

NUTRITION ESSENTIALS



Stephanie Green and Kelli Shallal
Open Maricopa

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This text was compiled on 09/27/2026

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Introduction

Nutrition plays an important role in your life in relation to good health and well-being. Maybe, you've really never given much thought about nutrition. However, by taking a proactive approach to your health, you can rebuild a better, stronger foundation and move towards good health. This book can help you understand which foods to include in your diet and how those nutrients provide support for growth and repair in your body. The science-based information in this book can help guide you on a new journey towards good health. Each chapter introduces you to easy to understand nutritional topics from why nutrients are essential, how your body uses them and which foods contain those vital nutrients. Additionally, we will look at common diseases associated with eating too much and too little.

How this book is organized

Each chapter focuses on a specific aspect of nutrition. We begin with where our food comes from and how we get nutrients into our bodies through the process of digestion and absorption. At the end of the book, we explore what nutrition looks like during each stage of the life cycle from conception to the elderly years.

Throughout the book, you'll find a variety of interactives such as informative videos, non-graded quizzes, and matching activities to help you pause and think about the information. You will also notice the book is formatted with colored heading boxes. The GREEN boxes identify what you will learn in each chapter and list the learning objectives at the end of each chapter. The BLUE boxes identify activities to enhance your learning. The PURPLE boxes identify areas that you may want to explore further.

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1.1: Introduction

Learn

- Food insecurity across the globe
- Sustainable food systems
- Local agriculture in Arizona
- Food Safety

1.2: Hunger Across the Globe

Most of us have felt hunger at some point in our lives, often as a passing sensation before a meal. But for much of the world, hunger is an everyday experience tied to food insecurity. Food insecurity means not having consistent access to enough safe, nutritious food and not obtaining it without resorting to emergency food programs, scavenging, or stealing. If you are food insecure, you may skip meals, eat less healthy food than you want to (because you are forced to eat what is available), and may need to rely on food banks or emergency food programs. As of the 2025 State of Food Security and Nutrition in the World (SOFI) report — the most current UN data — an estimated 673 million people (8.2% of the global population) faced hunger in 2024, and about 2.3 billion people experienced moderate or severe food insecurity. Source: data.unicef.org/resources/sofi-2025/

Watch this short video on Food Insecurity

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



To find out what the Food Insecurity rate Arizona, click on the [Food Insecurity Map of the United States](#). Use your cursor to hover over the state of Arizona and enter your answer below.

The Arizona Food Insecurity rate in Maricopa County is _____ %.

Answer available at the end of this section.

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[View this Interactive Content online](#)



Malnutrition is defined as poor nutrition and is often a result of food insecurity. Malnutrition can present in two ways:

- Undernutrition: when people do not have enough food, resulting in both a lack of calories (energy) and nutrients. In areas where agriculture and/or food distribution are interrupted by bad weather, poor policies or systems, or even war, people may not get enough food.
- Overnutrition: when people consume too many calories but not enough nutrients. Much of America suffers from overnutrition; the population eats a diet of highly processed foods that are low in nutrients yet unnecessarily high in calories.

We have a few federal programs to help feed people, such as the Supplemental Nutrition Assistance Program (SNAP) and Women, Infants, and Children (WIC). But what is the long-term answer? How do we reduce malnutrition worldwide and successfully feed everyone? The path forward lies in sustainable food systems.

Answers

YouTube Video

13.2

1.3: A Solution to Hunger- Sustainable Food Systems

A sustainable food system meets our current needs and supports an ongoing ecosystem for future generations without damaging the environment. Some challenges to building a sustainable food system include:

- Making food affordable and accessible.
- Building a system that supplies highly-nutritious food.
- Eliminating food deserts.
- The negative impact of industrial technology on food production and distribution.

What can you do to help create better food systems? On the policy level, support laws that require farming methods to be sustainable. On a personal level, eat more locally grown foods.

Did You Know?

Locate local foods near you using the [USDA Local Food Directories](#)

1.4: The Impact of Industrial Technology on Food Production and Distribution

The food industry is a trillion-dollar business that starts on the farm and ends in your home. Along the way, a great deal of industrial technology shapes — and sometimes damages — the food, the process, and the environment. The U.S. government subsidizes only eight crops, which narrows the diet available to Americans and makes farmers more likely to choose a small variety of plants. Additionally, farmers use many herbicides and pesticides to improve yield; these chemicals end up in the water we drink and ultimately harm the environment. After harvest, produce is often processed to enable long-distance shipping. Although preservation increases the amount of food available, the process frequently adds salt or sugar or strips food of important nutrients. There is also an inherent cost to shipping items: energy and fossil fuels are expended to move food long distances, with negative impacts on both the food and the environment. Industrialization has allowed improvements to parts of the food production and distribution system — but at what cost? Similar, and even more complex, issues affect sectors involved in livestock raising, fishing, and farmed seafood.

Arizona Agriculture – How long does it take to get Lettuce from the field to the store?

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



How do Oranges Grow?

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



1.5: What does Agriculture Look Like in Arizona?

Living in the desert, you might not expect to find many farms — but cattle are raised in every county in Arizona. Agriculture is a significant industry in the state, with ranching and farming as its second-largest revenue source. Arizona is known for the “Five C’s”: climate, citrus, cotton, cattle, and copper. The climate is perfect for growing citrus fruits like oranges, tangerines, lemons, and grapefruit, because temperatures typically do not fall below freezing in most of the state. Cotton was Arizona’s original crop. Nowadays, cattle are especially important, as 98% of Arizona’s agricultural land is used for grazing. One interesting aspect of Arizona agriculture is gender equity: nationally, 36% of farmers are female, while in Arizona, nearly 48% of producers are women.

Agriculture in Arizona

Click on the arrow to learn more.

Citrus available at the end of this section.

Cotton available at the end of this section.

Ranching available at the end of this section.

Cattle available at the end of this section.

Copper available at the end of this section.

Answers

Agriculture in Arizona

Arizona is perfect for growing citrus like oranges, tangerines, lemons and grapefruit

Agriculture in Arizona

Cotton was Arizona's original crop

Agriculture in Arizona

Arizona's climate makes it perfect for farming and ranching: No freezing temperatures Crops can be planted/harvested at most times of the year

Agriculture in Arizona

Cattle are raised in every county in Arizona 98% of Arizona's agriculture land is used for grazing

Agriculture in Arizona

Arizona produces 64% of domestic copper

1.6: Food Safety

Every year, tens of millions of Americans get sick from eating or drinking contaminated food or beverages, making food safety a serious public health concern. Not only do people get sick, but there are also serious economic consequences — including medical costs and lost wages. A person has a **foodborne illness** when they become ill from eating or drinking something contaminated. There is a broad range of foodborne illnesses, with signs and symptoms varying by source of contamination.

Contamination can come from bacteria, viruses, parasites, heavy metals such as mercury or cadmium, molds, poisonous mushrooms, pesticides, or pollutants. The two contaminants most commonly reported in the news are Salmonella and E. coli. Regardless of how a person becomes ill, the contaminant enters the body through food or drink and travels into the gastrointestinal tract. Therefore, common symptoms include gut-related issues such as diarrhea, abdominal pain, and nausea. Additional symptoms include dehydration, lightheadedness, rapid heartbeat, and vomiting. More severe symptoms can include high fever, diarrhea lasting more than three days, bloody stools, prolonged vomiting, and signs of shock. Importantly, a foodborne illness can develop several hours or even days after ingesting the contaminant — it is not necessarily the last meal you ate that made you sick.

A common treatment for a food borne illness includes:

- Rest
- Drink plenty of liquids
- Avoid antidiarrheal medication

How Long Will Your Favorite Food or Beverage Stay Safe?

Visit [Stilltasty](#) and search for “eggs” to learn how long you can keep them past the date on the carton, then search for your favorite food or beverage.

Fill in the blank below

You were asked to search for eggs in the Still Tasty guide. How long can you keep eggs-cooked, hard boiled in your refrigerator? _____ days

Answer available at the end of this section.

In the USA, four key agencies work to educate the public about food infections and prevent the spread of disease: the **CDC** (Centers for Disease Control and Prevention), the **FDA** (Food and Drug Administration), the **EPA** (Environmental Protection Agency), and the **USDA** (United States Department of Agriculture). These agencies identify outbreaks of foodborne illness, enforce food safety laws, monitor pesticide use, and track water quality. The government works hard to keep our food safe — but you must also take action. Here are the key steps to prevent foodborne illness:

Steps to prevent food borne illness

1. **CLEAN** -Wash your hands, surfaces, utensils, fruits, and vegetables.
2. **SEPARATE** – Do not mix meat, poultry, seafood, and eggs with other foods. Store them separately and use separate cutting boards.
3. **COOK** – Heat food to the correct internal temperature, and keep it hot after cooking.
4. **CHILL** -Keep food cold. Do not thaw or marinate food at room temperature. Refrigerate leftovers promptly.

Produce Safety

Produce-Pro-Consumer-Fact-Sheet

Do You Know?

Which of the following are good food safety tips for using fresh produce like fruits and vegetables? Choose all that apply.

- a. Wash your hands for 20 seconds with warm soap and water before preparing fresh produce.
- b. Store perishable produce in the refrigerator at or below 40 degrees.
- c. Use soap to wash fresh produce.
- d. Rinse your produce BEFORE you peel it or slice into it with a knife to prevent the spread of bacteria.

Answer available at the end of this section.

Additional tips to stay healthy

- Buy food from a clean, reputable store.
- Inspect food for signs of mold or rot.
- Do not buy dented or bulging cans.
- Avoid torn or open packages.
- Do not buy frozen items covered with frost or ice crystals.
- Keep raw meat, poultry, and seafood for no more than two days and wrap them well to prevent leakage and cross-contamination.
- Do not store leftovers in the can they came in.
- Consume properly refrigerated leftovers within three to five days.

At-Risk Groups

No one is immune to consuming contaminated food. Whether you become seriously ill depends on the microorganism involved, the amount consumed, and your overall health. Some groups, however, face a higher risk of developing severe complications from foodborne disease. Young children, older adults, and pregnant women all have a greater chance of becoming very ill after consuming contaminated food. Other high-risk groups include people with compromised immune systems due to HIV/AIDS, immunosuppressive medications (such as those taken after an organ transplant), and long-term steroid use for asthma or arthritis. People with diabetes, cancer, liver disease, or stomach problems related to low stomach acid or previous stomach surgery are also at elevated risk. Everyone — but especially these groups — should handle food carefully, ensure that food has been cooked thoroughly to the proper temperatures, and avoid any risky exposures.

Answers

How Long Will Your Favorite Food or Beverage Stay Safe?

7

Do You Know?

a, b, d

1.7: End Chapter

Learning Objectives

- Discuss a few of the key domestic and global hunger issues commonly faced in your area and across the globe.
- Define malnutrition, including undernutrition and overnutrition. Identify factors that cause each type of malnutrition locally and globally.
- Discuss why it's important to advocate for and support the development of sustainable agricultural systems.
- Discuss the impact of industrial technology on health and the environment.
- Define the four key agencies that work together to regulate food safety.
- Define the 5 C's and discuss Arizona's agricultural strengths.
- Discuss food borne illnesses, including contamination sources, common symptoms, at risk-groups, and recommended treatment options.
- Define the four key steps of food safety.

2: NUTRITION AND YOUR HEALTH

Close message

[Learn more](#)

Welcome to your new guide!

Click on "New" to build out your guide.



[2.1: Introduction](#)

[2.2: What Should I Eat to be Healthy?](#)

[2.3: Federal Dietary Guidance- From MyPlate to the New Food Pyramid](#)

[2.4: The Nutrition Partnership- Food, Activity, and Mental Health](#)

[2.5: End Chapter](#)

2.1: Introduction

Learn

- The connection between diet and health
- Components of a balanced diet
- Factors that influence your health and food choices
- Eat to help prevent disease

Good nutrition will help you feel better, think more clearly, and be healthier. By making a conscious effort to regularly choose healthier foods, you can help your body fight off disease. This chapter explores what a healthy diet looks like, how to use current federal dietary guidance to make healthier choices, and how your lifestyle and behaviors affect your health. Be sure to complete the activities in each blue text box

2.2: What Should I Eat to be Healthy?

Everyone knows how to eat, but knowing what to eat takes a bit more thought. A healthy diet focuses on fresh, whole foods that have been sustaining people for generations. The term **whole foods** refers to food prepared as close to its natural state as possible. For example, an apple is a whole food, while apple juice is not. Whole foods supply more of the nutrients the body needs — such as vitamins, minerals, protein, carbohydrates, fats, and fiber — all essential to good health. Commercially prepared and fast foods lack nutrients and often contain a great deal of sugar, salt, and saturated and trans fats, all of which are associated with conditions such as atherosclerosis, heart disease, stroke, cancer, obesity, diabetes, and other illnesses.

Do You Know?

Click on the items that are NOT Whole Foods



Answer available at the end of this section.

Achieving a healthy diet is a matter of balancing the quality and quantity of food that is eaten. There are five key factors to a healthy diet:

1. **Adequate:** providing enough nutrients, fiber, and calories.
2. **Balanced nutrients:** consuming the appropriate ratios of nutrients.
3. **Balanced calories:** eating about as many calories as you burn each day.
4. **Moderation:** no extreme eating; not too much or too little.
5. **Variety:** regularly eating different foods from each of the food groups.

Adequate

An adequate diet favors **nutrient-dense foods** and provides at least the minimum levels of essential nutrients. Nutrient-dense foods are foods that contain many essential nutrients per calorie, such as fruits and vegetables, lean meats, poultry, fish, low-fat dairy products, and whole grains. Nutrient-dense foods are the opposite of **nutrient-poor foods** — such as sugary carbonated beverages — which provide calories without meaningful nutrients.

Balanced Nutrients and Calories

Achieving balance in your diet means not consuming one nutrient at the expense of another. For example, calcium is essential for healthy teeth and bones, but too much calcium can interfere with iron absorption. Because most foods that are good sources of iron are poor sources of calcium, a proper balance between food choices is needed to get adequate amounts of both. It is also important to balance the calories you consume with the calories you burn every day.

Moderation

Eating in moderation is crucial for optimal health. Eating nutrient-poor foods every day will eventually lead to poor health. Does that mean you should never eat a cookie? Absolutely not! Cookies are delicious, but they should be eaten in moderation alongside nutrient-rich foods.

Variety

Variety involves eating different foods from all the food groups. A varied diet helps ensure that you consume and absorb adequate amounts of all the essential nutrients required for health. One of the major drawbacks of a monotonous diet is the risk of consuming too much of some nutrients and not enough of others. Trying new foods can also be a source of pleasure — you never know what you might like until you try it.

Do You Know?

Which photo contains nutrient rich foods?



Answer available at the end of this section.

Answers

Do You Know?



Peanut Butter may have added ingredients besides the peanuts. 1 of 3 NOT a Whole Food.

Flour Tortilla's are not a whole food because they are made from flour which, is no longer a whole grain 2 of 3 NOT a Whole Food.

Orange Juice is not a whole food because it has been processed and could include extra ingredients not present in the actual oranges like added sugars. 3 of 3 NOT a Whole Food.

Do You Know?

The photo on the LEFT of vegetables are nutrient rich foods.

2.3: Federal Dietary Guidance- From MyPlate to the New Food Pyramid

How do we know what is good for us? Through quality research. The U.S. government publishes Dietary Guidelines based on that research and updates them every five years. The most current edition — the **2025–2030 Dietary Guidelines for Americans** — was released on January 7, 2026, and is available at [Real Food](#). The guidelines' central message is simple: eat real, whole, nutrient-dense food and limit highly processed foods, added sugars, and refined carbohydrates.

Dietary guidelines can be difficult to translate into everyday choices. Protein, Each category provides important nutrients your body needs to be healthy. The number of servings from each group depends on your age and how many calories you need every day.

Fruits

watermelon and berries <i>Watermelon and Berries</i>	Fruits provide essential nutrients such as vitamin C and folate, the mineral potassium, dietary fiber, and phytonutrients. 2 daily servings: (amounts vary by age and calorie needs) One serving of fruit equals: • 1 cup raw or cooked fruit • ½ cup dried fruit • 1 cup 100% fruit juice
---	--

Vegetables

Vegetables <i>Vegetables</i>	Vegetables provide essential nutrients including vitamins A and C, folate, potassium, dietary fiber, and phytonutrients. 3 daily servings: (amounts vary by age and calorie needs) One serving of vegetables equals: • 1 cup raw or cooked vegetables • 2 cups leafy salad greens • 1 cup 100% vegetable juice
---------------------------------	--

Grains

Wheat in field <i>A Field of Wheat Growing</i>	Grains provide B vitamins and minerals such as iron, magnesium, and selenium. Whole grains also contain dietary fiber. 2-4 daily servings: approximately 6 ounce-equivalents per day (amounts vary by age and calorie needs) One serving of grains equals: • 1 slice of bread • 1 ounce ready-to-eat cereal • ½ cup cooked rice, pasta, or cereal grain
---	---

Protein

Chef holding a fish Chef Joshua Moore, Executive Chef & Managing Partner of Volare Restaurant in Louisville, Kentucky, receives fresh fish each week. Chef Moore is holding a Moonfish from Hilo, Hawaii.	Protein provides essential amino acids, the building blocks of the body. Consume high-quality, nutrient-dense protein foods at every meal. Aim for 20–35 grams of protein at each meal and 10–20 grams at snacks, for a total of 1.2–1.6 grams per kilogram of body weight daily. Recommended daily protein intake: approximately 1.2–1.6 grams per kilogram of body weight per day. For most adults, this is roughly 12–18 traditional protein servings daily, depending on body weight and activity level. • Lean meats, poultry, or seafood • Eggs • Peanut butter • Cooked beans or peas • Nuts or seeds
--	---

Category: Dairy

Dairy products are a key source of calcium, along with potassium, zinc, magnesium, selenium, choline, vitamins A and D, and some B vitamins. These nutrients help build and maintain strong bones.	Milk Cows Milk
Recommended daily servings: approximately 3 per day (amounts vary by age and calorie needs)	
One serving of dairy equals:	
1 cup milk	
1 cup yogurt	
1 cup fortified soy beverage	
1½ ounces natural cheese (such as cheddar) or 2 ounces processed cheese	

Some people may avoid one of these important food groups due to a food allergy or personal choice. If so, it is important to develop an alternative plan to ensure your body does not miss out on those vital nutrients. For example, a dairy allergy is one of the most common food allergies. If you are following a 2,000-calorie plan, you would need to identify other foods to include each day to obtain the nutrients provided by the dairy group — especially calcium.

Watch the Video

Learn how dairy intolerance differs from a dairy allergy by watching the video below and then answer the question.

A lactose intolerance means you have a deficiency in the enzyme lactase?

True or False

Answer available at the end of this section.

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Create Your Customized Food Plan

www.choosemyplate.gov/widgets/myplate-plan-start/sm

Answers

YouTube Video

True

2.4: The Nutrition Partnership- Food, Activity, and Mental Health

Eating well will only take you so far on your path to good health. Genetics, your activity level, and mental health all contribute to overall wellness. You cannot change your genes, but you can improve your fitness and mental health.

Physical Activity- 20 Minutes a Day Makes a Difference!

Physical activity helps protect your health by decreasing your risk of chronic diseases such as type 2 diabetes, heart disease, and cancer. Being active also improves your mental state by elevating your mood, decreasing stress levels, and improving sleep quality. With all these benefits, why doesn't everyone get active? Unfortunately, regular physical activity is not high on most Americans' priority list. The Centers for Disease Control and Prevention (CDC) recommends that adults engage in 150 minutes of moderate-intensity activity each week — that is only about 20 minutes per day, but it can make a meaningful difference in your health.

gardening icon

Some activities that count toward your weekly goal

- Recreational swimming and water aerobics
- Brisk walking (at least 2.5 miles per hour)
- Bicycling slower than 10 mph on level ground
- Tennis (doubles)
- Power yoga
- Line dancing
- General housework, gardening, and home repair

Mental Health- De-stress!

Are you stressed out? You are not alone. Americans frequently report elevated stress levels compared to people in many other countries. What you eat also affects your mental health: certain nutrients such as omega-3 fatty acids (found in salmon and flaxseed) help the brain manage stress. Additionally, practicing meditation, deep breathing, journaling, and regular exercise supports mental health. In today's technology-driven world, you are exposed to constant streams of information, which can be stressful. Everyone needs a way to unplug, relax, and de-stress each day.

Activity – How to Decrease Stress

Try this simple breathing technique now to de-stress

Sit comfortably and close your eyes.

Inhale slowly and deeply through your nose.

Breathe out slowly through pursed lips, limiting the airflow from your mouth.

Repeat two more times.

How do you feel?

2.5: End Chapter

Learning Objectives

- Define a balanced diet and describe why variety is a key component.
- Describe what MyPlate is and the five food groups that it contains.
- Describe how healthful eating and physical movement can reduce the risk of disease.
- Define the recommended physical activity guidelines.
- Discuss the relationship between diet and health.
- Identify key components that are important for a healthy diet.
- Discuss the differences between a food allergy and a food sensitivity.

3: ENERGY NEEDS, OBESITY, AND DISORDERED EATING

3.1: Introduction

3.2: Nutrition and Your Body

3.3: How can we tell if the Body is Healthy?

3.4: Balancing Energy Input and Energy Output

3.5: Basal Metabolic Rate

3.6: Disordered Eating

3.7: End Chapter

3.1: Introduction

Learn

- Your Energy Needs
- Body Mass Index (BMI)
- Obesity Trends
- Disordered Eating

3.2: Nutrition and Your Body

Physical appearances can be deceiving when it comes to health status. Just because someone looks muscular and fit does not mean their cholesterol and blood pressure are in a healthy range. In this chapter, we will examine the Body Mass Index, body shape, and obesity trends, and then explore how we judge our appearance and the issue of disordered eating.

3.3: How can we tell if the Body is Healthy?

One way to assess whether a body is healthy is to determine its **body composition** — that is, how much of the body is muscle versus fat. There are numerous ways to measure body composition, but the one you may have heard about at the doctor's office or in the news is **BMI**, which stands for body mass index. BMI is calculated from height and weight and is an inexpensive, easy screening method for indicating your weight category.

BMI	Weight Category
Below 18.5	Underweight
18.5-24.9	Healthy weight
Over 25-29.9	Overweight
Over 30	Obese

Having a high BMI is associated with an increased risk for many diseases and health conditions, including heart disease, type 2 diabetes, hypertension, endometrial, breast, and colon cancers, stroke, osteoarthritis, liver disease, gallbladder disorders, and hormonal disorders. However, BMI is not a perfect measure; other assessments are needed to diagnose obesity and disease risk. One well-known limitation is that BMI may incorrectly categorize someone who is very muscular, such as an athlete or bodybuilder, as overweight or obese, though this is a less common scenario. You will learn your own BMI later in this chapter.

Measuring Body Fat and Distribution

Body Fat Caliper

Another way to evaluate body composition is to measure fat directly and assess its distribution. The easiest method is a **skinfold test** using a caliper — a tool that looks somewhat like a pair of pinchers — to measure the thickness of skin at the back of the arm, the back, and several other areas. This test is inexpensive, non-invasive, and fairly accurate.

The **distribution** of fat on the body is just as important as the total amount of fat. An easy way to measure distribution is by calculating the **waist-to-hip ratio**. A greater difference between your waist and hip measurements indicates a **pear shape**, while little difference between the two suggests an **apple shape** — a pattern associated with greater risk for chronic disease. Where you carry your weight affects your health.

Watch this video to learn how to calculate your waist-to-hip ratio

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



3.4: Balancing Energy Input and Energy Output

The United States has been contending with an obesity epidemic for more than thirty years. The number of people considered overweight or obese has now surpassed the number who are undernourished. There are many reasons for this enormous rise in obesity, but a primary cause is that people are consuming too much and moving too little.

The Obesity Trend Across the United States 1985-2010

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<https://www.cdc.gov/obesity/data/prevalence-maps.html>

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3.5: Basal Metabolic Rate

Your **basal metabolic rate (BMR)** is the number of calories your body burns while at rest. Surprisingly, you burn the largest percentage of your daily calories — about two-thirds — while sleeping or sitting. These calories fuel essential body processes such as brain function, breathing, growth, and repair.

Another important consideration is your ratio of lean muscle mass to body fat. Muscle tissue is metabolically active, meaning it burns more calories throughout the day. Men typically have a larger percentage of lean muscle mass than women and therefore tend to have a higher BMR. Fat tissue, by contrast, is not metabolically active. If you consume more food than you need for energy, your body converts those excess calories into fat. People who are taller or who are pregnant also burn more calories.

While you can calculate how much energy you take in by counting calories, it is harder to know how much you are burning, because calories are expended through three different activities:

- Resting (BMR)
- Physical exercise
- Digesting food

Activity Levels

Sedentary: A lifestyle that includes only the physical activity of independent living.

