the posterior portion of the atria but **inferior** to the opening of the superior vena cava.

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3.7: Right Ventricle

Right Ventricle

The right ventricle receives blood from the right atrium through the tricuspid valve. Each flap of the valve is attached to strong strands of connective tissue, the chordae tendineae literally “tendinous cords,” poetically referred to as “heart strings.”

When the myocardium of the ventricle contracts, pressure within the ventricular chamber rises. Blood, like any fluid, flows from higher pressure to lower pressure areas, in this case, toward the pulmonary trunk and the atrium. To prevent any potential backflow, the papillary muscles also contract generating tension on the chordae tendineae. This prevents the flaps of the valves from being forced into the atria and regurgitation of the blood back into the atria during ventricular contraction. Figure shows papillary muscles and chordae tendineae attached to the tricuspid valve.

Chordae Tendineae and Papillary Muscles

This photo shows the inside of the heart with the main muscles labeled.In this frontal section, you can see papillary muscles attached to the tricuspid valve on the right as well as the mitral valve on the left via chordae tendineae. (credit: modification of work by “PV KS”/flickr.com)

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3.8: Left Atrium

Left Atrium

After exchange of gases in the pulmonary capillaries, blood returns to the left atrium high in oxygen via one of the four pulmonary veins. Blood flows nearly continuously from the pulmonary veins back into the atrium which acts as the receiving chamber and from here through an opening into the left ventricle. The opening between the left atrium and ventricle is guarded by the the Left AV or bicuspid valve. The myocardium of the thick walled left ventricle pumps strongly creating enough pressure to force blood flow through the entire body. As the blood leaves the left ventricle, it passes through the aortic valve into the aorta. Although both sides of the heart will pump the same amount of blood, the muscular layer is much thicker in the left ventricle compared to the right.

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3.9: Left Ventricle

The Left Ventricle

Recall that, although both sides of the heart will pump the same amount of blood, the muscular layer is much thicker in the **left** ventricle compared to the right. Like the right ventricle, the left also has trabeculae carneae, but there is no moderator band. The bicuspid valve is connected to papillary muscles via chordae tendineae. There are two papillary muscles. The left ventricle is the **major pumping chamber** for the systemic circuit; it ejects blood into the aorta through the aortic semilunar valve.

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3.10: Importance of the Human Heart

The human heart consists of a pair of atria which receives deoxygenated blood and pumps it into a pair of ventricles which pump blood into the vessels. The right atrium receives the systemic blood from the superior and inferior venae cavae which are relatively low in oxygen and pumps it into the right ventricle which pumps it into the pulmonary circuit, lungs. Exchange of oxygen and carbon dioxide occurs in the lungs, and blood **high in oxygen** returns to the left atrium which pumps blood into the left ventricle which in turn pumps blood into the aorta and the remainder of the systemic circuit. The septa are the partitions that separate the chambers of the heart.

At the base of the aorta is the aortic valve which prevents backflow from the aorta. It normally is composed of three flaps. When the ventricle relaxes and blood attempts to flow back into the ventricle from the aorta, blood will fill the cusps of the valve causing it to close. This process repeats itself every second throughout the heart and one minute throughout the body.

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CHAPTER OVERVIEW

4: Physical Activity

4.1: Physical Activity

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4.1: Physical Activity

The rate of obesity among children is rapidly rising in the United States. To combat childhood obesity and ensure that children get a healthy start in life, First Lady Michelle Obama in 2010 launched the Let's Move! campaign. The goal of this campaign is to educate parents and caregivers on providing healthy nutrition and encouraging active lifestyles in future generations. This program aims to involve the entire community, including parents, teachers, and healthcare providers to ensure that children have access to healthy foods—more fruits, vegetables, and whole grains—and consume fewer calories from processed foods. Another goal is to ensure that children get physical activity. With the increase in television viewing and stationary pursuits such as video games, sedentary lifestyles have become the norm. Visit www.letsmove.gov to learn more.

For information on active lifestyles for all generations visit the Alliance for a Healthier Generation.

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CHAPTER OVERVIEW

5: The Respiratory System

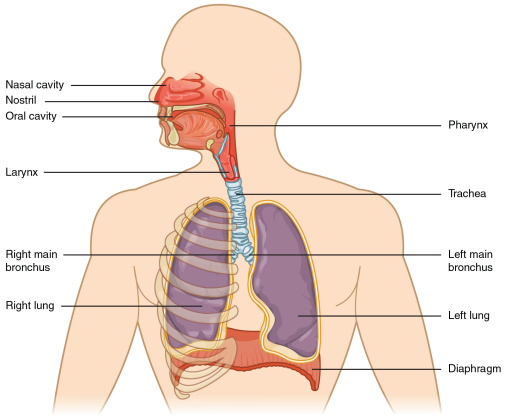
5.1: Respiratory System
5.2: The Nose
5.3: Larynx
5.4: Trachea
5.5: Alveoli
5.6: Pharynx
5.7: Bronchial Tree
5.8: Diseases of the Respiratory System
5.9: Importance of the Respiratory System

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5.1: Respiratory System

The major organs of the respiratory system function primarily to provide oxygen to body tissues for cellular respiration, remove the waste product carbon dioxide, and help to maintain acid-base balance. Portions of the respiratory system are also used for non-vital functions such as sensing odors, speech production, and for straining such as during childbirth or coughing (Figure).

Major Respiratory Structures



The major respiratory structures span the nasal cavity to the diaphragm.

Functionally, the respiratory system can be divided into a conducting zone and a respiratory zone. The conducting zone of the respiratory system includes the organs and structures not directly involved in gas exchange. The gas exchange occurs in the respiratory zone.

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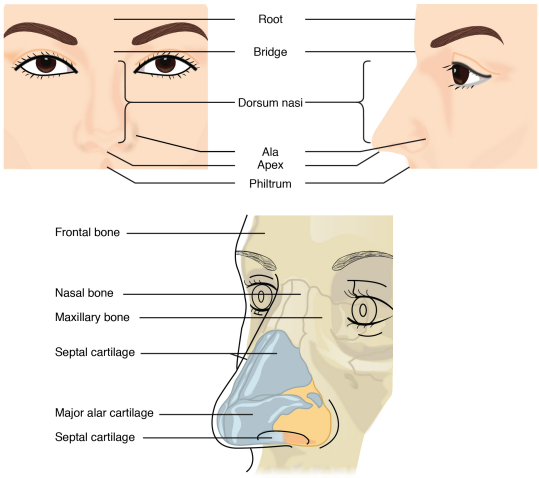
5.2: The Nose

The Nose

The major entrance and exit for the respiratory system is through the nose. When discussing the nose, it is helpful to divide it into two major sections: the external nose, and the nasal cavity or internal nose.

The external nose consists of the surface and skeletal structures that result in the outward appearance of the nose and contribute to its numerous functions (Figure). The root is the region of the nose located between the eyebrows. The bridge is the part of the nose that connects the root to the rest of the nose. The dorsum nasi is the length of the nose. The apex is the tip of the nose. On either side of the apex, the nostrils are formed by the alae (singular = ala). An ala is a cartilaginous structure that forms the lateral side of each naris (plural = nares), or nostril opening. The philtrum is the concave surface that connects the apex of the nose to the upper lip.

Nose



This illustration shows features of the external nose (top) and skeletal features of the nose (bottom).

Underneath the thin skin of the nose are its skeletal features. While the root and bridge of the nose consist of bone, the protruding portion of the nose is composed of cartilage. As a result, when looking at a skull, the nose is missing. The nasal bone is one of a pair of bones that lies under the root and bridge of the nose.

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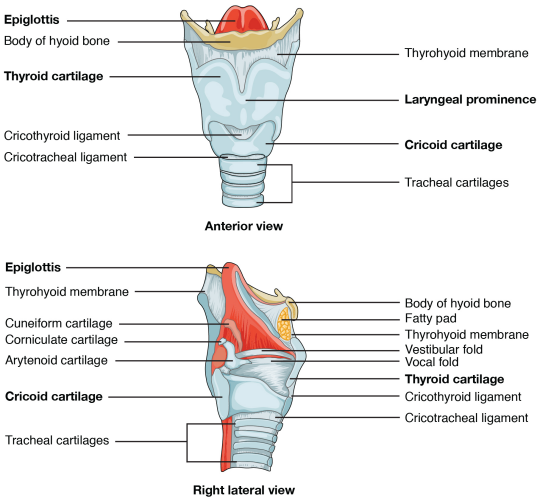
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5.3: Larynx

The Larynx

The larynx is a cartilaginous structure inferior to the laryngopharynx that connects the pharynx to the trachea and helps regulate the volume of air that enters and leaves the lungs (Figure). The structure of the larynx is formed by several pieces of cartilage. Three large cartilage pieces—the thyroid cartilage (anterior), epiglottis (superior), and cricoid cartilage (inferior)—form the major structure of the larynx. The thyroid cartilage is the largest piece of cartilage that makes up the larynx. The thyroid cartilage consists of the laryngeal prominence, or "Adam's apple," which tends to be more prominent in males. The thick cricoid cartilage forms a ring, with a wide posterior region and a thinner anterior region. Three smaller, paired cartilages—the arytenoids, corniculates, and cuneiforms—attach to the epiglottis and the vocal cords and muscle that help move the vocal cords to produce speech.

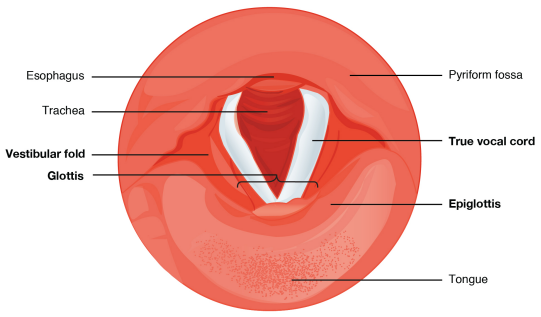
Larynx



The larynx extends from the laryngopharynx and the hyoid bone to the trachea.

The epiglottis, attached to the thyroid cartilage, is a very flexible piece of elastic cartilage that covers the opening of the trachea (see Figure). When in the "closed" position, the unattached end of the epiglottis rests on the glottis. The glottis is composed of the vestibular folds, the true vocal cords, and the space between these folds (Figure). A vestibular fold, or false vocal cord, is one of a pair of folded sections of mucous membrane. A true vocal cord is one of the white, membranous folds attached by muscle to the thyroid and arytenoid cartilages of the larynx on their outer edges. The inner edges of the true vocal cords are free, allowing oscillation to produce sound. The size of the membranous folds of the true vocal cords differs between individuals producing voices with different pitch ranges. Folds in males tend to be larger than those in females which create a deeper voice. The act of swallowing causes the pharynx and larynx to lift upward allowing the pharynx to expand and the epiglottis of the larynx to swing downward closing the opening to the trachea. These movements produce a larger area for food to pass through while preventing food and beverages from entering the trachea.

Vocal Cords



The true vocal cords and vestibular folds of the larynx are viewed inferiorly from the laryngopharynx.

Continuous with the laryngopharynx, the superior portion of the larynx is lined with stratified squamous epithelium, transitioning into pseudostratified ciliated columnar epithelium that contains goblet cells. Similar to the nasal cavity and nasopharynx, this specialized epithelium produces mucus to trap debris and pathogens as they enter the trachea. The cilia beat the mucus upward towards the laryngopharynx where it can be swallowed down the esophagus.

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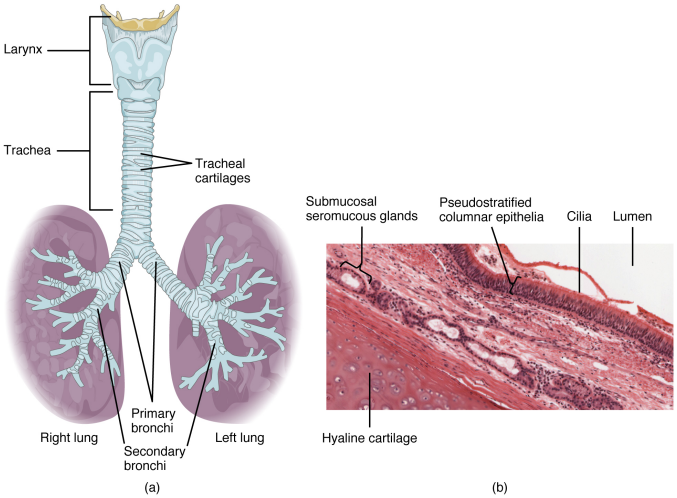
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5.4: Trachea

Trachea

The trachea (windpipe) extends from the larynx toward the lungs (Figure**a**). The trachea is formed by 16 to 20 stacked, C-shaped pieces of hyaline cartilage that are connected by dense connective tissue. The trachealis muscle and elastic connective tissue together form the fibroelastic membrane, a flexible membrane that closes the posterior surface of the trachea, connecting the C-shaped cartilages. The fibroelastic membrane allows the trachea to stretch and expand slightly during inhalation and exhalation, whereas the rings of cartilage provide structural support and prevent the trachea from collapsing. In addition, the trachealis muscle can be contracted to force air through the trachea during exhalation. The trachea is lined with pseudostratified ciliated columnar epithelium, which is continuous with the larynx. The esophagus borders the trachea posteriorly.

Trachea



(a) The tracheal tube is formed by stacked, C-shaped pieces of hyaline cartilage. (b) The layer visible in this cross-section of tracheal wall tissue between the hyaline cartilage and the lumen of the trachea is the mucosa which is composed of pseudostratified ciliated columnar epithelium that contains goblet cells. LM × 1220. (Micrograph provided by the Regents of University of Michigan Medical School © 2012)

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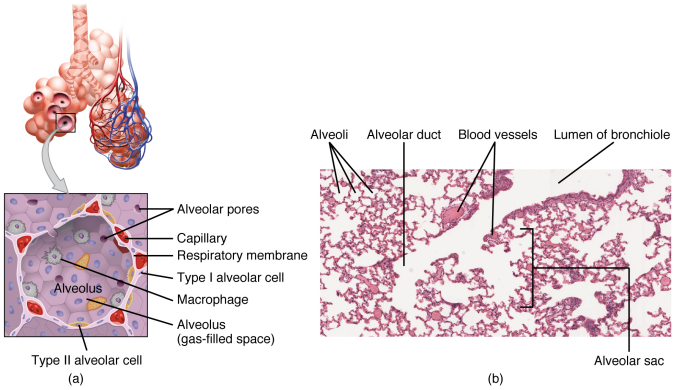
5.5: Alveoli

Alveoli

An alveolar duct is a tube composed of smooth muscle and connective tissue, which opens into a cluster of alveoli. An alveolus is one of the many small, grape-like sacs that are attached to the alveolar ducts.

An alveolar sac is a cluster of many individual alveoli that are responsible for gas exchange. An alveolus is approximately 200 mm in diameter with elastic walls that allow the alveolus to stretch during air intake, which greatly increases the surface area available for gas exchange. Alveoli are connected to their neighbors by alveolar pores, which help maintain equal air pressure throughout the alveoli and lung (Figure).

Structures of the Respiratory Zone



(a) The alveolus is responsible for gas exchange. (b) A micrograph shows the alveolar structures within lung tissue. LM × 178. (Micrograph provided by the Regents of University of Michigan Medical School © 2012)

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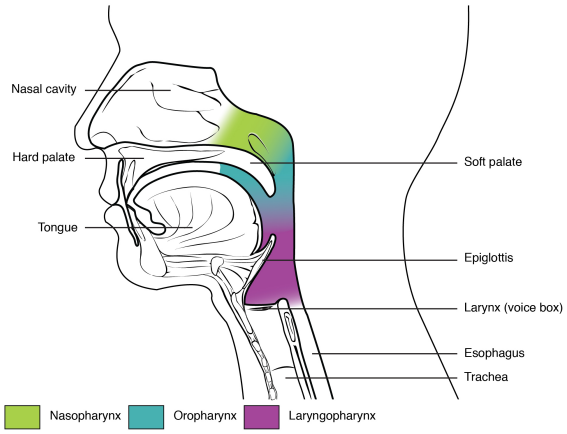
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5.6: Pharynx

Pharynx

The pharynx is a tube formed by skeletal muscle and lined by mucous membrane that is continuous with that of the nasal cavities (see Figure). The pharynx is divided into three major regions: the nasopharynx, the oropharynx, and the laryngopharynx (Figure).

Divisions of the Pharynx



The pharynx is divided into three regions: the nasopharynx, the oropharynx, and the laryngopharynx.

The nasopharynx is flanked by the conchae of the nasal cavity, and it serves only as an airway. At the top of the nasopharynx are the pharyngeal tonsils. A pharyngeal tonsil, also called an adenoid, is an aggregate of lymphoid reticular tissue similar to a lymph node that lies at the superior portion of the nasopharynx. The function of the pharyngeal tonsil is not well understood, but it contains a rich supply of lymphocytes and is covered with ciliated epithelium that traps and destroys invading pathogens that enter during inhalation. The pharyngeal tonsils are large in children, but interestingly, tend to regress with age and may even disappear. The uvula is a small bulbous, teardrop-shaped structure located at the apex of the soft palate. Both the uvula and soft palate move like a pendulum during swallowing, swinging upward to close off the nasopharynx to prevent ingested materials from entering the nasal cavity. In addition, auditory (Eustachian) tubes that connect to each middle ear cavity open into the nasopharynx. This connection is why colds often lead to ear infection.

The oropharynx is a passageway for both air and food. The oropharynx is bordered superiorly by the nasopharynx and anteriorly by the oral cavity. The fauces is the opening at the connection between the oral cavity and the oropharynx. As the nasopharynx becomes the oropharynx, the epithelium changes from pseudostratified ciliated columnar epithelium to stratified squamous epithelium. The oropharynx contains two distinct sets of tonsils, the palatine and lingual tonsils. A palatine tonsil is one of a pair of structures located laterally in the oropharynx in the area of the fauces. The lingual tonsil is located at the base of the tongue. Similar to the pharyngeal tonsil, the palatine and lingual tonsils are composed of lymphoid tissue, and trap and destroy pathogens entering the body through the oral or nasal cavities.

The laryngopharynx is inferior to the oropharynx and posterior to the larynx. It continues the route for ingested material and air until its inferior end where the digestive and respiratory systems diverge. The stratified squamous epithelium of the oropharynx is continuous with the laryngopharynx. Anteriorly, the laryngopharynx opens into the larynx; whereas, posteriorly, it enters the esophagus.