Moderately active: A lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

Active: A lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the activities of independent living.

*Estimates for females do not include women who are pregnant or breastfeeding.

Complete the activity in the blue text box below to determine your individual nutrient needs.

What is Your Daily Nutrient Recommendations (DRI)?

Use the link below to the DRI calculator to learn your:

- Estimated daily calorie needs
- Macronutrient needs (carbohydrates, protein, and fat)
- Micronutrients (vitamins & minerals)
- BMI

<https://www.nal.usda.gov/fnic/dri-calculator/>

If you want to increase the energy you burn, the most effective approach is to increase your physical activity. However, energy intake and expenditure are regulated by highly complex systems and influenced by genetics, behavior, and the environment. The equation is not simply “energy in = energy out.” Dieting is practically an American pastime, but it is not a solution for poor eating habits or lack of physical activity. There are health risks associated with both being overweight and being underweight. Talk to your physician and a registered dietitian about how to improve your diet and exercise routine to optimize your health.

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3.6: Disordered Eating

A person with **disordered eating** has attitudes and behaviors toward their body that range from unhappiness with their body shape to unhealthy eating, dieting, and exercise habits. A formal eating disorder must be diagnosed by a physician or psychologist using the criteria in the **Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)**, which lists the symptoms associated with each type of disorder.

Disordered Eating

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[View this YouTube Video online](#)



Eating disorders can have severe consequences for health. Here are five eating disorders listed below. Click on each type to learn more.

Anorexia Nervosa available at the end of this section.

Bulimia Nervosa available at the end of this section.

Binge Eating Disorder available at the end of this section.

Orthorexia Nervosa available at the end of this section.

Pica available at the end of this section.

Which eating disorder results in the most deaths?

- a. Bulimia
- b. Anorexia
- c. Orthorexia

Answer available at the end of this section.

Guess Her Weight

Watch the video and see if you can guess the correct weight for these women.

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Anorexia Nervosa

Anorexia nervosa — more often referred to simply as “anorexia” — is a psychiatric illness in which a person becomes obsessed with their weight and with the food they eat. Anorexia results in extreme nutritional inadequacy and, eventually, organ malfunction. The condition is relatively rare: the National Institute of Mental Health (NIMH) reports a lifetime prevalence of 0.9 percent in females and 0.3 percent in males. Even so, it is a powerful example of how a severely unbalanced diet can affect health.

Anorexia frequently manifests during adolescence and has the highest mortality rate of all mental illnesses. People with anorexia consume, on average, fewer than 1,000 kilocalories per day and exercise excessively — a severe caloric imbalance. Some may also engage in binge eating, self-induced vomiting, or purging with laxatives or enemas. The exact causes of anorexia are not fully known, but many factors contribute, including socioeconomic status (it is more prevalent in higher-income families), genetics (it is often passed from one generation to the next), and abnormalities in pregnancy, brain development, the endocrine system, and the immune system.

The primary signs of anorexia include fear of being overweight, extreme dieting, a distorted perception of body image, and depression. Secondary signs and symptoms — related to caloric and nutrient deficiencies — include excessive weight loss, skin abnormalities, diarrhea, tooth decay and loss, osteoporosis, and liver, kidney, and heart failure. Because there is no single physical test that can diagnose anorexia and distinguish it from other mental illnesses, a correct diagnosis requires ruling out other mental illnesses, hormonal imbalances, and nervous system abnormalities through blood tests, urine tests, and imaging.

Treatment of anorexia involves the individual as well as their family, friends, and a psychiatric counselor, and typically includes a dietitian who helps develop dietary solutions that may need to be adjusted over time. The goals of treatment are to restore a healthy body weight and significantly reduce the behaviors associated with the eating disorder. Relapse is common. While many people recover from anorexia, most continue to have a lower-than-normal body weight for the rest of their lives.

Bulimia Nervosa

Bulimia nervosa, like anorexia, is a psychiatric illness with potentially severe health consequences. The NIMH reports a lifetime prevalence of 0.5 percent in females and 0.1 percent in males.

Bulimia is characterized by episodes of eating large amounts of food followed by purging through vomiting, laxatives, or diuretics. Unlike people with anorexia, those with bulimia often have a normal weight, which makes the disorder more difficult to detect and diagnose. Signs and symptoms similar to those of anorexia may be present, such as fear of being overweight, extreme dieting, and excessive exercise. Additional physical signs include gastric reflux, severe erosion of tooth enamel, dehydration, electrolyte imbalances, lacerations in the mouth from vomiting, and peptic ulcers. Repeated damage to the esophagus also puts people with bulimia at increased risk for esophageal cancer.

Bulimia is also highly heritable, is linked to depression and anxiety disorders, and most commonly occurs in adolescent girls and young women. Treatment often involves antidepressant medications and, as with anorexia, has better outcomes when both the individual and their family participate in nutritional and psychiatric counseling.

Binge-Eating Disorder

Like people with anorexia and bulimia, people with binge-eating disorder (BED) have lost control of their eating. Unlike those with bulimia, however, their loss of control is not followed by fasting, purging, or compulsive exercise. As a result, people with BED are often overweight or obese and face chronic disease risks associated with high body weight, such as hypertension, cardiovascular disease, and type 2 diabetes. They frequently experience guilt, shame, and depression, and BED is commonly associated with depression and anxiety disorders.

According to the NIMH, binge-eating disorder is more prevalent than anorexia and bulimia, affecting 3.5 percent of females and 2.0 percent of males at some point during their lifetime. Treatment often involves antidepressant medication along with nutritional and psychiatric counseling.

Orthorexia Nervosa

Orthorexia nervosa is an obsession with healthful eating. The term was coined in 1998. Unlike the eating disorders described

above, orthorexia is not currently listed in the DSM-5, which makes it difficult to estimate how many people are affected. Orthorexia may involve the following behaviors:

- A compulsion to check ingredient lists and labels
- Increased concern and stress about the health of ingredients
- Spending a large percentage of time obsessing about your food and what others eat
- Eating a very limited variety of foods due to the elimination of various food groups

Pica

Pica is a psychological disorder in which the person compulsively eats items with no nutritional value, such as dirt, chalk, laundry detergent, or hair. The diagnosis is made from a clinical history of the patient.

Watch the video to learn more about PICA (4 minutes)

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Answers

Disordered Eating

A psychiatric illness where a person obsesses about the food that they eat and their weight, often consuming extremely little food and starving their bodies. People with anorexia nervosa are often very, very thin. This illness is relatively rare but has the highest mortality rate of all mental illnesses.

Disordered Eating

A psychiatric illness characterized by eating large amounts and then purging the body of the food either by vomiting or using diuretics. People suffering from bulimia nervosa often have a normal body weight; it can be hard to detect and diagnose.

Disordered Eating

A loss of control over eating, where people periodically overeat to the extreme. People with this disorder are often overweight or obese. This disorder is more prevalent than both anorexia and bulimia.

Disordered Eating

An eating disorder where a person develops an unhealthy obsession with healthy eating. Unlike other eating disorders, orthorexia revolves around food quality not quantity. People who suffer orthorexia are usually not focused on weight. Instead they are obsessed with the benefits of healthy eating.

Disordered Eating

An eating disorder that involves eating items that we don't usually classify as food and are lacking in nutritional value, such as dirt, paper, soap, hair, chalk, and paint.

Disordered Eating

b. Anorexia

3.7: End Chapter

Learning Objectives

- Define and discuss common measurements to assess body composition and health risk.
- Utilize the DRI tool to determine your BMI and nutrient needs.
- Describe what energy balance is and how it affects weight status.
- Compare and contrast body types with health status.
- Name the five common eating disorders and briefly describe them.

4: DIET TRENDS AND SURGICAL WEIGHT LOSS

- 4.1: Introduction
- 4.2: Diet Trends and Health
- 4.3: Dietary Food Trends
- 4.4: Functional Foods
- 4.5: Popular Diets
- 4.6: Surgical Weight Loss Methods
- 4.7: End Chapter

4.1: Introduction

Learn

- Popular Diets
- Functional Foods
- Surgical Weight Loss

4.2: Diet Trends and Health

In the past, health was regarded merely as the absence of illness. However, a growing understanding of the human condition's complexity and potential has prompted a new way of thinking about health. Today, we focus on the idea of wellness, which involves a great deal more than just not being sick. Wellness is a state of optimal well-being that enables an individual to maximize their potential. This concept includes a host of dimensions—physical, mental, emotional, social, environmental, and spiritual—which affect one's quality of life. Striving for wellness begins with an examination of dietary choices.

4.3: Dietary Food Trends

Hundreds of years ago, when food was less accessible and daily life required much more physical activity, people worried less about obesity and more about simply getting enough to eat. In today's industrialized nations, conveniences have solved some problems and introduced new ones, including obesity and diabetes. Fad diets gained popularity as more North Americans struggled with excess pounds. However, new evidence-based approaches that emphasize more holistic measures are on the rise. These new dietary trends encourage those seeking to lose weight to eat healthy, whole foods first while adopting a more active lifestyle. These sound practices put dietary choices in the context of wellness and a healthier approach to life.

4.4: Functional Foods

Many people seek out foods that provide the greatest health benefits. This trend gives rise to functional foods, which help meet basic nutritional needs and are reported to fight illness and aging. According to the Academy of Nutrition and Dietetics (AND), functional foods may reduce disease risk or promote optimal health. AND recognizes four types of functional foods. They are conventional foods, modified foods, medical foods, and special dietary use foods.

The first group, conventional foods, represents the simplest form of functional foods. They are whole foods that have not been modified. Examples include whole fruits and vegetables (which are abundant in phytochemicals and antioxidants), yogurt and kefir (which contain natural probiotic bacteria that can help maintain digestive system health), and moderate amounts of dark chocolate made with 70% or more cacao (which contains antioxidants).

Modified foods have been fortified, enriched, or enhanced with additional nutrients or bioactive compounds. Foods are modified using biotechnology to improve their nutritional value and health attributes. Examples of modified foods include calcium-fortified orange juice, bread enriched with B vitamins, iodized salt, cereals fortified with vitamins and minerals, margarine enhanced with plant sterols, and energy drinks that have been enriched with herbs (ginseng or guarana) or amino acids (taurine). It is important to consider that some modified foods' health claims may be debatable or entirely fraudulent. Check with a health professional regarding the effects of modified foods on your health.

Medical foods are created to meet precise nutritional requirements. These foods are designed to pass through the stomach undigested and be broken down in the intestine. Examples of medical foods include liquid formulas for people with kidney disease, liver disease, diabetes, or other health issues. Medical food is also given to comatose patients through a gastronomy tube because they cannot eat by mouth.

Special dietary use foods do not have to be administered under a doctor's care and can be found in various stores. Like medical foods, they address special dietary needs and meet the nutritional requirements of certain health conditions. For example, a bottled oral supplement administered under medical supervision is a medical food, but it becomes a special dietary food sold to retail customers. Examples of special dietary use foods include gluten-free foods, lactose-free dairy products, and formulas and shakes that promote weight loss.

4.5: Popular Diets

The concept of functional foods represents initiatives aimed at addressing health problems. Specific diet plans take this concept one step further by striving to prevent or treat specific conditions. For example, it is widely understood that people with diabetes need to follow a particular diet. Although some of these diet plans may be nutritionally sound, use caution because some diets may be fads or be so extreme that they actually cause health problems.

Before experimenting with a diet, discuss your plans with your doctor or a registered dietitian. Throughout this section, we will discuss some of the more popular diets. Some fall under the category of fad diets, while others are backed by scientific evidence. Those who fall into the latter category provide a good foundation for building a solid regimen for optimal health.

The DASH Diet

The Dietary Approaches to Stop Hypertension, or DASH diet, focuses on reducing sodium intake to either 2,300 milligrams per day (recommended by the Dietary Guidelines for Americans) or 1,500 milligrams per day for certain populations. The DASH diet is an evidence-based eating plan that can help reduce high blood pressure. This plan may also decrease the risk of heart attack, stroke, diabetes, osteoporosis, and certain cancers.

DASH tips to lower sodium include:

- Using spices instead of salt to add flavor
- Reading sodium content on processed or canned food labels and choosing low-sodium options.
- Removing some sodium from canned foods (such as beans) by rinsing the product before consumption
- Avoiding salt when cooking

DASH dieters are recommended to consume various whole grains and high-fiber fruits and vegetables and moderate amounts of low-fat dairy products, lean meats, and heart-healthy fish. Also, DASH limits the use of saturated fats to less than 7 percent of total calories and limits sweets and alcohol consumption. The DASH diet also calls for consuming less added sugar and drinking fewer sugar-sweetened drinks. It replaces red meat with fish and legumes and calls for increased calcium, magnesium, potassium, and fiber. Also, even though some people on the DASH diet may find it lowers their HDL (good) cholesterol along with their LDL (bad) cholesterol, it still has a positive cumulative effect on heart health.

The Gluten-Free Diet

The gluten-free diet helps people whose bodies cannot tolerate gluten, a protein found in wheat, barley, and rye. One of the most important ways to treat this condition is to avoid problematic foods, which is not easy. Although following a gluten-free diet is challenging, it is prescribed for patients with gluten intolerance and celiac disease, an autoimmune disorder with a genetic link. People who have celiac disease cannot consume gluten products without damaging their intestinal lining. Eating a gluten-free diet means finding replacements for bread, cereal, pasta, and more. It also means emphasizing fresh fruits, vegetables, and other foods without gluten. However, it is important to note that the gluten-free trend has become something of a fad, even for those without a gluten intolerance. Celiac disease is a relatively rare condition found in only 1 percent of the population. Therefore, a gluten-free diet should be followed only with a physician's recommendation.

Low-Carb Diets / KETO

Low-carb diets, including the Keto, Atkins Diet, and the South Beach Diet, focus on limiting carbohydrates—such as grains, fruit, and starchy vegetables—to promote weight loss. The theory behind the low-carb diet is that insulin prevents the breakdown of fat by allowing sugar in the form of blood glucose to be used for energy. Proponents of this approach believe that because limiting carbs generally lowers insulin levels, it would cause the body to burn stored fat instead. They believe this method brings about weight loss and reduces the risk factors for several conditions. However, some studies have shown that people who followed certain low-carb diet plans for two years lost an average of nearly 9 pounds, which is similar to the amount of weight lost on higher carbohydrate diets.

This kind of diet benefits includes an emphasis on whole, unprocessed foods and a de-emphasis of refined carbohydrates, such

as white flour, white bread, and white sugar. However, there are several downsides. Typically, the first two weeks allow for only 20 grams of carbs per day, which can be dangerously low. Dieters using the low-carb approach consume twice as many saturated fats as people on a diet high in healthy carbohydrates. Low-carb diets are also associated with higher energy intake. The notion that “calories don’t count,” which is prevalent in this kind of diet, is not supported by scientific evidence.

The Macrobiotic Diet

The macrobiotic diet is part of a health and wellness regimen based on Eastern philosophy. It combines certain tenets of Zen Buddhism with a vegetarian diet and supports a balance of yin and yang’s oppositional forces. Foods are paired based on their so-called yin or yang characteristics. Yin foods are thought to be sweet, cold, and passive, while yang foods are salty, hot, and aggressive.

Whole grains make up about 50 percent of the calories consumed and are believed to have the best balance of yin and yang. Raw and cooked vegetables comprise about 30 percent of the diet and include kale, cabbage, collards, bok choy, and broccoli daily, along with mushrooms and celery a few times a week. Bean or vegetable-based soups and broths can make up 5 to 10 percent of daily caloric intake. Additionally, the diet allows small amounts of fish and seafood several times a week, along with a few servings of nuts. The macrobiotic diet prohibits certain foods, such as chocolate, tropical fruits, and animal products, because they are believed to fall on the far end of the yin-yang spectrum, which would make it difficult to achieve a Zen-like balance.

The macrobiotic diet focuses on low in saturated fats and high in fiber, which can lower the risk of cardiovascular disease. Proponents of this diet also believe that it may protect against cancer. However, many nutritionists and healthcare providers express concerns, particularly if the diet is followed strictly. Extreme macrobiotic eating can be low in protein low in calories and pose a risk for starvation. Also, the diet is deficient in essential vitamins and minerals.

The Mediterranean Diet

The traditional Mediterranean diet incorporates many elements of people living in Greece and southern Italy. The Mediterranean diet focuses on small portions of nutritionally-sound food. This diet features food from plant sources, including vegetables, fruits, whole grains, beans, nuts, seeds, bread and potatoes, and olive oil. It also limits processed food consumption and recommends eating locally grown foods rich in micronutrients and antioxidants. Other aspects of this eating plan include consuming fish and poultry at least twice per week, eating red meat only a few times per month, having up to seven eggs per week, and drinking red wine in moderation. Unlike most diets, the Mediterranean diet does not cut fat consumption across the board. Instead, it incorporates low-fat cheese and dairy products, and it substitutes olive oil, canola oil, and other healthy oils for butter and margarine.

More than fifty years of nutritional and epidemiological research have shown that people who follow the Mediterranean diet have some of the lowest rates of chronic disease and the highest longevity rates among the world’s populations. Studies have also shown that the Mediterranean diet significantly decreases excess body weight, blood pressure, blood fats, blood sugar, and insulin levels.

The Raw Food Diet

The raw food diet is followed by those who avoid cooking as much as possible to take advantage of foods’ full nutrient content. The principle behind raw foodism is that plant foods in their natural state are the most wholesome for the body. The raw food diet is not a weight-loss plan; it is a lifestyle choice. People who practice raw foodism eat only uncooked and unprocessed foods, emphasizing whole fruits and vegetables. Staples of the raw food diet include whole grains, beans, dried fruits, seeds and nuts, seaweed, sprouts, and unprocessed produce. As a result, food preparation mainly involves peeling, chopping, blending, straining, and dehydrating fruits and vegetables.

This eating method’s positive aspects include consuming foods that are high in fiber and nutrients and low in calories and saturated fat. However, the raw food diet offers little protein, dairy, or fats, which can cause deficiencies of vitamins A, D, E, and K. Also, not all foods are healthier uncooked, such as spinach and tomatoes. Also, cooking eliminates potentially harmful microorganisms that can cause foodborne illnesses. Therefore, people who primarily eat raw foods should thoroughly clean all fruit and vegetables before eating them. Poultry and other meats should always be cooked before eating.

Vegetarian and Vegan Diets

Vegetarian and vegan diets have been followed for thousands of years for different reasons, including spiritual practice, respect for living things, health reasons, or environmental concerns. For many people, being a vegetarian is a logical outgrowth of “thinking green.” A meat-based food system requires more energy, land, and water resources than a plant-based food system. This may suggest that the plant-based diet is more sustainable than the average meat-based diet in the U.S. By avoiding animal flesh, vegetarians hope to look after their health and that of the planet at the same time. Broadly speaking, vegetarians eat beans, grains, fruits, and vegetables and do not eat red meat, poultry, seafood, or other animal flesh. Some vegetarians, known as Lacto vegetarians, will eat dairy products. Others, known as Lacto-ovo vegetarians, will eat dairy products and eggs. A vegan diet is the most restrictive vegetarian diet—vegans do not eat dairy, eggs, or other animal products, and some do not eat honey.

Vegetarian diets have many benefits. Well-balanced eating plans can lower the risk of several chronic conditions, including heart disease, diabetes, and obesity. They also help to promote sustainable agriculture. However, if a vegetarian does not vary his or her food choices, the diet may be insufficient in calcium, iron, omega-3 fatty acids, zinc, and vitamin B12. Also, if people who follow these diets do not plan out their meals, they may gravitate toward foods high in fats.

The Pros and Cons of Seven Popular Diets

Diet	Pros	Cons
DASH Diet	- Recommended by the National Heart, Lung, and Blood Institute, the American Heart Association, and many physicians - Helps to lower blood pressure and cholesterol - Reduces risk of heart disease and stroke - Reduces the risk of certain cancers - Reduces diabetes risk	- There are very few negative factors associated with the DASH diet. - Risk for hyponatremia
Gluten-Free Diet	- Reduces the symptoms of gluten intolerance, such as chronic diarrhea, cramping, constipation, and bloating - Promotes healing of the small intestines for people with celiac disease, preventing malnutrition - It may be beneficial for other autoimmune diseases, such as Parkinson’s disease, rheumatoid arthritis, and multiple sclerosis.	- Risk of folate, iron, thiamin, riboflavin, niacin, and vitamin B6 deficiencies - Special gluten-free products can be hard to find and expensive. - Requires constant vigilance and careful food label reading since gluten is found in many products
Low-Carb Diet/Keto	- Restricts refined carbohydrates, such as white flour and white sugar - May temporarily improve blood sugar or blood cholesterol levels.	- Not entirely evidence-based - Results in higher fat and protein consumption - Does not meet the RDA for carbohydrates to provide glucose to the brain
Macrobiotic Diet	- Low in saturated fats and high in fiber - Emphasizes whole foods and de-emphasizes processed foods - Rich in phytoestrogens, which may reduce the risk of estrogen-related cancers	- Not entirely evidence-based - Lacks certain vitamins and minerals; supplements are often required. - Can result in a deficient caloric intake - Lack of energy may result from inadequate protein.

Diet	Pros	Cons
Mediterranean Diet	• Reduced risk of cardiovascular disease and mortality • Lower risk of cancer • De-emphasizes processed foods and emphasizes whole foods and healthy fats • Lower sodium intake due to fewer processed foods • Emphasis on monosaturated fats leads to lower cholesterol. • Highlighting fruits and vegetables raises the consumption of antioxidants.	• Does not specify daily serving amounts • Potential for high fat and high-calorie intake as nuts and oils are calorie-dense foods. • Drinking one to two glasses of wine per day may not be healthy for those with certain conditions.
Raw Food Diet	• Emphasizes whole foods • Focuses on nutritionally rich foods	• Not entirely evidence-based • Very restrictive and limits protein and healthy fat intake • Could encourage the development of foodborne illness • Extremely difficult to follow • High in fiber, which can cause essential nutrient deficiencies
Vegetarianism and Veganism	• May reduce some chronic diseases such as cancer, heart disease, and Type 2 diabetes. • It may help with weight reduction and weight maintenance	• Guidelines regarding fat and nutrient consumption must be followed. • Higher risk for nutrient deficiencies such as protein, iron, zinc, omega-3, vitamin B12 • Consumption of a high fiber diet interferes with mineral and nutrient bioavailability. • Vegetarian and vegan protein sources are of lower quality, with the majority missing at least one essential amino acid.

4.6: Surgical Weight Loss Methods

You've probably seen advertisements for weight loss surgery. However, this is only recommended for severely obese patients with a BMI of 40 or greater or a BMI of 35 with other chronic diseases such as Diabetes. Most people who have undergone these procedures lose and maintain 45-90 pounds of weight loss, depending on the surgery type. However, surgical weight loss is a "surgery," and with all surgical procedures, there are associated risks, and many people die due to complications from the surgery. Additionally, people who have undergone bariatric surgery require monitoring for the rest of their life. When they are improperly monitored, it can lead to complications and death.

Watch this video – Gastric Bypass vs. Gastric Sleeve

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Many people die due to complications from the surgical weight loss surgery.

True or False

Answer available at the end of this section.

To learn more about bariatric surgeries, visit the link below.

<https://www.niddk.nih.gov/health-information/weight-management/bariatric-surgery/types>

Answers

Watch this video – Gastric Bypass vs. Gastric Sleeve

True

4.7: End Chapter

Learning Objectives

- Explain the importance of healthful eating and physical movement in chronic and acute disease prevention and identify the nutrient adjustments needed to support optimal health throughout the lifecycle. (MCCCD Competency 4)
- Evaluate the merits of functional foods. (MCCCD Competency 6)
- Locate, evaluate, and use credible sources of nutrition information. (MCCCD Competency 3)

5: UNDERSTANDING FOOD LABELS AND HEALTH CLAIMS

- 5.1: Introduction
- 5.2: The Food label
- 5.3: Claims on Labels
- 5.4: Health Claims and Foods
- 5.5: Allergy Warnings
- 5.6: Ingredient List
- 5.7: Who to Trust for Nutrition Information
- 5.8: Evaluating nutrition information in the Media
- 5.9: End Chapter

5.1: Introduction

Learn

- How to use a Food Label
- Health Claims & Foods
- Characteristics of a Nutrition Expert

5.2: The Food label

undefined

The Nutrition Labeling and Education Act made it a law that foods sold in the United States have a food label that provides the accurate contents of nutrients within them. This label is called a Nutrition Facts panel, which gives information on the number of servings per container, the number of calories per serving, and certain nutrients. Specifically, it lists the macronutrients and four of the most important micronutrients people need to pay special attention to, such as Vitamin D, Calcium, Iron, and potassium.