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5.7: Bronchial Tree

Bronchial Tree

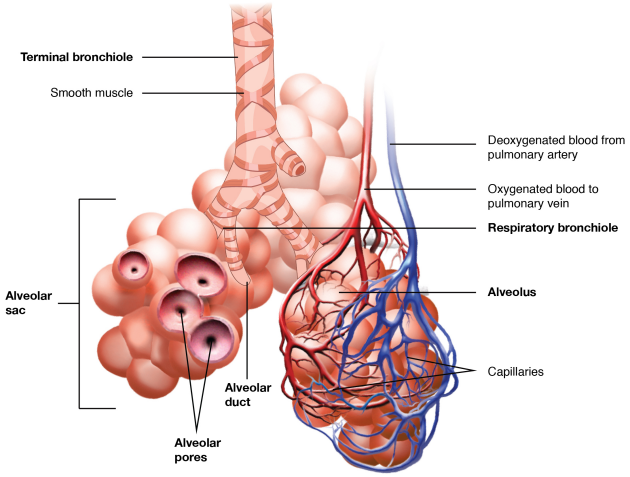
The trachea branches into the right and left primary bronchi at the carina. These bronchi are also lined by pseudostratified ciliated columnar epithelium containing mucus-producing goblet cells (Figure). The carina is a raised structure that contains specialized nervous tissue that induces violent coughing if a foreign body such as food is present. Rings of cartilage similar to those of the trachea support the structure of the bronchi and prevent their collapse. The primary bronchi enter the lungs at the hilum, a concave region where blood vessels, lymphatic vessels, and nerves also enter the lungs. The bronchi continue to branch into bronchial a tree. A bronchial tree (or respiratory tree) is the collective term used for these multiple-branched bronchi. The main function of the bronchi, like other conducting zone structures, is to provide a passageway for air to move into and out of each lung. In addition, the mucous membrane traps debris and pathogens.

A bronchiole branches from the tertiary bronchi. Bronchioles, which are about 1 mm in diameter, further branch until they become the tiny terminal bronchioles, which lead to the structures of gas exchange. There are more than 1000 terminal bronchioles in each lung. The muscular walls of the bronchioles do not contain cartilage like those of the bronchi. This muscular wall can change the size of the tubing to increase or decrease airflow through the tube.

Respiratory Zone

In contrast to the conducting zone, the respiratory zone includes structures that are directly involved in gas exchange. The respiratory zone begins where the terminal bronchioles join a respiratory bronchiole, the smallest type of bronchiole (Figure), which then leads to an alveolar duct, opening into a cluster of alveoli.

Respiratory Zone



Bronchioles lead to alveolar sacs in the respiratory zone where gas exchange occurs.
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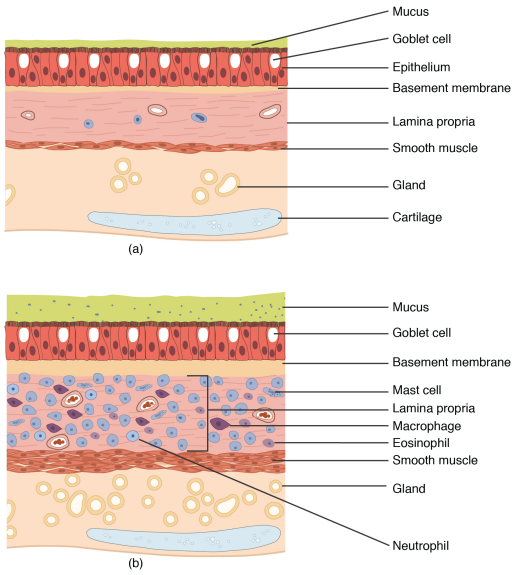
5.8: Diseases of the Respiratory System

Diseases of the…

Respiratory System: Asthma Asthma is common condition that affects the lungs in both adults and children. Approximately 8.2 percent of adults (18.7 million) and 9.4 percent of children (7 million) in the United States suffer from asthma. In addition, asthma is the most frequent cause of hospitalization in children.

Asthma is a chronic disease characterized by inflammation and edema of the airway and bronchospasms (that is, constriction of the bronchioles), which can inhibit air from entering the lungs. In addition, excessive mucus secretion can occur which further contributes to airway occlusion (Figure). Cells of the immune system, such as eosinophils and mononuclear cells, may also be involved in infiltrating the walls of the bronchi and bronchioles.

Bronchospasms occur periodically and lead to an “asthma attack.” An attack may be triggered by environmental factors such as dust, pollen, pet hair, or dander, changes in the weather, mold, tobacco smoke, and respiratory infections, or by exercise and stress.



(a) Normal lung tissue does not have the characteristics of lung tissue during (b) an asthma attack which include thickened mucosa, increased mucus-producing goblet cells, and eosinophil infiltrates.

Symptoms of an asthma attack involve coughing, shortness of breath, wheezing, and tightness of the chest. Symptoms of a severe asthma attack that requires immediate medical attention would include difficulty breathing that results in blue (cyanotic) lips or face, confusion, drowsiness, a rapid pulse, sweating, and severe anxiety. The severity of the condition, frequency of attacks, and identified triggers influence the type of medication that an individual may require. Longer-term treatments are used for those with more severe asthma. Short-term, fast-acting drugs that are used to treat an asthma attack are typically administered via an inhaler. For young children or individuals who have difficulty using an inhaler, asthma medications can be administered via a nebulizer.

In many cases, the underlying cause of the condition is unknown. However, recent research has demonstrated that certain viruses, such as human rhinovirus C (HRVC), and the bacteria *Mycoplasma pneumoniae* and *Chlamydia pneumoniae* that are contracted in infancy or early childhood, may contribute to the development of many cases of asthma.

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5.9: Importance of the Respiratory System

The respiratory system is responsible for obtaining oxygen and getting rid of carbon dioxide and aiding in speech production and in sensing odors. From a functional perspective, the respiratory system can be divided into two major areas: the conducting zone and the respiratory zone. The conducting zone consists of all of the structures that provide passageways for air to travel into and out of the lungs: the nasal cavity, pharynx, trachea, bronchi, and most bronchioles. The nasal passages contain the conchae and meatuses that expand the surface area of the cavity which helps to warm and humidify incoming air while removing debris and pathogens. The pharynx is composed of three major sections: the nasopharynx which is continuous with the nasal cavity; the oropharynx which borders the nasopharynx and the oral cavity, and the laryngopharynx which borders the oropharynx, trachea, and esophagus. The respiratory zone includes the structures of the lung that are directly involved in gas exchange: the terminal bronchioles and alveoli.

References

Bizzintino J, Lee WM, Laing IA, Vang F, Pappas T, Zhang G, Martin AC, Khoo SK, Cox DW, Geelhoed GC, et al. Association between human rhinovirus C and severity of acute asthma in children. Eur Respir J [Internet]. 2010 [cited 2013 Mar 22]; 37(5):1037–1042. Available from: http://erj.ersjournals.com/gca?submit=Go&gca=erj%3B37%2F5%2F1037&allch=

Kumar V, Ramzi S, Robbins SL. Robbins Basic Pathology. 7th ed. Philadelphia (PA): Elsevier Ltd; 2005.

Martin RJ, Kraft M, Chu HW, Berns, EA, Cassell GH. A link between chronic asthma and chronic infection. J Allergy Clin Immunol [Internet]. 2001 [cited 2013 Mar 22]; 107(4):595-601. Available from: http://erj.ersjournals.com/gca?submit=Go&gca=erj%3B37%2F5%2F1037&allch

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CHAPTER OVERVIEW

6: The Digestive System

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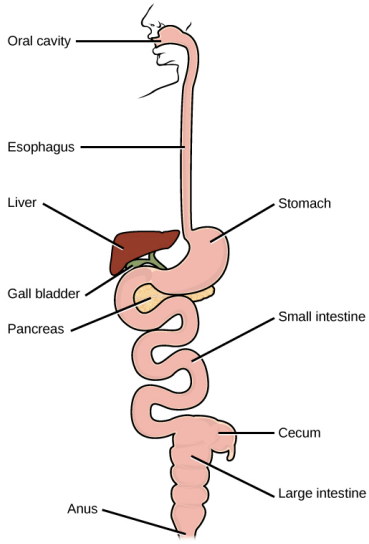
6.1: Digestive System

All living organisms need nutrients to survive. While plants can obtain nutrients from their roots and the energy molecules required for cellular function through the process of photosynthesis, animals obtain their nutrients by the consumption of other organisms. The conversion of the food consumed to the nutrients required is a multistep process involving digestion and absorption. During digestion, food particles are broken down to smaller components which are later absorbed by the body. This happens by both physical means such as chewing and by chemical means.

One of the challenges in human nutrition is maintaining a balance between food intake, storage, and energy expenditure. Taking in more food energy than is used in activity leads to storage of the excess in the form of fat deposits. The rise in obesity and the resulting diseases like type 2 diabetes makes understanding the role of diet and nutrition in maintaining good health all the more important.

The Human Digestive System

The process of digestion begins in the mouth with the intake of food (Figure). The teeth play an important role in masticating (chewing) or physically breaking food into smaller particles. The enzymes present in saliva also begin to chemically break down food. The food is then swallowed and enters the esophagus—a long tube that connects the mouth to the stomach. Using peristalsis, or wave-like smooth-muscle contractions, the muscles of the esophagus push the food toward the stomach. The stomach contents are extremely acidic, with a pH between 1.5 and 2.5. This acidity kills microorganisms, breaks down food tissues, and activates digestive enzymes. Further breakdown of food takes place in the small intestine where bile produced by the liver, and enzymes produced by the small intestine and the pancreas, continue the process of digestion. The smaller molecules are absorbed into the blood stream through the epithelial cells lining the walls of the small intestine. The waste material travels on to the large intestine where water is absorbed and the drier waste material is compacted into feces; it is stored until it is excreted through the anus.



The components of the human digestive system are shown.

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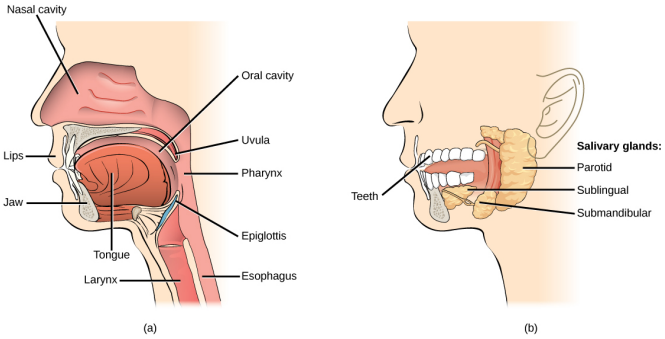
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6.2: Oral Cavity

Oral Cavity

Both physical and chemical digestion begin in the mouth or oral cavity which is the point of entry of food into the digestive system. The food is broken into smaller particles by mastication, the chewing action of the teeth. All mammals have teeth and can chew their food to begin the process of physically breaking it down into smaller particles.

The chemical process of digestion begins during chewing as food mixes with saliva produced by the salivary glands (Figure). Saliva contains mucus that moistens food and buffers the pH of the food. Saliva also contains lysozyme which has antibacterial action. It also contains an enzyme called salivary amylase that begins the process of converting starches in the food into a disaccharide called maltose. Another enzyme called lipase is produced by cells in the tongue to break down fats. The chewing and wetting action provided by the teeth and saliva prepare the food into a mass called the bolus for swallowing. The tongue helps in swallowing—moving the bolus from the mouth into the pharynx. The pharynx opens to two passageways: the esophagus and the trachea. The esophagus leads to the stomach and the trachea leads to the lungs. The epiglottis is a flap of tissue that covers the tracheal opening during swallowing to prevent food from entering the lungs.



(a) Digestion of food begins in the mouth. (b) Food is masticated by teeth and moistened by saliva secreted from the salivary glands. Enzymes in the saliva begin to digest starches and fats. With the help of the tongue, the resulting bolus is moved into the esophagus by swallowing. (credit: modification of work by Mariana Ruiz Villareal)

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6.3: Esophagus

Esophagus

The esophagus is a tubular organ that connects the mouth to the stomach. The chewed and softened food passes through the esophagus after being swallowed. The smooth muscles of the esophagus undergo peristalsis that pushes the food toward the stomach. The peristaltic wave is unidirectional—it moves food from the mouth the stomach, and reverse movement is not possible, except in the case of the vomit reflex. The peristaltic movement of the esophagus is an involuntary reflex; it takes place in response to the act of swallowing.

Ring-like muscles called sphincters form valves in the digestive system. The gastro-esophageal sphincter (or cardiac sphincter) is located at the stomach end of the esophagus. In response to swallowing and the pressure exerted by the bolus of food, this sphincter opens and the bolus enters the stomach. When there is no swallowing action, this sphincter is shut and prevents the contents of the stomach from traveling up the esophagus. Acid reflux or “heartburn” occurs when the acidic digestive juices escape into the esophagus.

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6.4: Stomach

Stomach

A large part of protein digestion occurs in the stomach (Figure). The stomach is a saclike organ of muscles that secretes gastric digestive juices.

Protein digestion is carried out by an enzyme called pepsin in the stomach chamber. The highly acidic environment kills many microorganisms in the food and combined with the action of the enzyme pepsin, results in the catabolism of protein in the food. Chemical digestion is facilitated by the churning action of the stomach caused by contraction and relaxation of smooth muscles. The partially digested food and gastric juice mixture is called chyme. Gastric emptying occurs within two to six hours after a meal. Only a small amount of chyme is released into the small intestine at a time. The movement of chyme from the stomach into the small intestine is regulated by hormones, stomach distension, and muscular reflexes that influence the pyloric sphincter.

The stomach lining is unaffected by pepsin and the acidity because pepsin is released in an inactive form and the stomach has a thick mucus lining that protects the underlying tissue.

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6.5: Small Intestine

Small Intestine

Chyme moves from the stomach to the small intestine. The small intestine is the organ where the digestion of protein, fats, and carbohydrates is completed. The small intestine is a long tube-like organ with a highly folded surface containing finger-like projections called the villi. The top surface of each villus has many microscopic projections called microvilli. The epithelial cells of these structures absorb nutrients from the digested food and release them to the bloodstream on the other side. The villi and microvilli, with their many folds, increase the surface area of the small intestine and increase absorption efficiency of the nutrients.

The human small intestine is over 6 m (19.6 ft) long and is divided into three parts: the duodenum, the jejunum and the ileum. The duodenum is separated from the stomach by the pyloric sphincter. The chyme is mixed with pancreatic juices, an alkaline solution rich in bicarbonate that neutralizes the acidity of chyme from the stomach. Pancreatic juices contain several digestive enzymes that break down starches, disaccharides, proteins, and fats. Bile is produced in the liver and stored and concentrated in the gallbladder; it enters the duodenum through the bile duct. Bile contains bile salts, which make lipids accessible to the water-soluble enzymes. The monosaccharides, amino acids, bile salts, vitamins, and other nutrients are absorbed by the cells of the intestinal lining.

The undigested food is sent to the colon from the ileum via peristaltic movements. The ileum ends and the large intestine begins at the ileocecal valve. The vermiform, “worm-like,” appendix is located at the ileocecal valve. The appendix of humans has a minor role in immunity.

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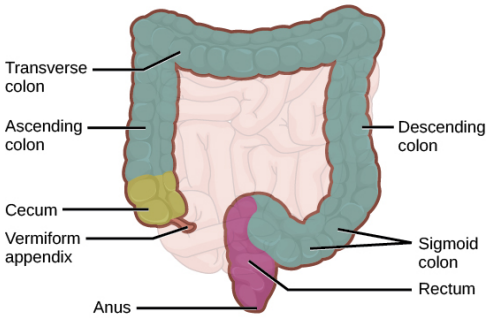
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6.6: Large Intestine

Large Intestine

The large intestine reabsorbs the water from indigestible food material and processes the waste material (Figure). The human large intestine is much smaller in length compared to the small intestine but larger in diameter. It has three parts: the cecum, the colon, and the rectum. The cecum joins the ileum to the colon and is the receiving pouch for the waste matter. The colon is home to many bacteria or “intestinal flora” that aids in the digestive processes. The colon has four regions: the ascending colon, the transverse colon, the descending colon, and the sigmoid colon. The main functions of the colon are to extract the water and mineral salts from undigested food and to store waste material.



The large intestine reabsorbs water from undigested food and stores waste until it is eliminated. (credit: modification of work by Mariana Ruiz Villareal)

The rectum (Figure) stores feces until defecation. The feces are propelled using peristaltic movements during elimination. The anus is an opening at the far-end of the digestive tract and is the exit point for the waste material. Two sphincters regulate the exit of feces; the inner sphincter is involuntary, and the outer sphincter is voluntary.

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6.7: Accessory Organs

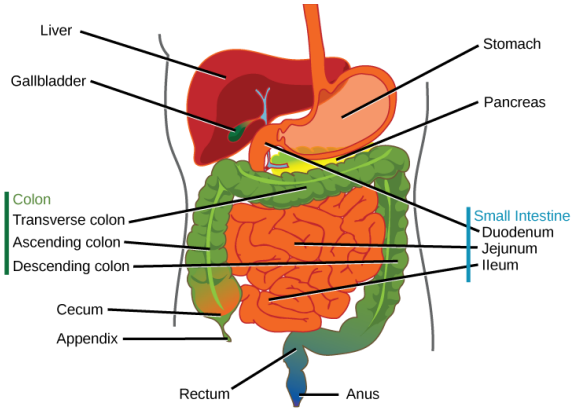
Accessory Organs

The organs discussed above are the organs of the digestive tract through which food passes. Accessory organs add secretions and enzymes that break down food into nutrients. Accessory organs include the salivary glands, the liver, the pancreas, and the gall bladder. The secretions of the liver, pancreas, and gallbladder are regulated by hormones in response to food consumption.

The liver is the largest internal organ in humans and it plays an important role in digestion of fats and detoxifying blood. The liver produces bile, a digestive juice that is required for the breakdown of fats in the duodenum. The liver also processes the absorbed vitamins and fatty acids and synthesizes many plasma proteins. The gallbladder is a small organ that aids the liver by storing bile and concentrating bile salts.

The pancreas secretes bicarbonate that neutralizes the acidic chyme and a variety of enzymes for the digestion of protein and carbohydrates.

Art Connection



The stomach has an extremely acidic environment where most of the protein gets digested. (credit: modification of work by Mariana Ruiz Villareal)

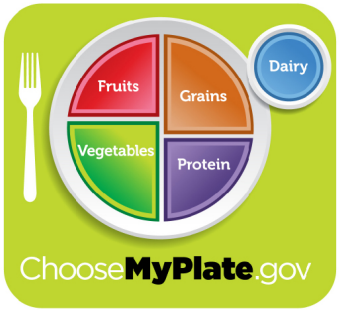
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6.8: Importance of Nutrition to the Digestive System

The human diet should be well balanced to provide nutrients required for bodily function and the minerals and vitamins required for maintaining structure and regulation necessary for good health and reproductive capability (Figure).



For humans, a balanced diet includes fruits, vegetables, grains, protein, and dairy. (credit: USDA)

There are many organs that work together to digest food and absorb nutrients. The mouth is the point of ingestion and the location where both mechanical and chemical breakdown of food begins. Saliva contains an enzyme called amylase that breaks down carbohydrates. The food bolus travels through the esophagus by peristaltic movements to the stomach. The stomach has an extremely acidic environment. The enzyme pepsin digests protein in the stomach. Further digestion and absorption take place in the small intestine. The large intestine reabsorbs water from the undigested food and stores waste until elimination.

Carbohydrates, proteins, and fats are the primary components of food. Some essential nutrients are required for cellular function but cannot be produced by the animal body. These include vitamins, minerals, some fatty acids, and some amino acids. Food intake in more than necessary amounts is stored as glycogen in the liver and muscle cells and in adipose tissue. Excess adipose storage can lead to obesity and serious health problems.

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CHAPTER OVERVIEW

7: Alcohol, Drugs, Tobacco

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7.1: Alcohol, Drugs, Tobacco

While we all experience altered states of consciousness in the form of sleep on a regular basis, some people use drugs and other substances that result in altered states of consciousness as well. This section will present brief descriptions of the effects of some of the more well-known drugs commonly used today such as alcohol, prescription and recreational drugs, and tobacco products.

More than three decades of research supported by the National Institute on Drug Abuse (NIDA) has proven that addiction is a complex brain disease characterized by compulsive, at times uncontrollable, drug craving, seeking, and use that persist despite potentially devastating consequences. Addiction is also a developmental disease; that is, it usually starts in adolescence or even childhood and can last a lifetime if untreated. Disagreements about the nature of addiction remain: namely, whether it reflects voluntary or involuntary behavior and whether it should be punished or treated as a health issue. Even though the first time a person takes a drug, it is often by choice—to achieve a pleasurable sensation or desired emotional state—we now know from a large body of research that this ability to choose can be affected by drugs. And when addiction takes hold in the brain, it disrupts a person's ability to exert control over behavior— reflecting the compulsive nature of this disease.

The human brain is an extraordinarily complex and fine-tuned communications network made up of billions of cells that govern our thoughts, emotions, perceptions, and drives. Our brains reward certain behaviors such as eating or procreating—registering these as pleasurable activities that we want to repeat. Drug addiction taps into these vital mechanisms geared for our survival. And although not a life necessity, to an addicted person, drugs become life itself, driving the compulsive use of drugs—even in the face of dire life consequences—*that is the essence of addiction*.

How Does Addiction Take Hold in the Brain?

The rewarding effects of drugs of abuse come from large and rapid upsurges in dopamine, a neurochemical critical to stimulating feelings of pleasure and to motivating behavior. The rapid dopamine "rush" from drugs of abuse mimics but greatly exceeds in intensity and duration the feelings that occur in response to such pleasurable stimuli as the sight or smell of food, for example. Repeated exposure to large, drug-induced dopamine surges has the insidious consequence of ultimately blunting the response of the dopamine system to everyday stimuli. Thus the drug disturbs a person's normal hierarchy of needs and desires and substitutes new priorities concerned with procuring and using the drug.

Drug abuse also disrupts the brain circuits involved in memory and control over behavior. Memories of the drug experience can trigger craving as can exposure to people, places, or things associated with former drug use. Stress is also a powerful trigger for craving. Control over behavior is compromised because the affected frontal brain regions are what a person needs to exert inhibitory control over desires and emotions.

That is why addiction is a brain disease. As a person's reward circuitry becomes increasingly dulled and desensitized by drugs, nothing else can compete with them—food, family, and friends lose their relative value, while the ability to curb the need to seek and use drugs evaporates. Ironically and cruelly, eventually even the drug loses its ability to reward, but the compromised brain leads addicted people to pursue it, anyway; the memory of the drug has become more powerful than the drug itself.

When does drug abuse become drug addiction? It rarely happens with the first use of a drug. Drug abuse and drug addiction can be thought of as points along a continuum. Any use of a mind-altering drug or the inappropriate use of medication (either prescription or over-the-counter drugs) is **drug abuse**, but the point when drug abuse becomes drug addiction is less clear. Different people may reach the point of addiction at different stages. Scientists continue to investigate the factors that contribute to the transition to drug addiction.

Drug addiction is defined as the continued compulsive use of drugs despite adverse health or social consequences. Drug-addicted people have lost control of their drug use. Individuals who are addicted to drugs often become isolated from family or friends, have difficulty at work or school, may commit crimes, and become involved with the criminal justice system. For a person addicted to drugs, continuing to take them becomes the primary focus in life.

Certain drugs, including opioids and alcohol, cause strong physical reactions in the body when drug use stops. When a person addicted to heroin stops taking heroin, he or she can experience a variety of symptoms ranging from watery eyes and a runny nose to irritability and loss of appetite and then diarrhea, shivering, sweating, abdominal cramps, increased sensitivity to pain, and sleep problems. In general, withdrawal from heroin makes people feel miserable. Withdrawal from alcohol can cause serious effects such as seizures and even death. Withdrawal from other drugs, such as cocaine and amphetamines, does not lead to strong physical reactions, but it may make the person feel depressed or lethargic. For most drugs, physical withdrawal symptoms can usually be

controlled effectively with medications. Even though withdrawal from some drugs does not cause the person abusing them to have physical reactions, stopping drug use is difficult because of the changes the drugs have caused in the brain. Once the drugs stop, the person will have **cravings**, or intense desire for the drugs. Craving arises from the brain's need to maintain a state of homeostasis that now relies on the presence of the drug. A person may experience cravings at any stage of drug abuse or addiction, even early in the experimentation phase of drug abuse. Cravings have a physical basis in the brain. Using PET imaging, scientists have shown that just seeing images of drug paraphernalia can stimulate the amygdala (part of the brain involved in emotional memory) in an addicted person.

Drugs of addiction do not merely cause short-term changes in an individual's cognitive skill and behavior. A drug "high" lasts a short time, ranging from less than an hour to 12 hours, depending on the drug, dose, and route of administration. The changes in the brain that result from continued drug use, however, can last a long time. Scientists believe that some of these changes disappear when drug use stops; some disappear within a short time after drug use stops, and other changes are potentially permanent.

One of the first changes in the brain that may occur in response to repeated drug abuse is tolerance. **Tolerance** develops when a person needs increasing doses of a drug to achieve the same high or "rush" that previously resulted from a lower dose of the drug. Two primary mechanisms underlie the development of tolerance. First, the body may become more efficient at metabolizing the drug, thereby reducing the amount that enters the brain. Second, the cells of the body and brain may become more resistant to the effect of the drug. For example, after continued cocaine use, neurons decrease the number of dopamine receptors, which results in decreasing cocaine's stimulatory effect. Opioids, on the other hand, do not cause a change in the number of receptors. Instead the opioid receptors become less efficient in activating associated cellular processes, thus reducing the effects of the opioids.

In addition to the functional and anatomical changes in the brain, drug abuse puts people at higher risk for other health problems. For example, inhalant abuse can lead to disruption of heart rhythms, and snorting cocaine can lead to ulcerations in the mucous membranes of the nose. In addition, injection drug users (IDUs) are at higher risk of contracting HIV through the sharing of potentially contaminated needles. Similarly, hepatitis B and hepatitis C are much more common among drug addicts than the general population. Drug abuse and addiction also are contributing factors in motor vehicle accidents. The list can go on and on!

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7.2: Alcohol

Alcohol

If you are like many Americans, you drink alcohol at least occasionally. For many people, moderate drinking is probably safe. It may even have health benefits, including reducing your risk of certain heart problems. Moderate drinking is one drink a day for women or anyone over 65, and two drinks a day for men under 65.
Some people should not drink at all, including alcoholics, children, pregnant women, people on certain medicines and people with some medical conditions.
Anything more than moderate drinking can be risky. Binge drinking – drinking five or more drinks at one time – can damage your health and increase your risk for accidents, injuries and assault. Years of heavy drinking can lead to liver disease, heart disease, cancer and pancreatitis. It can also cause problems at home, at work and with friends.

Quick Quiz

Source:*College Health, CDC, http://www.cdc.gov/Features/CollegeHealth/*

1. How many drinks for males within a short period of time is considered binge drinking? How many drinks for females within a short period of time is considered binge drinking?
2. True or false: Binge drinking is a risk factor for sexual assault, especially among young women in college settings. Each year, about 1 in 20 college women are sexually assaulted. Binge drinking also increases the chances of car crashes, violence against others, unintended pregnancies, and the spread of HIV and sexually transmitted diseases.
3. What is the most commonly used and abused substance among youth in the United States, more than tobacco and illicit drugs?
4. True or false: Teens and young adults who do not get enough sleep are at risk for automobile crashes, poor grades and performance in school, depressed moods, and problems with peer and adult relationships.

Quick Quiz Answers: 1) males-5 or more within a short period of time, females- 4 or more within a short period of time; 2) true; 3) Alcohol; 4) true

Ethanol, which we commonly refer to as alcohol, is in a class of psychoactive drugs known as depressants (Figure). A depressant is a drug that tends to suppress central nervous system activity. Other depressants include barbiturates and benzodiazepines.

Acute alcohol administration results in a variety of changes to consciousness. At rather low doses, alcohol use is associated with feelings of euphoria. As the dose increases, people report feeling sedated. Generally, alcohol is associated with decreases in reaction time and visual acuity, lowered levels of alertness, and reduction in behavioral control. With excessive alcohol use, a person might experience a complete loss of consciousness and/or difficulty remembering events that occurred during a period of intoxication (McKim & Hancock, 2013). In addition, if a pregnant woman consumes alcohol, her infant may be born with a cluster of birth defects and symptoms collectively called fetal alcohol spectrum disorder (FASD) or fetal alcohol syndrome (FAS).

With repeated use of many central nervous system depressants, such as alcohol, a person becomes physically dependent upon the substance and will exhibit signs of both tolerance and withdrawal. Psychological dependence on these drugs is also possible. Therefore, the abuse potential of central nervous system depressants is relatively high.

Drug withdrawal is usually an aversive experience, and it can be a life-threatening process in individuals who have a long history of very high doses of alcohol and/or barbiturates. This is of such concern that people who are trying to overcome addiction to these substances should only do so under medical supervision.

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7.3: Moderate and Binge Drinking

Moderate and Binge Drinking

Source: *Moderate & Binge Drinking, National Institute on Alcohol Abuse and Alcoholism, NIAAA, NIH*

Moderate or "low-risk" drinking
Research shows that people who drink moderately may be less likely to experience an alcohol use disorder (AUD). These drinking levels, which differ for men and women, are:
For men:

- No more than 4 drinks on any single day AND no more than 14 drinks per week

For women:

- No more than 3 drinks on any single day AND no more than 7 drinks per week

To stay low risk for AUDs, you must keep within both the single-day and weekly limits.
Even within these limits, you can have problems if you drink too quickly or have other health issues. To keep your risk for problems low, make sure you:

- Drink slowly
- Eat enough while drinking

Certain people should avoid alcohol completely, including those who:

- Plan to drive a vehicle or operate machinery
- Take medications that interact with alcohol
- Have a medical condition that alcohol can aggravate
- Are pregnant or trying to become pregnant

Heavy or "at-risk" drinking
For healthy adults in general, heavy drinking means consuming more than the single-day or the weekly amounts listed above. About 1 in 4 people who drink above these levels already has alcohol dependence or alcohol abuse problems.

Binge drinking
Binge drinking means drinking so much within about 2 hours that blood alcohol concentration (BAC) levels reach 0.08g/dL. For women, this usually occurs after about 4 drinks, and for men, after about 5.
Drinking this way can pose health and safety risks, including car crashes and injuries. Over the long term, binge drinking can damage the liver and other organs.

A Little Goes a Long Way: Know the Amounts

Source: *Beyond Hangovers, NIAAA, NIH, http://www.nlm.nih.gov/medlineplus/alcohol.html*

Knowing how much alcohol constitutes a "standard" drink can help you determine how much you are drinking and understand the risks. One standard drink contains about 0.6 fluid ounces or 14 grams of pure alcohol. In more familiar terms, the following amounts constitute one standard drink:

- 12 fluid ounces of beer (about 5% alcohol)
- 8 to 9 fluid ounces of malt liquor (about 7% alcohol)
- 5 fluid ounces of table wine (about 12% alcohol)
- 1.5 fluid ounces of hard liquor (about 40% alcohol)

You're chatting with friends at a party and a waitress comes around with glasses of champagne. You drink one, then another, maybe even a few more. Before you realize it, you are laughing more loudly than usual and swaying as you walk. By the end of the evening, you are too slow to move out of the way of a waiter with a dessert tray and have trouble speaking clearly. The next morning, you wake up feeling dizzy and your head hurts. You may have a hard time remembering everything you did the night before.
These reactions illustrate how quickly and dramatically alcohol affects the brain. The brain is an intricate maze of connections that keeps our physical and psychological processes running smoothly. Disruption of any of these connections can affect how the brain works. Alcohol also can have longer-lasting consequences for the brain—changing the way it looks and works and resulting in a

range of problems.
Most people do not realize how extensively alcohol can affect the brain. But recognizing these potential consequences will help you make better decisions about what amount of alcohol is appropriate for you.

HomeWhat happens inside the brain?

The brain's structure is complex. It includes multiple systems that interact to support all of your body's functions—from thinking to breathing to moving.
These multiple brain systems communicate with each other through about a trillion tiny nerve cells called neurons. Neurons in the brain translate information into electrical and chemical signals the brain can understand. They also send messages from the brain to the rest of the body.
Chemicals called *neurotransmitters* carry messages between the neurons. Neurotransmitters can be very powerful. Depending on the type and the amount of neurotransmitter, these chemicals can either intensify or minimize your body's responses, your feelings, and your mood. The brain works to balance the neurotransmitters that speed things up with the ones that slow things down to keep your body operating at the right pace.
Alcohol can slow the pace of communication between neurotransmitters in the brain.

HomeFetal Alcohol Syndrome

Alcohol can affect the brain at any stage of development—even before birth. Fetal alcohol spectrum disorders are the full range of physical, learning, and behavioral problems, and other birth defects that result from prenatal alcohol exposure. The most serious of these disorders, *fetal alcohol syndrome* (FAS), is characterized by abnormal facial features and is usually associated with severe reductions in brain function and overall growth. FAS is the leading preventable birth defect associated with mental and behavioral impairment in the United States today.
The brains of children with FAS are smaller than normal and contain fewer cells, including neurons. These deficiencies result in life-long learning and behavioral problems. Current research is investigating whether the brain function of children and adults with FAS can be improved with complex rehabilitative training, dietary supplements, or medications.

HomeAlcohol and Heart Disease

Americans know how prevalent heart disease is—about 1 in 12 of us suffer from it. What we don't always recognize are the connections heart disease shares with alcohol. On the one hand, researchers have known for centuries that excessive alcohol consumption can damage the heart. Drinking a lot over a long period of time or drinking too much on a single occasion can put your heart—and your life—at risk. On the other hand, researchers now understand that drinking moderate amounts of alcohol can protect the hearts of some people from the risks of coronary artery disease.
Deciding how much, if any, alcohol is right for you can be complicated. To make the best decision for yourself, you need to know the facts and then consult your physician.

HomeKnow the Benefits

Research shows that healthy people who drink moderate amounts of alcohol may have a lower risk of developing coronary heart disease than nondrinkers. Moderate drinking is usually defined as no more than two drinks in a given day for men and one drink per day for women who are not pregnant or trying to conceive.
A variety of factors, including diet, genetics, high blood pressure, and age, can cause fat to build up in your arteries, resulting in coronary heart disease. An excess of fat narrows the coronary arteries, which are the blood vessels that supply blood directly to the heart. Clogged arteries reduce blood supply to the heart muscle, and make it easier for blood clots to form. Blood clots can lead to both heart attacks and strokes.
According to recent studies, drinking moderately can protect your heart from these conditions. Moderate drinking helps inhibit and reduce the build-up of fat in the arteries. It can raise the levels of HDL—or "good" cholesterol—in the blood, which wards off heart disease. It can help guard against heart attack and stroke by preventing blood clots from forming and by dissolving blood clots that do develop. Drinking moderately also may help keep blood pressure levels in check.
These benefits may not apply to people with existing medical conditions, or who regularly take certain medications. In addition, researchers discourage people from beginning to drink just for the health benefits. Rather, you can use this research to help you spark a conversation with your medical professional about the best path for you.

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7.4: Cancer Risk with Alcohol

Cancer Risk

Genetics, environment, and lifestyle habits can all heighten your risk of getting cancer. We can't do anything to change our genes, and we often can't do much to change our environment. But lifestyle habits are a different story.

Drinking too much alcohol is one lifestyle habit that can increase your risk of developing certain cancers. This does not mean that anyone who drinks too much will develop cancer. But numerous studies do show the more you drink, the more you increase your chances of developing certain types of cancer.

For example, a group of Italy-based scientists reviewed more than 200 studies examining alcohol's impact on cancer risk. The collective results of these studies clearly demonstrate that the more you drink, the higher your risk for developing a variety of cancers. The National Cancer Institute identifies alcohol as a risk factor for the following types of cancer:

- Mouth
- Esophagus
- Pharynx
- Larynx
- Liver
- Breast

At least 7 out of 10 people with mouth cancer drink heavily. Drinking five or more drinks per day can also increase your risk of developing other types of cancers, including colon or rectal cancer. In fact, summary estimates from the recent World Cancer Research Fund report indicate that women who drink five standard alcohol drinks each day have about 1.2 times the risk of developing colon or rectal cancer than women who do not drink at all.