The Nutrition Facts panel not only tells you about the nutritional content of the product, but it also allows you to compare products. Because the serving sizes are included on the label, you can see how much each nutrient is in each serving. Knowing how to read the label is important because of the way some foods are presented. For example, a package of mixed nuts may seem like a healthy snack to eat on the way to class. However, it is important to look at that label before you decide. Does it contain one serving or multiple servings? Unless you are buying the individual serving packages, chances are the bag you picked up provides multiple servings. Always check the food label to evaluate total calories, fat, protein, carbohydrates, vitamin, and sodium content. The percent DV (daily value) is the nutrient's percentage in the food about its recommended intake. It is a guide to determine if a food is a good or poor source of nutrients.

Do You Know

Click on the interactive label link below and explore each part of the nutrition facts panel.

www.accessdata.fda.gov/scripts/InteractiveNutritionFactsLabel/#intro

5.3: Claims on Labels

The FDA has standardized words for label claims to ensure accuracy (see table below). If a food label states that it is 'low-fat,' it can only have 3 or fewer grams of fat!

Common Label Terms Defined

Term	Explanation
low-fat	Three or fewer grams of fat
low salt	Fewer than 140 milligrams of sodium
low cholesterol	Fewer than 20 milligrams cholesterol and 2 grams of saturated fat
lean	Ever than a set amount of grams of fat for that particular cut of meat
high	It contains more than 20% of the nutrient's daily value
good source	Contains 10 to 19% of nutrient's daily value
light/lite	Contains $\frac{1}{3}$ fewer calories or 50% less fat; if more than half of the calories come from fat, then fat content must be reduced by 50% or more
organic	It contains 95% organic ingredients

Source: Food Labeling Guide. US Food and Drug Administration. <http://www.fda.gov>.

5.4: Health Claims and Foods

To keep companies from making false claims, the FDA provides food manufacturers with regulations in putting labels on packages that promote health. There are three levels of health claims:

1. A health claim is supported by scientific evidence. An example is “reduces heart disease.”
2. A qualified claim has supportive evidence, which is **NOT** proven with scientific evidence. There is evidence to SUGGEST a health benefit, but there is no scientific evidence. An example is “Supportive but not conclusive research shows that consumption of EPA and DHA omega-3 fatty acids may reduce the risk of coronary artery disease.” They are suggesting that this could be true, but they can’t prove it.
3. Amazingly enough, a company can claim a health benefit even though no scientific or supportive evidence exists. An example is “may boost your immune system.” However, they **MUST** add a disclaimer to the label that states that the FDA has not evaluated this claim.

No labels can make claims of diagnosis, cures, treatment, or disease prevention. If you find food or drinks that make wild claims of curing or treating a disease or symptom (or making you lose weight or gain muscle), note that it is NOT TRUE. These are not valid or allowed claims on food labels.

Test Your Knowledge

The phrase, “reduces heart disease” on a box of cereal is a health claim that is supported by scientific evidence.

True or False

Answer available at the end of this section.

Answers

Test Your Knowledge

True

5.5: Allergy Warnings

The FDA requires food manufacturers to list their packages if the product contains any of the eight most common ingredients that cause food allergies. These eight common allergens are as follows: milk, eggs, peanuts, tree nuts, fish, shellfish, soy, and wheat. The FDA does not require warnings that cross-contamination may occur during packaging; however, most manufacturers include this advisory as a courtesy. For instance, you may notice a label that states, “This product is manufactured in a factory that also processes peanuts.” If you have food allergies, it is best to avoid products that may have been contaminated with the allergen.

5.6: Ingredient List

Ingredients are listed in descending order by weight. For instance, if the first ingredient is sugar in a product, then by weight, that product has more sugar than anything else. Manufacturers in the USA must list potential allergens in the ingredient list in parenthesis or after the ingredient list stating which allergens a product contains. Foods with a high amount of ingredients you don't recognize usually contain a high amount of preservatives and additives and are therefore considered highly processed foods. Preservatives and additives are added to the food to extend shelf life and improve the texture, color, or other food properties. Generally, the more processed food is, the fewer nutrients it offers, so choose foods with recognizable ingredients as often as possible.

5.7: Who to Trust for Nutrition Information

Everyone seems to be sharing a new diet or meal plan these days to help you get fit fast and drop weight easily. Which of these diets have you heard of?

- Keto
- Juice your meals
- Avoid gluten
- Don't eat any fruit

How do you decide if a diet plan is dangerous to your health or not? Ask a registered dietitian nutritionist (RDN), a healthcare professional with the knowledge and credentials to provide health and wellness direction. Most RDNs specialize in areas such as weight loss, sports nutrition, diabetes, food allergies, and more. RDNs apply nutritional science, using evidence-based best practices, to help people nourish their bodies and improve their lives. Becoming a registered dietitian requires a Master's degree in dietetics, including biology, organic chemistry, biochemistry, microbiology, anatomy and physiology, nutrition, and food-service management. RDNs must complete a dietetic internship along with over 900 supervised hours and pass a national exam. Conversely, the term "nutritionist" is not regulated, and anyone can call themselves a nutritionist. Because the term is unregulated, a nutritionist may have anything from a 2-week certificate 'earned' on the internet to a Master's Degree. Registered Dietitian Nutritionists are recognized as medical professionals; nutritionists are NOT.

When not talking with an RDN, how do you know what to believe? In this age, where a world of information is just a click away, it is easily misled. Reliable nutritional news will be based upon solid scientific evidence, supported by multiple studies, and published in peer-reviewed journals. Be sure the website you use for information comes from a credible and trustworthy source. Here are some reputable organizations and websites from which you can obtain valid nutrition information:

- Centers for Disease Control and Prevention (CDC)
- The Academy of Nutrition and Dietetics (AND)
- US Department of Agriculture (USDA)
- US Department of Health and Human Services (HHS)

5.8: Evaluating nutrition information in the Media

When you come across an article or advertisement that reads: “Boost your metabolism by drinking coffee with butter every day,” should you believe it or not? When reading nutrition-related claims, articles, websites, or advertisements, always remember that one study does not substantiate a fact. One study neither proves nor disproves anything. Readers looking for complex answers to nutritional dilemmas can quickly misconstrue such statements and be led down a path of misinformation. When reading such news, ask yourself, “Is this making sense?” Suppose a headline professes a new remedy for a nutrition-related topic. In that case, it may well be a research-supported piece of news. Still, more often than not, it is a sensational story designed to catch the attention of an unsuspecting consumer and persuade him or her to purchase a product.

Ask yourself the following questions when you read nutrition information.

1. The scientific study under discussion should be published in a peer-reviewed journal, such as the *Journal of Nutrition*. Peer-reviewed articles deliver a broad perspective and include many studies' findings on the same subject. Studies that come from less trustworthy sources (such as non-peer-reviewed journals or websites) are not formally published.
2. Track down the original journal article to see if it supports the conclusions drawn in the news report.
3. The report should disclose the methods used by the researcher(s). Did the study last for three or thirty weeks? Were there ten or one hundred participants? What did the participants actually do? Did the researcher(s) observe the results themselves, or did they rely on program participants' self-reports?
4. Who were the subjects of this study? Humans or animals? Men or women? Would you fit into the program participant groups based on your age, sex, and weight?
5. Credible reports often disseminate new findings in the context of previous research. A single study on its own gives you minimal information, but if a body of literature supports a finding, it adds to credibility.
6. Who wrote the article? Is he or she a credentialed expert like a registered dietitian nutritionist (RDN) or a medical doctor (MD)? What experience does he or she have with this topic?

5.9: End Chapter

Learning Objectives

- Define the three types of macronutrients and the two types of micronutrients. (MCCCD Competency 2)
- Identify where you can obtain information about the micronutrient and macronutrient content of food. (MCCCD Competency 2)
- Understand and be able to utilize information on food labels. (MCCCD Competency 2)
- Discuss the difference in the types of health claims. (MCCCD Competency 2)
- Discuss the educational differences between a “nutritionist” and a Registered Dietitian Nutritionist. (MCCCD Competency 2)
- Identify credible nutrition information. (MCCCD Competency 2)
- Understand and be able to use the Dietary Guidelines for Americans. (MCCCD Competency 4)

6: ESSENTIAL NUTRIENTS

6.1: What are the nutrients?

6.2: Macronutrients

6.3: Micronutrients

6.4: Dietary Guidelines

6.5: End Chapter

6.1: What are the nutrients?

Learn

- The six essential nutrients
- Macronutrients vs. Micronutrients
- Dietary Guidelines for Americans

What are the nutrients?

The foods we eat contain nutrients. Nutrients are substances required by the body to perform its basic functions. Nutrients must be obtained from our diet since the human body can not make them. Nutrients have one or more of three basic functions: they provide energy, contribute to body structure, and/or regulate chemical processes in the body. These basic functions allow us to detect and respond to environmental surroundings, move, excrete wastes, breathe, grow, and reproduce. There are six classes of nutrients required for the body to function and maintain overall health. These are carbohydrates, lipids, proteins, water, vitamins, and minerals. Foods also contain non-nutrient that may be harmful such as natural toxins common in plant foods and additives like some dyes and preservatives or beneficial like antioxidants.

YouTube Video

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Key Functions of the 6 Essential Nutrients

Protein	Necessary for tissue formation, cell reparation, and hormone and enzyme production. It is essential for building strong muscles and a healthy immune system.
Carbohydrates	Provide a ready source of energy for the body and provide structural constituents for the formation of cells.
Fat	Provides stored energy for the body, functions as structural components of cells, and signaling molecules for proper cellular communication. It provides insulation to vital organs and works to maintain body temperature.
Vitamins	Regulate body processes and promote normal body-system functions.
Minerals	Regulate body processes, are necessary for proper cellular function, and comprise body tissue.
Water	Transports essential nutrients to all body parts, transports waste products for disposal, and aids with body temperature maintenance.

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6.2: Macronutrients

Nutrients that are needed in large amounts are called macronutrients. There are three classes of macronutrients: carbohydrates, lipids, and proteins. These can be metabolically processed into cellular energy. The energy from macronutrients comes from their chemical bonds. This chemical energy is converted into cellular energy used to perform work, allowing our bodies to conduct their basic functions. A unit of measurement of food energy is the calorie. On nutrition food labels, the amount given for “calories” is actually equivalent to each calorie multiplied by one thousand. A kilocalorie (Calorie) is the amount of heat generated by a particular macronutrient that raises the temperature of 1 kilogram of water 1 degree Celsius. On the Nutrition Facts panel, the calories within a particular food are expressed as kilocalories, which is commonly denoted as “Calories” with a capital “C” (1 kcal = 1 Calorie = 1,000 calories). Water is also a macronutrient in the sense that you require a large amount of it, but unlike the other macronutrients, it does not provide calories.

Carbohydrates

Carbohydrates are molecules composed of carbon, hydrogen, and oxygen. The major food sources of carbohydrates are grains, milk, fruits, and starchy vegetables, like potatoes. Non-starchy vegetables also contain carbohydrates but in lesser quantities. Carbohydrates are broadly classified into two forms based on their chemical structure: simple carbohydrates, simple sugars, and complex carbohydrates.

Simple carbohydrates consist of one or two basic units. Examples of simple sugars include sucrose, the type of sugar you would have in a bowl on the breakfast table, and glucose, the type of sugar that circulates in your blood.

Complex carbohydrates are long chains of simple sugars that can be unbranched or branched. During digestion, the body breaks down digestible complex carbohydrates into simple sugars, mostly glucose. Glucose is then transported to all our cells, stored, used to make energy, or used to build macromolecules. Fiber is also a complex carbohydrate, but digestive enzymes cannot break it down in the human intestine. As a result, it passes through the digestive tract undigested unless the bacteria that inhabit the colon or large intestine break it down.

One gram of digestible carbohydrates yields four kilocalories of energy for the body’s cells to perform work. Besides providing energy and serving as building blocks for bigger macromolecules, carbohydrates are essential for the nervous system’s proper functioning, heart, and kidneys. As mentioned, glucose can be stored in the body for future use. In humans, the storage molecule of carbohydrates is called glycogen, and in plants, it is known as starch. Glycogen and starch are complex carbohydrates.

Protein

Proteins are macromolecules composed of chains of subunits called amino acids. Amino acids are simple subunits composed of carbon, oxygen, hydrogen, and nitrogen. Food sources of proteins include meats, dairy products, seafood, and various plant-based foods, most notably soy. The word protein comes from a Greek word meaning “of primary importance,” which is an apt description of these macronutrients; they are also known colloquially as the “workhorses” of life. Proteins provide four kilocalories of energy per gram; however, providing energy is not protein’s most important function. Proteins provide structure to bones, muscles, and skin and play a role in conducting most of the chemical reactions that take place in the body. Scientists estimate that greater than one-hundred thousand different proteins exist within the human body. The genetic codes in DNA are basically protein recipes that determine the order in which 20 different amino acids are bound together to make thousands of specific proteins.

Lipids

Lipids are also a family of molecules composed of carbon, hydrogen, and oxygen, but they are insoluble in water, unlike carbohydrates. Lipids are found predominantly in butter, oils, meats, dairy products, nuts, seeds, and processed foods. The three main types of lipids are triglycerides (triacylglycerols), phospholipids, and sterols. The main job of lipids is to provide or store energy. Lipids provide more energy per gram than carbohydrates (nine kilocalories per gram of lipids versus four kilocalories per gram of carbohydrates). In addition to energy storage, lipids serve as a major component of cell membranes, surround and protect organs (in fat-storing tissues), provide insulation to aid in temperature regulation, and regulate many other body functions.

Water

There is one other nutrient that we must have in large quantities: water. Water does not contain carbon but is composed of two hydrogens and one oxygen per molecule of water. More than 60 percent of your total body weight is water. Without it, nothing could be transported in or out of the body, chemical reactions would not occur, organs would not be cushioned, and body temperature would fluctuate widely. On average, an adult consumes just over two liters of water per day from food and drink combined. Since water is so critical for life's basic processes, the amount of water input and output is significant, a topic we will explore in detail.

6.3: Micronutrients

Micronutrients are nutrients required by the body in lesser amounts but are still essential for carrying out bodily functions. Micronutrients include all the essential minerals and vitamins. There are sixteen essential minerals and thirteen vitamins. In contrast to carbohydrates, lipids, and proteins, micronutrients are not sources of energy (calories), but they assist in the process as cofactors or components of enzymes (i.e., coenzymes). Enzymes are proteins that catalyze chemical reactions in the body and are involved in all aspects of body functions, from producing energy to digesting nutrients to building macromolecules. Micronutrients play many essential roles in the body.

Minerals

Minerals are solid inorganic substances that form crystals and are classified depending on how much of them we need. Trace minerals, such as molybdenum, selenium, zinc, iron, and iodine, are only required in a few milligrams or less. Macrominerals, such as calcium, magnesium, potassium, sodium, and phosphorus, are required in hundreds of milligrams. Many minerals are critical for enzyme function. Others are used to maintain fluid balance, build bone tissue, synthesize hormones, transmit nerve impulses, contract and relax muscles, and protect against harmful free radicals in the body that can cause health problems such as cancer.

Minerals	Major Functions
Macro	
Sodium	Fluid balance, nerve transmission, muscle contraction
Chloride	Fluid balance, stomach acid production
Potassium	Fluid balance, nerve transmission, muscle contraction
Calcium	Bone and teeth health maintenance, nerve transmission, muscle contraction, blood clotting
Phosphorus	Bone and teeth health maintenance, acid-base balance
Magnesium	Protein production, nerve transmission, muscle contraction
Sulfur	Protein production
Trace	
Iron	Carries oxygen, assists in energy production
Zinc	Protein and DNA production, wound healing, growth, immune system function
Iodine	Thyroid hormone production, growth, metabolism
Selenium	Antioxidant
Copper	Coenzyme, iron metabolism
Manganese	Coenzyme
Fluoride	Bone and teeth health maintenance, tooth decay prevention
Chromium	Assists insulin in glucose metabolism
Molybdenum	Coenzyme

Vitamins

The thirteen vitamins are categorized as either water-soluble or fat-soluble. The water-soluble vitamins are vitamin C and all the B vitamins, including thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, biotin, folate, and cobalamin. The fat-soluble vitamins are A, D, E, and K. Vitamins are required to perform many functions in the body, such as making red blood cells, synthesizing bone tissue, and playing a normal vision, nervous system function, and immune system function.

Vitamins		Major Functions
Water-soluble		
Thiamin (B1)		Coenzyme, energy metabolism assistance
Riboflavin (B2)		Coenzyme, energy metabolism assistance
Niacin (B3)		Coenzyme, energy metabolism assistance
Pantothenic acid (B5)		Coenzyme, energy metabolism assistance
Pyridoxine (B6)		Coenzyme, amino acid synthesis assistance
Biotin (B7)		Coenzyme, amino acid, and fatty acid metabolism
Folate (B9)		Coenzyme, essential for growth
Cobalamin (B12)		Coenzyme, red blood cell synthesis
C (ascorbic acid)		Collagen synthesis, antioxidant
Fat-soluble		
A		Vision, reproduction, immune system function
D		Bone and teeth health maintenance, immune system function
E		Antioxidant, cell membrane protection
K		Bone and teeth health maintenance, blood clotting

6.4: Dietary Guidelines

How do you know if you are eating the correct amounts of the macro and micronutrients for good health? Every 5 years, the U.S. Department of Health and Human Services (HHS) and the U.S. Department of Agriculture (USDA) publish *The Dietary Guidelines for Americans*. The goal is to promote healthier eating habits to prevent chronic diseases like heart disease, diabetes, and hypertension. The guidelines are developed from an analysis of the latest science-based research and recommendations. Review the infographic below on the process to develop the new dietary guidelines for Americans.

Dietary Guidelines for Americans

Click on the link to review the current recommendations.

www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

The Dietary Guidelines for Americans, 2020-2025 report on the Facts About Nutrition-Related Health Conditions statistics page reports that 50% of adults are overweight or have obesity.

True or False?

Answer available at the end of this section.

Answers

Dietary Guidelines for Americans

False

6.5: End Chapter

Learning Objectives

- Define and discuss the six essential nutrients. (MCCCD Competency 5)
- Identify where to obtain information about the micronutrient and macronutrient content of food?(MCCCD Competency 2)
- Discover the Dietary Guidelines for Americans and identify your unique nutrient needs. (MCCCD Competency 4)
- Summarize the process required to develop the Dietary Guidelines for Americans. (MCCCD Competency 4)

7: THE PROCESS OF DIGESTION AND ABSORPTION

7.1: Introduction

7.2: Human Anatomy and Systems

7.3: Digestion

7.4: Your Gut Microbiome

7.5: Digestive Diseases and Disorders

7.6: End Chapter

7.1: Introduction

Learn

- The Body's Organ System
- How Your Digestive System Works
- Probiotics and Prebiotics
- Common Digestive Diseases and Disorders

Introduction

When you smell coffee or fresh baked cookies, what happens? Do those aromas stimulate your desire to drink or eat? The sight and smell of foods are enough to prime your digestive tract and stimulate saliva production. This chapter will look at the steps of digestion and absorption and how your body breaks down the food into usable components. Additionally, we will investigate digestive diseases and disorders.

7.2: Human Anatomy and Systems

Human bodies are made of a system of cells. Cells are the basic structure and functional unit of all life; groups of cells form tissues, and tissues form organs. The human body depends on organs working together, as organ systems, to do specific jobs in the body.

The Eleven Organ Systems in Your Body

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The Eleven Organ Systems in the Human Body and Their Major Functions

Organ System	Organ Components	Major Function
Circulatory	heart, blood/lymph vessels, blood, lymph	Transport nutrients and waste products
Digestive	mouth, esophagus, stomach, intestines	Digestion and absorption
Endocrine	all glands (thyroid, ovaries, pancreas)	Produce and release hormones
Immune	white blood cells, lymphatic tissue, marrow	Defend against foreign invaders
Integumentary	skin, nails, hair, sweat glands	Protective, body temperature regulation
Muscular	skeletal, smooth, and cardiac muscle	Body movement
Nervous	brain, spinal cord, nerves	Interprets and responds to stimuli
Reproductive	gonads, genitals	Reproduction and sexual characteristics
Respiratory	lungs, nose, mouth, throat, trachea	Gas exchange
Skeletal	bones, tendons, ligaments, joints	Structure and support
Urinary	kidneys, bladder, ureters	Waste excretion, water balance

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7.3: Digestion

We obtain nutrition by eating food. Unlike gasoline, which is perfectly designed to power a car, food is not ready for the body to use in its current form. The tacos you ate last night doesn't go right into your body and power your body; A LOT has to happen to it for the body to be able to use it. The process of transforming food into usable nutrition for the body is called digestion. There are 4 steps to digestion:

1. Eat food.
2. Break down the food into tiny pieces.
3. Absorb nutrition into the body; move the small particles out of the digestive system and the rest of the body.
4. Get rid of the waste, which is anything your body can't use.

The digestive tract is a tube through the body, starting at the mouth and ending with the anus. The digestive system includes the mouth, esophagus, stomach, small intestine, pancreas, liver, gallbladder, and large intestine.

Watch the Video on Digestion and Absorption

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[View this YouTube Video online](#)



Do you recall the information from the video? Ask yourself, and then flip the card to find out.

1. How long does food remain inside your digestive tract?
2. What is Peristalsis?
3. What is Chyme?
4. What are Villi?
5. How much saliva does your body produce each day?

Answer available at the end of this section.

As food moves through the body, it is broken down by mechanical and chemical breakdown.

Mechanical breakdown is when you physically break food into pieces. Mechanical breakdown starts in the mouth, with the teeth tearing, ripping, and grinding food into smaller pieces. The mechanical breakdown also occurs with the muscular action of the esophagus, stomach, and small intestines. Have you ever bought a bag of grated cheese, and it's all clumped up, so you whack the bag on the counter or massage it with your fingers to break up all the cheese? That's essentially what the body does; the digestive system's muscles massage and separate and move food along through your body. This process is strong and happens even if working against gravity; if you drink a glass of water and then quickly do a headstand, your body will still be able to move that water through the digestive system even if you are upside down.

The chemical breakdown is when the body makes enzymes (chemicals) that break food down into small molecules. Enzymes are added to the mechanically broken down food from the salivary glands, stomach, pancreas, and small intestine. Additionally, the liver makes a chemical called bile, stored in the gallbladder, which helps the body digest fat. These chemicals are necessary to break the food down into molecules.

On the first half of the journey of a piece of food through the body, mechanical and chemical breakdown occurs. However, in the small intestine, absorption is also happening: the body absorbs the molecules from the food, taking them through the intestine wall and into the blood where the energy and building blocks can be delivered throughout the body. But hold on, the process of digestion is not done yet! No breakdown occurs in the large intestine, but some molecules and reabsorption of water are absorbed. Lastly, the large intestine packages and pushes the remaining undigested and indigestible food out of the body through

the anus; it eliminates the waste. Digestion is complete!

Can You Identify The Digestive Organs?

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[View this Interactive Content online](#)



What should your indigestible food look like as it exits your body?

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Bristol Stool Chart

Use the link below to access the Bristol Stool Chart and then compare the categories to your stools.

<https://cdhf.ca/digestive-disorders/constipation/signs-and-symptoms/>

Answers

Watch the Video on Digestion and Absorption

1. 30-40 hours
2. The wave-like movements that push your partially digested food through your digestive tract.
3. Chyme is made of partially digested food, and gastric juices. It is what we now call the food as it passes out of the stomach and into the small intestines.
4. Villi are fingerlike projections that line the inside of the small intestine. They help increase the surface area and the uptake of nutrients.
5. Your body produces approximately 1.5 Liters of saliva each day. Saliva is a watery liquid secreted by your salivary glands in the mouth that provide lubrication to help you taste, chew, and swallow foods. Saliva also contains a digestive enzyme called amylase that helps you breakdown carbohydrates.

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7.4: Your Gut Microbiome

Another feature of the large intestine is that it is where an enormous quantity of bacteria live. That may seem kind of gross to discover that your gut is home to more bacteria than there are cells in your body, but most of these bacteria are harmless, and some are even beneficial. You may have heard about probiotics and prebiotics in the news or seen them listed on food labels. Probiotics are defined as live bacteria that provide health benefits to the host (us), such as warding off diarrhea and reducing the effects of lactose intolerance. On the other hand, prebiotics is a type of fiber in some foods, which serves as a food source for probiotics. An analogy is to think of your gut as a farm. The probiotics are farm animals; the more farm animals on the farm, the better the farm is doing. But to keep the farm animals in good condition, you have to feed them. The hay you feed them is the prebiotics. We call this 'farm' your gut biome; the more and the healthier the probiotics, the healthier your gut biome. Foods such as yogurt contain probiotics, which can add to your gut biome. Some foods are prebiotics, like onions, bananas, and oats, which can feed your gut biome. A strong gut biome is thought to provide a host of health benefits.

Watch the Video on Pro/PreBiotics

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7.5: Digestive Diseases and Disorders

Many people suffer from digestive irregularity from time to time.

- **LACTOSE INTOLERANCE:** Lactose intolerance happens when the body can't break down the sugar found in milk, which causes gas, bloating, pain, and diarrhea. People can avoid dairy products or take supplements such as Lactaid to digest the sugar (lactose) found in milk.
- **DIARRHEA:** Diarrhea is a term used to describe very watery stools. It typically occurs with stomach pain and frequent trips to the bathroom. Diarrhea can be the symptom of stress, foodborne illness, or other infection. If a person has diarrhea, they should pay special attention to hydration as they lose more water than normal through diarrhea. Acute diarrhea often resolves on its own and needs no other treatment than rest, hydration, and over the counter medication. On the other hand, it can be a symptom of a more severe disorder and disease.
- **CONSTIPATION:** Constipation occurs when a person has difficulty passing stool and generally has three or fewer bowel movements a week. There can be numerous causes of constipation, including underlying digestive disorders and diseases, hormonal imbalances such as thyroid issues, or the slowing of food transit that happens in pregnancy. The first line of defense against constipation is increasing water, dietary fiber, and activity levels.

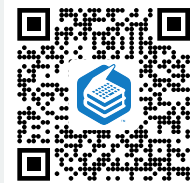
Many diseases and disorders related to the digestive system. Unbalanced diets can cause/effect disease; for example, high-fat diets can exacerbate GERD, IBS, and IBD symptoms.

- **PEPTIC ULCERS:** Peptic ulcers are sores in the stomach lining brought on by microbiome disturbances, stress, and infection. GERD medications are often provided to decrease stomach acid and allow healing.
- **GERD:** Gastroesophageal Reflux Disease. This disease is a type of persistent acid reflux that tends to occur in people with an unbalanced high-fat diet. Additionally, some food and drink such as spicy foods and chocolate make the symptoms worse. Treatment for GERD is making lifestyle changes, including dietary modifications to reduce weight and pressure on the stomach.
- **IBS:** Irritable Bowel Syndrome. This syndrome is characterized by muscle spasms in the colon, resulting in abdominal pain, bloating, constipation, and/or diarrhea. An unbalanced diet and stress primarily cause IBS. Treatment includes diet and lifestyle modifications.
- **IBD:** Irritable Bowel Disease. This disease is inflammation and damage to the GI tract. If the damage is mostly in the small intestines, it is called Crohn's Disease; if it is only in the large intestine, it is called Ulcerative Colitis (UC). The cause is unknown. The proper course of treatment is unclear but may include drugs and surgery.
- **Celiac Disease:** This disease is an autoimmune disorder that damages the villi in the small intestines, resulting in IBS and IBD symptoms. Damage is caused by the body overreacting to gluten, a common component in grains and found in most bread. Once diagnosed properly, a person who avoids gluten will heal their gut and stop the negative symptoms within six months.

What is Gluten?

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7.6: End Chapter

Learning Objectives

- Identify the parts of the Digestive System: mouth, esophagus, stomach, small intestine, pancreas, liver, gallbladder, large intestine. (MCCCD Competency 10)
- Define what probiotics and prebiotics and their contribution to health. (MCCCD Competency 6)
- Define common digestive diseases and disorders, including GERD/Gastritis, Crohn's Disease, Ulcerative Colitis, Constipation, Diarrhea, Celiac disease, and lactose intolerance. (MCCCD Competency 10)

8: CARBOHDYRATES

8.1: Introduction

8.2: Carbohydrate Overview and Structure

8.3: The Argument for Eating Fiber

8.4: Understanding Carbohydrates from Product Information

8.5: Diseases Related to Carbohydrates

8.6: End Chapter

8.1: Introduction

Learning Objectives

- The chemical structure and function of carbohydrates
- Foods rich in carbohydrates
- How the two types of fiber support your health
- How your body uses sugar and sugar alternatives
- Diseases related to carbohydrate disorders

8.2: Carbohydrate Overview and Structure

Carbohydrates are the perfect nutrient to meet your body's nutritional needs. They nourish your brain and nervous system, provide energy to all of your cells (and within proper caloric limits), and help keep your body fit and lean. Specifically, digestible carbohydrates provide bulk in foods, vitamins, and minerals, while indigestible carbohydrates provide a good amount of fiber with a host of other health benefits. Like fruit, vegetables, and whole grains, the plants we eat synthesize the fast-releasing carbohydrate, glucose, from carbon dioxide in the air and water and by harnessing the sun's energy. Plants convert the energy in sunlight to chemical energy in the molecule glucose. Plants use glucose to make other larger, more slow-releasing carbohydrates. When we eat plants, we harvest the energy of glucose to support life.

Carbohydrates are organic compounds containing a ratio of one carbon atom to two hydrogen atoms to one oxygen atom. Basically, they are hydrated carbons. The word "carbo" means carbon, and "hydrate" means water. Glucose is the more abundant carbohydrate in the human body.

Watch the video about carbohydrates and sugars

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Carbohydrates: Two Very Different Types

There are two types of carbohydrates based on how quickly they break down in the body, either fast or slow:

Fast-releasing carbohydrates are sugars. Simple sugars break down very quickly, flooding your body with quick energy.

Slow-releasing carbohydrates are starches and fibers.

Starch molecules are found in abundance in grains, legumes, and root vegetables, such as potatoes. Eating raw foods containing starches provides very little energy as the digestive system has a hard time breaking them down. Cooking breaks down the crystal structure of starches, making them much easier to break down in the human body, providing energy.

Fiber provides something different from the body: humans lack the enzymes to break down fiber, but the bacteria in our gut biome can provide some assistance. These bacteria break down some of the fiber, but most of the fiber we consume functions to make us feel full (help us regulate our appetite) and help clean out the intestinal tract. Think of fiber as a broom that sweeps out the insides of your intestinal tract.

Functions of Carbohydrates

The four primary functions of carbohydrates in the body are:

1) To provide energy – The simplest carbohydrate, and the one most abundant in the body, is glucose. For all organisms, from bacteria to plants to animals, glucose is the preferred fuel source. The brain is completely dependent on glucose as its energy source (except during extreme starvation conditions). Many other more complex carbohydrates break down and become glucose in the body.

2) Store energy – Extra carbohydrates are stored in our liver and muscles, ready for the body to use if necessary; it's like having a backup battery.

3) Build macromolecules – Although most absorbed glucose is used to make energy, some glucose is converted to ribose and deoxyribose, which are essential building blocks of important macromolecules, such as RNA, DNA, and ATP. Glucose is additionally utilized to make the molecule NADPH, which is important for protection against oxidative stress and is used in many other chemical reactions in the body. If all of the energy, glycogen-storing capacity, and building needs of the body are met, excess glucose can make fat.

4) Spare protein and fat for other uses – When the body needs glucose and doesn't have any, the body will scavenge proteins (your muscles) and convert them into glucose. Adequate glucose in the body spares the breakdown of proteins from being used to make glucose needed by the body.

What Foods are Rich in Carbohydrates?

Carbohydrates are contained in all five food groups: grains, fruits, vegetables, meats, beans (only in some processed meats and beans), and dairy products. Fast-releasing carbohydrates are more prevalent in fruits, fruit juices, and dairy products, while slow-releasing carbohydrates are more plentiful in starchy vegetables, beans, and whole grains. Fast-releasing carbohydrates are also found in large amounts in processed foods, soft drinks, and sweets. On average, a serving of fruits, whole grains, or starches contains 15 grams of carbohydrates.

In choosing dietary sources of carbohydrates, the best ones are those that are nutrient-dense, meaning they contain more essential nutrients per calorie of energy. In general, nutrient-dense carbohydrates are minimally processed and include whole-grain bread and cereals, low-fat dairy products, fruits, vegetables, and beans. In contrast, empty-calorie carbohydrate foods are highly processed and often contain added sugars and fats. Soft drinks, cakes, cookies, and candy are examples of empty-calorie carbohydrates. When you choose nutrient-dense food, you give your body better nutrition and more opportunities to function optimally. We all want to live our best life, feel our best, chose our food wisely.

8.3: The Argument for Eating Fiber

Adult females need 25 grams of fiber per day and males need 38 grams for good health, but most Americans get only about 15 grams a day. The Dietary Guidelines Advisory Committee states that there is enough scientific evidence to support that diets high in fiber reduce the risk of obesity and diabetes, which are primary risk factors for cardiovascular disease. Dietary fibers are very beneficial to our health. Fiber is found in peas, beans, oats, barley, rye, whole-grain foods, flax, cauliflower, and avocados. Cellulose is the most abundant fiber in plants, making up the cell walls and providing structure.

Whole Grains & Health

Bread Basket

Whole grains are vital to a healthy diet. In addition to fiber, whole grains offer other slow-releasing carbohydrates, antioxidants, vitamins, and minerals, all of which are needed for good health. But unfortunately, most people consume diets heavy in enriched flour, even though this has been proven to damage our health. Why would we eat white flour when whole grains are so much healthier for us? Good question! Let's learn about grains, the history of flour to catch you up on why we eat what we eat.

What is Whole Grain?

A grain is the seed of a plant. A whole-grain refers to eating the entire seed, not just the white insides (endosperm), but also the hard exterior layers (bran and germ). Many countries grow and eat wheat (a grain), but many other grains can make flour, such as rye, rice, and spelling.

Watch the video on the health benefits of whole grains

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For more information on Whole Grains, check out the link to Whole Grains 101 below.

<https://wholegrainscouncil.org/whole-grains-101/whats-whole-grain-refined-grain>

How We Ended Up With White Flour

If you swallow a grain whole, it will travel through your body without being broken down, and therefore you aren't getting any energy or nutrition from the grain. To make the grain into food, humans discovered they had to crack it open before eating it. In ancient times whole grains were cracked open using quern stones that required hours of hand labor, as in the photo to the right.

As technology slowly advanced, the quern stone was modified into the millstone. The process of milling breaks the hard outer bran coat of the wheat seeds. The bran and germ, which contain the most fiber, vitamins, and minerals, are removed by sifting. In America, Oliver Evans built the first flour mill, which was powered by a watermill. It used a series of elevators that moved grain through the mill, cleaning it first, then grinding and sifting it. Today, the vast majority of flour milled and used in foods and cooking in America is white flour. The modern milling process of preparing white flour removes between 50 and 85 percent of B vitamins, vitamin E, calcium, iron, potassium, chromium, phosphorus, zinc, magnesium, manganese, and cobalt. We developed an industry where we could take tons of grain and crack them open to make the nutrition accessible to the body; HOWEVER, we REMOVED most of the nutrition in making flour. Surprise, surprise, when you remove nutrition from one of the most common

items eaten, people end up with vitamin and mineral deficiencies such as pellagra (niacin, B3), beriberi (thiamine, B1), and anemia (iron) plagued. One of the first public health campaigns to improve Americans' health was to make flour nutritious again. Instead of rethinking the process of milling, we decided to enrich the flour. Enrichment means adding to; we added back in the B vitamins, niacin, thiamine, riboflavin, and folate, along with iron, to combat dietary deficiencies. Enriching white flour has been a successful strategy to improve public health. However, enriched flour contains only 6 percent or less of the recommended daily intake of the vitamins and minerals it "replaces." Overwhelming scientific evidence now shows that diets containing high amounts of whole grains rather than refined white flour decrease weight gain and the risk for many chronic diseases, including certain types of cancer and diabetes. Whole grains contain a whole nutrient package that is not replaced by enriched flour.

More Reasons to Eat Whole Grains

Whole grains contain more starches and fiber, so they are more satisfying. Additionally, once in the stomach, whole-grain foods take longer to digest. This increased digestive time in your stomach means that you literally feel (and are!) full longer. Remember, too, that they contain fiber, which makes elimination much smoother. Whole-grain foods satisfy the body the entire way through the digestive tract and provide the nutrients that also better satisfy the body's functional needs. The 2015 Dietary Guidelines recommend that half of all grains in your diet come from whole grains, as you recall from a previous chapter. What percentage of your diet is a whole grain? Next time you are buying foods, look at the labels closely, and see if you can incorporate some whole grain options to improve your health and decrease disease risk.

How to Find Whole Grains

Consumers are becoming more aware of the many health benefits of whole grains and are starting to look for whole grains in the foods they buy. The food industry wants to capitalize on this interest without improving their products, so they use words on the packaging that leads you to think you are getting whole grains, but you are not. For example, 'whole wheat' does not mean the product is made from 100% whole grains. In fact, brown bread isn't necessarily better for you than white bread: some manufacturers add caramel coloring to the bread dough, not whole grains (which contribute a darker color). The Food and Drug Administration (FDA) now mandates that the food industry label whole-grain foods as made from 100% whole grains. Anything else, it's not whole grains (and you won't reap the health benefits of whole grains). This means that if you look at an ingredient label, it must say 100% whole-grain or 100% whole-wheat flour as the first ingredient and not contain wheat flour, white flour, yellow corn semolina flour, degerminated flour, or durum flour. In America, whole-grain choices are improving, but progress still needs to be made on reducing the added sugar content of many industrially prepared bread, assuring added fiber comes from good sources, eliminating ambiguous labels and claims on packaging, and reducing the costs of whole-grain bread, which still exceed that of white bread.

Sugar and Sugar Alternatives

Sweetness is one of the five basic taste sensations of foods and beverages and is sensed by taste buds on your tongue. Many carbohydrates are sugars and taste sweet. However, not all carbohydrates are equally sweet. Some carbohydrates break down really quickly; these are called fast-releasing carbohydrates, and they taste the sweetest. That said, your tongue is so sensitive that even meager amounts of slow-releasing carbohydrates can be detected and will stimulate the sweetness taste sensation. Sweetness varies between the different carbohydrate types—some are much sweeter than others.

Due to the potential health consequences of consuming too many added sugars, sugar substitutes have replaced them in many foods and beverages. Sugar substitutes may be from natural sources or artificially made. Those that are artificially made are called artificial sweeteners and must be approved by the FDA for use in foods and beverages. The artificial sweeteners approved by the FDA are saccharin, aspartame, acesulfame potassium, neotame, and sucralose. Stevia is an example of a naturally-derived sugar substitute. Consuming foods and beverages containing sugar substitutes may benefit health by reducing the consumption of simple sugars, which are higher in calories, cause tooth decay, and are potentially linked to chronic disease. However, the most common side effect of consuming sugar substitute products is gastrointestinal upset due to their incomplete digestion.

8.4: Understanding Carbohydrates from Product Information

While nutrition facts labels can help you figure out how many carbohydrates to eat (the whole package? half?), these same labels do not help in determining whether a food is refined or not. The ingredients list does provide some help. It lists all the food's ingredients in order of weight. The first ingredient is the one that is most present in the food. When choosing between two pieces of bread, pick the one that lists whole wheat (not wheat flour) as the first ingredient, and avoid those with other flour ingredients, such as white flour, enriched flour, or cornflour. Eat less of products that list high fructose corn syrup and other sugars such as sucrose, honey, dextrose, and cane sugar in the first five ingredients. If you want to eat less processed foods, then in general, stay away from products with long ingredient lists.

On the front of food and beverages, the manufacturers may include claims such as “sugar-free,” “reduced sugar,” “high fiber,” etc... The Nutrition and Labeling Act of 1990 has defined the food industry and consumers what these labels mean, so there is a standardized definition. See the table below.

Food Label Claims

Label	Definition
Sugar-free	Contains less than 0.5 grams of sugar per serving
Reduced sugar	It contains 25 percent less sugar than a similar product.
Less sugar	It contained 25 percent less sugar than a similar product and was not altered by processing.
No sugars added	No sugars added during processing.
High fiber	Contains at least 20 percent of the daily value of fiber in each serving
A good source of Fiber	It contains between 10 and 19 percent of the daily value of fiber per serving.
More fiber	Contains 10 percent or more of the daily value of fiber per serving

Source: US Food and Drug Administration. “Appendix A: Definitions of Nutrient Claims.” Guidance for Industry: A Food Labeling Guide.

8.5: Diseases Related to Carbohydrates

Consumption of too much sugar can lead to Oral Disease, which includes decay of the teeth, gums, and mouth tissues. To avoid or reduce oral disease, switch to a non-sugar drink, and brush your teeth. Overconsumption of sugar does not cause diabetes. With diabetes, just like other diseases, genetics, nutrition, environment, and lifestyle factors are all involved in determining a person's risk of developing diabetes. There are two types of diabetes. **Type 1 Diabetes** was once a death sentence but can now be treated with insulin injections. However, insulin injections do not cure the disease, and people with diabetes can suffer many disease complications. Diabetes complications can be relieved by strictly managing blood-glucose levels, adhering to a healthy diet, and increasing physical activity. The incidence of **Type 2 Diabetes** has more than doubled in America in the past thirty years, and the rise is partly attributed to the increase in obesity. The front-line approach for treating **Type 2 Diabetes** includes eating a healthy diet and increasing physical activity. The long-term health consequences of diabetes are severe. They result from chronically high glucose concentrations in the blood and other metabolic abnormalities such as high blood lipid levels.

What Is Diabetes?

Diabetes is a disease of insulin deficiency (the body doesn't make enough insulin, which is essential in moving glucose out of the bloodstream and into cells for use) and glucose over-sufficiency. Diabetes is a metabolic disease and is one of the top three diseases in America. It affects millions of people and causes tens of thousands of deaths each year. Like other diseases, genetics, nutrition, environment, and lifestyle are all involved in determining a person's risk of developing diabetes. One sure way to decrease your chances of getting diabetes is to maintain optimal body weight by consuming a balanced diet balanced in carbohydrate, fat, and protein intake. There are three types of diabetes: **Type 1** diabetes, **Type 2** diabetes, and gestational diabetes. According to the Center for Disease Control (CDC), 34.2 million Americans—just over 1 in 10—have diabetes. 88 million American adults—approximately 1 in 3—have prediabetes.

Are You at Risk for Prediabetes?

Follow the link to the short survey.

<https://www.cdc.gov/diabetes/risktest/index.html>

Type 1 Diabetes

Type 1 diabetes is a metabolic disease in which insulin-secreting cells in the pancreas are killed by an abnormal response of the immune system, causing a lack of insulin in the body. Its onset typically occurs in children and adolescents. However, young adults can also develop the disease. Type 1 diabetes accounts for about 10 percent of diabetes cases. The only way to prevent the deadly symptoms of this disease is to inject insulin under the skin. Before this treatment was discovered, people with Type 1 diabetes died rapidly after disease onset. Death was the result of extremely high blood-glucose levels affecting brain function and leading to coma and death.

A person with Type 1 diabetes usually has a rapid onset of hunger, excessive thirst and urination, and rapid weight loss. Because the main function of glucose is to provide energy for the body. When insulin is no longer present, no message is sent to cells to take up glucose from the blood. Instead, cells use fat and proteins to make energy, resulting in weight loss. If Type 1 diabetes goes untreated, individuals with the disease will develop a life-threatening condition called ketoacidosis. This condition occurs when the body uses fats and not glucose to make energy, resulting in a build-up of ketone bodies in the blood. It is a severe form of ketosis with vomiting, dehydration, rapid breathing, confusion, and eventually coma and death. Upon insulin injection, these severe symptoms are treated, and death is avoided. Unfortunately, while insulin injection prevents death, it is not considered a cure. People who have this disease must follow a balanced diet to prevent the development of serious complications. Type 1 diabetics are advised to count the total grams of carbohydrates they eat and spread them out evenly over the course of the day to help maintain a balance in their blood sugar levels. It is also recommended that they consume complex carbohydrates and eat small frequent meals throughout the day. Frequent exercise also helps manage blood-glucose levels.

Type 2 Diabetes

The other 90 percent of diabetes cases are Type 2 diabetes. Type 2 diabetes is defined as a metabolic disease of insulin insufficiency. Still, it is also caused by the muscle, liver, and fat cells no longer responding to the body's insulin. Therefore, the body cells have become resistant to insulin and are no longer able to take up glucose from the blood. Thus, similar to patients with Type 1 diabetes, those with Type 2 diabetes also have high blood glucose levels.

For Type 2 diabetics, the onset of symptoms is more gradual and less noticeable than for Type 1 diabetics. The symptoms are increased thirst and urination, unexplained weight loss, and hunger. The first stage of Type 2 diabetes is characterized by high glucose and insulin levels. This is because the insulin-secreting cells in the pancreas attempt to compensate for insulin resistance by making more insulin. In the second stage of Type 2 diabetes, the pancreas' insulin-secreting cells become exhausted and die. At this point, Type 2 diabetics also have to be treated with insulin injections. The front-line approach for treating Type 2 diabetes includes eating a healthy, balanced diet and increasing physical activity. If blood glucose levels are not able to be controlled by diet and exercise, a combination of treatments such as oral medications and insulin shots may be included in the treatment.

Glucose Monitoring Goes High Tech

Learn how technology can provide continuous glucose monitoring to people with diabetes.

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[View this YouTube Video online](#)



Gestational Diabetes

Gestational diabetes can occur in pregnant women who did not have diabetes before their pregnancy. It typically occurs between 24-28 weeks into the pregnancy. Like in Type 2 diabetes, the first attempt to control blood glucose levels is diet and exercise. However, if blood glucose levels remain elevated, insulin may be included in the treatment.

Women with uncontrolled gestational diabetes will birth and an extra-large baby due to the higher circulating glucose level. This can cause a C-Section instead of natural delivery because the baby is too large. Additional problems for women with Gestational diabetes include the risk of high blood pressure and low blood sugar. To learn more about Gestational Diabetes, click on the link below.

[Learn More About Gestational Diabetes](#)

www.cdc.gov/pregnancy/documents/Diabetes_and_Pregnancy508.pdf

Watch the Video About Diabetes & Obesity

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As glucose levels rise over time the blood vessels stiffen and become prone to injury.

True or False?

Answer available at the end of this section.

Answers

Watch the Video About Diabetes & Obesity

True

8.6: End Chapter

Learning Objectives

- Define the four functions of carbohydrates. (MCCCD Competency 5)
- Recall the chemical structure of simple and complex carbohydrates. (MCCCD Competency 5)
- Identify the types of foods that have carbohydrates. (MCCCD Competency 2)
- Discuss the key issues surrounding the use of sugar and sugar alternatives. (MCCCD Competency 1)
- Identify common sugar alternatives. (MCCCD Competency 2)
- List 3 diseases related to carbohydrate metabolism. (MCCCD Competency 9)

9: LIPIDS

- 9.1: Introduction
- 9.2: What is Lipid?
- 9.3: What Lipids Do In the Body
- 9.4: Food Sources of Lipids
- 9.5: Saturated and Unsaturated Fats
- 9.6: Lipids and Disease
- 9.7: Omega-3 fatty acids
- 9.8: Cholesterol – Made by you for you!
- 9.9: End Chapter

9.1: Introduction

Learn

- Lipids
- Dietary fat and its function in your body
- Foods that contain saturated and unsaturated fats
- Health risks associated with too much dietary fat

Introduction

This chapter will learn about the three main types of lipids and their functions in our bodies. In the body, fat functions as an important depot for energy storage offers insulation and protection and plays important roles in regulating and signaling. Large amounts of dietary fat are not required to meet these functions because they can synthesize most fat molecules from other organic molecules like carbohydrates and protein (except for two essential fatty acids). However, fat also plays unique roles in the diet, including increasing the absorption of fat-soluble vitamins and contributing to food flavor and satisfaction. Let's take a closer look at each of these fats' functions in the body and the diet. Let's **begin by watching the video below for a brief introduction to lipids.**

Watch the video about lipids

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[View this YouTube Video online](#)



9.2: What is Lipid?

Lipids are important fats that serve different roles in the human body. The three main types of lipids are triacylglycerols (also known as triglycerides), phospholipids, and sterols.

1. **Triglycerides** make up more than 95 percent of lipids in the diet and are commonly found in fried foods, butter, milk, cheese, and some meats. Naturally occurring triacylglycerols are found in many foods, including avocados, olives, corn, and nuts. We commonly call the triglycerides in our food “fats” and “oils.” Fats are lipids that are solid at room temperature, whereas oils are liquid.
2. **Phospholipids** make up only about 2 percent of dietary lipids. They are water-soluble and are found in both plants and animals. Phospholipids are crucial for building the protective barrier, or membrane, around your body’s cells. In fact, phospholipids are synthesized in the body to form cell and organelle membranes. In blood and body fluids, phospholipids form structures in which fat is enclosed and transported throughout the bloodstream.
3. **Sterols** are the least common type of lipid. Cholesterol is perhaps the best well-known sterol. Though cholesterol has a notorious reputation, the body gets only a small amount of its cholesterol through food—the body produces most of it. Cholesterol is an important component of the cell membrane and is required to synthesize sex hormones, vitamin D, and bile salts.