People who drink are also more likely to smoke, and the combination increases the risk significantly. Smoking alone is a known risk factor for some cancers. But smoking and drinking together intensifies the cancer-causing properties of each substance. The overall effect poses an even greater risk.

The risk of throat and mouth cancers is especially high because alcohol and tobacco both come in direct contact with those areas. Overall, people who drink and smoke are 15 times more likely to develop cancers of the mouth and throat than nondrinkers and nonsmokers. In addition, recent studies estimate that alcohol and tobacco together are responsible for:

- 80 percent of *throat and mouth cancer* in men
- 65 percent of throat and mouth cancer in women
- 80 percent of *esophageal squamous cell carcinoma*, a type of esophagus cancer
- 25 to 30 percent of all liver cancers

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7.5: Drug Abuse

Drug abuse is a serious public health problem that affects almost every community and family in some way. Each year drug abuse results in around 40 million serious illnesses or injuries among people in the United States. Abused drugs include:

- Club drugs
- Amphetamines
- Anabolic steroids
- Cocaine
- Heroin
- Inhalants
- Marijuana
- Prescription drugs
- Over-the-counter drugs (OTC)
- Alcohol

Drug abuse also plays a role in many major social problems, such as drugged driving, violence, stress and child abuse. Drug abuse can lead to homelessness, crime and missed work or problems with keeping a job. There are different types of treatment for drug abuse. But the best is to prevent drug abuse in the first place.

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7.6: Tobacco

The 30th tobacco-related Surgeon General's report issued since 1964 describes in detail the specific pathways by which tobacco smoke damages the human body. The scientific evidence supports the following conclusions:

HomeThere is no safe level of exposure to tobacco smoke.

- Any exposure to tobacco smoke – even an occasional cigarette or exposure to secondhand smoke – is harmful.
- You don't have to be a heavy smoker or a long-time smoker to get a smoking-related disease or have a heart attack or asthma attack that is triggered by tobacco smoke.
- Low levels of smoke exposure, including exposures to secondhand tobacco smoke, lead to a rapid and sharp increase in dysfunction and inflammation of the lining of the blood vessels, which are implicated in heart attacks and stroke.
- Cigarette smoke contains more than 7,000 chemicals and compounds. Hundreds are toxic and at least 69 cause cancer. Tobacco smoke itself is a known human carcinogen.
- Chemicals in tobacco smoke interfere with the functioning of fallopian tubes, increasing risk for adverse pregnancy outcomes such as ectopic pregnancy, miscarriage, and low birth weight. They also damage the DNA in sperm which might reduce fertility and harm fetal development.

HomeDamage from tobacco smoke is immediate.

- The chemicals in tobacco smoke reach your lungs quickly every time you inhale. Your blood then carries the toxicants to every organ in your body.
- The chemicals and toxicants in tobacco smoke damage DNA, which can lead to cancer. Nearly one-third of all cancer deaths every year are directly linked to smoking. Smoking causes about 85% of lung cancers in the U.S.
- Exposure to tobacco smoke quickly damages blood vessels throughout the body and makes blood more likely to clot. This damage can cause heart attacks, strokes, and even sudden death.
- The chemicals in tobacco smoke inflame the delicate lining of the lungs and can cause permanent damage that reduces the ability of the lungs to exchange air efficiently and leads to chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis.

HomeSmoking longer means more damage.

- Both the risk and the severity of many diseases caused by smoking are directly related to how long the smoker has smoked and the number of cigarettes smoked per day.
- Chemicals in tobacco smoke cause inflammation and cell damage, and can weaken the immune system. The body makes white blood cells to respond to injuries, infections, and cancers. White blood cell counts stay high while smoking continues, meaning the body is constantly fighting against the damage caused by smoking which can lead to disease in almost any part of the body.
- Smoking can cause cancer and weaken your body's ability to fight cancer. With any cancer – even those not related to tobacco use – smoking can decrease the benefits of chemotherapy and other cancer treatments. Exposure to tobacco smoke can help tumors grow.
- The chemicals in tobacco smoke complicate the regulation of blood sugar levels, exacerbating the health issues resulting from diabetes. Smokers with diabetes have a higher risk of heart and kidney disease, amputation, eye disease causing blindness, nerve damage and poor circulation.

HomeCigarettes are designed for addiction.

- The design and contents of tobacco products make them more attractive and addictive than ever before. Cigarettes today deliver nicotine more quickly from the lungs to the heart and brain.
- The powerful addicting elements of tobacco products affect multiple types of nicotine receptors in the brain.
- Evidence suggests that psychosocial, biologic, and genetic factors may also play a role in nicotine addiction.

HomeThere is no safe cigarette.

- The evidence indicates that changing cigarette designs over the last five decades, including filtered, low-tar, and "light" variations, have NOT reduced overall disease risk among smokers and may have hindered prevention and cessation efforts.
- The overall health of the public could be harmed if the introduction of novel tobacco products encourages tobacco use among people who would otherwise be unlikely to use a tobacco product or delays cessation among persons who would otherwise quit using tobacco altogether.

The only proven strategy for reducing the risk of tobacco-related disease and death is to never smoke, and if you do smoke to quit.

- Quitting at any age and at any time is beneficial. It's never too late to quit, but the sooner the better.
- Quitting gives your body a chance to heal the damage caused by smoking.
- When smokers quit, the risk for a heart attack drops sharply after just 1 year; stroke risk can fall to about the same as a nonsmoker's after 2-5 years; risks for cancer of the mouth, throat, esophagus, and bladder are cut in half after 5 years; and the risk for dying of lung cancer drops by half after 10 years.
- Smokers often make several attempts before they are able to quit, but new strategies for cessation, including nicotine replacement and non-nicotine medications, can make it easier.

The evidence indicates that changing cigarette designs over the last five decades, including filtered, low-tar, and "light" variations, have NOT reduced overall disease risk among smokers and may have hindered prevention and cessation efforts.
The overall health of the public could be harmed if the introduction of novel tobacco products encourages tobacco use among people who would otherwise be unlikely to use a tobacco product or delays cessation among persons who would otherwise quit using tobacco altogether.

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- Tobacco, A Report of the Surgeon General: How Tobacco Smoke Causes Disease. **Authored by**: The Biology and Behavioral Basis for Smoking-Attributable Disease Fact Sheet 2010. **Provided by**: OpenStaxCollege. **Located at**: http://www.surgeongeneral.gov/library/tobaccosmoke/factsheet.html%20More%20Information. **License**: *Public Domain: No Known Copyright*

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7.7: Prescription Drugs

HomePrescription Drugs

Most people take medicines only for the reasons their doctors prescribe them. But an estimated 20 percent of people in the United States have used prescription drugs for nonmedical reasons. This is prescription drug abuse. It is a serious and growing problem. Abusing some prescription drugs can lead to addiction. You can develop an addiction to:

- Narcotic painkillers
- Sedatives and tranquilizers
- Stimulants

Experts don't know exactly why this type of drug abuse is increasing. The availability of drugs is probably one reason. Doctors are prescribing more drugs for more health problems than ever before. Online pharmacies make it easy to get prescription drugs without a prescription, even for youngsters.

How to Identify Unknown Pills:
Pillbox was developed to aid in the identification of unknown solid dosage pharmaceuticals. The system combines high-resolution images of tablets and capsules with appearance information (imprint, shape, color, etc.) to enable users to visually search for and identify an unknown solid dosage pharmaceutical.

This system is designed for use by emergency physicians, first responders, other health care providers, Poison Control Center staff, and concerned citizens.

The system enables users to identify solid dosage forms based on physical criteria: imprint (characters or number printed on a medication), shape, color, size, and scoring. Users are shown thumbnail images of possible matches. These images are continually updated as the user enters additional information.

- Visit the Pillbox to check the pills in your family medicine cabinet.
- Find any surprises?

Opioids

An opioid is one of a category of drugs that includes heroin, morphine, methadone, and codeine. Opioids have analgesic properties; that is, they decrease pain. Humans have an endogenous opioid neurotransmitter system—the body makes small quantities of opioid compounds that bind to opioid receptors reducing pain and producing euphoria. Thus, opioid drugs, which mimic this endogenous painkilling mechanism, have an extremely high potential for abuse. Natural opioids, called opiates, are derivatives of opium, which is a naturally occurring compound found in the poppy plant. There are now several synthetic versions of opiate drugs (correctly called opioids) that have very potent painkilling effects, and they are often abused. For example, the National Institutes of Drug Abuse has sponsored research that suggests the misuse and abuse of the prescription pain killers hydrocodone and oxycodone are significant public health concerns (Maxwell, 2006). In 2013, the U.S. Food and Drug Administration recommended tighter controls on their medical use.

Historically, heroin has been a major opioid drug of abuse (Figure). Heroin can be snorted, smoked, or injected intravenously. Like the stimulants described earlier, the use of heroin is associated with an initial feeling of euphoria followed by periods of agitation. Because heroin is often administered via intravenous injection, users often bear needle track marks on their arms and, like all abusers of intravenous drugs, have an increased risk for contraction of both tuberculosis and HIV.

Aside from their utility as analgesic drugs, opioid-like compounds are often found in cough suppressants, anti-nausea, and anti-diarrhea medications. Given that withdrawal from a drug often involves an experience opposite to the effect of the drug, it should be no surprise that opioid withdrawal resembles a severe case of the flu. While opioid withdrawal can be extremely unpleasant, it is not life-threatening (Julien, 2005). Still, people experiencing opioid withdrawal may be given methadone to make withdrawal from the drug less difficult. Methadone is a synthetic opioid that is less euphorigenic than heroin and similar drugs. Methadone clinics help people who previously struggled with opioid addiction manage withdrawal symptoms through the use of methadone. Other drugs, including the opioid buprenorphine, have also been used to alleviate symptoms of opiate withdrawal.

Codeine is an opioid with relatively low potency. It is often prescribed for minor pain, and it is available over-the-counter in some other countries. Like all opioids, codeine does have abuse potential. In fact, abuse of prescription opioid medications is becoming a major concern worldwide (Aquina, Marques-Baptista, Bridgeman, & Merlin, 2009; Casati, Sedefov, & Pfeiffer-Gerschel, 2012).

HomeCommonly Abused Prescription Drugs

Medications can be effective when they are used properly, but some can be addictive and dangerous when abused. Some prescribed medications that – when used in ways or by people other than prescribed – have the potential for adverse medical consequences, including addiction.

In 2010, approximately 16 million Americans reported using a prescription drug for nonmedical reasons in the past year; 7 million in the past month.
After marijuana, prescription and over-the-counter medications account for most of the commonly abused drugs.

HomeWhat types of prescription drugs are abused?

Three types of drugs are abused most often:

- Opioids—prescribed for pain relief
- CNS depressants—barbiturates and benzodiazepines prescribed for anxiety or sleep problems (often referred to as sedatives or tranquilizers)
- Stimulants—prescribed for attention-deficit hyperactivity disorder (ADHD), the sleep disorder narcolepsy, or obesity.

HomeHow can you help prevent prescription drug abuse?

- Ask your doctor or pharmacist about your medication, especially if you are unsure about its effects.
- Keep your doctor informed about all medications you are taking, including over-the-counter medications.
- Read the information your pharmacist provides before starting to take medications.
- Take your medication(s) as prescribed.
- Keep all prescription medications secured at all times and properly dispose of any unused medications.

HomePrescription Drug Advertising

Your healthcare provider is the best source of information about the right medicines for you.
The Food and Drug Administration (FDA) protects public health by assuring the safety, effectiveness, and security of a wide range of products, including human prescription drugs. We also advance public health by helping people get the accurate, science-based information they need to use medicines appropriately and improve their health. Prescription drug advertisements can provide useful information for consumers to work with their health care providers to make wise decisions about treatment.

Source:*FDA, http://www.fda.gov/Drugs/ResourcesForYou/Consumers/PrescriptionDrugAdvertising/ucm071964.htm*
The FDA serves the public health and welfare in many ways. One way is overseeing the approval and marketing of prescription drugs. It's authority is based on a number of federal laws, including the Federal Food, Drug, and Cosmetic Act. Among other areas, this law specifically addresses prescription drug advertising. This law requires that advertisements for prescription drugs be accurate and not misleading.

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7.8: True/False about Smoking and Cigarettes

HomeSmoking is just a choice.

The first time? Yes. After just a few cigarettes? No. Addiction to nicotine can happen quickly. It changes the chemical balance in your brain. Smoking may seem like it's just a choice or a habit. In fact, most people who use tobacco are addicted. Breaking nicotine addiction is harder for some people than others. Quitting can take several tries. But don't give up. If you need help to quit, ask your doctor about nicotine replacement, medicines, or coaching.

HomeFilters make cigarettes safer.

Filters do not protect you. They are designed to make smoke particles smaller. That makes nicotine easier to absorb. This increases addiction. Cigarettes have been engineered to speed up nicotine's path to your brain. Their design feeds addiction. Light or low-tar cigarettes may sound less dangerous. They aren't. These misleading labels are no longer allowed. No cigarette is safe. Tobacco smoke contains more than 7,000 chemicals. At least 250 are toxic.

HomeAn occasional cigarette is no big deal.

Smoking doesn't just cause diseases for heavy smokers or longtime smokers. The 2010 Surgeon General's Report shows how breathing tobacco smoke can cause immediate harm. Tobacco smoke can trigger sudden heart attacks and death, even in nonsmokers. Each cigarette you smoke hurts your lungs, your blood vessels, and cells throughout your body. Smoking a few cigarettes a week can cause a heart attack. Cutting back is not enough to protect you. You have to quit entirely.

HomeIt's too late to quit—the damage is already done.

It's true that the longer you use tobacco, the more you hurt your body. But at any age, the sooner you quit, the sooner your health can improve. The 2010 Surgeon General's Report shows how using tobacco causes disease almost everywhere in your body. Within 20 minutes after quitting, your body starts to heal. After 2 to 5 years, your risk for stroke is similar to that of a nonsmoker. In 10 years, your lung cancer risk is cut in half.

HomeSecondhand smoke may bother people, but it isn't dangerous.

Tens of thousands of nonsmokers die every year from breathing others' secondhand smoke. Breathing the chemicals in tobacco smoke changes your blood's chemistry almost immediately. Deadly clots can form and block arteries to your heart or brain. When you smoke at work, home, or at a restaurant, everyone there breathes poisons. If you smoke in your car, rolling down a window does not protect your passengers. It is not healthy to breathe any amount of tobacco smoke.

HomeThe little bit of smoke that my kids get doesn't hurt them.

Don't smoke or let others smoke around your children. They can get bronchitis, pneumonia, and ear infections from smoke. Even if you only smoke by an open window, some of the smoke stays in your house and poisons the air your children breathe. Children with asthma can have a serious, even deadly, asthma attack from breathing secondhand smoke. The best way to protect children is to quit smoking. If you or someone else in your household are not ready to quit, be sure to make your home and car 100% smoke-free.

Nicotine is highly addictive, and the use of tobacco products is associated with increased risks of heart disease, stroke, and a variety of cancers. In the central nervous system, it plays a role in arousal and reward mechanisms. Nicotine is most commonly used in the form of tobacco products like cigarettes or chewing tobacco; therefore, there is a tremendous interest in developing effective smoking cessation techniques. To date, people have used a variety of nicotine replacement therapies in addition to various psychotherapeutic options in an attempt to discontinue their use of tobacco products. In general, smoking cessation programs may be effective in the short term, but it is unclear whether these effects persist (Cropley, Theadom, Pravettoni, & Webb, 2008; Levitt, Shaw, Wong, & Kaczorowski, 2007; Smedslund, Fisher, Boles, & Lichtenstein, 2004)

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7.9: Medical Marijuana

Medical Marijuana

While the possession and use of marijuana is illegal in most states, it is now legal in Washington and Colorado to possess limited quantities of marijuana for recreational use. In contrast, medical marijuana use is now legal in nearly half of the United States and in the District of Columbia. Medical marijuana is marijuana that is prescribed by a doctor for the treatment of a health condition. For example, people who undergo chemotherapy will often be prescribed marijuana to stimulate their appetites and prevent excessive weight loss resulting from the side effects of chemotherapy treatment. Marijuana may also have some promise in the treatment of a variety of medical conditions (Mather, Rauwendaal, Moxham-Hall, & Wodak, 2013; Robson, 2014; Schicho & Storr, 2014).



Medical marijuana shops are becoming more and more common in the United States. (credit: Laurie Avocado)

While medical marijuana laws have been passed on a state-by-state basis, federal laws still classify this as an illicit substance, making conducting research on the potentially beneficial medicinal uses of marijuana problematic. There is quite a bit of controversy within the scientific community as to the extent to which marijuana might have medicinal benefits due to a lack of large-scale, controlled research (Bostwick, 2012). As a result, many scientists have urged the federal government to allow for relaxation of current marijuana laws and classifications in order to facilitate a more widespread study of the drug's effects (Aggarwal et al., 2009; Bostwick, 2012; Kogan & Mechoulam, 2007).

Until recently, the United States Department of Justice routinely arrested people involved and seized marijuana used in medicinal settings. In the latter part of 2013, however, the United States Department of Justice issued statements indicating that they would not continue to challenge state medical marijuana laws. This shift in policy may be in response to the scientific community's recommendations and/or reflect changing public opinion regarding marijuana.

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CHAPTER OVERVIEW

8: Human Sexuality, Female

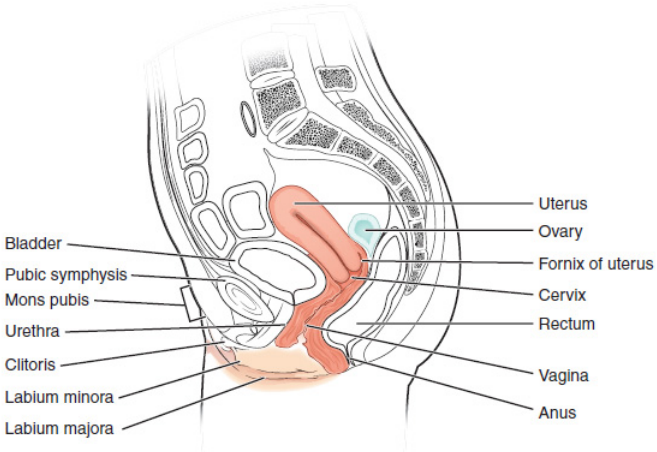
8.1: Female Reproductive System
8.2: Female Genitals
8.3: Vagina
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8.5: Uterus and Cervix
8.6: Ovaries
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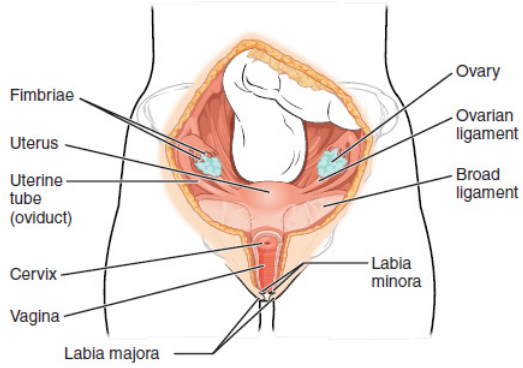
8.1: Female Reproductive System

Female Reproductive System

The female reproductive system functions to produce gametes and reproductive hormones just like the male reproductive system; however, it also has the additional task of supporting the developing fetus and delivering it to the outside world. Unlike its male counterpart, the female reproductive system is located primarily inside the pelvic cavity (Figure). Recall that the ovaries are the female gonads. The gamete they produce is called an oocyte. We'll discuss the production of oocytes in detail shortly. First, let's look at some of the structures of the female reproductive system.



(a) Human female reproductive system: lateral view



(b) Human female reproductive system: anterior view

The major organs of the female reproductive system are located inside the pelvic cavity.

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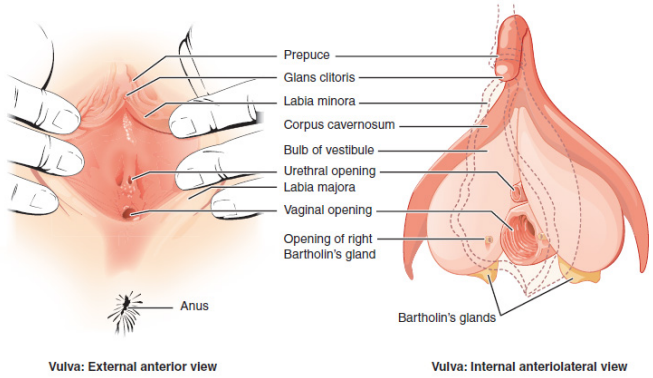
8.2: Female Genitals

External Female Genitals

The external female reproductive structures are referred to collectively as the vulva (Figure). The mons pubis is a pad of fat that is located at the anterior, over the pubic bone. After puberty, it becomes covered in pubic hair. The labia majora (labia = “lips”; majora = “larger”) are folds of hair-covered skin that begin just posterior to the mons pubis. The thinner and more pigmented labia minora (labia = “lips”; minora = “smaller”) extend medial to the labia majora. Although they naturally vary in shape and size from woman to woman, the labia minora serve to protect the female urethra and the entrance to the female reproductive tract.

The superior, anterior portions of the labia minora come together to encircle the clitoris (or glans clitoris), an organ that originates from the same cells as the glans penis and has abundant nerves that make it important in sexual sensation and orgasm. The hymen is a thin membrane that sometimes partially covers the entrance to the vagina. An intact hymen cannot be used as an indication of “virginity”; even at birth, this is only a partial membrane, as menstrual fluid and other secretions must be able to exit the body, regardless of penile–vaginal intercourse. The vaginal opening is located between the opening of the urethra and the anus. It is flanked by outlets to the Bartholin’s glands (or greater vestibular glands).

The Vulva



The external female genitalia are referred to collectively as the vulva.

The external female genitalia are collectively called the vulva. The vagina is the pathway into and out of the uterus. The man’s penis is inserted into the vagina to deliver sperm, and the baby exits the uterus through the vagina during childbirth.

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8.3: Vagina

Vagina

The vagina, shown at the bottom of Figure and Figure, is a muscular canal (approximately 10 cm long) that serves as the entrance to the reproductive tract. It also serves as the exit from the uterus during menses and childbirth. The outer walls of the anterior and posterior vagina are formed into longitudinal columns, or ridges, and the superior portion of the vagina—called the fornix—meets the protruding uterine cervix. The walls of the vagina are lined with an outer, fibrous adventitia; a middle layer of smooth muscle; and an inner mucous membrane with transverse folds called rugae. Together, the middle and inner layers allow the expansion of the vagina to accommodate intercourse and childbirth. The thin, perforated hymen can partially surround the opening to the vaginal orifice. The hymen can be ruptured with strenuous physical exercise, penile–vaginal intercourse, and childbirth. The Bartholin's glands and the lesser vestibular glands (located near the clitoris) secrete mucus, which keeps the vestibular area moist.

The vagina is home to a normal population of microorganisms that help to protect against infection by pathogenic bacteria, yeast, or other organisms that can enter the vagina. In a healthy woman, the most predominant type of vaginal bacteria is from the genus *Lactobacillus*. This family of beneficial bacterial flora secretes lactic acid, and thus protects the vagina by maintaining an acidic pH (below 4.5). Potential pathogens are less likely to survive in these acidic conditions. Lactic acid, in combination with other vaginal secretions, makes the vagina a self-cleansing organ. However, douching—or washing out the vagina with fluid—can disrupt the normal balance of healthy microorganisms, and actually increase a woman's risk for infections and irritation. Indeed, the American College of Obstetricians and Gynecologists recommend that women do not douche, and that they allow the vagina to maintain its normal healthy population of protective microbial flora.

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8.4: Uterine Tubes

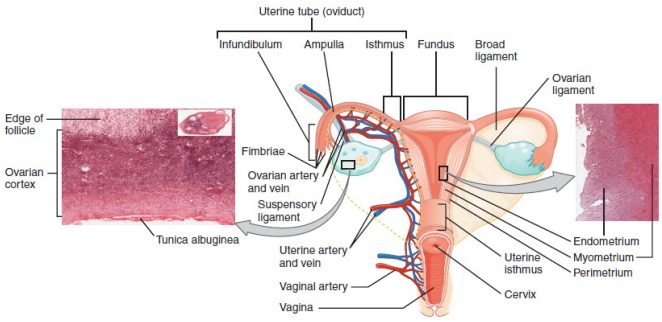
The Uterine Tubes

The uterine tubes (also called fallopian tubes or oviducts) serve as the conduit of the oocyte from the ovary to the uterus (Figure). Each of the two uterine tubes is close to, but not directly connected to, the ovary and divided into sections. The isthmus is the narrow medial end of each uterine tube that is connected to the uterus. The wide distal infundibulum flares out with slender, finger-like projections called fimbriae. The middle region of the tube, called the ampulla, is where fertilization often occurs. The uterine tubes also have three layers: an outer serosa, a middle smooth muscle layer, and an inner mucosal layer. In addition to its mucus-secreting cells, the inner mucosa contains ciliated cells that beat in the direction of the uterus, producing a current that will be critical to move the oocyte.

Following ovulation, the secondary oocyte surrounded by a few granulosa cells is released into the peritoneal cavity. The nearby uterine tube, either left or right, receives the oocyte. Unlike sperm, oocytes lack flagella, and therefore cannot move on their own. So how do they travel into the uterine tube and toward the uterus? High concentrations of estrogen that occur around the time of ovulation induce contractions of the smooth muscle along the length of the uterine tube. These contractions occur every 4 to 8 seconds, and the result is a coordinated movement that sweeps the surface of the ovary and the pelvic cavity. Current flowing toward the uterus is generated by coordinated beating of the cilia that line the outside and lumen of the length of the uterine tube. These cilia beat more strongly in response to the high estrogen concentrations that occur around the time of ovulation. As a result of these mechanisms, the oocyte–granulosa cell complex is pulled into the interior of the tube. Once inside, the muscular contractions and beating cilia move the oocyte slowly toward the uterus. When fertilization does occur, sperm typically meet the egg while it is still moving through the ampulla.

If the oocyte is successfully fertilized, the resulting zygote will begin to divide into two cells, then four, and so on, as it makes its way through the uterine tube and into the uterus. There, it will implant and continue to grow. If the egg is not fertilized, it will simply degrade—either in the uterine tube or in the uterus, where it may be shed with the next menstrual period.

Ovaries, Uterine Tubes, and Uterus



This anterior view shows the relationship of the ovaries, uterine tubes (oviducts), and uterus. Sperm enter through the vagina, and fertilization of an ovulated oocyte usually occurs in the distal uterine tube. From left to right, LM × 400, LM × 20. (Micrographs provided by the Regents of University of Michigan Medical School © 2012)

The open-ended structure of the uterine tubes can have significant health consequences if bacteria or other contagions enter through the vagina and move through the uterus, into the tubes, and then into the pelvic cavity. If this is left unchecked, a bacterial infection (sepsis) could quickly become life-threatening. The spread of an infection in this manner is of special concern when unskilled practitioners perform abortions in non-sterile conditions. Sepsis is also associated with sexually transmitted bacterial infections, especially gonorrhea and chlamydia. These increase a woman's risk for pelvic inflammatory disease (PID), infection of the uterine tubes or other reproductive organs. Even when resolved, PID can leave scar tissue in the tubes, leading to infertility.

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8.5: Uterus and Cervix

The Uterus and Cervix

The uterus is the muscular organ that nourishes and supports the growing embryo (see Figure). Its average size is approximately 5 cm wide by 7 cm long (approximately 2 in by 3 in) when a female is not pregnant. It has three sections. The portion of the uterus superior to the opening of the uterine tubes is called the fundus. The middle section of the uterus is called the body of uterus (or corpus). The cervix is the narrow inferior portion of the uterus that projects into the vagina. The cervix produces mucus secretions that become thin and stringy under the influence of high systemic plasma estrogen concentrations, and these secretions can facilitate sperm movement through the reproductive tract.

Several ligaments maintain the position of the uterus within the abdominopelvic cavity. The broad ligament is a fold of peritoneum that serves as a primary support for the uterus, extending laterally from both sides of the uterus and attaching it to the pelvic wall. The round ligament attaches to the uterus near the uterine tubes, and extends to the labia majora. Finally, the uterosacral ligament stabilizes the uterus posteriorly by its connection from the cervix to the pelvic wall.

The wall of the uterus is made up of three layers. The most superficial layer is the serous membrane, or perimetrium, which consists of epithelial tissue that covers the exterior portion of the uterus. The middle layer, or myometrium, is a thick layer of smooth muscle responsible for uterine contractions. Most of the uterus is myometrial tissue, and the muscle fibers run horizontally, vertically, and diagonally, allowing the powerful contractions that occur during labor and the less powerful contractions (or cramps) that help to expel menstrual blood during a woman's period. Anteriorly directed myometrial contractions also occur near the time of ovulation, and are thought to possibly facilitate the transport of sperm through the female reproductive tract.

The innermost layer of the uterus is called the endometrium. The endometrium contains a connective tissue lining, the lamina propria, which is covered by epithelial tissue that lines the lumen. Structurally, the endometrium consists of two layers: the stratum basalis and the stratum functionalis (the basal and functional layers). The stratum basalis layer is part of the lamina propria and is adjacent to the myometrium; this layer does not shed during menses. In contrast, the thicker stratum functionalis layer contains the glandular portion of the lamina propria and the endothelial tissue that lines the uterine lumen. It is the stratum functionalis that grows and thickens in response to increased levels of estrogen and progesterone. In the luteal phase of the menstrual cycle, special branches off of the uterine artery called spiral arteries supply the thickened stratum functionalis. This inner functional layer provides the proper site of implantation for the fertilized egg, and—should

ertilization not occur—it is only the stratum functionalis layer of the endometrium that sheds during menstruation.

Recall that during the follicular phase of the ovarian cycle, the tertiary follicles are growing and secreting estrogen. At the same time, the stratum functionalis of the endometrium is thickening to prepare for a potential implantation. The post-ovulatory increase in progesterone, which characterizes the luteal phase, is key for maintaining a thick stratum functionalis. As long as a functional corpus luteum is present in the ovary, the endometrial lining is prepared for implantation. Indeed, if an embryo implants, signals are sent to the corpus luteum to continue secreting progesterone to maintain the endometrium, and thus maintain the pregnancy. If an embryo does not implant, no signal is sent to the corpus luteum and it degrades, ceasing progesterone production and ending the luteal phase. Without progesterone, the endometrium thins and, under the influence of prostaglandins, the spiral arteries of the endometrium constrict and rupture, preventing oxygenated blood from reaching the endometrial tissue. As a result, endometrial tissue dies and blood, pieces of the endometrial tissue, and white blood cells are shed through the vagina during menstruation, or the menses. The first menses after puberty, called menarche, can occur either before or after the first ovulation.

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8.6: Ovaries

Ovaries

The ovaries are the female gonads (see Figure). Paired ovals, they are each about 2 to 3 cm in length, about the size of an almond. The ovaries are located within the pelvic cavity, and are supported by the mesovarium, an extension of the peritoneum that connects the ovaries to the broad ligament. Extending from the mesovarium itself is the suspensory ligament that contains the ovarian blood and lymph vessels. Finally, the ovary itself is attached to the uterus via the ovarian ligament.

The ovary comprises an outer covering of cuboidal epithelium called the ovarian surface epithelium that is superficial to a dense connective tissue covering called the tunica albuginea. Beneath the tunica albuginea is the cortex, or outer portion, of the organ. The cortex is composed of a tissue framework called the ovarian stroma that forms the bulk of the adult ovary. Oocytes develop within the outer layer of this stroma, each surrounded by supporting cells. This grouping of an oocyte and its supporting cells is called a follicle. The growth and development of ovarian follicles will be described shortly. Beneath the cortex lies the inner ovarian medulla, the site of blood vessels, lymph vessels, and the nerves of the ovary. You will learn more about the overall anatomy of the female reproductive system at the end of this section.

The Ovarian Cycle

The ovarian cycle is a set of predictable changes in a female's oocytes and ovarian follicles. During a woman's reproductive years, it is a roughly 28-day cycle that can be correlated with, but is not the same as, the menstrual cycle (discussed shortly). The cycle includes two interrelated processes: oogenesis (the production of female gametes) and folliculogenesis (the growth and development of ovarian follicles).

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8.7: The Menstrual Cycle

The Menstrual Cycle

Now that we have discussed the maturation of the cohort of tertiary follicles in the ovary, the build-up and then shedding of the endometrial lining in the uterus, and the function of the uterine tubes and vagina, we can put everything together to talk about the three phases of the menstrual cycle—the series of changes in which the uterine lining is shed, rebuilds, and prepares for implantation.

The timing of the menstrual cycle starts with the first day of menses, referred to as day one of a woman's period. Cycle length is determined by counting the days between the onset of bleeding in two subsequent cycles. Because the average length of a woman's menstrual cycle is 28 days, this is the time period used to identify the timing of events in the cycle. However, the length of the menstrual cycle varies among women, and even in the same woman from one cycle to the next, typically from 21 to 32 days.

Just as the hormones produced by the granulosa and theca cells of the ovary "drive" the follicular and luteal phases of the ovarian cycle, they also control the three distinct phases of the menstrual cycle. These are the menses phase, the proliferative phase, and the secretory phase.

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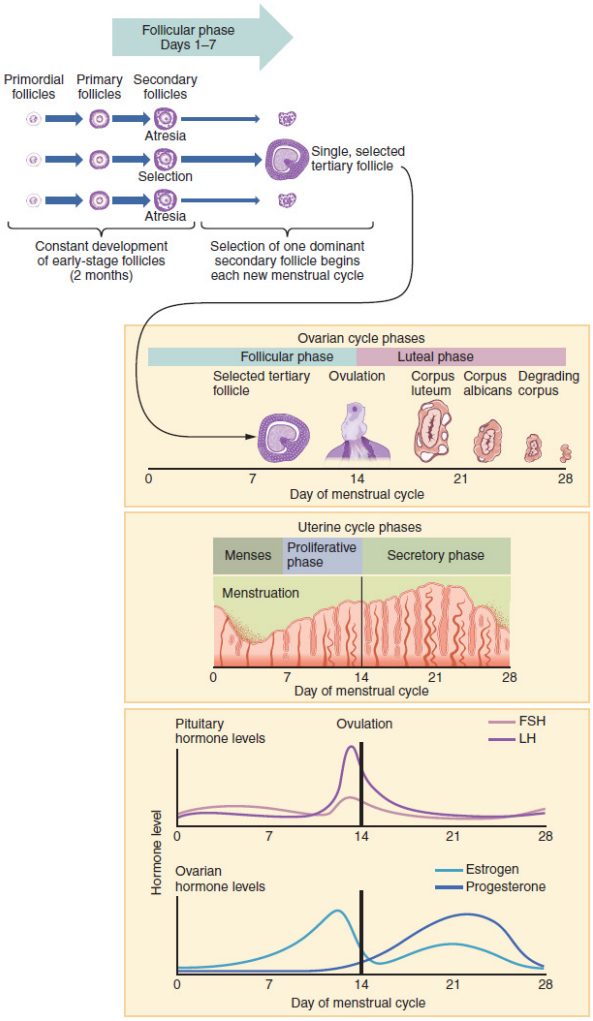
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8.8: The Menses Phase

Menses Phase

The menses phase of the menstrual cycle is the phase during which the lining is shed; that is, the days that the woman menstruates. Although it averages approximately five days, the menses phase can last from 2 to 7 days, or longer. As shown in Figure, the menses phase occurs during the early days of the follicular phase of the ovarian cycle, when progesterone, FSH, and LH levels are low. Recall that progesterone concentrations decline as a result of the degradation of the corpus luteum, marking the end of the luteal phase. This decline in progesterone triggers the shedding of the stratum functionalis of the endometrium.

Hormone Levels in Ovarian and Menstrual Cycles



The correlation of the hormone levels and their effects on the female reproductive system is shown in this timeline of the ovarian and menstrual cycles. The menstrual cycle begins at day one with the start of menses. Ovulation occurs around day 14 of a 28-day cycle, triggered by the LH surge.

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8.9: Phases after Menstrual Flow

Proliferative Phase

Once menstrual flow ceases, the endometrium begins to proliferate again, marking the beginning of the proliferative phase of the menstrual cycle (see Figure). It occurs when the granulosa and theca cells of the tertiary follicles begin to produce increased amounts of estrogen. These rising estrogen concentrations stimulate the endometrial lining to rebuild.