9.3: What Lipids Do In the Body

Fats satisfy **appetite** (the **desire** to eat) because they add flavor to foods. Fat contains dissolved compounds that contribute to mouth-watering aromas and flavors. Fat also adds texture, making baked foods moist and flakey, fried foods crispy, and adding creaminess to foods like ice cream and cream cheese. Consider fat-free cream cheese; when fat is removed from the cream, much of the flavor is also lost. As a result, it is grainy and flavorless—nothing like its full-fat counterpart—and many additives are used to replace the lost flavor.

Fats satisfy **hunger** (the **need** to eat) because they're slower to be digested and absorbed than other macronutrients. Dietary fat thus contributes to **satiety**—the feeling of being satisfied or full. When fatty foods are swallowed, the body responds by enabling the processes controlling digestion to slow the movement of food along the digestive tract, giving fats more time to be digested and absorbed and promoting an overall sense of fullness. Sometimes, before the feeling of fullness arrives, people overindulge in fat-rich foods, finding the delectable taste irresistible. Slowing down to appreciate the taste and texture of foods can give your body time to send satiety signals to your brain, so you can eat enough to be satisfied without feeling overly full.

Lipids perform many functions within the body:

1) Store Energy – When we take in more energy than we need, the body stores it as adipose tissue (fatty tissue, which we call fat). Carbohydrates and lipids provide most of the energy required by the human body. As discussed in the Carbohydrates unit, glucose is stored in the body as glycogen. While glycogen provides a ready source of energy, it is quite bulky with heavy water content, so the body cannot store much of it for long. Fats, on the other hand, can serve as a larger and more long-term energy reserve. Fats pack together tightly without water and store far greater amounts of energy in a reduced space. A fat gram is densely concentrated with energy, containing more than double the amount of energy as a gram of carbohydrate.

We draw on the energy stored in fat to help meet our basic energy needs when we're at rest and fuel our muscles for movement throughout the day, from walking to class, playing with our kids, dancing through dinner prep, or powering through a shift at work. Historically, when humans relied on hunting and gathering wild foods or on crops' success, storing energy as fat was vital to survival through lean times. Hunger remains a problem for people worldwide, and being able to store energy when times are good can help them endure a period of food insecurity. In other cases, the energy stored in adipose tissue might allow a person to weather a long illness.

Unlike other body cells that can store fat in limited supplies, fat cells are specialized for fat storage and can expand almost indefinitely in size. An overabundance of adipose tissue can be detrimental to your health, from mechanical stress on the body due to excess weight and hormonal and metabolic changes. Obesity can increase the risk for many diseases, including type 2 diabetes, heart disease, stroke, kidney disease, and certain types of cancer. It can also interfere with reproduction, cognitive function, and mood. Thus, while some body fat is critical to our survival and good health, it can be a deterrent to maintaining good health in large quantities.

2) Regulate and Signal – Lipids regulate the temperature of your body, keeping it steady, not too hot, and not too cold. Lipids also help the body produce and regulate hormones for everything from appetite to the reproductive system to blood clotting. Lipids are key to brain structure and function; the lipids form nerve cell membranes, insulate neurons (the cables that send messages throughout the body), and help send signals within the brain.

3) Insulate and Protect – Our bodies are padded with fat, protecting us from everyday friction. The average body fat for a man is 18 to 24 percent and for a woman is 25 to 31 percent¹. Still, adipose tissue can comprise a much larger percentage of bodyweight depending on the degree of obesity of the individual. Some of this fat is stored within the abdominal cavity, called **visceral fat**, and some are stored just underneath the skin, called **subcutaneous fat**. Visceral fat protects vital organs—such as the heart, kidneys, and liver. The blanket layer of subcutaneous fat insulates the body from extreme temperatures and helps keep the internal climate under control. It pads our hands and buttocks and prevents friction, as these areas frequently come in contact with hard surfaces. It also gives the body the extra padding required when engaging in physically demanding activities such as ice skating, horseback riding, or snowboarding. There are two types of fat stored as adipose tissue: subcutaneous fat and visceral fat.

4) Aid Digestion and Increase Bioavailability – When food breaks down in the gut, fat is released and combines with fat-soluble nutrients. The combination of the fat and the nutrients allows the nutrients to be digested more easily and absorbed into the body. This improved absorption is called increased bioavailability. Dietary fats can also increase the bioavailability of compounds known as **phytochemicals**—non-essential plant compounds considered beneficial to human health. Many phytochemicals are fat-soluble, such as lycopene found in tomatoes and beta-carotene found in carrots, so dietary fat improves the absorption of these molecules in the digestive tract.

In addition to improving the bioavailability of fat-soluble vitamins, some of the best dietary sources of these vitamins are also foods that are high in fat. For example, good vitamin E sources are nuts (including peanut butter and other nut butter), seeds, and plant oils such as those found in salad dressings. It isn't easy to consume enough vitamin E if you're eating a very low-fat diet. (Although fried foods are usually cooked in vegetable oils, vitamin E is destroyed by high heat so that you won't find much vitamin E in french fries or onion rings. Your best bets are minimally-processed, whole foods.) Vegetable oils also provide some vitamin K, and fatty fish and eggs are good sources of vitamins A and D.

Below are images of foods that contain the four fat-soluble vitamins.

<u>Vitamin A</u>	<u>Vitamin D</u>	<u>Vitamin K</u>	<u>Vitamin E</u>

Vitamin A, D, K, and E are the four fat-soluble vitamins and can be found in an array of foods like butternut squash, broccoli, and salmon. Eating dietary fat in a balanced diet helps you absorb these fat-soluble vitamins, such as a kale salad with olive oil dressing and walnuts.

9.4: Food Sources of Lipids

Dietary lipids are primarily oils (liquid) and fats (solid). Commonly consumed oils are canola, corn, olive, peanut, safflower, soy, and sunflower oil. Foods rich in oils include salad dressing, olives, avocados, peanut butter, nuts, seeds, and some fish. Fats are found in animal meat, dairy products, and cocoa butter.

Search for Food Sources High in Fat with MyPlate

Using what you have learned about MyPlate in previous chapters, click on the words on MyPlate to identify foods that contain fat.

Always remember that fats are important and can be found across the spectrum. Visit [MyPlate](#)(opens in new tab) for more information.

9.5: Saturated and Unsaturated Fats

Most oils are high in monounsaturated or polyunsaturated fat and low in saturated fat. Monounsaturated fats help regulate blood cholesterol levels, thereby reducing the risk of heart disease and stroke. Both monounsaturated fats and polyunsaturated fats provide nutrition that is essential for normal cell development and healthy skin.

- **Monounsaturated fat** – This type of fat is found in plant oils. Common sources are nuts (almonds, cashews, pecans, peanuts, and walnuts) and nut products, avocados, extra virgin olive oil, sesame oil, high oleic safflower oil, sunflower oil, and canola oil.
- **Polyunsaturated fat** – This type of fat is found mainly in plant-based foods, oils, and fish. Common sources are nuts (walnuts, hazelnuts, pecans, almonds, and peanuts), soybean oil, corn oil, safflower oil, flaxseed oil, canola oil, and fish (trout, herring, and salmon).
- **Saturated fat** – This fat is found in animal products, dairy products, palm and coconut oils, and cocoa butter. Limit these products to less than 10 percent of your overall dietary fat consumption. Saturated fat, which is found in meat, dairy products, and some plant oils, is associated with increased bloodstream cholesterol. High cholesterol levels indicate that a person is at a major risk for disease, such as heart attack. Avoid saturated fat, or at least consume in moderation.

Unsaturated vs. Saturated Fat

Identify the following images below as a food high in saturated or unsaturated fat by dragging the images to their correct box.

Saturated fat	Unsaturated fat
	

Answer available at the end of this section.

Answers

Unsaturated vs. Saturated Fat

Saturated fat	Unsaturated fat
---------------	-----------------





9.6: Lipids and Disease

An increased intake of lipids is associated with heart disease, obesity, cardiovascular disease, and other problems. Making dietary choices that limit the intake of saturated (and trans, another type of fat) fats to the recommended levels, replacing saturated and trans fats with unsaturated fats, increasing physical activity, and quitting smoking can reduce the risk of developing heart disease and other ailments. Note that a diet too low in fat is also problematic; fat is essential for many body functions, making food taste great and satiating the appetite. Like with so many things in life, the best results come from balance: eat enough lipids but not too much.

The total fat (% kcal) goal is based on the acceptable macronutrient distribution range (AMDR). Omega-3 and -6 goals are based on adequate intake (AI) to ensure nutritional adequacy. Sources: National Institutes of Health: Nutrient Recommendations: Dietary Reference Intakes (DRIs) & Dietary Guidelines for Americans 2015-2020: Appendix 7.

9.7: Omega-3 fatty acids

Omega-3 fatty acids, also known as alpha-linolenic acid, are two major classes of polyunsaturated fats. Omega-3 fatty acids play an important role in the diet for overall cell health and growth and include additional heart health benefits. Two commonly known omega-3 fatty acids are eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) and are commonly found in fatty fish like salmon, sardines, and herring. Other sources of omega-3 fatty acids include flaxseeds, walnuts, soybean oil, and chia seeds.

The recommended daily intake of omega-3 fatty acids for an individual's diet should make up about 0.6 – 1.2% of overall total calories. Studies have shown that intake of omega-3 fatty acids, especially at least two EPA and DHA servings a week, can reduce cardiovascular disease risk.

9.8: Cholesterol – Made by you for you!

Cholesterol is primarily produced by the body and is important for synthesizing Vitamin D, bile salts, and reproductive hormones. Cholesterol is also an essential component of the cell membrane. Minimal intake of cholesterol is consumed through food like animal sources, cheese, or egg yolks. An increased build-up of cholesterol can contribute to the build-up of plaque and lead to many coronary artery disease complications. Factors that can contribute to high cholesterol include unhealthy eating habits with increased intake of processed and fried foods, lack of physical activity, and smoking.

The liver produces lipoproteins that help carry fat and cholesterol through your bloodstream. Two commonly discussed lipoproteins include low-density lipoprotein (LDL) and high-density lipoprotein (HDL). LDL is known as the “bad” cholesterol and helps contribute to the build-up of plaque in your arteries’ walls. HDL cholesterol is known as the “good” cholesterol and helps remove cholesterol and transport it back to the liver.

9.9: End Chapter

THE FACTS ABOUT FAT

True/False

1. You can become deficient in some vitamins if you avoid fat in your diet. True or False?
2. You need to eat cholesterol weekly to help your body meet its daily needs to function properly. True or False?
3. Which foods are great sources of omega-3 fatty acids?
 - a. Flaxseeds
 - b. Ground beef
 - c. Soybean oil
 - d. Salmon

Answer available at the end of this section.

Learning Objectives

- Recognize the structure of lipids. (MCCCD Competency 1)
- Discuss the four functions of fat. (MCCCD Competency 5)
- Identify the types of foods that contain various types of fat. (MCCCD Competency 2)
- Explain the relation between dietary fat and associated health risks. (MCCCD Competency 4)
- Define monounsaturated fats, unsaturated fats, and saturated fats. (MCCCD Competency 5)

Answers

True/False

1. You can become deficient in some vitamins if you avoid fat in your diet. True
2. You need to eat cholesterol weekly to help your body meet its daily needs to function properly. False
3. a. Flaxseeds, c. Soybean oil, d. Salmon

10: PROTEIN

10.1: Introduction to Protein

10.2: What is Protein?

10.3: Sources of Protein

10.4: Important Roles of Protein in the Body

10.5: Why You Should Eat Protein

10.6: What about vegetarians and vegans

10.7: Athletes and Protein intake

10.8: End Chapter

10.1: Introduction to Protein

Learn

- The function of proteins
- Impact of too little or too much protein in your diet
- Best food sources for protein
- Essential and nonessential amino acids
- Complementary proteins

Introduction to Protein

Protein makes up approximately 20 percent of the human body and is present in every single cell. The word protein is a Greek word, meaning “of utmost importance.” Proteins are called the workhorses of life as they provide the body with structure and perform a vast array of functions. You can dance, run, play racquetball, hula-hoop, and more because of your protein-rich muscles. Protein is necessary for proper immune system function, digestion, hair and nail growth, and numerous other body functions. In fact, it is estimated that more than one hundred thousand different proteins exist within the human body. In this chapter, you will learn about the components of protein, the important roles that protein serves within the body, how the body uses protein, the risks and consequences associated with too much or too little protein, and where to find healthy sources in your diet.

10.2: What is Protein?

Proteins, simply put, are macromolecules composed of amino acids. Amino acids are commonly called protein's building blocks. Proteins are crucial for the nourishment, renewal, and continuance of life. Proteins contain carbon, hydrogen, and oxygen just as carbohydrates and lipids do, but proteins are the only macronutrient with nitrogen.

Watch the video on Proteins to learn how protein is used in your body

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



10.3: Sources of Protein

The protein food group consists of foods made from meat, seafood, poultry, eggs, soy, beans, peas, nuts, and seeds. Animal protein and vegetable protein provide different nutrients for the body. They contain other vitamins and minerals as well as different kinds of fat. Protein-rich animal-based foods commonly have high amounts of B vitamins, vitamin E, iron, magnesium, and zinc. Seafood often contains healthy fats. Plant sources of protein contain a high amount of fiber. Some animal-based protein-rich foods have an unhealthy amount of saturated fat and cholesterol, so it is important to be mindful of how much of one source of protein you are consuming. It is best to vary protein sources to help the body receive an adequate diet of different nutrients.

Examples of protein-rich foods like fish, poultry, lentils, and tofu.

We cannot make essential amino acids in the body, so we need to get them in our diet. When a food item contains all nine amino acids, it is called a complete protein. Some examples of complete protein foods would be meat, quinoa, eggs, and soybeans. We can combine two incomplete food items to make a complete protein. Some examples are beans and rice, peanut butter on toast, and a salad with chickpeas and sunflower seeds. For more ideas with complementary foods, visit: health.bastyr.edu/news/health-tips/2019/05/what-are-complementary-proteins-and-how-do-we-get-them

<u>Essential Amino Acids</u>	<u>NonEssential Amino Acids</u>
Histidine	Alanine
Isoleucine	Arginine*
Leucine	Asparagine
Lysine	Aspartic acid
Methionine	Cysteine*
Phenylalanine	Glutamic acid
Threonine	Glutamine*
Tryptophan	Glycine*
Valine	Proline*
	Serine
Conditionally Essential	Tyrosine

What are essential, nonessential, and conditionally essential amino acids?

Directions: Fill in the blanks with the correct number of essential, nonessential, and conditionally essential amino acids. Then fill in the blanks with the definition for essential, nonessential, and conditionally essential amino acids.

Fill in the missing words

For amino acids, there are _____ nonessential, _____ conditionally essential, and _____ essential. The _____ amino acids need to be obtained from the diet and the _____ amino acids are those that our body can make ourselves. _____ amino acids are also those that are body can also make, but may need to be supplied through the diet in certain circumstances.

Answer available at the end of this section.

Do You Know?

Watch the video below, “From DNA to protein – 3D,” to help you learn the process of building proteins. The three key steps are:

- Transcription
- Translation
- Folding

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Answers

What are essential, nonessential, and conditionally essential amino acids?

For amino acids, there are **5** nonessential, **6** conditionally essential, and **9** essential. The **essential** amino acids need to be obtained from the diet and the **nonessential** amino acids are those that our body can make ourselves. **Conditionally essential** amino acids are also those that are body can also make, but may need to be supplied through the diet in certain circumstances.

10.4: Important Roles of Protein in the Body

Proteins are the “workhorses” of the body and participate in many bodily functions. Proteins come in all sizes and shapes, and each is specifically structured for its particular function:

1. **Structure and Motion:** more than one hundred different structural proteins have been discovered in the human body, but the most abundant by far is collagen, which makes up about 6 percent of total body weight. Collagen makes up 30 percent of bone tissue and comprises large amounts of tendons, ligaments, cartilage, skin, and muscle. Collagen is a strong, fibrous protein made up of mostly glycine and proline amino acids. Within its quaternary structure, three protein strands twist around each other like a rope, and then these collagen ropes overlap with others. This highly ordered structure is even stronger than steel fibers of the same size. Collagen makes bones strong but flexible. Collagen fibers in the skin's dermis provide it with structure, and the accompanying elastin protein fibrils make it flexible. Pinch the skin on your hand and then let go; the collagen and elastin proteins in the skin allow it to go back to its original shape. Smooth-muscle cells secrete collagen and elastin proteins surround blood vessels, providing the vessels with structure and the ability to stretch back after blood is pumped through them. Another strong, fibrous protein is keratin, which is what skin, hair, and nails are made of.

Amino Acid Refresh

Directions: Complete the statement below by filling in the blanks.

Put the words into the correct boxes

Collagen is made up of mostly _____ and _____ amino acids. These are _____ amino acids and can be made by our bodies unless under special circumstances.

proline

glycine

conditionally essential

Answer available at the end of this section.

2. **Enzymes:** Although proteins are found in the greatest amounts in connective tissues such as bone, their most extraordinary function is enzymes. Enzymes are proteins that conduct specific chemical reactions. An enzyme's job is to provide a site for a chemical reaction and to lower the amount of energy and time it takes for that chemical reaction to happen (this is known as “catalysis”). On average, more than one hundred chemical reactions occur in cells every single second, and most of them require enzymes. The liver alone contains over one thousand enzyme systems. Enzymes are specific and will use only particular substrates that fit into their active site, similar to how a lock can be opened only with a specific key. Nearly every chemical reaction requires a specific enzyme. Fortunately, an enzyme can repeatedly fulfill its role as a catalyst, although it is eventually destroyed and rebuilt. All bodily functions, including the breakdown of nutrients in the stomach and small intestine, transforming nutrients into molecules a cell can use, and building all macromolecules, including protein itself, involve enzymes.
3. **Hormones:** proteins are responsible for hormone synthesis. Hormones are the chemical in the body that communicates a message to initiate a specific reaction or cellular process. For instance, after you eat a meal, your blood glucose levels rise. In response to the increased blood glucose, the pancreas releases the hormone insulin. Insulin tells the body cells that glucose is available and takes it up from the blood and stores it or uses it to make energy or build macromolecules. A major function of hormones is to turn enzymes (and therefore processes) on and off. While not all hormones are made from proteins, many of them are.
4. **Fluid and Acid-Base Balance:** The body is in an ever-changing environment. Eating enough protein helps the body maintain balance. Fluid balance refers to maintaining the distribution of water in the body. If too much water in the blood suddenly moves into a tissue, the results are swelling and, potentially, cell death. To keep the water evenly distributed between blood and cells, proteins continuously circulate in the blood. The most abundant protein in blood is the butterfly-shaped protein known as albumin. Albumin's presence in the blood makes the protein concentration in the blood similar to that in cells. Therefore, fluid exchange between the blood and cells is not extreme but rather minimized to preserve the status quo. Protein

is also essential in maintaining proper pH balance (how acidic or basic a substance is) in the blood. Even a slight change in blood pH can affect body functions. The body has several systems that hold the blood pH within the normal range to prevent this from happening. One of these is the circulating albumin. Albumin acts as a buffer against abrupt changes in molecules' concentrations, thereby balancing blood pH and maintaining the status quo. The protein hemoglobin also participates in acid-base balance.

True/False - What do proteins contain again?

Proteins contain hydrogen, carbon, and oxygen.

True or False

Answer available at the end of this section.

5. **Transport:** proteins serve to transport molecules around the body and through cell membranes. Proteins can either carry, like a taxi, the molecule (passenger) through the membrane, or the protein can be a fixed tunnel in the side of the membrane, which a molecule can pass through easily like a pedestrian walking through a tunnel built under a road, allowing them safe passage from one side of the road to the other.

Molecules move in and out of cells through transport proteins, which are either channels or carriers.

6. Protection: proteins play an important role in protecting the body against unwanted intruders, from building the strong collagen fibers in the skin to provide it protection from the world, to be the chemicals that the immune system uses to attack and destroy invaders. You've heard of antibodies: they are proteins that seek and destroy invaders in the system.

7. Wound Healing and Tissues Regeneration: Proteins are involved in all aspects of wound healing. If a diet is insufficient in protein, the process of wound healing is markedly slowed. Tissue regeneration is when there is no wound, and it's just the regular maintenance of the body. For example, skin cells are constantly dying. They are not replaced by scar tissue but instead by new identical skin cells. The same is true for cells lining the digestive tract, which are replaced every 3-5 days. Protein-inadequate diets impair tissue regeneration, causing many health problems, including impairment of nutrient digestion and absorption and, most visibly, hair and nail growth.

8. Energy Production: protein can be used for energy if necessary due to a lack of carbohydrates or fats.

Did You Know?

Watch the video below on wound healing.

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Test Your Knowledge about Cell Regeneration

After watching the wound healing video and reading the text, complete the activity below by dragging the cells to their correct box on which they regenerate at a high rate or not.

Cell Regeneration - Drag & Drop

High rate of regeneration	Do not regenerate at a fast rate
Hair Cells, Intestinal Cells, Nail Cells, Nerve Cells, Skin Cells, Heart-muscle Cells	

Answer available at the end of this section.

Answers

Amino Acid Refresh

Collagen is made up of mostly **glycine** and **proline** amino acids. These are **conditionally essential** amino acids and can be made by our bodies unless under special circumstances.

True/False - What do proteins contain again?

False

Test Your Knowledge about Cell Regeneration

High rate of regeneration	Do not regenerate at a fast rate
Nail Cells Intestinal Cells Hair Cells Skin Cells	Nerve Cells Heart-muscle Cells

10.5: Why You Should Eat Protein

Protein deficiency syndromes are a leading cause of death in children under five in poor, underdeveloped countries. Protein deficiency can cause swelling, fatigue, skin problems, irritability, muscle wasting, and eventual death from infection. A severe form of protein malnutrition is called kwashiorkor. This is characterized by potbelly stomachs relating to an imbalance of osmotic solutions. You can see an example pictured to the right. The long-term health consequences of high-protein diets have not been adequately studied. As with any nutrient, protein must be eaten in proper amounts. Moderation and variety are key strategies for achieving a healthy diet and need to be considered when optimizing protein intake. Eat proteins in moderation, at least 10 percent of the calories you take in and not more than 35 percent. A simple calculation for protein intake is to take your weight in kilograms (weight in pounds divided by 2.2) and multiply it by 0.8 to get the total grams of protein needed for a normal healthy adult each day based on the RDA. For example, if you weigh 165 lbs, we can convert it to kg by dividing by 2.2; $165 \text{ lbs} / 2.2 = 75 \text{ kg}$. If you weigh 75 kg and protein recommendations are 0.8 g/kg, we can do the math; $75 \text{ kg} \times 0.8 = 60 \text{ g}$ of protein per day based on recommendations. Too little protein impairs bodily functions, and too much may lead to chronic disease. Protein deficiency is not a concern for most Americans as protein consumption is typically greater than need on a daily basis.

10.6: What about vegetarians and vegans

People who consume a vegetarian and vegan diet may be at risk of lower protein intake. There are different levels of vegetarianism, and some may be at greater risk. Lacto vegetarians only consume dairy from animal sources like milk, cheese, or yogurt. Lacto-Ovo vegetarians consume dairy and eggs from animals. Pescatarians will consume fish and seafood on top of dairy and eggs. Eating a wider variety of protein-rich foods helps provide the body with essential nutrients. One nutrient that is very common to be low with vegetarians and vegans is vitamin B12. This is essential for keeping blood, nerves, and DNA healthy. Without animal products, vitamin B12 consumption may be low, so it is important to speak with a health care professional about supplementation or consuming a high fortified diet.

While there may be challenges when following a vegetarian diet, a diet that is varied and balanced has been shown to reduce the risk of chronic diseases. Nutritional benefits from a vegetarian diets may include:

- Reduced risk for some cancers – associated with higher fiber intake.
- Fewer digestive issues – associated with higher fiber intake.
- Reduced risk of kidney diseases – associated with higher intake of vegetable proteins (legumes, soy).
- Reduced risk for heart disease – associated with decreased saturated fat intake.
- Lower blood pressure – associated with increased intake of fruits and vegetables.