Recall that the high estrogen concentrations will eventually lead to a decrease in FSH as a result of negative feedback, resulting in atresia of all but one of the developing tertiary follicles. The switch to positive feedback—which occurs with the elevated estrogen production from the dominant follicle—then stimulates the LH surge that will trigger ovulation. In a typical 28-day menstrual cycle, ovulation occurs on day 14. Ovulation marks the end of the proliferative phase as well as the end of the follicular phase.

Secretory Phase

In addition to prompting the LH surge, high estrogen levels increase the uterine tube contractions that facilitate the pick-up and transfer of the ovulated oocyte. High estrogen levels also slightly decrease the acidity of the vagina, making it more hospitable to sperm. In the ovary, the luteinization of the granulosa cells of the collapsed follicle forms the progesterone-producing corpus luteum, marking the beginning of the luteal phase of the ovarian cycle. In the uterus, progesterone from the corpus luteum begins the secretory phase of the menstrual cycle, in which the endometrial lining prepares for implantation (see Figure). Over the next 10 to 12 days, the endometrial glands secrete a fluid rich in glycogen. If fertilization has occurred, this fluid will nourish the ball of cells now developing from the zygote. At the same time, the spiral arteries develop to provide blood to the thickened stratum functionalis.

If no pregnancy occurs within approximately 10 to 12 days, the corpus luteum will degrade into the corpus albicans. Levels of both estrogen and progesterone will fall, and the endometrium will grow thinner. Prostaglandins will be secreted that cause constriction of the spiral arteries, reducing oxygen supply. The endometrial tissue will die, resulting in menses—or the first day of the next cycle.

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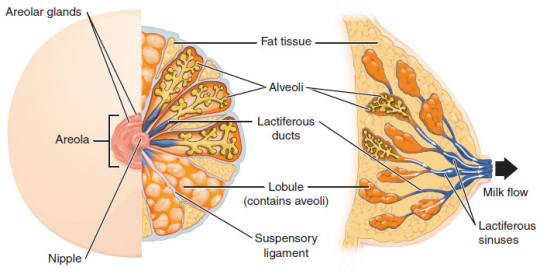
8.10: Breasts

The Breasts

Whereas the breasts are located far from the other female reproductive organs, they are considered accessory organs of the female reproductive system. The function of the breasts is to supply milk to an infant in a process called lactation. The external features of the breast include a nipple surrounded by a pigmented areola (Figure), whose coloration may deepen during pregnancy. The areola is typically circular and can vary in size from 25 to 100 mm in diameter. The areolar region is characterized by small, raised areolar glands that secrete lubricating fluid during lactation to protect the nipple from chafing. When a baby nurses, or draws milk from the breast, the entire areolar region is taken into the mouth.

Breast milk is produced by the mammary glands, which are modified sweat glands. The milk itself exits the breast through the nipple via 15 to 20 lactiferous ducts that open on the surface of the nipple. These lactiferous ducts each extend to a lactiferous sinus that connects to a glandular lobe within the breast itself that contains groups of milk-secreting cells in clusters called alveoli (see Figure). The clusters can change in size depending on the amount of milk in the alveolar lumen. Once milk is made in the alveoli, stimulated myoepithelial cells that surround the alveoli contract to push the milk to the lactiferous sinuses. From here, the baby can draw milk through the lactiferous ducts by suckling. The lobes themselves are surrounded by fat tissue, which determines the size of the breast; breast size differs between individuals and does not affect the amount of milk produced. Supporting the breasts are multiple bands of connective tissue called suspensory ligaments that connect the breast tissue to the dermis of the overlying skin.

Anatomy of the Breast



During lactation, milk moves from the alveoli through the lactiferous ducts to the nipple.

During the normal hormonal fluctuations in the menstrual cycle, breast tissue responds to changing levels of estrogen and progesterone, which can lead to swelling and breast tenderness in some individuals, especially during the secretory phase. If pregnancy occurs, the increase in hormones leads to further development of the mammary tissue and enlargement of the breasts.

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8.11: Hormonal Birth Control

Hormonal Birth Control

Birth control pills take advantage of the negative feedback system that regulates the ovarian and menstrual cycles to stop ovulation and prevent pregnancy. Typically they work by providing a constant level of both estrogen and progesterone, which negatively feeds back onto the hypothalamus and pituitary, thus preventing the release of FSH and LH. Without FSH, the follicles do not mature, and without the LH surge, ovulation does not occur. Although the estrogen in birth control pills does stimulate some thickening of the endometrial wall, it is reduced compared with a normal cycle and is less likely to support implantation.

Some birth control pills contain 21 active pills containing hormones, and 7 inactive pills (placebos). The decline in hormones during the week that the woman takes the placebo pills triggers menses, although it is typically lighter than a normal menstrual flow because of the reduced endometrial thickening. Newer types of birth control pills have been developed that deliver low-dose estrogens and progesterone for the entire cycle (these are meant to be taken 365 days a year), and menses never occurs. While some women prefer to have the proof of a lack of pregnancy that a monthly period provides, menstruation every 28 days is not required for health reasons, and there are no reported adverse effects of not having a menstrual period in an otherwise healthy individual.

Because birth control pills function by providing constant estrogen and progesterone levels and disrupting negative feedback, skipping even just one or two pills at certain points of the cycle (or even being several hours late taking the pill) can lead to an increase in FSH and LH and result in ovulation. It is important, therefore, that the woman follow the directions on the birth control pill package to successfully prevent pregnancy.

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8.12: Disorders of the Female Reproductive System

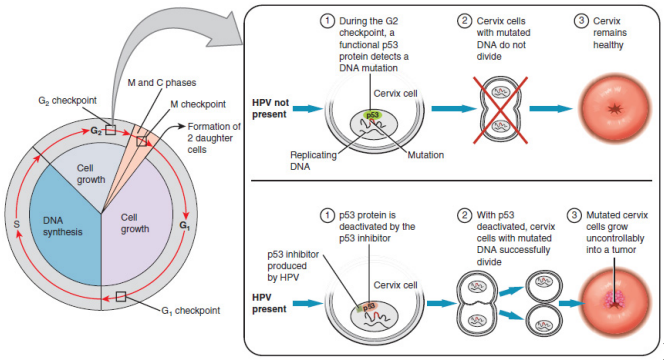
Female Reproductive System Research over many years has confirmed that cervical cancer is most often caused by a sexually transmitted infection with human papillomavirus (HPV). There are over 100 related viruses in the HPV family, and the characteristics of each strain determine the outcome of the infection. In all cases, the virus enters body cells and uses its own genetic material to take over the host cell's metabolic machinery and produce more virus particles.

HPV infections are common in both men and women. Indeed, a recent study determined that 42.5 percent of females had HPV at the time of testing. These women ranged in age from 14 to 59 years and differed in race, ethnicity, and number of sexual partners. Of note, the prevalence of HPV infection was 53.8 percent among women aged 20 to 24 years, the age group with the highest infection rate.

HPV strains are classified as high or low risk according to their potential to cause cancer. Though most HPV infections do not cause disease, the disruption of normal cellular functions in the low-risk forms of HPV can cause the male or female human host to develop genital warts. Often, the body is able to clear an HPV infection by normal immune responses within 2 years. However, the more serious, high-risk infection by certain types of HPV can result in cancer of the cervix (Figure). Infection with either of the cancer-causing variants HPV 16 or HPV 18 has been linked to more than 70 percent of all cervical cancer diagnoses. Although even these high-risk HPV strains can be cleared from the body over time, infections persist in some individuals. If this happens, the HPV infection can influence the cells of the cervix to develop precancerous changes.

Risk factors for cervical cancer include having unprotected sex; having multiple sexual partners; a first sexual experience at a younger age, when the cells of the cervix are not fully mature; failure to receive the HPV vaccine; a compromised immune system; and smoking. The risk of developing cervical cancer is doubled with cigarette smoking.

Development of Cervical Cancer



In most cases, cells infected with the HPV virus heal on their own. In some cases, however, the virus continues to spread and becomes an invasive cancer.

When the high-risk types of HPV enter a cell, two viral proteins are used to neutralize proteins that the host cells use as checkpoints in the cell cycle. The best studied of these proteins is p53. In a normal cell, p53 detects DNA damage in the cell's genome and either halts the progression of the cell cycle—allowing time for DNA repair to occur—or initiates apoptosis. Both of these processes prevent the accumulation of mutations in a cell's genome. High-risk HPV can neutralize p53, keeping the cell in a state in which fast growth is possible and impairing apoptosis, allowing mutations to accumulate in the cellular DNA.

The prevalence of cervical cancer in the United States is very low because of regular screening exams called pap smears. Pap smears sample cells of the cervix, allowing the detection of abnormal cells. If pre-cancerous cells are detected, there are several highly effective techniques that are currently in use to remove them before they pose a danger. However, women in developing countries often do not have access to regular pap smears. As a result, these women account for as many as 80 percent of the cases of cervical cancer worldwide.

In 2006, the first vaccine against the high-risk types of HPV was approved. There are now two HPV vaccines available: Gardasil® and Cervarix®. Whereas these vaccines were initially only targeted for women, because HPV is sexually transmitted, both men and women require vaccination for this approach to achieve its maximum efficacy. A recent study suggests that the HPV vaccine has cut the rates of HPV infection by the four targeted strains at least in half. Unfortunately, the high cost of manufacturing the vaccine is currently limiting access to many women worldwide.

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8.13: Aging and the Female Reproductive System

Aging and the Female Reproductive System

Female Reproductive System Female fertility (the ability to conceive) peaks when women are in their twenties, and is slowly reduced until a women reaches 35 years of age. After that time, fertility declines more rapidly, until it ends completely at the end of menopause. Menopause is the cessation of the menstrual cycle that occurs as a result of the loss of ovarian follicles and the hormones that they produce. A woman is considered to have completed menopause if she has not menstruated in a full year. After that point, she is considered postmenopausal. The average age for this change is consistent worldwide at between 50 and 52 years of age, but it can normally occur in a woman's forties, or later in her fifties. Poor health, including smoking, can lead to earlier loss of fertility and earlier menopause.

As a woman reaches the age of menopause, depletion of the number of viable follicles in the ovaries due to atresia affects the hormonal regulation of the menstrual cycle. During the years leading up to menopause, there is a decrease in the levels of the hormone inhibin, which normally participates in a negative feedback loop to the pituitary to control the production of FSH. The menopausal decrease in inhibin leads to an increase in FSH. The presence of FSH stimulates more follicles to grow and secrete estrogen. Because small, secondary follicles also respond to increases in FSH levels, larger numbers of follicles are stimulated to grow; however, most undergo atresia and die. Eventually, this process leads to the depletion of all follicles in the ovaries, and the production of estrogen falls off dramatically. It is primarily the lack of estrogens that leads to the symptoms of menopause.

The earliest changes occur during the menopausal transition, often referred to as peri-menopause, when a women's cycle becomes irregular but does not stop entirely. Although the levels of estrogen are still nearly the same as before the transition, the level of progesterone produced by the corpus luteum is reduced. This decline in progesterone can lead to abnormal growth, or hyperplasia, of the endometrium. This condition is a concern because it increases the risk of developing endometrial cancer. Two harmless conditions that can develop during the transition are uterine fibroids, which are benign masses of cells, and irregular bleeding. As estrogen levels change, other symptoms that occur are hot flashes and night sweats, trouble sleeping, vaginal dryness, mood swings, difficulty focusing, and thinning of hair on the head along with the growth of more hair on the face. Depending on the individual, these symptoms can be entirely absent, moderate, or severe.

After menopause, lower amounts of estrogens can lead to other changes. Cardiovascular disease becomes as prevalent in women as in men, possibly because estrogens reduce the amount of cholesterol in the blood vessels. When estrogen is lacking, many women find that they suddenly have problems with high cholesterol and the cardiovascular issues that accompany it. Osteoporosis is another problem because bone density decreases rapidly in the first years after menopause. The reduction in bone density leads to a higher incidence of fractures.

Hormone therapy (HT), which employs medication (synthetic estrogens and progestins) to increase estrogen and progestin levels, can alleviate some of the symptoms of menopause. In 2002, the Women's Health Initiative began a study to observe women for the long-term outcomes of hormone replacement therapy over 8.5 years. However, the study was prematurely terminated after 5.2 years because of evidence of a higher than normal risk of breast cancer in patients taking estrogen-only HT. The potential positive effects on cardiovascular disease were also not realized in the estrogen-only patients. The results of other hormone replacement studies over the last 50 years, including a 2012 study that followed over 1,000 menopausal women for 10 years, have shown cardiovascular benefits from estrogen and no increased risk for cancer. Some researchers believe that the age group tested in the 2002 trial may have been too old to benefit from the therapy, thus skewing the results. In the meantime, intense debate and study of the benefits and risks of replacement therapy is ongoing. Current guidelines approve HT for the reduction of hot flashes or flushes, but this treatment is generally only considered when women first start showing signs of menopausal changes, is used in the lowest dose possible for the shortest time possible (5 years or less), and it is suggested that women on HT have regular pelvic and breast exams.

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CHAPTER OVERVIEW

9: Human Sexuality, Male

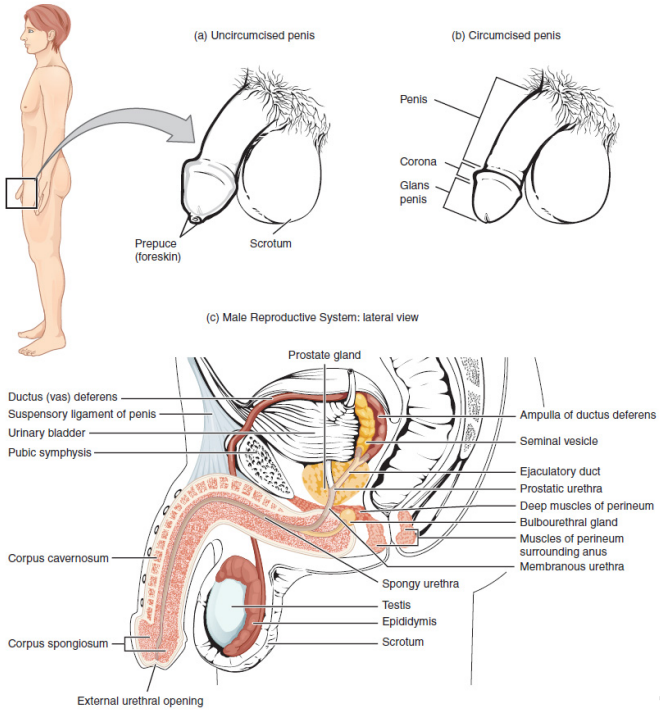
9.1: The Reproductive System, Male
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9.7: Semen
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9.1: The Reproductive System, Male

Unique for its role in human reproduction, a gamete is a specialized sex cell carrying 23 chromosomes—one half the number in body cells. At fertilization, the chromosomes in one male gamete, called a sperm (or spermatozoon), combine with the chromosomes in one female gamete, called an oocyte. The function of the male reproductive system (Figure) is to produce sperm and transfer them to the female reproductive tract. The paired testes are a crucial component in this process, as they produce both sperm and androgens, the hormones that support male reproductive physiology. In humans, the most important male androgen is testosterone. Several accessory organs and ducts aid the process of sperm maturation and transport the sperm and other seminal components to the penis, which delivers sperm to the female reproductive tract. In this section, we examine each of these different structures, and discuss the process of sperm production and transport.

Male Reproductive System



The structures of the male reproductive system include the testes, the epididymides, the penis, and the ducts and glands that produce and carry semen. Sperm exit the scrotum through the ductus deferens which is bundled in the spermatic cord. The seminal vesicles and prostate gland add fluids to the sperm to create semen.

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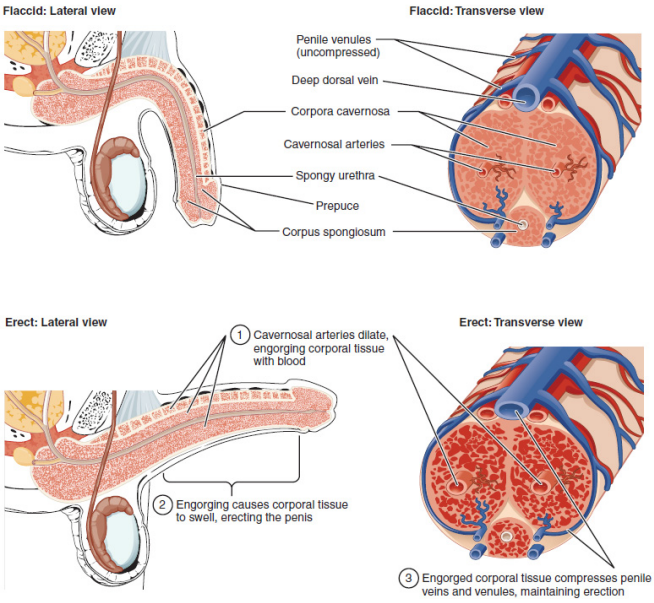
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9.2: The Penis

The Penis

The penis is the male organ of copulation (sexual intercourse). It is flaccid for non-sexual actions,such as urination and turgid and rod-like with sexual arousal. When erect, the stiffness of the organ allows it to penetrate into the vagina and deposit semen into the female reproductive tract.

Cross-Sectional Anatomy of the Penis



Three columns of erectile tissue make up most of the volume of the penis.

The shaft of the penis surrounds the urethra (Figure). The shaft is composed of three column-like chambers of erectile tissue that span the length of the shaft. Each of the two larger lateral chambers is called a corpus cavernosum (plural = corpora cavernosa). Together, these make up the bulk of the penis. The corpus spongiosum, which can be felt as a raised ridge on the erect penis, is a smaller chamber that surrounds the spongy, or penile, urethra. The end of the penis called the glans penis has a high concentration of nerve endings resulting in very sensitive skin that influences the likelihood of ejaculation (see Figure). The skin from the shaft extends down over the glans and forms a collar called the prepuce (or foreskin). The foreskin also contains a dense concentration of nerve endings and both lubricate and protect the sensitive skin of the glans penis. A surgical procedure called circumcision, often performed for religious or social reasons, removes the prepuce typically within days of birth.

Both sexual arousal and REM sleep (during which dreaming occurs) can induce an erection. Penile erections are the result of engorgement of the tissues because of more arterial blood flowing into the penis than is leaving in the veins. The rapid increase in blood volume fills the erectile chambers, and the increased pressure of the filled chambers compresses the thin-walled penile venules preventing venous drainage of the penis. The result of this increased blood flow to the penis and reduced blood return from the penis is erection. Depending on the flaccid dimensions of a penis, it can increase in size slightly or greatly during erection with the average length of an erect penis measuring approximately 15 cm.

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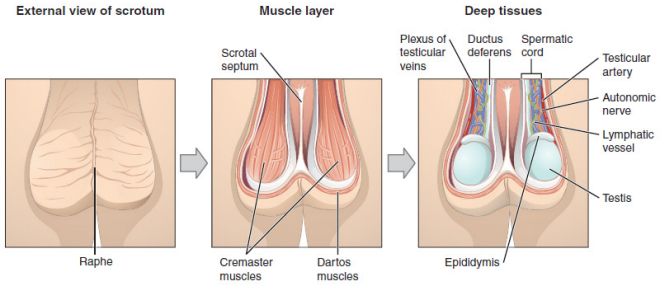
9.3: Scrotum and Testes

Scrotum

The testes are located in a skin-covered, highly pigmented, muscular sack called the scrotum that extends from the body behind the penis (see Figure). This location is important in sperm production which occurs within the testes and proceeds more efficiently when the testes are kept 2 to 4°C below core body temperature.

The dartos muscle makes up the subcutaneous muscle layer of the scrotum (Figure). It continues internally to make up the scrotal septum, a wall that divides the scrotum into two compartments each housing one testis. Descending from the internal oblique muscle of the abdominal wall are the two cremaster muscles which cover each testis like a muscular net. By contracting simultaneously, the dartos and cremaster muscles can elevate the testes in cold weather (or water) moving the testes closer to the body and decreasing the surface area of the scrotum to retain heat. Alternatively, as the environmental temperature increases, the scrotum relaxes moving the testes farther from the body core and increasing scrotal surface area which promotes heat loss. Externally, the scrotum has a raised medial thickening on the surface called the raphae.

The Scrotum and Testes



This anterior view shows the structures of the scrotum and testes.

Testes

The testes (singular = testis) are the male gonads—that is, the male reproductive organs. They produce both sperm and androgens such as testosterone and are active throughout the reproductive lifespan of the male.

Paired ovals, the testes are each approximately 4 to 5 cm in length and are housed within the scrotum (see Figure). Sperm develop in structures called seminiferous tubules. During the seventh month of the developmental period of a male fetus, each testis moves through the abdominal musculature to descend into the scrotal cavity. This is called the “descent of the testis.” Cryptorchidism is the clinical term used when one or both of the testes fail to descend into the scrotum prior to birth.

Formed sperm are transferred to the epididymis where they mature. They leave the epididymis during an ejaculation via the ductus deferens. The tightly coiled seminiferous tubules form the bulk of each testis. They are composed of developing sperm cells surrounding a lumen, the hollow center of the tubule where formed sperm are released into the duct system of the testis.

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9.4: Epididymis

Role of the Epididymis

From the lumen of the seminiferous tubules, the immotile sperm are surrounded by testicular fluid and moved to the epididymis (plural = epididymides), a coiled tube attached to the testis where newly formed sperm continue to mature (see Figure). Though the epididymis does not take up much room in its tightly coiled state, it would be approximately 6 m (20 feet) long if straightened. It takes an average of 12 days for sperm to move through the coils of the epididymis with the shortest recorded transit time in humans being one day. Sperm enter the head of the epididymis and are moved along predominantly by the contraction of smooth muscles lining the epididymal tubes. As they are moved along the length of the epididymis, the sperm further mature and acquire the ability to move under their own power. Once inside the female reproductive tract, they will use this ability to move independently toward the unfertilized egg. The more mature sperm are then stored in the tail of the epididymis (the final section) until ejaculation occurs.

During ejaculation, sperm exit the tail of the epididymis and are pushed by smooth muscle contraction to the ductus deferens (also called the vas deferens). The ductus deferens is a thick, muscular tube that is bundled together inside the scrotum with connective tissue, blood vessels, and nerves into a structure called the spermatic cord (see Figure and Figure). Because the ductus deferens is physically accessible within the scrotum, surgical sterilization to interrupt sperm delivery can be performed by cutting and sealing a small section of the ductus (vas) deferens. This procedure is called a vasectomy, and it is an effective form of male birth control. Although it may be possible to reverse a vasectomy, clinicians consider the procedure permanent and advise men to undergo it only if they are certain they no longer wish to father children.

From each epididymis, each ductus deferens extends superiorly into the abdominal cavity through the inguinal canal in the abdominal wall. From here, the ductus deferens continues posteriorly to the pelvic cavity ending posterior to the bladder where it dilates in a region called the ampulla (meaning “flask”).

Sperm make up only 5 percent of the final volume of semen, the thick, milky fluid that the male ejaculates. The bulk of semen is produced by three critical accessory glands of the male reproductive system: the seminal vesicles, the prostate, and the bulbourethral glands.

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9.5: Spermatogenesis

Spermatogenesis occurs in the seminiferous tubules that form the bulk of each testis (see Figure). The process begins at puberty, after which time sperm are produced constantly throughout a man's life. One production cycle from spermatogonia through formed sperm takes approximately 64 days. A new cycle starts approximately every 16 days although this timing is not synchronous across the seminiferous tubules. Sperm counts—the total number of sperm a man produces—slowly decline after age 35, and some studies suggest that smoking can lower sperm counts irrespective of age.

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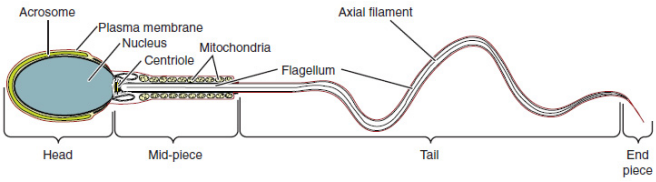
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9.6: Sperm

Structure of Formed Sperm

Sperm are smaller than most cells in the body; in fact, the volume of a sperm cell is 85,000 times less than that of the female gamete. Approximately 100 to 300 million sperm are produced each day; whereas, women typically ovulate only one oocyte per month. Sperm have a distinctive head, mid-piece, and tail region (Figure). The head of the sperm contains the extremely compact nucleus with very little cytoplasm. These qualities contribute to the overall small size of the sperm (the head is only 5 μm long). A structure called the acrosome covers most of the head of the sperm cell as a “cap” that is filled with enzymes important for preparing sperm to participate in fertilization. The flagellum extends from the neck and the mid-piece through the tail of the sperm enabling it to move the entire sperm cell. The central strand of the flagellum is formed from inside the maturing sperm cell during the final stages of spermatogenesis.

Structure of Sperm



Sperm cells are divided into a head, containing DNA; a mid-piece, containing mitochondria; and a tail, providing motility. The acrosome is oval and somewhat flattened.

To fertilize an egg, sperm must be moved from the seminiferous tubules in the testes, through the epididymis, and—later during ejaculation—along the length of the penis and out into the female reproductive tract.

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9.7: Semen

Seminal Vesicles

As sperm pass out at ejaculation, they mix with fluid from the associated seminal vesicle (see Figure). The paired seminal vesicles are glands that contribute approximately 60 percent of the semen volume. Seminal vesicle fluid contains large amounts of fructose which allows movement through the female reproductive tract. The fluid, now containing both sperm and seminal vesicle secretions, moves into the prostate gland.

Prostate Gland

As shown in Figure, the centrally located prostate gland sits anterior to the rectum at the base of the bladder surrounding the prostatic urethra (the portion of the urethra that runs within the prostate). About the size of a walnut, the prostate is formed of both muscular and glandular tissues. It excretes an alkaline, milky fluid to the passing seminal fluid—now called semen—that is critical to first coagulate and then decoagulate the semen following ejaculation. The temporary thickening of semen helps retain it within the female reproductive tract providing time for sperm to utilize the fructose provided by seminal vesicle secretions. When the semen regains its fluid state, sperm can then pass farther into the female reproductive tract.

The prostate normally doubles in size during puberty. At approximately age 25, it gradually begins to enlarge again. This enlargement does not usually cause problems; however, abnormal growth of the prostate, or benign prostatic hyperplasia (BPH), can cause constriction of the urethra as it passes through the middle of the prostate gland, leading to a number of lower urinary tract symptoms such as a frequent and intense urge to urinate, a weak stream, and a sensation that the bladder has not emptied completely. By age 60, approximately 40 percent of men have some degree of BPH. By age 80, the number of affected individuals has jumped to as many as 80 percent. Treatments for BPH attempt to relieve the pressure on the urethra so that urine can flow more normally. Mild to moderate symptoms are treated with medication; whereas, severe enlargement of the prostate is treated by surgery in which a portion of the prostate tissue is removed.

Another common disorder involving the prostate is prostate cancer. According to the Centers for Disease Control and Prevention (CDC), prostate cancer is the second most common cancer in men. However, some forms of prostate cancer grow very slowly and thus may not ever require treatment. Aggressive forms of prostate cancer, in contrast, involve metastasis to vulnerable organs like the lungs and brain. There is no link between BPH and prostate cancer, but the symptoms are similar. Prostate cancer is detected by a medical history, a blood test, and a rectal exam that allows physicians to palpate the prostate and check for unusual masses. If a mass is detected, the cancer diagnosis is confirmed by biopsy of the cells.

Bulbourethral Glands

The final addition to semen is made by two bulbourethral glands (or Cowper's glands) that release a thick, salty fluid that lubricates the end of the urethra and the vagina and helps to clean urine residues from the penile urethra. The fluid from these accessory glands is released after the male becomes sexually aroused and shortly before the release of the semen. It is therefore sometimes called pre-ejaculate. It is important to note that, in addition to the lubricating proteins, it is possible for bulbourethral fluid to pick up sperm already present in the urethra, and therefore it may be able to cause pregnancy.

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9.8: Testosterone

Testosterone

Testosterone, an androgen, is a steroid hormone produced by Leydig cells. The alternate term for Leydig cells, interstitial cells, reflects their location between the seminiferous tubules in the testes. In male embryos, testosterone is secreted by Leydig cells by the seventh week of development with peak concentrations reached in the second trimester. This early release of testosterone results in the anatomical differentiation of the male sexual organs. In childhood, testosterone concentrations are low. They increase during puberty activating characteristic physical changes and initiating spermatogenesis.

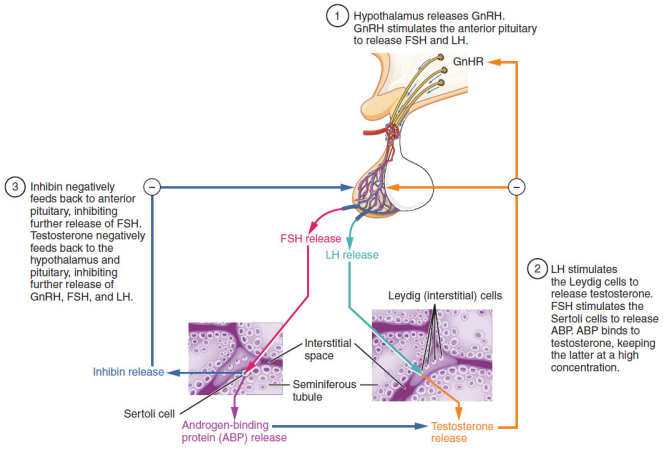
Functions of Testosterone

The continued presence of testosterone is necessary to keep the male reproductive system working properly, and Leydig cells produce approximately 6 to 7 mg of testosterone per day. Testicular steroidogenesis (the manufacture of androgens, including testosterone) results in testosterone concentrations that are 100 times higher in the testes than in the circulation. Maintaining these normal concentrations of testosterone promotes spermatogenesis; whereas, low levels of testosterone can lead to infertility. In addition to intratesticular secretion, testosterone is also released into the systemic circulation and plays an important role in muscle development, bone growth, the development of secondary sex characteristics, and maintaining libido (sex drive) in both males and females. In females, the ovaries secrete small amounts of testosterone although most is converted to estradiol. A small amount of testosterone is also secreted by the adrenal glands in both sexes.

Control of Testosterone

The regulation of testosterone concentrations throughout the body is critical for male reproductive function. The intricate interplay between the endocrine system and the reproductive system is shown in Figure.

Regulation of Testosterone Production



The hypothalamus and pituitary gland regulate the production of testosterone and the cells that assist in spermatogenesis.

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9.9: Erectile Dysfunction of the Male Reproductive System

Male Reproductive System Erectile dysfunction (ED) is a condition in which a man has difficulty either initiating or maintaining an erection. The combined prevalence of minimal, moderate, and complete ED is approximately 40 percent in men at age 40, and reaches nearly 70 percent by 70 years of age. In addition to aging, ED is associated with diabetes, vascular disease, psychiatric disorders, prostate disorders, the use of some drugs such as certain antidepressants, and problems with the testes resulting in low testosterone concentrations. These physical and emotional conditions can result in an inability to achieve an erection.

In the 1990s, clinical trials of a PDE5 inhibitor called sildenafil were initiated to treat hypertension and angina pectoris (chest pain caused by poor blood flow through the heart). The trial showed that the drug was not effective at treating heart conditions, but many men experienced erection and priapism (erection lasting longer than 4 hours). Because of this, a clinical trial was started to investigate the ability of sildenafil to promote erections in men suffering from ED. In 1998, the FDA approved the drug, marketed as Viagra®. Since approval of the drug, sildenafil and similar PDE inhibitors now generate over a billion dollars a year in sales and are reported to be effective in treating approximately 70 to 85 percent of cases of ED. Importantly, men with health problems—especially those with cardiac disease taking nitrates—should avoid Viagra or talk to their physician to find out if they are a candidate for the use of this drug as deaths have been reported for at-risk users.

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9.10: Aging for the Male Reproductive System

Declines in Leydig cell activity can occur in men beginning at 40 to 50 years of age. The resulting reduction in circulating testosterone concentrations can lead to symptoms of andropause also known as male menopause. While the reduction in sex steroids in men is akin to female menopause, there is no clear sign—such as a lack of a menstrual period—to denote the initiation of andropause. Instead, men report feelings of fatigue, reduced muscle mass, depression, anxiety, irritability, loss of libido, and insomnia. A reduction in spermatogenesis resulting in lowered fertility is also reported, and sexual dysfunction can also be associated with andropausal symptoms.

Whereas some researchers believe that certain aspects of andropause are difficult to tease apart from aging in general, testosterone replacement is sometimes prescribed to alleviate some symptoms. Recent studies have shown a benefit from androgen replacement therapy on the new onset of depression in elderly men; however, other studies caution against testosterone replacement for long-term treatment of andropause symptoms showing that high doses can sharply increase the risk of both heart disease and prostate cancer.

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CHAPTER OVERVIEW

10: Diseases and Disorders

10.1: Introduction to Diseases and Disorders
10.2: Introduction to Epidemiology
10.3: Disease Transmission
10.4: The Chain of Infection Model
10.5: Noncommunicable and Communicable Diseases and Disorders
10.6: Health risk reduction for non-communicable diseases
10.7: Immunity and Immunizations

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10.1: Introduction to Diseases and Disorders

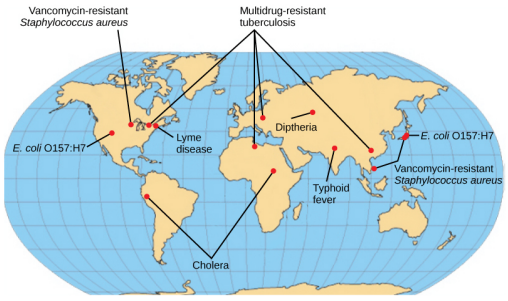
People have illness and physicians diagnose and treat disease. Disease is an objective term which implies a malfunctioning of the body or part of the body. Disease is pathological and is diagnosed on the basis of recognizable signs and symptoms. Illness is the subjective experience of pain, discomfort or disorder. Although it is mostly safe to say that illness is the subjective experience of disease, it is possible to experience illness without having a disease and it is possible to have a disease and not feel ill.

Devastating pathogen-borne diseases and plagues, both viral and bacterial in nature, have affected humans since the beginning of human history. The true cause of these diseases was not understood at the time, and some people thought that diseases were a spiritual punishment. Over time, people came to realize that staying apart from afflicted persons, and disposing of the corpses and personal belongings of victims of illness, reduced their own chances of getting sick.

Epidemiologists study how diseases affect a population. An epidemic is a disease that occurs in an unusually high number of individuals in a population at the same time. A pandemic is a widespread, usually worldwide, epidemic. An endemic disease is a disease that is constantly present, usually at low incidence, in a population.

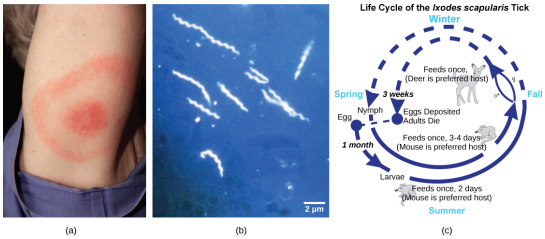
Emerging and Re-emerging Diseases

The distribution of a particular disease is dynamic. Therefore, changes in the environment, the pathogen, or the host population can dramatically impact the spread of a disease. According to the World Health Organization (WHO) an emerging disease (Figure) is one that has appeared in a population for the first time, or that may have existed previously but is rapidly increasing in incidence or geographic range. This definition also includes re-emerging diseases that were previously under control. Approximately 75 percent of recently emerging infectious diseases affecting humans are zoonotic diseases, zoonoses, diseases that primarily infect animals and are transmitted to humans; some are of viral origin and some are of bacterial origin. Brucellosis is an example of a prokaryotic zoonosis that is re-emerging in some regions, and necrotizing fasciitis (commonly known as flesh-eating bacteria) has been increasing in virulence for the last 80 years for unknown reasons.



The map shows regions where bacterial diseases are emerging or reemerging. (credit: modification of work by NIH)

Some of the present emerging diseases are not actually new, but are diseases that were catastrophic in the past (Figure). They devastated populations and became dormant for a while, just to come back, sometimes more virulent than before, as was the case with bubonic plague. Other diseases, like tuberculosis, were never eradicated but were under control in some regions of the world until coming back, mostly in urban centers with high concentrations of immunocompromised people. The WHO has identified certain diseases whose worldwide re-emergence should be monitored. Among these are two viral diseases (dengue fever and yellow fever), and three bacterial diseases (diphtheria, cholera, and bubonic plague). The war against infectious diseases has no foreseeable end.