10.7: Athletes and Protein intake

For an athlete, those following an omnivorous, vegetarian, or vegan diet should aim to consume 1.2-2.0 g/kg/day of protein to help support muscle repair and turnover. For more information about protein intake with athletes, visit www.gssiweb.org/sports-science-exchange/article/vegetarian-and-vegan-diets-for-athletic-training-and-performance

10.8: End Chapter

Learning Objectives

- Define the roles of protein in the body. (MCCCD Competency 5)
- Identify your protein needs. (MCCCD Competency 1)
- Discuss the differences between animal and vegetable-based protein sources. (MCCCD Competency 1)
- Define a complete protein. (MCCCD Competency 5)
- Define essential and nonessential amino acids. MCCCD Competency 5)
- Discuss the disorders of too much and too little protein in the diet. (MCCCD Competency 9)

11: FOOD ALLERGIES

11.1: Introduction

11.2: Food intolerance

11.3: Food Sensitivities

11.4: End Chapter

11.1: Introduction

Learn

- Food allergies
- Common foods associated with an allergic reaction
- The difference between food sensitivity, food allergy, and food intolerance

Watch this video about food allergies

YouTube Video

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[View this YouTube Video online](#)



A food allergy is an immunologically based abnormal reaction to a food. This can be an overreaction to the proteins found in a food item causing symptoms on the body. Food allergy symptoms usually develop within a few minutes to two hours after eating a food to which they are allergic. These symptoms can range from the annoying to the potentially fatal and include:

- Mouth tingling
- Swelling tongue and/or throat
- Difficulty breathing
- Hives
- Stomach cramps
- Diarrhea
- Vomiting
- Drop-in blood pressure
- Loss of consciousness
- Death

There are no clear treatments for food allergies. Epinephrine is sometimes used to control severe reactions, and individuals with known and dangerous allergies may get prescriptions for self-injectable devices. The only certain way to avoid allergic reactions to food is to avoid the foods that cause them. Educating yourself about what is in food means reading food labels carefully or even calling manufacturers for product information. These eight foods cause ninety percent of food allergies:

1. Milk
2. Eggs
3. Peanuts
4. Tree nuts
5. Fish
6. Shellfish
7. Wheat
8. Soy

It is important to understand and identify what foods contain the protein that causes an allergic reaction, so you can avoid consuming that food. Check out the website below to help identify food allergens.

<https://www.fda.gov>

The 8 Most Common Allergenic Foods:

Milk	Eggs	Peanuts	Tree nuts

Fish	Shellfish	Wheat	Soy

Watch this video about EpiPen use

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

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With a severe allergic reaction, someone may experience anaphylaxis, which is a life-threatening allergic reaction. An EpiPen may deliver epinephrine in an auto-injector to help ease a severe allergic reaction. If someone is wheezing after eating an allergen or has any cause for concern, it is best to administer the shot right away.

11.2: Food intolerance

Food intolerances refer to a reaction to food that has nothing to do with the immune system. For example, lactose intolerance occurs when a person doesn't make any or enough enzyme lactase to break down the milk's sugar lactose. The inability to break this sugar down causes gas, bloating, and diarrhea. It can be challenging to distinguish food intolerances from food sensitivities, anxiety, or other causes of symptoms. People with lactose intolerance can avoid symptoms by avoiding lactose. Knowing and identifying which products contain lactose requires reading labels and learning what is in the dairy category to avoid it!

Milk	Cheese	Yogurt

11.3: Food Sensitivities

Food sensitivities are reactions to food that do not cause an allergic reaction and are not an intolerance. Although symptoms can be uncomfortable, they do not cause life-threatening symptoms. There is more research needed to determine which conditions and symptoms may be related to food sensitivities.

11.4: End Chapter

Test your Knowledge:

Drag the words into the correct boxes

It may take up to _____ hours to show signs of a food allergy. There are _____ common foods that can cause a food allergy.

A food intolerance may be difficult to distinguish from a food _____. A food _____ may be life threatening, but a food intolerance may only cause some discomfort.

two

eight

allergy

sensitivity

Answer available at the end of this section.

Learning Objectives

- Define a food allergy. (MCCCD Competency 1)
- Explain how people can live with food allergies. (MCCCD Competency 4)
- List the eight common food allergens.(MCCCD Competency 1)
- Discuss the difference between food allergy, intolerance, and food sensitivity. (MCCCD Competency 4)

Answers

Test your Knowledge:

It may take up to **two** hours to show signs of a food allergy. There are **eight** common foods that can cause a food allergy.

A food intolerance may be difficult to distinguish from a food **sensitivity**. A food **allergy** may be life threatening, but a food intolerance may only cause some discomfort.

12: VITAMINS

12.1: Introduction

12.2: Water-Soluble Vitamins

12.3: Fat-Soluble Vitamins

12.4: Supplements

12.5: End Chapter

12.1: Introduction

Learn

- Discovery of vitamins
- Functions of water-soluble and fat-soluble vitamins
- Deficiency disorders associated with too much or too little intake of vitamins
- How supplements are approved for use
- Risks associated with taking supplements

Vitamins help your body carry out many functions. While your body can make some vitamins, others must come from the food you eat. There are two main categories for vitamins, water-soluble and fat-soluble. This chapter will explore each of the vitamins, how much you need, and the health implications of too much or too little.

Vitamin Overview

Watch this video for an introduction to vitamins.

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



Vitamins are organic compounds we need in large amounts to keep the body functioning.

True or False

Answer available at the end of this section.

Answers

False

12.2: Water-Soluble Vitamins

Water-soluble vitamins are ones that can dissolve in water. They are carried throughout the body into the tissues, but they are not stored in them. They get excreted when they are not needed, which means the body needs to get these more often to utilize them in the body. The water-soluble vitamins are made up of mainly vitamin C and the B complex vitamins.

Vitamin C

Vitamin C is also called ascorbic acid. Vitamin C functions to help with wound healing. It helps form collagen, an important protein in many body tissues. It also is known for aiding in the absorption of iron in the body. Vitamin C is very fragile, so it may be broken down or destroyed easily. Cooking (with high heat and for a long duration) and exposure to oxygen are two common instances where Vitamin C can be destroyed. Scurvy is the deficiency disease associated with vitamin C. Sailors who traveled on long voyages across the sea did not have access to fresh foods while on the water for an extended period of time. The sailors suffered from poor wound healing and bleeding gums, and in fact, many died. It was discovered that sailors who consumed citrus did were healthier and lived. Vitamin C is typically found in citrus, peppers, potatoes, papaya, kiwi, dark green, and yellow vegetables. The RDA for vitamin C is 75 mg for adult women and 90 mg for adult men.

Thiamine (B1)

Thiamine is essential in glucose metabolism. It acts as a cofactor for enzymes that break down glucose for energy production. Additionally, thiamine plays a role in the synthesis of ribose from glucose and is therefore required for RNA, DNA, and ATP synthesis. The brain and heart are most affected by a deficiency in thiamine. **Thiamine deficiency, also known as beriberi, can cause fatigue, confusion, movement impairment, pain in the lower extremities, swelling, and heart failure.** It is prevalent in societies whose main dietary staple is white rice. During the processing of white rice, the bran is removed, along with what were called in the early nineteenth century, “accessory factors,” vital for metabolism. Dutch physician Dr. Christiaan Eijkman cured chickens of beriberi by feeding them unpolished rice bran in 1897. The recommended intake for thiamine is 1.1 mg for females and 1.2 mg for males. Thiamine can be found in grains, wheat germ, pork, liver, salmon, black beans, and enriched foods.

Riboflavin (B2)

Riboflavin is an essential component of flavoproteins, coenzymes involved in many metabolic pathways of carbohydrate, lipid, and protein metabolism. Flavoproteins aid in the transfer of electrons in the electron transport chain. Furthermore, the functions of other B-vitamin coenzymes, such as vitamin B6 and folate, are dependent on the actions of flavoproteins. The “flavin” portion of riboflavin gives a bright yellow color to riboflavin, an attribute that helped lead to its discovery as a vitamin. Riboflavin deficiency, sometimes referred to as ariboflavinosis, is often accompanied by other dietary deficiencies (most notably protein) and can be common in people that suffer from alcoholism. Its signs and symptoms include dry, scaly skin, mouth inflammation and sores, sore throat, itchy eyes, and light sensitivity. The recommended intake is 1.1 mg for females and 1.3 mg for males. Riboflavin can be found in beef liver, kidneys, meat, milk, egg, green vegetables, and cheese.

Niacin (B3)

Niacin is a component of the coenzymes NADH and NADPH, which are involved in the breakdown and/or synthesis of carbohydrates, lipids, and proteins. NADH is the predominant electron carrier and transfers electrons to the electron-transport chain to make ATP. NADPH is also required for the anabolic pathways of fatty-acid and cholesterol synthesis. In contrast to other vitamins, niacin can be synthesized by humans from the amino acid tryptophan in an anabolic process requiring enzymes dependent on riboflavin, vitamin B6, and iron. Niacin is made from tryptophan only after tryptophan has met all of its other needs in the body. The contribution of tryptophan-derived niacin to niacin needs in the body varies widely, and a few scientific studies have demonstrated that diets high in tryptophan have minimal effect on niacin deficiency. Niacin deficiency is commonly known

as pellagra and is characterized by diarrhea, dermatitis, dementia, and sometimes death. The recommended intake for niacin is 14 mg for women and 16 mg for men daily. Niacin containing foods are peanuts, ready-to-eat cereals, chicken, rice, yeast, and milk.

Pantothenic Acid (B5)

Pantothenic acid forms coenzyme A, which is the main carrier of carbon molecules in a cell. Acetyl-CoA is the carbon carrier of glucose, fatty acids, and amino acids into the citric acid cycle. Coenzyme A is also involved in the synthesis of lipids, cholesterol, and acetylcholine (a neurotransmitter). Vitamin B5 deficiency is exceptionally rare. Signs and symptoms include fatigue, irritability, numbness, muscle pain, and cramps. You may have seen pantothenic acid on many ingredient lists for skin and hair care products; however, there is no good scientific evidence that pantothenic acid improves human skin or hair. The recommended intake for pantothenic acid is 5 mg a day for an adult. Foods containing vitamin B5 are meats, fish, dairy, poultry, grains, and legumes.

Pyroxidine (B6)

Pyroxidine is the coenzyme involved in nitrogen transfer between amino acids and plays a role in amino-acid synthesis and catabolism. Also, it functions to release glucose from glycogen in the catabolic pathway of glycogenolysis and is required by enzymes for the synthesis of multiple neurotransmitters and hemoglobin. A deficiency in vitamin B6 can cause signs and symptoms of muscle weakness, dermatitis, mouth sores, fatigue, and confusion.

Vitamin B6 is a required coenzyme for the synthesis of hemoglobin. A deficiency in vitamin B6 can cause anemia, but it is of a different type than that caused by insufficient folate, cobalamin, or iron, although the symptoms are similar. The size of red blood cells is normal or somewhat smaller, but the hemoglobin content is lower. This means each red blood cell has less capacity for carrying oxygen, resulting in muscle weakness, fatigue, and shortness of breath. The recommended intake for pyroxidine is 1.3 mg per day for an adult. Foods containing vitamin B6 are pork, liver, wheat, corn, yeast, ready-to-eat cereals, banana, sweet potatoes, and avocados.

Cobalamin (B12)

Cobalamin contains cobalt, making it the only vitamin that contains a metal ion. Cobalamin is an essential part of coenzymes. It is necessary for fat and protein catabolism, folate coenzyme function, and hemoglobin synthesis. A folate-dependent enzyme needs an enzyme requiring cobalamin to synthesize DNA. Thus, a cobalamin deficiency has similar consequences to health as folate deficiency. In children and adults, cobalamin deficiency causes macrocytic anemia, and in babies born to cobalamin-deficient mothers, there is an increased risk for neural tube defects. Cells in the stomach secrete a protein called intrinsic factor necessary for cobalamin absorption, which occurs in the small intestine. Impairment of secretion of this protein either caused by an autoimmune disease or by chronic inflammation of the stomach (such as that occurring in some people with *H.pylori* infection), can lead to the disease pernicious anemia, a type of macrocytic anemia. Vitamin B12 malabsorption is most common in the elderly, who may have impaired digestive organs, a normal consequence of aging. Pernicious anemia is treated by large oral doses of vitamin B12 or by putting the vitamin under the tongue, where it is absorbed into the bloodstream without passing through the intestine. In patients that do not respond to oral or sublingual treatment, vitamin B12 is given by injection. The recommended intake for cobalamin is 2.4 mcg per day for an adult. Foods containing vitamin B12 are animal foods like meat, eggs, and dairy.

Biotin

Biotin is required as a coenzyme in the citric acid cycle and lipid metabolism. It is also required as an enzyme in the synthesis of glucose and some nonessential amino acids. A specific enzyme, biotinidase, is required to release biotin from protein to be absorbed in the gut. Biotin deficiency is rare but can be caused by eating large amounts of egg whites over an extended period of time. This is because a protein in egg whites tightly binds to biotin, making it unavailable for absorption. A rare genetic disease-causing malfunction of the biotinidase enzyme also results in biotin deficiency. Symptoms of biotin deficiency are similar to those of other B vitamins but may also include hair loss when severe. The recommended intake of biotin is 30 mcg a day for adults. Foods that contain biotin are liver, kidney, egg yolk, and yeast.

Folate

Folate is a required coenzyme to synthesize the amino acid methionine and make RNA and DNA. Therefore, rapidly dividing cells are most affected by folate deficiency. Red blood cells, white blood cells, and platelets are continuously being synthesized in the bone marrow from dividing stem cells. A consequence of folate deficiency is macrocytic, also called megaloblastic anemia. Macrocytic and megaloblastic mean “big cell,” and anemia refers to fewer red blood cells or red blood cells containing less hemoglobin. Macrocytic anemia is characterized by larger and fewer red blood cells. It is caused by red blood cells being unable to produce DNA and RNA fast enough—cells grow but do not divide, making them large in size.

Folate is especially essential for the growth and specialization of cells of the central nervous system. Children whose mothers were folate-deficient during pregnancy have a higher risk of neural-tube congenital disabilities. Folate deficiency is causally linked to the development of spina bifida, a neural-tube defect that occurs when the spine does not completely enclose the spinal cord.

Spina bifida can lead to many physical and mental disabilities. Observational studies show that the prevalence of neural-tube defects was decreased after the fortification of enriched cereal grain products with folate in 1996 in the United States compared to before grain products were fortified with folate. Results of clinical trials have demonstrated that neural-tube defects are significantly decreased in the offspring of mothers who began taking folate supplements one month before becoming pregnant and throughout the pregnancy. The RDA for folate is 600 mcg per day for pregnant women and 400 mcg for an adult. Food sources for folate include fortified dry cereal, liver, kidney beans, green leafy vegetables, brussels sprouts, and broccoli.

Summary of the water-soluble vitamins

B Vitamin	Function	Deficiency: Signs and Symptoms
B1 (thiamine)	Coenzyme: assists in glucose metabolism, RNA, DNA, and ATP synthesis	Beriberi: fatigue, confusion, movement impairment, swelling, heart failure
B2 (riboflavin)	Coenzyme: assists in glucose, fat and carbohydrate metabolism, electron carrier, other B vitamins are dependent on	Ariboflavinosis: dry, scaly skin, mouth inflammation and sores, sore throat, itchy eyes, light sensitivity
B3 (niacin)	Coenzyme: assists in glucose, fat, and protein metabolism, electron carrier	Pellagra: diarrhea, dermatitis, dementia, death
B5 (pantothenic acid)	Coenzyme: assists in glucose, fat, and protein metabolism, cholesterol and neurotransmitter synthesis	Muscle numbness and pain, fatigue, irritability
B6 (pyroxidine)	Coenzyme; assists in amino-acid synthesis, glycogenolysis, neurotransmitter, and hemoglobin synthesis	Muscle weakness, dermatitis, mouth sores, fatigue, confusion
Biotin	Coenzyme; assists in glucose, fat, and protein metabolism, amino-acid synthesis	Muscle weakness, dermatitis, fatigue, hair loss
Folate	Coenzyme; amino acid synthesis, RNA, DNA, and red blood cell synthesis	Diarrhea, mouth sores, confusion, anemia, neural-tube defects
B12 (cobalamin)	Coenzyme; fat and protein catabolism, folate function, red-blood-cell synthesis	Muscle weakness, sore tongue, anemia, nerve damage, neural-tube defects

Lets Practice – Water Soluble Vitamins

Match the word in the correct statement.

- _____ deficiency can lead to spina bifida.
- Blood clots need _____ to form.
- _____ is bright yellow.

4. Eating too many egg whites can cause a _____ deficiency.
5. _____ forms coenzyme A.

Vitamin K

Pantothenic acid

Riboflavin

Biotin

Folate

Answer available at the end of this section.

Answers

Lets Practice – Water Soluble Vitamins

1. **Folate** deficiency can lead to spina bifida.
2. Blood clots need **Vitamin K** to form.
3. **Riboflavin** is bright yellow.
4. Eating too many egg whites can cause a **Biotin** deficiency.
5. **Pantothenic acid** forms coenzyme A.

12.3: Fat-Soluble Vitamins

Fat-soluble vitamins are ones that get dissolved in fat, also known as lipids. Unlike the water-soluble vitamins, these can be stored in the tissues to be used later. These do not need to be replenished in a healthy adult daily as the body can use what it stores. The fat-soluble vitamins include A, D, E, and K.

Vitamin A

Vitamin A has a wide variety of functions in the body. Some of the functions are to help with our skin, vision, reproduction, and immune function. Vitamin A helps to enable the epithelial tissue (the thin outer layer of the body and the lining that protects your organs) and bone cells to form. Vitamin A is stored in the liver and adipose tissue of the body. Signs of deficiency of vitamin A typically relate to eye problems. One concern is nyctalopia, also known as night blindness. Other deficiencies are Xerophthalmia, dryness of the eye, and Bitott's spots, keratinization of the eye's conjunctiva. It is recommended to get 700 mcg for women and 900 mcg for vitamin A for men to avoid any concerns. Foods that contain vitamin A are orange vegetables like carrots and bell peppers. Kale, spinach, fish, and chicken.

Vitamin D

Children with ricketsVitamin D is an important vitamin for our bones. Our body has the ability to turn UV light from the sun into vitamin D₃ to be used in the body. The darker the skin tone, the less vitamin D is absorbed due to melanin's surface level in darker skin tones. Bodies need vitamin D to absorb calcium and to build and maintain bone health. If someone is deficient in vitamin D, they are at risk for osteoporosis (low bone mass) or get rickets in children. Rickets is when the bones do not mineralize correctly. We can get vitamin D in our body through sunlight, fortified milk, salmon, or egg yolks. Recommendations for vitamin D is 15 mcg for adults.

Vitamin E

Vitamin E is an important antioxidant for the body. This vitamin helps to protect the cells from free radicals that are found in the body. The free radicals are produced from our bodies, converting food into energy. Vitamin E also helps to keep the skin moisturized and healthy. Hemolytic anemia may occur in deficient populations. Sources of vitamin E include sunflower seeds, almonds, peanuts, spinach, kiwis, and tomatoes. The recommended intake is 15 mg per day. This is not a very toxic vitamin, and the UI is 1,000 mg.

Vitamin K

Vitamin K is required for optimal bone metabolism and critical for blood function. It is a coenzyme for enzymes involved in blood clotting. Blood-clotting proteins are continuously circulating in the blood. Upon injury to a blood vessel, platelets stick to the wound forming a plug. The clotting factors circulating close by respond in a series of protein-protein interactions resulting in the fibrous protein's formation, fibrin, which reinforces the platelet plug. There is no RDA or UI for vitamin K; however, adult males need about 120 mcg per day, and adult females, 90 mcg per day.

A deficiency in vitamin K causes bleeding disorders. It is relatively rare, but people who have liver or pancreatic disease, celiac disease, or malabsorption conditions are at higher risk for vitamin K deficiency. Signs and symptoms include nosebleeds, easy bruising, broken blood vessels, bleeding gums, and heavy menstrual bleeding in women. The function of the anticoagulant drug warfarin is impaired by excess vitamin K intake from supplements. Calcium additionally plays a role in the activation of blood-clotting proteins.

How Did The Vitamins Get Their Name?

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Exercise

Please answer the true or false questions.

1. Vitamin E is a water-soluble vitamin. True or False
2. Vitamin D can be made in the body using the UV from the sun. True or False
3. Vitamin A is essential for making blood clots. True or False
4. Fat-soluble vitamins do not get stored in the body. True or False

Answer available at the end of this section.

Answers

Exercise

1. Vitamin E is a water-soluble vitamin. False
2. Vitamin D can be made in the body using the UV from the sun. True
3. Vitamin A is essential for making blood clots. False
4. Fat-soluble vitamins do not get stored in the body. False

12.4: Supplements

These are the most common supplements, according to the FDA:

- Calcium
- Echinacea
- Fish Oil
- Ginseng
- Glucosamine and/or
- Chondroitin Sulphate
- Garlic
- Vitamin D
- St. John's Wort
- Saw Palmetto
- Ginkgo
- Green Tea

How are they approved?

Supplements are widely available in the United States. In 1994 the Dietary Supplement Health and Education Act (DSHEA) was approved and defined the term “dietary supplement” to mean a product (other than tobacco) intended to supplement the diet that bears or contains one or more dietary ingredients, including a vitamin, a mineral, an herb or other botanical, an amino acid, a dietary substance for use by man to supplement the diet by increasing the total dietary intake, or a concentrate, metabolite, constituent, extract or combination of any of the aforementioned ingredients. The FDA regulates and approves supplements that are sold to the general public. FDA regulates dietary supplements under a different set of regulations than those covering “conventional” foods and drug products. Dietary supplements are marketed as tablets, capsules, soft gels, gelcaps, powders, and liquids. The FDA only looks at the vitamin's safety if it contains a new ingredient, not for the effectiveness, so the manufacturer needs to test its effectiveness.

For more information about vitamins, visit www.fda.gov/food/buy-store-serve-safe-food/what-you-need-know-about-dietary-supplements.

What are the risks?

There can be many risks to taking vitamins, as it does contain active ingredients. Some of the common risks include:

- Combining supplements
 - Using supplements with medicines (whether prescription or over-the-counter)
 - Substituting supplements for prescription medicines
 - Taking too much of some supplements, such as vitamin A, vitamin D, or iron
- Some supplements can also have unwanted effects *before, during, and after* surgery. So, be sure to inform your healthcare provider, including your pharmacist, about any supplements you are taking.

How to protect yourself

If supplements are needed, it is best to speak with a doctor before purchasing the supplement to ensure no consumption concerns. When buying supplements online, it is best to buy off a noncommercial website as some sellers online may have a misleading website or have misleading labels. Be aware of claims that a supplement may work better than a prescription drug or that it has no side effects. Always keep in mind that advertising on supplement labels is not regulated.

12.5: End Chapter

Learning Objectives

- Explain the history of vitamins. (MCCCD Competency 1)
- Explain the functions of water-soluble and fat-soluble vitamins. (MCCCD Competency 5)
- Summarize deficiency disorders associated with too much or too little intake of vitamins. (MCCCD Competency 5)
- Discuss how supplements are approved for use. (MCCCD Competencies 1 & 2)
- Identify risks associated with taking a supplement. (MCCCD Competency 6)

13: ANTIOXIDANTS AND PHYTOCHEMICALS

13.1: Introduction

13.2: Antioxidants

13.3: Phytochemicals

13.4: End Chapter

13.1: Introduction

Learn

- Antioxidants
- How antioxidants help support health and prevent disease
- Phytochemicals in foods
- Free radicals

13.2: Antioxidants

The market is flooded with advertisements for “super antioxidant” supplements teeming with molecules that block free radical production, stimulate the immune system, prevent cancer, and reduce aging signs. Based on the antioxidant-supplement industry’s success, the general public appears to believe these health claims. However, these claims are not backed by scientific evidence; rather, some evidence suggests that supplements can actually cause harm. While scientists have found evidence supporting the consumption of antioxidant-rich foods as a method of reducing the risk of chronic disease, there is no “miracle cure”; no pill or supplement alone can provide the same benefits as a healthy diet. Remember, it is the combination of antioxidants and other nutrients in healthy foods that is beneficial. This section will review how particular antioxidants function in the body, learn how they work together to protect the body against free radicals, and explore the best nutrient-rich dietary sources of antioxidants. One dietary source of antioxidants is vitamins, some of which also function as antioxidants.

Antioxidants & Free Radicals

Watch this video to gain a better understanding of how free radicals harm the body.

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Antioxidants and Their Function in the Body

Vitamin A	Protects cellular membranes, prevents glutathione depletion, maintains free radical detoxifying enzyme systems, reduces inflammation
Vitamin E	Protects cellular membranes, prevents glutathione depletion.
Vitamin C	Protects DNA, RNA, proteins, and lipids, aids in regenerating vitamin E
Carotenoids	Free radical scavengers
Lipoic acid	Free radical scavenger aids in regeneration of vitamins C and E

Phenolic acids	Free radical scavengers protect cellular membranes.
Selenium	Cofactor of free radical detoxifying enzymes, maintains glutathione levels, aids in regeneration of vitamins C & E.
Zinc	Protects cellular membranes and decreases oxidative damage

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13.3: Phytochemicals

Phytochemicals are chemicals in plants that may provide some health benefits. They are not considered nutrients as they are not required to sustain life; however, consuming foods with phytochemicals on a regular basis has been linked to reducing risk for cardiovascular disease, diabetes, and cancer, as well as age-related physical and mental decline. Carotenoids are one type of phytochemical. Phytochemicals also include indoles, lignans, phytoestrogens, stanols, saponins, terpenes, flavonoids, carotenoids, anthocyanidins, phenolic acids, and many more. Phytochemicals are found in fruits, vegetables, grains, seeds, nuts, and legumes; and they are what give plants their color.

- Carotenoids are found in foods that are red, orange, and deep green.
- Flavonoids are found in berries, black and green tea, purple grapes, and chocolate.
- Phenolic acids are found in coffee beans and fruits.
- Phytoestrogens are found in soy products.
- Indoles are found in garlic, leeks, and onions.

Phytochemicals are present in small amounts in the food supply, and although thousands have been and are currently being scientifically studied, their health benefits remain largely unknown. Also largely unknown is their potential for toxicity, which could be substantial if taken in large amounts in the form of supplements. Moreover, phytochemicals often act in conjunction with each other and with micronutrients. Thus, supplementing with only a few may impair the functions of other phytochemicals or micronutrients. The antioxidant vitamins are the mixture and variety of phytochemicals in foods linked to health benefits. Many phytochemicals act as antioxidants, but they have several other functions, such as mimicking hormones, altering cholesterol absorption, inhibiting inflammatory responses, and blocking certain enzymes' actions.

13.4: End Chapter

Learning Objectives

- Identify vitamins that serve as antioxidants. (MCCCD Competency 1)
- Explain the function of antioxidants in disease prevention. (MCCCD Competency 6)
- Identify which foods contain phytochemicals. (MCCCD Competency 6)
- Explain how free radicals attack your body and how to prevent damage. (MCCCD Competency 1)

14: MINERALS

14.1: Introduction

14.2: Mineral Classification

14.3: End Chapter

14.1: Introduction

Learn

- Minerals
- Food sources of major and trace minerals
- How minerals impact bone and blood health
- Mineral deficiencies
- Foods that increase or decrease absorption

Minerals make up about 4% of your total body weight; however, they have many functions and play an important role in your body. Minerals serve as structural components of bones and teeth, as enzyme cofactors, assist with nerve impulses, and help support the immune and circulatory system. In this chapter, we'll take a look at how your body uses minerals to support good health.

14.2: Mineral Classification

Minerals are inorganic elements that come from the earth (water, soil, plants). They are classified based on the amounts needed for human metabolism. Those that are needed in large amounts are called major (also called macro). Major minerals are also found in larger amounts in the body and are required by adults in amounts greater than 100 mg per day. On the other hand, trace (also called micro) are needed in smaller amounts and are sometimes further divided into an ultratrace. Adults require trace minerals in amounts of about 1-100 mg per day, and ultratrace elements are required by adults in amounts less than 1 mg per day. It is important to note that the quantities needed are irrelevant to a mineral's importance as both macro and trace are necessary for optimal metabolic function.

Mineral Type	Examples	Intake Requirements
Essential Major/Macro Minerals	Calcium, phosphorus, magnesium, sodium, potassium, chloride	>100 mg/d
Essential Trace Minerals	Iron, zinc, copper, molybdenum	<100 mg/d
Essential Ultratrace Minerals	Selenium, iodine, molybdenum, chromium	<1 mg/d
Nonessential trace and ultratrace	Fluoride, arsenic, boron, nickel, silicon, vanadium, cobalt	<1 mg/d

Calcium

Calcium plays a vital role in the body. About 99% of it is stored in bone tissue. The most well-known calcium function is to build and strengthen bones and teeth. Calcium plays several vital roles in the body, including bone (skeleton) mineralization, muscle contraction, and blood clot formation. Calcium is also needed to help secrete hormones and enzymes and to send messages through the nervous system. Blood calcium levels are controlled very carefully so that if blood levels drop, the body will rapidly respond by stimulating bone resorption and releasing stored calcium into the blood. Different hormones regulate calcium levels; parathyroid hormone and calcitriol work together to increase calcium levels in the blood, while calcitonin does the opposite and decreases blood calcium levels. Low calcium levels can lead to osteoporosis and bone fractures. The body needs about 1000-1200 mg of calcium a day to maintain levels. Sources of calcium include dairy products, leafy vegetables, legumes, sardines, and fortified orange juice. Certain factors can impact calcium absorption. For example, vitamin D improves calcium absorption. Other components in foods such as phytic acid and oxalic acid (found in spinach, collard greens, and beans) can inhibit its absorption. For people who eat a variety of foods, these factors have little effect on nutritional status.

An Overview of Bone

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Phosphorus

Phosphorus is the second most abundant mineral in the human body. About 85% of it is housed in the skeleton. In addition to serving as a primary mineral in the skeleton, phosphorus in the form of phosphate is a component of the backbones of RNA

and DNA, the cellular energy-storing molecule, adenosine triphosphate (ATP), and phospholipids. Phosphorus deficiency is rare. Phosphorus can be found in foods (organic phosphorus) and is naturally found in protein-rich foods such as meats, poultry, fish, nuts, beans, and dairy. Phosphorus that has been added to food in the form of an additive or preservative (inorganic phosphorus) is found in foods such as fast foods, canned and bottled drinks, ready to eat foods and most processed foods. The absorption of phosphorus varies by dietary source; food additives are more readily absorbed. The recommended intake of phosphorus is 700 mg per day. The UL set for phosphorous is 4,000 milligrams per day for adults and 3,000 milligrams per day for people over age seventy.

True or False: Phosphorus is widely available in the food system.

True or False

Answer available at the end of this section.

Magnesium

Approximately 60% of magnesium in the human body is stored in the skeleton, making up about 1% of mineralized bone tissue. Magnesium is involved in many body functions, including bone mineralization, enzymatic reactions, platelet activity, and calcium regulation. A magnesium-deficient diet is associated with decreased parathyroid hormone levels and vitamin D activation, leading to bone remodeling damage. Magnesium is found in most foods. Foods high in magnesium include nuts, seeds, and wholegrain cereals. Food processing, such as refining whole wheat, substantially reduces its magnesium content (by over 75%). Leafy green vegetables also provide a significant magnesium amount; the chlorophyll is found in the vegetables containing magnesium. Legumes, lentils, spices, seafood, and dairy products also contribute to dietary magnesium. The recommended intake for magnesium is 420 mg per day for an adult male and 320 mg per day for an adult female.

SUMMARY OF MAJOR MINERALS

Mineral	Functions	Deficiency symptoms	Selected food sources	RDA
Calcium	Component of bones and teeth; role in cellular processes, muscle contractions, blood clotting, enzyme activation, other	Rickets, osteoporosis, tetany	Dairy products, canned sardines, clams, oysters, turnip and mustard, greens, broccoli, legumes	19-50 years 1,000 mg
Phosphorus	Component of bone, muscle contractions, ATP-ADP phosphate transfer, nerve signaling, pH regulation	Neuromuscular, skeletal, hematologic, and cardiac manifestations; rickets, osteomalacia	Meat poultry, fish, eggs, dairy products, nuts, legumes	19 + years 700 mg
Magnesium	Component of bones, nerve impulse transmission, enzymatic reactions, ATP use, calcium regulation, ion transfer, other	Neuromuscular hyperexcitability, cardiovascular effects, central nervous system effects	Nuts, legumes, whole-grain cereals, leafy green vegetables	19- 30 years 420 mg males 320 mg females

Sulfur

Sulfur is a major mineral, but it does not function independently in the body as a nutrient. Sulfur is found in the body as part of

the structures of vitamins (biotin and thiamin) and sulfur-containing amino acids (methionine, taurine, and cysteine) lipoic acid, among other compounds. Due to its presence in amino acids, sulfur is commonly found in protein-containing foods and body proteins, especially in nails, skin, and hair. There is no recommended intake or deficiencies for sulfur when protein needs are met. Sources of sulfur include animal proteins like meat, eggs, and dairy.

Essential Trace and ultratrace Minerals

Iron

Iron provides many functions in your body. Hemoglobin is a protein that carries oxygen from the lungs throughout the body. It is also part of myoglobin, a protein that provides oxygen to the muscles. Iron is also needed to make some hormones. Over 65% of body iron is found in hemoglobin, up to 10% is found as myoglobin, about 1-5% is found as part of enzymes, and the remaining body iron is found in the blood and storage. Iron is found in foods in two forms: heme and nonheme. Heme iron comes from hemoglobin and myoglobin and is found in animal products, such as meat, poultry, and fish. Nonheme iron is the main form of iron in plant foods, especially whole grains, nuts, legumes, lentils and peas, fruits and vegetables, and tofu. Iron from plant sources is absorbed better when eaten with foods such as meat, poultry, seafood, and foods that contain vitamin C, such as citrus fruits, strawberries, sweet peppers, tomatoes, and broccoli. Factors that inhibit iron absorption include polyphenols (tannins in tea or coffee), oxalates, phytates, and other minerals. The recommended daily intake for iron is 8 mg per day for males and 18 mg per day.

Match the source with the correct type of iron by dragging the words to the correct boxes

_____ animal sources

_____ plant sources

Answer available at the end of this section.

Watch the Video to Learn About Anemia

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Zinc

Zinc is found in all organs, tissues (especially muscle and bone), and body fluids cells

throughout the body. It helps the immune system fight off invading bacteria and viruses. Zinc is also needed to make proteins and DNA. It also helps with wound healing and is important for proper senses of taste and smell. Great sources of zinc are red meats (especially organ meats) and seafood, such as oysters. Other relatively good animal sources of zinc include poultry, pork, and dairy products. Animal products are thought to provide 40-70% of zinc consumed by most people in the United States. Whole grains and legumes also provide moderate amounts of zinc. Fortified cereals are thought to provide about 30% of the zinc in the U.S. diet. Fruits contain little amounts of zinc. Zinc from plants is absorbed less than that from animal sources like meat. The recommended daily intake is 11 mg for males and 8 mg for females.

Despite their copper color, pennies are actually 98% zinc.

penny

Copper

Copper is found in all body tissues and most secretions. The distribution of copper in the body can be categorized as 40% in bone, 24% in muscle, 9% in the liver, and 6% in the brain. Copper carries out various functions, including healthy nerves, bones, collagen, and skin pigment expression. It also aids in iron absorption. Copper, like iron, assists in red blood cell formation. The richest sources of copper are meats (especially organ meats) and shellfish. Plant food sources rich in copper include nuts, seeds, legumes, and dried fruits. Potatoes, whole grains, and cocoa (chocolate) are also good sources of the mineral. The daily recommended amount for copper is 900 mcg per day.

Selenium

Selenium is important for reproduction, thyroid gland function, DNA production, and protecting the body from damage caused by free radicals and infection. Generally, the richest sources of selenium are seafood, muscle meats, and plants. Organic forms of selenium are found in animal-based foods, mainly as selenocysteine, and in plant foods, mainly as selenomethionine. Inorganic forms of selenium are found in vegetables (e.g., beets and cabbage) and in livestock that has been supplemented with inorganic selenium. Selenium varies greatly in soil, and as a result, the content of foods grown on these soils is also variable. The recommended amount for selenium is 55 mcg per day.

Chromium

Chromium is a metal that is present in the air, soil, and water. It exists in several oxidation states from Cr^{2-} to Cr^{6+} . However, the most stable oxidation state is the trivalent form, Cr^{3+} , which is the most important in humans. Chromium is thought to enhance the action of insulin; however, it is still unclear. Many studies continue to explore the effectiveness of chromium supplements on improvements in glucose control measures in individuals with type 2 diabetes. Good dietary sources of chromium are generally thought to include meats and whole grains, along with vegetables and fruits. However, few foods have been analyzed to quantify chromium content accurately. The adequate intake amount for chromium is 35 mcg per day for males and 25 mcg per day for females. Most adults in the United States consume about 23-54 mcg of chromium a day.

Iodine

A woman suffering from goiter

Iodine plays an important role in the synthesis of thyroid hormones within the thyroid gland. These hormones control the body's metabolism and many other important functions. The body also needs thyroid hormones for proper bone and brain development

during pregnancy and infancy. Iodine content in foods is highly variable and depends greatly on soil concentrations. Seafood, meats, dairy, and eggs are all good sources of iodine. The recommended amount for iodine is 150 mcg per day. Goiter, an enlarged thyroid gland, is often the first visible sign of iodine deficiency.

Fun Fact

In 1924, the United States began iodizing salt to help prevent goiter and improve intake in regions where soil composition was low.

SUMMARY OF ESSENTIAL TRACE MINERALS

Mineral	Selected roles	Deficiency symptoms	Food sources	RDA or AI*(adults)
Chromium	Possibly enhances the action of insulin	Glucose intolerance, glucose and lipid metabolism abnormalities	Meats, grain products, fruits, vegetables, Brewer's yeast	35 mcg* for males; 25 mcg* for females
Copper	Iron absorption; synthesis of red blood cells; supports the immune system, blood vessels, nerves, and bone health	Anemia, neutropenia, bone and blood vessel abnormalities, impaired immune function	Liver, shellfish, nuts, seeds, legumes, meat, fish	900 mcg
Iodine	Thyroid hormone synthesis	Enlarged thyroid gland (goiter)	Iodized salt, salt-water seafood, dairy products, liver, eggs, legumes	150 mcg
Iron	O ₂ transport and use; amino acid metabolism; antioxidant; carnitine, collagen, and thyroid hormone synthesis	Anemia, fatigue, impaired work performance, decreased resistance to infection	Organ meats (liver), meat, clams, oysters, nuts, legumes, green leafy vegetables, dried fruits, enriched/whole grains	8 mg for males; 18 mg for females.
Selenium	Protection against free radicals, thyroid hormone function, and DNA production	Myalgia, cardiac myopathy, poor growth	Oysters, tuna, meat, poultry, fish, cereals, Brazil nuts	55 mcg
Zinc	Helps the immune system, protein and DNA formation wound healing	Poor wound healing, slow growth, hair loss, loss of appetite	Oysters, meat, liver, poultry, whole grains, legumes	11 mg for males; 8 mg for females

*Indicates Adequate intake values

Fluoride

Fluoride is known as the mineral that combats tooth decay. It assists in tooth and bone development and maintenance. Fluoride combats tooth decay by three different mechanisms: blocking acid formation by bacteria, preventing demineralization of teeth, and enhancing the remineralization of destroyed enamel. Solid foods do not contain a large amount of fluoride. The fluoride content in foods depends on whether it was grown in soils and water that contained fluoride or cooked with fluoridated water. More than 70% of a person's fluoride comes from drinking fluoridated water. Even though they should not be consumed, most toothpaste and mouthwashes contain fluoride that can slightly add to the daily fluoride intake. Most people in the United States get enough fluoride from what they eat and drink and ant dental products they use.

Answers

True

Heme iron animal sources

Non-heme iron plant sources

14.3: End Chapter

Learning Objectives

- Identify and explain the function of minerals in your body. (MCCCD Competency 1)
- Identify foods that contain minerals. (MCCCD Competency 5)
- Discuss the role of minerals in supporting bone and blood health. (MCCCD Competency 5)
- Identify foods that help increase or decrease iron absorption. (MCCCD Competency 5)
- Discuss mineral deficiencies. (MCCCD Competency 1)

15: WATER AND ELECTROLYTES

15.1: Introduction

15.2: Water and Electrolytes

15.3: Functions of Water in the Body

15.4: Importance of Electrolyte Balance in the Body

15.5: Consequences of getting too much or too little water and electrolytes

15.6: Water Consumption

15.7: Alcohol Consumption; Metabolism, Health Benefits and Health Risks

15.8: End Chapter

15.1: Introduction

Learn

- Electrolytes
- Foods sources of electrolytes
- How your body maintains fluid balance
- Health consequences of disrupting your water and electrolyte balance
- How your body processes alcoholic beverages
- Alcoholic liver disease

15.2: Water and Electrolytes

Water makes up about 60% of an adult's total body weight. It plays a key role in many body functions such as chemical reactions, body temperature control, blood volume maintenance, lubrication, and protection. Water also serves as a solvent and transport medium. Electrolytes are what help distribute and move water throughout the body. Electrolytes are minerals in your body with an electric charge, such as sodium, chloride, potassium, calcium, phosphate, and magnesium. This chapter will review water and electrolytes' functions, the importance of fluid balance, and the consequences of disrupting the fluid balance.

What would happen if you didn't drink water?

YouTube Video

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



15.3: Functions of Water in the Body

Water is the most critical of all the nutrients, as its absence proves lethal within a few days. Water is used throughout the body and can be categorized into four basic functions:

1. Transportation

Water is called the “universal solvent” because more substances dissolve in it than any other fluid. Molecules dissolve in water because of the hydrogen and oxygen molecules’ ability to loosely bond with other molecules. The solvent action of water allows for substances to be more readily transported. Examples of body fluids containing these solutes include blood, urine, saliva, bile, and pancreatic juice.

2. Chemical Reactions

Water is required for even the most basic chemical reactions. Water is an ideal medium for chemical reactions as it can store a large amount of heat, is electrically neutral, and has a pH of 7.0, meaning it is not acidic or basic. Additionally, water is involved in many reactions as an agent to break bonds or to form bonds.

3. Lubrication & Shock Absorption

Water is the main component of the lubricating fluid between joints and eases the movement of bones. The fluid in the eyeball, around the brain, and in the spinal cord is primarily water and buffers these organs against sudden environmental changes. Watery fluids surrounding organs provide both chemical and mechanical

Embryo at approximately 8-10 weeks

protection. Just two weeks after fertilization, water fills the amniotic sac in a pregnant woman providing a cushion of protection for the developing embryo.

Additionally, nasal mucus, also commonly referred to as snot, is also a front-line defense against injury and foreign invaders. It is composed of more than 90% water and helps discharge nasal irritants, lubricate cells in the lungs to enable you to breathe, transports nutrients along the gastrointestinal tract, and aids in eliminating waste materials through the rectum.

4. Temperature Regulation

Human life is supported within a narrow range of temperatures. The temperature set point of the body is 98.6°F (37°C). Too low or too high of a temperature causes enzymes and metabolism to halt. Too cold and the muscles fail, and hypothermia sets in. At the opposite extreme, if it’s too hot, the central nervous system fails, and death results. The body has multiple ways to move body water around, distribute or share heat and **equalize body temperature**. Also, water is good at storing heat, which means that it helps the body maintain temperature despite changes in the surrounding environment; this is how you can stay warm during a snowstorm and cool during hot Arizona summers. Additionally, other methods regulate heat, such as sweating, which releases heat, or shivering, which helps your body generate heat.

Heat Safety in Extreme Climates – Arizona

<https://www.azdhs.gov/preparedness/e....php#heat-hom>

15.4: Importance of Electrolyte Balance in the Body

While water makes up the largest percentage of body volume, it is not pure water. Instead, it is a mix of water and cells, proteins, glucose, electrolytes, and other substances. How water moves around within the body is regulated by moving electrolytes in and out of cells. The key electrolytes in the body are sodium, chloride, and potassium.

SODIUM

Sodium is the primary regulator of water balance and plays an important role in nerve transmission, muscle contraction, nutrient absorption, and reabsorption. The kidneys control how much sodium is in the body. When there is too much sodium present in the body, the kidneys have difficulty getting rid of it, which causes it to build up in the blood. This can lead to high blood pressure and other health problems. The American diet's major sodium source is salt, which is made up of sodium chloride, and processed foods are high in sodium. This includes fast and processed foods like pizza, chips, and condiments. The sodium present in foods such as milk, meat, eggs, and most vegetables only makes up about 10% of consumed sodium. The Dietary Guidelines recommend consuming less than 2,300 mg of sodium per day. For reference, **one teaspoon of salt provides 2,300 mg of sodium. Most people exceed this recommendation by approximately 3,400 mg each day.**

Get the scoop on salt!

www.cdc.gov/salt/pdfs/sodium...guidelines.pdf

CHLORIDE

Chloride aids in fluid balance by helping to maintain neutrality. Chloride also plays a role in controlling fluid releases, such as the flow of pancreatic juice into the small intestine and mucus. Food sources of chloride include tomatoes, lettuce, celery, and olives. Chloride is also found in table salt, sea salt as sodium chloride, and a salt substitute known as potassium chloride. The recommendation for chloride is less than 2300 mg a day.

POTASSIUM

Potassium is the most abundant positively charged ion inside of cells. It is present in all body tissues and is required for normal cell function due to its role in maintaining fluid balance. It is important for many body functions, including kidney and heart function, muscle contraction, and nerve transmission. Potassium is abundant in fruits and vegetables, which are great food sources. Foods exceptionally rich in potassium include potatoes, tomatoes, avocados, bananas, orange juice, and vegetables such as root and leafy green vegetables. It is mainly added as a part of a salt substitute. The average recommended daily amount is 3,400 mg for males and 2,600 mg for women.

Moving water around inside your body is managed by electrolyte balance. It would help if you had both fluid and electrolyte balance to have water available and do the work it needs to do.

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15.5: Consequences of getting too much or too little water and electrolytes

As with all nutrients, having too much or too little water has health consequences. Overhydration is excessive water intake, not a common situation, which can dilute electrolytes' blood levels. Electrolytes are critical to the body's functioning; the body can become impaired and lead to death.

Dehydration is having too little water in the body and is quite common. The number-one cause of early-childhood death worldwide is diarrhea-induced dehydration. Chronic dehydration is linked to higher incidences of some diseases. There is strong evidence that dehydration increases the risk of kidney stones and exercise-induced asthma. Additionally, dehydration is the primary cause of heatstroke. Heatstroke is when the body gets so hot that the body's cooling systems cannot correct the situation. Signs and symptoms are dry skin, dizziness, trouble breathing, rapid pulse, confusion, agitation, seizures, coma, and possibly death.

High blood pressure, also called hypertension, is common in chronically dehydrated people. When the body's cells lack water, the brain sends a signal that causes blood vessels' tightening. This increases the force of blood flowing through the blood vessels. When your blood pressure stays high over time, it causes the heart to pump harder, possibly leading to serious health problems.

Hypertension

YouTube Video

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One effective measure to decrease blood pressure is to reduce sodium intake. One good way to lower your sodium intake is by following the DASH diet. DASH stands for Dietary Approaches to Stop Hypertension and suggests ways to avoid excess salt in the diet, such as reducing the number of prepared foods that you eat. The DASH diet is based on eating meals rich in fruits and vegetables and low-fat or non-fat dairy, with whole grains. It is a high fiber, low to moderate fat diet, rich in potassium, calcium, and magnesium. The DASH diet is a healthy plan designed for the whole family.

www.nhlbi.nih.gov/health-topics/dash-eating-plan

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15.6: Water Consumption

In 1974, the US federal government enacted The Safe Drinking Water Act to help provide the American public with safe drinking water. In the decades immediately following the implementation of water chlorination and disinfection methods, water-borne illnesses, such as cholera and typhoid fever, essentially disappeared in the United States. The treatment of drinking water is touted as one of the top public-health achievements of the last century. If you have questions about your tap water safety, visit the municipality's website in which you live. They are required by law to provide this information to the public. For most of America, tap water is safe to drink. Still, occasionally problems occur, such as the case in Flynt, Michigan, where there were unsafe levels of lead present in tap water due to inappropriate choices made by the city government officials.

Flint Water Crisis

www.nrdc.org/stories/flint-w...-you-need-know

Is Phoenix's tap water safe?

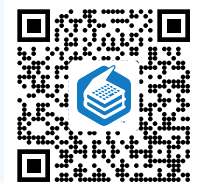
<https://www.phoenix.gov/water-services/envservices/drinking-water/faqs#:~:text=Is%20Phoenix's%20tap%20water%20safe,water%20treatment%20and%20distribution%20systems>

Water is usually the best choice before, during, and after physical activity. However, some individuals may benefit from a sports drink if they sweated a lot during intense or long-term activity. An example of this can be a runner or cyclist in a long-distance event. Sports drinks help replace water and electrolytes lost through sweat. It is important to keep in mind that sports drinks may contain sugars and have little nutritional value.

Watch the video about the creation of the first sports drink

This interactive element is not available in this format. Visit the link or scan the QR code to access it online.

[View this YouTube Video online](#)



15.7: Alcohol Consumption; Metabolism, Health Benefits and Health Risks

Alcohol is both a beverage providing some sustenance and a drug. For thousands of years, humans have created and consumed alcohol. It is consumed in just about every country and often in excess. Alcohol is a psychoactive drug. A psychoactive drug is any substance that crosses the blood-brain barrier, primarily affecting the functioning of the brain, be it altering mood, thinking, memory, motor control, or behavior.

The US Dietary Guidelines define moderate alcohol intake as no more than one drink per day for women and no more than two drinks per day. A standard drink is equivalent to 12 ounces of beer, 5 ounces of red or white wine, or 1.5 ounces of distilled spirits. The recommendation is lower for women because women absorb and metabolize alcohol differently than men. Research has discovered that women produce smaller quantities of an enzyme called alcohol dehydrogenase (ADH), which is released in the liver and breaks down alcohol. Women also tend to have naturally higher body fat levels, and fat is known to retain alcohol, so its effects last longer in the body.