Lyme disease often, but not always, results in (a) a characteristic bullseye rash. The disease is caused by a (b) Gram-negative spirochete bacterium of the genus *Borrelia*. The bacteria (c) infect ticks, which in turns infect mice. Deer are the preferred secondary host, but the ticks also may feed on humans. Untreated, the disease causes chronic disorders in the nervous system, eyes,

joints, and heart. The disease is named after Lyme, Connecticut, where an outbreak occurred in 1995 and has subsequently spread. The disease is not new, however. Genetic evidence suggests that Ötzi the Iceman, a 5,300-year-old mummy found in the Alps, was infected with *Borrelia*. (credit a: James Gathany, CDC; credit b: CDC; scale-bar data from Matt Russell)

Section Summary

Devastating diseases and plagues have been among us since early times. There are records about microbial diseases as far back as 3000 B.C. Infectious diseases remain among the leading causes of death worldwide. Emerging diseases are those rapidly increasing in incidence or geographic range. They can be new or re-emerging diseases (previously under control). Many emerging diseases affecting humans, such as brucellosis, are zoonoses. The WHO has identified a group of diseases whose re-emergence should be monitored: Those caused by bacteria include bubonic plague, diphtheria, and cholera.

Biofilms are considered responsible for diseases such as bacterial infections in patients with cystic fibrosis, Legionnaires' disease, and otitis media. They produce dental plaque; colonize catheters, prostheses, transcutaneous, and orthopedic devices; and infect contact lenses, open wounds, and burned tissue. Biofilms also produce foodborne diseases because they colonize the surfaces of food and food-processing equipment. Biofilms are resistant to most of the methods used to control microbial growth. The excessive use of antibiotics has resulted in a major global problem, since resistant forms of bacteria have been selected over time. A very dangerous strain, methicillin-resistant *Staphylococcus aureus* (MRSA), has wreaked havoc recently. Foodborne diseases result from the consumption of contaminated food, pathogenic bacteria, viruses, or parasites that contaminate food.

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10.2: Introduction to Epidemiology

Source: *Centers for Disease Control, EXCITE, http://www.cdc.gov/excite/classroom/intro_epi.htm*

This background lesson provides several working definitions of epidemiology—the basic science of public health. First to set the stage, consider the three incidents that follow, stepping into the shoes of the public health officer who received the initial report and asking yourself the question, "What do I do now?" Some of these examples made national news and may be familiar to you.

HomeFirst Incident

In March 1985, a nurse epidemiologist in a county health department noted, while reviewing surveillance data, three cases in a single month of hepatitis B of unusual origin. Hepatitis B, or serum hepatitis, is transmitted through sexual contact and by exposure to infected bodily fluids, but these three patients did not seem to have the usual risk factors. All three people did, however, indicate having received injections at the same health care facility.
The nurse's immediate questions were:

Is this a coincidence? Did these three cases occur by chance or is there a link? In this instance, the nurse decided to pursue an investigation.

HomeSecond Incident

At 8:30 in the morning on August 2, 1976, Dr. Robert B. Craven of Centers for Disease Control's (CDC) Viral Diseases Division received a call from a nurse at a Veterans' Hospital in Philadelphia, Pennsylvania. The nurse reported two cases of severe respiratory illness, one of which had been fatal. Both people had attended the annual American Legion Convention held July 21-24. By the evening of August 2, 71 more of the people attending the convention had the same illness, with symptoms of acute onset of fever, chills, headache, malaise, dry cough, and myalgia. Further conversations with local and state public health officials revealed that between July 26 and August 2, 18 conventioneers had died. Deaths were due primarily to pneumonia.
An intense investigation began immediately. The incident became known as the first outbreak of Legionnaires' disease and led to the discovery of the gram-negative pathogen, Legionnella pneumophila.

HomeThird Incident

On October 30, 1989, a New Mexico physician notified the state's health department of three patients with marked peripheral eosinophilia and severe myalgia. All three patients had been taking oral preparations of L-tryptophan, a nonprescription drug sold as a dietary supplement in health food stores. Despite extensive clinical evaluation and testing, the illness could not be identified.
An investigation followed and resulted in the characterization of eosinophilia-myalgia syndrome, EMS. The investigation implicated a vehicle for exposure—L-tryptophan dietary supplements—before a suspected agent was identified, and the product was taken off the market. Eventually, the problem was traced to a contaminant that had been introduced by changes in the production process at a single manufacturing facility.
These three examples illustrate some of the key reasons for needing applied, or field, epidemiology:

- They were unexpected.
- They demanded a response.
- The investigators had to go out into the field to solve the problem.

Epidemiology Defined

A definition of epidemiology is "the study of the distribution and determinants of health-related states in specified populations, and the application of this study to control health problems." A look at the key words will help illuminate the meaning:

- Epidemiology is the basic science of public health. It's a highly quantitative discipline based on principles of statistics and research methodologies.
- Distribution Epidemiologists study the distribution of frequencies and patterns of health events within groups in a population. To do this, they use descriptive epidemiology, which characterizes health events in terms of time, place, and person
- Determinant Epidemiologists also attempt to search for causes or factors that are associated with increased risk or probability of disease. This type of epidemiology, where we move from questions of "who," "what," "where," and "when" and start trying to answer "how" and "why," is referred to as analytical epidemiology

A comparison between the practice of public health and the more familiar practice of health care helps in describing epidemiology. First, where health care practitioners collect data on an individual patient by taking a medical history and conducting a physical

exam, epidemiologists collect data about an entire population through surveillance systems or descriptive epidemiological studies. The health care practitioner uses his or her data to make a differential diagnosis. The epidemiologist's data is used to generate hypotheses about the relationships between exposure and disease. Both disciplines then test the hypotheses, the health care practitioner by conducting additional diagnostic studies or tests, the epidemiologist by conducting analytical studies such as cohort or case-control studies. The final step is to take action. The health care practitioner prescribes medical treatment, and the epidemiologist, some form of community intervention to end the health problem and prevent its recurrence.

Health Care Professional	**Epidemiologist**
Collects data on an individual patient by taking a medical history and conducting a physical exam	Collects data about an entire population through surveillance systems or descriptive epidemiological studies
Uses his or her data to make a differential diagnosis	Data is used to generate hypotheses about the relationships between exposure and disease
Tests the hypothesis by conducting additional diagnostic studies or tests	Tests the hypothesis by conducting analytical studies such as cohort or case-control studies
Prescribes medical treatment	Develops community intervention to end the health problem and prevent its recurrence

One way to sum up the task of epidemiologists is to say that they "count things." Basically, epidemiologists count cases of disease or injury, define the affected population, and then compute rates of disease or injury in that population. Then they compare these rates with those found in other populations and make inferences regarding the patterns of disease to determine whether a problem exists.

For example, in the hepatitis B example earlier, you might ask: Is the rate of disease among people with no know risk factors greater than we would expect? Is the pattern or distribution of the cases suspicious? Once a problem has been identified, the data are used to determine the cause of the health problem; the modes of transmission; any factors that are related to susceptibility, exposure, or risk; and any potential environmental determinants.

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10.3: Disease Transmission

Disease Transmission

In talking about epidemiology, it is important to review how outbreaks occur. First, we'll look at three commonly used and often misunderstood terms: "epidemic," "outbreak," and "cluster." An **epidemic** is the occurrence of more cases of disease than would normally be expected in a specific place or group of people over a given period of time. To an epidemiologist, "**outbreak**" means basically the same thing. In the public's mind, however, "epidemic" has a far more serious connotation than "outbreak." For this reason, "outbreak" is often used to avoid sensationalism. The third term "**cluster**" is occasionally used incorrectly in place of "epidemic" or "outbreak." A cluster is a group of cases in a specific time and place that may or may not be greater than the expected rate. Often the aim of investigating clusters is to determine the baseline rate of disease for that time and place. Two other terms you will come across are "**endemic**" meaning a high background rate of disease, and "**pandemic**" meaning very widespread often global disease.

For an outbreak or epidemic to occur, the basic elements of disease causation and an adequate chain of transmission must be present. Disease occurs when an outside **agent** capable of causing the disease meets a **host** that is vulnerable to the agent in an **environment** that allows the agent and host to interact. Then, given a chain of transmission from one host to another and a suitable mode of spread, an outbreak can develop. These basic concepts help guide the selection of public health strategies to prevent health problems. Depending on which approach might be most effective, we might direct efforts at the specific agent (e.g., guinea worm), host (e.g., immunization to prevent measles), or environment (e.g., sanitation improvements to prevent salmonella). We can also target a specific point in the chain of transmission. This was the response in the E.coli outbreak in Washington State in the early 1990s when health officials called for the thorough cooking of hamburgers to interrupt transmission of the bacterium.

The **host** is the person, or in a more generic definition the organism, that is susceptible to the effect of the agent. The status of the host is quite important and is generally classifiable as susceptible, immune, or infected. Finally, and also quite important, is that the host's response to exposure can vary widely from showing no effect to manifesting illness.

The **environment** is the conditions or influences that are not part of either the agent or the host but that influence its interaction. A wide variety of factors, including physical, climatologic, biologic, social, and economic conditions, can come into play. For instance, in a study of motor vehicle injuries, the agent (mechanical energy) and the host (driver) could be affected by the topography, the weather, and the actions of other drivers. In many infectious disease outbreaks, social and economic conditions cause overcrowding and lead to high levels of exposure.

Agent, host and environment alone are not sufficient to cause an epidemic; an adequate chain of transmission must be present. This process requires a source for the agent, a portal of exit, a mode of transmission, and a portal of entry. The first element, the **source for the agent**, is often the place where the agent originates, where it lives, grows, and multiplies, but this is not always the case. The agent that causes botulism (*Clostridium botulinum*), for example, originates in soil, but the source of most botulism infections is improperly canned food containing *C. botulinum* spores.

The second element, a **portal of exit**, is a pathway by which the agent can leave the source. This pathway is usually related to the place where the agent is localized. For instance, the agents causing tuberculosis and the flu are released through the respiratory tract, whereas agents for many stomach ailments are released through the digestive tract. Agents found in the blood, such as hepatitis B and HIV can be released through cuts or needles.
Once the agent leaves the source a **mode of transmission**, or means of carrying it to the host, is needed. This can happen in a number of ways some of which are direct and some indirect. **Direct transmission** includes contact with soil or plants as well as contact between people. In **indirect transmission**, the agent can be **airborne**, **vector borne**, or **vehicle borne**. In airborne transmission, the agent is carried from the source to the host suspended in air particles. Vector-borne diseases are transmitted indirectly by a live carrier usually an arthropod such as mosquitos, fleas, or ticks. Vehicle-borne diseases are carried by inanimate objects such as food or water, blood, or items like handkerchiefs, bedding, and surgical instruments.

Finally, there must be a pathway into the host, a **portal of entry**, that gives the agent access to tissue where it can multiply or act. Often the agent enters the host in the same way that it left the source. This is the case with the flu virus which leaves the source through the respiratory tract and enters a new host through the respiratory tract.

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10.4: The Chain of Infection Model

This model explains the spread of a communicable disease from one host (or person) to another. The basic idea represented in the chain of infection is that individuals can break the chain (reduce the risk) at any point; thus the spread of the disease can be stopped.

Chain of infection.

Component of the model	Definition	Preventive measures
Communicable disease	Disease caused by an infectious agent	Pasteurization, chlorination, antibiotics, disinfectants, hand washing, etc.
Human reservoir	The human being who is harboring the infectious agent	Isolation, surveillance, treatment with medications, etc.
Portal of exit	The body part through which the infectious agent is exiting from the reservoir, for example the mouth or the anus	Utilization of handkerchiefs, condoms, hair nets, insect repellents, hand washing, etc.
Transmission	The spread of the infectious agent from the reservoir to the host	Isolation, hand washing, mosquito control, sexual abstinence, condom users, etc.
Portal of entry	The body part through which the infectious agent will enter the new host, for example the skin after a mosquito bite, the mouth	Condoms, hair nets, insect repellents, hand washing, etc.
Establishment of disease in new host (susceptible person)	The host develops signs and symptoms of the new disease. Immunizations, health education, nutrition promotion; sexual abstinence, condom use, etc.	

There are two sets of components that have some similar preventive measures. As a way of helping yourself become familiar with this chart see if you can spot which these are.

The portal of entry and exit both involve preventive measures such as hand washing, condoms, hair nets and insect repellents, while the human reservoir and transmission measures both involve isolation. Be sure you have a clear picture of the definition and prevention of each element before you continue.

With the application of such information, health education can help to create programs that are aimed at breaking the chain and reducing the risks of infection in other people.

The communicable disease model

- The **communicable diseasemodel** presents three elements; infectious agent, host and environment, as the minimal requirements for the presence and spread of a communicable disease in a population.
- The **infectious agent** is the element that must be present for the disease to occur and spread. Bacteria, viruses and parasites are examples of infectious agents.
- The **host** is any susceptible organism. Plants, animals or humans can be invaded by the infectious agent and become the host.
- The **environment** includes all other factors that either promote or prohibit disease transmission.

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10.5: Noncommunicable and Communicable Diseases and Disorders

Noncommunicable Diseases and Disorders

Diseases are classified as either communicable or noncommunicable. Communicable diseases are spread to other people and they are caused by viral, bacterial, parasitic, or fungal infection. Noncommunicable diseases, also known as non- infectious diseases, are not transferred and are typically caused by heredity, deficiencies in nutrition, or factors involving the environment. Some noncommunicable diseases include –

- Respiratory disorders
- Diabetes
- Headaches
- Arthritis
- Skin disorders
- Neurological disorders
- Cancer
- Cardiovascular Diseases and Disorders

HomeCommunicable (Infectious) Diseases

Infectious diseases kill more people worldwide than any other single cause. Infectious diseases are caused by germs. Germs are tiny living things that are found everywhere – in air, soil and water. You can get infected by touching germs.

There are four main kinds of germs:

- Bacteria – one-celled germs that multiply quickly and may release chemicals which can make you sick
- Viruses – capsules that contain genetic material, and use your own cells to multiply
- Fungi – primitive vegetables, like mushrooms or mildew
- Protozoa – one-celled animals that use other living things for food and a place to live

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10.6: Health risk reduction for non-communicable diseases

Both the chain of infection and communicable disease models are helpful in trying to prevent disease caused by an infectious agent. However, these models are *not* applicable to non-communicable diseases which include many of the chronic diseases such as heart disease and cancers. Most of these diseases become apparent in people over a period of time and are not caused by a single factor but by a combination of factors. The concept of “caused by many factors” is often called the multi causation disease model. For example, it is known that heart disease is most likely to be a problem for individuals who are older, who smoke, who do not exercise, who are overweight, who have high blood pressure, who have high blood cholesterol and who have a family history of heart disease.
Note that within the list of factors you have just read there are both modifiable and non-modifiable risk factors. Which factors do you think are modifiable? All but one, history of heart disease.

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10.7: Immunity and Immunizations

Vaccines

In 2010, a pertussis (whooping cough) outbreak in California sickened 9,143 people and resulted in 10 infant deaths: the worst outbreak in 63 years (Centers for Disease Control 2011b). Researchers, suspecting that the primary cause of the outbreak was the waning strength of pertussis vaccines in older children, recommended a booster vaccination for 11–12-year-olds and also for pregnant women (Zacharyczuk 2011). Pertussis is most serious for babies; one in five needs to be hospitalized, and since they are too young for the vaccine themselves, it is crucial that people around them be immunized (Centers for Disease Control 2011b). Several states, including California, have been requiring the pertussis booster for older children in recent years with the hope of staving off another outbreak.

But what of people who do not want their children to have this vaccine or any other? That question is at the heart of a debate that has been simmering for years. Vaccines are biological preparations that improve immunity against a certain disease. Vaccines have contributed to the eradication and weakening of numerous infectious diseases including smallpox, polio, mumps, chicken pox, and meningitis.

However, many people express concern about potential negative side effects from vaccines. These concerns range from fears about overloading the child's immune system to controversial reports about devastating side effects of the vaccines. One misapprehension is that the vaccine itself might cause the disease it is supposed to be immunizing against.

Another commonly circulated concern is that vaccinations, specifically the MMR vaccine (MMR stands for measles, mumps, and rubella), are linked to autism. The autism connection has been particularly controversial. In 1998, a British physician named Andrew Wakefield published a study in Great Britain's Lancet magazine that linked the MMR vaccine to autism. The report received a lot of media attention, resulting in British immunization rates decreasing from 91 percent in 1997 to almost 80 percent by 2003, accompanied by a subsequent rise in measles cases (Devlin 2008). A prolonged investigation by the British Medical Journal proved that not only was the link in the study nonexistent, but that Dr. Wakefield had falsified data in order to support his claims (CNN 2011). Dr. Wakefield was discredited and stripped of his license, but the doubt still lingers in many parents' minds.

In the United States, many parents still believe in the now discredited MMR-autism link and refuse to vaccinate their children. Other parents choose not to vaccinate for various reasons like religious or health beliefs. In one instance, a boy whose parents opted not to vaccinate returned home to the U.S. after a trip abroad; no one yet knew he was infected with measles. The boy exposed 839 people to the disease and caused 11 additional cases of measles, all in other unvaccinated children including one infant who had to be hospitalized. According to a study published in Pediatrics (2010), the outbreak cost the public sector $10,376 per diagnosed case. The study further showed that the intentional non-vaccination of those infected occurred in students from private schools, public charter schools, and public schools in upper-socioeconomic areas (Sugerman et al. 2010).
Consider these questions about immunization:

- Should parents be forced to immunize their children?
- How does this story of vaccines in a high-income region compare to that in a low-income region, like sub-Saharan Africa, where populations are often eagerly seeking vaccines rather than refusing them?
- Do you believe all children should receive vaccinations?

Vaccinations may hurt a little… but the diseases they can prevent can hurt a lot more! Immunization vaccinations are essential. They protect against things like measles, mumps, rubella, hepatitis B, polio, diphtheria, tetanus and pertussis (whooping cough). Immunizations are important for adults as well as for children. Here's why:
Your immune system helps your body fight germs by producing substances to combat them. Once it does, the immune system "remembers" the germ and can fight it again. Vaccines contain germs that have been killed or weakened. When given to a healthy person, the vaccine triggers the immune system to respond and thus build immunity.
Before vaccines, people became immune only by actually getting a disease and surviving it. Immunizations are an easier and less risky way to become immune.

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