Calculate a blood alcohol content

- Visit this site www.alcohol.org/bac-calculator/
- Calculate the correct number of hours.

Use the blood alcohol website to calculate how many hours it will take for a Female, weighing 150 pounds, who consumes **two**, 1.5 ounces servings of liquor in 30 minutes. It will take her _____ hours to reach a 0% BAC.

Answer available at the end of this section.

The liver metabolizes alcohol. The liver can only metabolize approximately one drink an hour. If you drink more than that, the alcohol stays in your bloodstream instead of being filtered out and is in your breath, sweat, and saliva, which is why a breathalyzer test is effective for detecting alcohol.

If you consistently drink more alcohol than your liver can metabolize, your liver will suffer damage, which results in scarring. New cells divide and create clusters around the scars, but the liver becomes less able to filter as it develops more scars. Alcoholic liver disease occurs after years of heavy drinking. Men are more likely to have this problem. However, women may develop this disease after less exposure to alcohol than men. Over time, cirrhosis can occur, which is the final phase of alcoholic liver disease, and it is not reversible.

Cirrhosis Overview

YouTube Video

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[View this YouTube Video online](#)



Answers

Calculate a blood alcohol content

5

15.8: End Chapter

Learning Objectives

- Identify and discuss the function of electrolytes. (MCCCD Competency 5)
- Identify foods that contain electrolytes.(MCCCD Competency 5)
- Explain how your body maintains fluid balance. (MCCCD Competency 7)
- Discuss the health consequences of disrupting your water and electrolyte balance. (MCCCD Competency 7)
- Discuss the metabolism of alcohol, the health benefits, and the consequences of consuming alcohol. (MCCCD Competency 5)

16: NUTRITION IN THE LIFECYCLE – CONCEPTION TO PREGNANCY

- 16.1: Introduction
- 16.2: The Early Days of Pregnancy
- 16.3: Weight Gain during Pregnancy
- 16.4: Weight Loss after Pregnancy
- 16.5: Nutritional Requirements
- 16.6: Energy and Macronutrients
- 16.7: Fluids
- 16.8: Vitamins and Minerals
- 16.9: Guide to Eating during Pregnancy
- 16.10: Foods to Avoid
- 16.11: Foodborne Illness
- 16.12: Food Cravings and Aversions
- 16.13: Physical Activity during Pregnancy
- 16.14: Complications during Pregnancy
- 16.15: End Chapter

16.1: Introduction

Learn

- Essential nutrients required before conception
- Optimal weight gain during pregnancy
- Nutrients needs during pregnancy
- Foods & beverages to avoid when pregnant
- Fetal Alcohol Syndrome
- Gestational Diabetes

This chapter will examine how a nutritious diet is essential for the mother and father before conception. We will learn the impact on the mother and child's health based on the mother's weight gain during pregnancy.

16.2: The Early Days of Pregnancy

Pregnancy is measured from the first day of a woman's last menstrual period until childbirth and typically lasts about forty-two weeks. It begins with the first trimester (weeks one to week twelve), extends into the second trimester (weeks thirteen to week twenty-seven), and ends with the third trimester (week twenty-eight to birth). Changes begin to occur in the earliest days, often weeks before a woman even knows that she is pregnant. During this period, adequate nutrition supports cell division, tissue differentiation, and organ development. Therefore, women trying to conceive should make proper dietary choices to ensure a healthy baby's delivery. Fathers-to-be should also consider their eating habits. A sedentary lifestyle and a diet low in fresh fruits and vegetables may affect male fertility. Men who drink too much alcohol may also damage the quantity and quality of their sperm.

Watch how fast growth occurs during the first trimester

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16.3: Weight Gain during Pregnancy

During pregnancy, a mother's body changes in many ways. One of the most notable and significant changes is weight gain. If a pregnant woman does not gain enough weight, her unborn baby will be at risk. Poor weight gain, especially in the third trimester, could result in low birth weight, infant mortality, and intellectual disabilities. Infant birth weight is one of the best indicators of a baby's future health. Pregnant women of normal weight should gain between 25 and 35 pounds throughout the entire pregnancy. The precise amount that a mother should gain usually depends on her beginning body mass index (BMI). The Institute of Medicine (IOM) recommends that women with a BMI between 18.5 and 24.9 gain 25-35 pounds.

IOM's Recommended Weight Gain

<u>Prepregnancy BMI</u>	<u>Weight Category</u>	<u>Recommended Weight Gain</u>
Below 18.5	Underweight	28-40 lbs.
18.5-24.9	Normal	25-35 lbs.
25.0-29.9	Overweight	15-25 lbs.
Above 30.0	Obese (all classes)	11-20 lbs.

A starting weight below or above the normal range can lead to complications. Pregnant women with a prepregnancy BMI below twenty are at a higher risk of preterm delivery and an underweight infant. Pregnant women with a prepregnancy BMI above thirty have an increased risk of needing a cesarean section during delivery. Therefore, it is optimal to have a BMI in the normal range before pregnancy. Women pregnant with more than one fetus are advised to gain even more weight to ensure their unborn babies health.

The weight an expectant mother gains during pregnancy is almost all lean tissue, including the placenta and fetus. Women gain 2 to 5 pounds in the first trimester. After that, it is best not to gain more than one pound per week. Weight gain often breaks down in the following manner, as shown below.

<u>Pregnancy Weight Distribution</u>
Blood 3-4 pounds
Protein and fat storage 8-10 pounds
Body fluids 3-4 pounds
Breast 1-2 pounds
Baby 6-8 pounds
Placenta 1-2 pounds
Uterus 1-2 pounds
Amniotic fluid 2-3 pounds

The pace of weight gain is also important. If a woman puts on weight too slowly, her physician may recommend nutritional counseling. If she gains weight too quickly, especially in the third trimester, it may result from edema or swelling due to excess fluid accumulation. Rapid weight gain may also result from increased calorie consumption or a lack of exercise.

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16.4: Weight Loss after Pregnancy

New mothers lose some weight during pregnancy with their child's delivery during labor. They continue to shed weight in the following weeks as they lose accumulated fluids, and their blood volume returns to normal. New mothers who gain healthy weight and participate in regular physical activity during their pregnancies also have an easier time shedding weight post-pregnancy. However, women who gain more weight than needed for a pregnancy typically retain that excess weight as body fat. If those few pounds increase a new mother's BMI by a unit or more, that could lead to complications such as hypertension or Type 2 diabetes in future pregnancies or later in life.

16.5: Nutritional Requirements

As a mother's body changes, so do her nutritional needs. Pregnant women must consume more calories and nutrients in the second and third trimesters than adult women. However, the average recommended daily caloric intake can vary depending on the activity level and the mother's average weight. Also, pregnant women should choose a high-quality, diverse diet, consume fresh foods, and prepare nutrient-rich meals. Steaming is the best way to cook vegetables. Vitamins are destroyed by overcooking, whereas uncooked vegetables and fruits have the highest vitamin content. It is also standard for pregnant women to take prenatal supplements to ensure adequate micronutrients intake.

16.6: Energy and Macronutrients

During the first trimester, a pregnant woman has the exact energy requirements as normal and should consume the same number of calories. However, as the pregnancy progresses, a woman must increase her caloric intake. According to the IOM, she should consume an additional 340 calories per day during the second trimester and 450 calories per day during the third trimester. This is partly due to increased metabolism, which rises during pregnancy and contributes to increased energy needs. A woman can quickly meet these increased needs by consuming more nutrient-dense foods.

During pregnancy, the recommended daily allowance, or RDA, of carbohydrates is about 175 to 265 grams per day to fuel fetal brain development. The best food sources for pregnant women include whole-grain bread and cereals, brown rice, root vegetables, legumes, and fruits. These and other unrefined carbohydrates provide nutrients, phytochemicals, antioxidants, and the extra 3 mg/day of fiber recommended during pregnancy. These foods also help build the placenta and supply energy for the growth of the unborn baby.

Protein builds muscle and other tissues, enzymes, antibodies, and hormones in the mother and the unborn baby. During pregnancy, extra protein is needed to synthesize new maternal and fetal tissues. Additional protein also supports increased blood volume and the production of amniotic fluid. The RDA of protein is 71 grams per day during pregnancy, which is 25 grams above the normal recommendation. Protein should be derived from healthy sources, such as lean red meat, white meat, poultry, legumes, nuts, seeds, eggs, and fish. Low-fat milk and other dairy products also provide protein, calcium, and other nutrients.

There are no specific recommendations for fats in pregnancy, apart from following normal dietary guidelines. Although this is the case, it is recommended to increase the amount of essential fatty acids because they are incorporated into the placenta and fetal tissues. Fats should make up 25 to 35 percent of daily calories, and those calories should come from healthy fats, such as avocados. It is not recommended for pregnant women to be on a very low-fat diet since it would be hard to meet the needs of essential fatty acids and fat-soluble vitamins. Fatty acids are important during pregnancy because they support the baby's brain and eye development.

16.7: Fluids

Fluid intake must also be monitored. According to the IOM, pregnant women should drink 2.3 liters (about 10 cups) of liquids per day to provide the body with enough fluid for blood production. It is also important to drink liquids during physical activity or hot and humid outside to replace fluids lost to perspiration.

16.8: Vitamins and Minerals

The daily requirements for nonpregnant women change with the onset of pregnancy. Taking a daily prenatal supplement or multivitamin helps to meet many nutritional needs. However, most of these requirements should be fulfilled with a healthy diet. The following table compares the standard required vitamins and minerals levels to those needed during pregnancy. For pregnant women, the RDA of nearly all vitamins and minerals increases.

Recommended Nutrient Intakes during Pregnancy

Nutrient	Nonpregnant Women	Pregnant Women
Vitamin A (mcg)	700.0	770.0
Vitamin B6 (mg)	1.5	1.9
Vitamin B12 (mcg)	2.4	2.6
Vitamin C (mg)	75.0	85.0
Vitamin D (mcg)	5.0	5.0
Vitamin E (mg)	15.0	15.0
Calcium (mg)	1,000.0	1,000.0
Folate (mcg)	400.0	600
Iron (mg)	18.0	27.0
Magnesium (mg)	320.0	360.0
Niacin (B3) (mg)	14.0	18.0
Phosphorus	700.0	700.0
Riboflavin (B2) (mg)	1.1	1.4
Thiamine (B1) (mg)	1.1	1.4
Zinc (mg)	8.0	11.0

The micronutrients involved with building the skeleton—vitamin D, calcium, phosphorus, and magnesium—are crucial during pregnancy to support fetal bone development. There is an increased need for all B vitamins during pregnancy. Adequate vitamin B6 supports the metabolism of amino acids, while more vitamin B12 is needed to synthesize red blood cells and DNA. Additional zinc is crucial for cell development and protein synthesis. The need for vitamin A also increases, and extra iron intake is essential becauseAn illustration of an infant with Spina Bifida of increased blood supply during pregnancy and supports the fetus and placenta. Iron is the one micronutrient that is almost impossible to obtain in adequate amounts from food sources only. Therefore, even if a pregnant woman consumes a healthy diet, there still is a need to take an iron supplement in the form of ferrous salts. Also, remember that folate needs increase during pregnancy to 600 micrograms per day to prevent neural tube defects. This micronutrient is crucial for fetal development because it helps produce the extra blood a woman's body requires during pregnancy.

Taking megadose supplements can lead to excessive amounts of certain micronutrients, such as vitamin A and zinc, which may produce toxic effects resulting

in congenital disabilities. For most other minerals, recommended intakes are similar to those for nonpregnant women, although pregnant women must meet the RDAs to reduce the risk of congenital disabilities. Also, expectant mothers should avoid exceeding any recommendations.

16.9: Guide to Eating during Pregnancy

While pregnant women have an increased need for energy, vitamins, and minerals, nutrient-dense foods are essential to a healthy diet. Examples of nutrient-dense foods include fruits, whole grains, peas, beans, reduced-fat dairy, and lean meats. Pregnant women should meet almost all of their increased needs via a healthy diet. However, expectant mothers should take a prenatal supplement to ensure an adequate intake of iron and folate. Here are some additional dietary guidelines for pregnant women:

- Eat iron-rich or iron-fortified foods, including meat or meat alternatives, bread, and cereals, help satisfy the increased need for iron, and prevent anemia.
To enhance iron absorption, include vitamin C-rich foods, such as orange juice, broccoli, or strawberries.
- Eat a well-balanced diet, including fruits, vegetables, whole grains, calcium-rich foods, lean meats, and a variety of cooked seafood (excluding fish high in mercury, such as swordfish and shark).
- Drink additional fluids, water especially.

Nutrition Tips During Pregnancy

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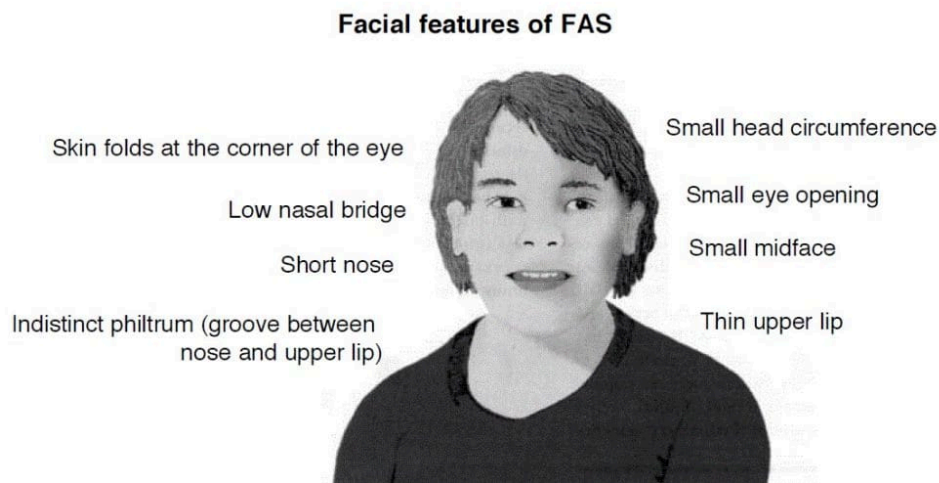
[View this YouTube Video online](#)



16.10: Foods to Avoid

Several substances can harm a growing fetus. Therefore, women need to avoid them throughout a pregnancy. Some are so dangerous that a woman should avoid them even if she suspects that she might be pregnant. For example, consumption of alcoholic beverages results in a range of abnormalities that fall under the umbrella of fetal alcohol spectrum disorders. They include learning and attention deficits, heart defects, and abnormal facial features. Alcohol enters the unborn baby via the umbilical cord and can slow fetal growth, damage the brain, or even result in miscarriage. The effects of alcohol are most severe in the first trimester when the organs develop. As a result, there is no safe amount of alcohol that a pregnant woman can consume. Although pregnant women in the past may have participated in behavior that was not known to be risky at the time, such as drinking alcohol or smoking cigarettes, today, we see that it is best to avoid those substances altogether to protect the health of the unborn baby.

Craniofacial features associated with fetal alcohol syndrome



Pregnant women should also limit caffeine intake, which is found in coffee and tea, colas, cocoa, chocolate, and some over-the-counter painkillers. Some studies suggest that very high amounts of caffeine have been linked to babies born with low birth weights. The American Journal of Obstetrics and Gynecology released a report that found that women who consume 200 milligrams or more caffeine a day (which amounts to 10 ounces of coffee or 25 ounces of tea) increase the risk of miscarriage. Consuming large quantities of caffeine affects the pregnant mother and leads to irritability, anxiety, and insomnia. Most experts agree that small amounts of caffeine each day are safe (about one 8-ounce cup of coffee a day or less). However, that amount should not be exceeded.

16.11: Foodborne Illness

For both mother and child, foodborne illness can cause significant health problems. For example, the foodborne illness caused by the bacteria *Listeria monocytogenes* can cause spontaneous abortion and fetal or newborn meningitis. According to the CDC, pregnant women are twenty times more likely to become infected with this disease, known as listeriosis, than nonpregnant, healthy adults. Symptoms include headaches, muscle aches, nausea, vomiting, and fever. If the infection spreads to the nervous system, it can result in a stiff neck, convulsions, or disorientation feeling. Foods that are more likely to contain the bacteria should be avoided are unpasteurized dairy products, especially soft cheeses, smoked seafood, hot dogs, paté, cold cuts, and uncooked meats. To avoid consuming contaminated foods, pregnant or breastfeeding women should practice food safety guidelines. It is always essential to avoid consuming contaminated food to prevent food poisoning. This is especially true during pregnancy. Heavy metal contaminants, particularly mercury, lead, and cadmium, pose risks to pregnant mothers. As a result, vegetables should be washed thoroughly or have their skins removed to avoid heavy metals.

Pregnant women can eat fish, ideally 8 to 12 ounces of different types each week. Expectant mothers can eat cooked shellfish such as shrimp, farm-raised fish such as salmon, and a maximum of 6 ounces of albacore or white, tuna. However, they should avoid fish with high methylmercury levels, such as shark, swordfish, tilefish, and king mackerel. Pregnant women should also avoid consuming raw shellfish to avoid foodborne illness. The Environmental Defense Fund eco-rates fish to provide guidelines to consumers about the safest and most environmentally friendly choices. Visit the FDA for more information <https://www.fda.gov/food/consumers/advice-about-eating-fish>.

Best Seafood Choices

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[View this YouTube Video online](#)



Eating seafood as you get older is crucial for healthy aging.

True or False

Answer available at the end of this section.

Answers

True

16.12: Food Cravings and Aversions

Food aversions and cravings do not significantly impact unless food choices are minimal. The most common food aversions are milk, meats, pork, and liver. It is not harmful to most women to indulge in the occasional craving, such as the desire for pickles and ice cream. However, a medical disorder known as pica willingly consumes foods with little or no nutritional value, such as dirt, clay, and laundry starch. In some places, this is a culturally accepted practice. However, it can be harmful if these substances take the place of nutritious foods or contain toxins.

16.13: Physical Activity during Pregnancy

For most pregnant women, physical activity is a must and is recommended in the 2015 Dietary Guidelines for Americans. Regular exercise of moderate intensity, about thirty minutes per day most days of the week, keeps the heart and lungs healthy. It also helps to improve sleep and boosts mood and energy levels. Also, women who exercise during pregnancy report fewer discomforts and may have an easier time losing excess weight after childbirth. Brisk walking, swimming, or an aerobics class geared toward expectant mothers are all great ways to get exercise during pregnancy. Healthy women who already participate in vigorous activities, such as running, can continue doing so during pregnancy, provided they discuss an exercise plan with their physicians.

However, pregnant women should avoid pastimes that could cause injuries, such as soccer, football, and other contact sports, or activities that could lead to falls, such as horseback riding and downhill skiing. It may be best for pregnant women not to participate in particular sports, such as tennis, that require them to jump or change direction quickly.

16.14: Complications during Pregnancy

Expectant mothers may face different complications during their pregnancy. About 4 percent of pregnant women suffer from a condition known as gestational diabetes, which is abnormal glucose tolerance during pregnancy. The body becomes resistant to the hormone insulin, enabling cells to transport glucose from the blood. Gestational diabetes is usually diagnosed around twenty-four to twenty-six weeks, although the condition can develop later into a pregnancy. This disease's signs and symptoms include extreme hunger, thirst, or fatigue. If blood sugar levels are not adequately monitored and treated, the baby might gain too much weight and require a cesarean delivery. Diet and regular physical activity can help to manage this condition. Most patients who have gestational diabetes also require daily insulin injections to boost glucose absorption from the bloodstream and promote glucose storage in glycogen in the liver and muscle cells. Gestational diabetes usually resolves after childbirth, although some women who suffer from this condition develop Type 2 diabetes later in life, mainly if they are overweight.

16.15: End Chapter

Learning Objectives

- Identify key nutrients required before conception. (MCCCD Competency 4)
- Learn how nutrient needs change during pregnancy. (MCCCD Competency 4)
- Identify optimal weight gain during pregnancy. (MCCCD Competency 9)
- Discuss the health complications associated with underweight and overweight mothers.(MCCCD Competency 9)
- Discuss the health consequences of gestational diabetes. (MCCCD Competency 9)
- Identify foods and beverages to avoid during pregnancy and the health impact for mother and child. (MCCCD Competency 5)

17: NUTRITION IN THE LIFECYCLE – INFANCY

- 17.1: Introduction
- 17.2: Breastfeeding
- 17.3: Components of Breastmilk
- 17.4: The Mother's Diet
- 17.5: Benefits of Breastfeeding
- 17.6: Barriers to Breastfeeding
- 17.7: Contraindications to Breastfeeding
- 17.8: Breast Milk versus Bottle Formula
- 17.9: Infancy (Birth to Age One)
- 17.10: Nutritional Requirements
- 17.11: Energy and Macronutrients
- 17.12: Micronutrients
- 17.13: Fluids
- 17.14: Bottle-Feeding
- 17.15: Introducing Solid Foods
- 17.16: Learning to Self-Feed
- 17.17: Food Allergies
- 17.18: Early Childhood Dental Caries
- 17.19: End Chapter

17.1: Introduction

Learn

- Nutrient Needs of an Infant
- Breastfeeding
- Bottled Formulas
- When to Introduce Solid Foods
- Food Allergies
- Dental Carries

One of the most important parenting jobs is ensuring that children receive an adequate amount of nutrients to provide a strong foundation for the rest of their lives. Diet and nutrition significantly impact a child's development from infancy into the adolescent years. A healthy diet affects growth and immunity, intellectual capabilities, and emotional well-being. This chapter will discuss the importance of breastfeeding, bottle formulas, and solid foods.

17.2: Breastfeeding

The choice to breastfeed is one that all new mothers face. Support from family members, friends, employers, and others can significantly help with both the decision-making process during pregnancy and the practice of breastfeeding after the baby's birth. In the United States, about 75 percent of babies start out being breastfed. Yet by the age of six months, when solid foods should begin to be introduced into a child's diet along with breast milk, only 15 percent of infants in the United States were still breastfed exclusively, according to the Centers for Disease Control and Prevention (CDC).

Education about breastfeeding typically begins with healthcare providers. During prenatal care and soon after a woman has given birth, doctors, nurses, and other clinicians can explain the benefits of breastfeeding and describe the proper technique. Nearly all births in the United States and Canada occur in hospital settings. Hospital practices in labor, delivery, postpartum care, and discharge planning can inform and support women who breastfeed. Once a new mother has left the hospital for home, she needs access to a trained individual who can provide consistent information. International Board Certified Lactation Consultants (IBCLCs) are healthcare professionals (often registered nurse or registered dietitian) certified in breastfeeding management that works with new mothers to solve problems and educate families about the benefits of this practice. Research shows that breastfeeding rates are higher among women who had infants in hospitals that make IBCLCs available to new mothers, rather than those who gave birth in institutions without these professionals on staff.

Besides, spouses, partners, and other family members can play critical roles in helping a pregnant woman decide to breastfeed and assist with feeding after the baby is born. Employment can also factor into a woman's decision to breastfeed or her ability to maintain the practice. Employed mothers have been less likely to initiate breastfeeding. They tend to breastfeed for a shorter time than new mothers who are not employed or have lengthy maternity leaves. In 2010 in the United States, the Affordable Care Act (ACA) passage called for employers to provide accommodations within the workplace for new mothers to pump breast milk. This law requires a private and clean space within the workplace, other than a restroom, along with adequate break time for a woman to express milk.

Members of a community can also promote and support breastfeeding. New mothers can join peer counseling groups or turn to other women within their community who have previous breastfeeding experience. Besides, community-based programs can provide education and support. The US Department of Agriculture's Women, Infants, and Children program provides information on breastfeeding for low-income families. Launched in 2004, the Loving Support program combines peer counseling with breastfeeding promotion efforts to increase duration rates across the United States. La Leche League is an international program that provides mother-to-mother support, encouragement, and breastfeeding education worldwide.

La Leche League of Arizona

www.llofaz.org/

Although breastfeeding should be recommended and encouraged for almost all new mothers, it is essential to remember that breastfeeding is a personal choice. Women should not be made to feel guilty if they cannot or choose not, to breastfeed their infants. A woman cannot breastfeed or is not in the baby's best interest in rare cases. Parents' Nutritional choices, such as breastfeed or bottle-feeding, affect early childhood development and a child's health and wellness later in life. Therefore, it is imperative to promote and support the best practices for infants' and mothers' well-being.

17.3: Components of Breastmilk

Human breast milk provides adequate nutrition for infants, but it also protects newborns from disease. Also, breast milk is rich in cholesterol, which is needed for brain development. It is helpful to know the different types and components of breastmilk, along with the nutrients they provide to enable an infant to survive and thrive. Colostrum is produced immediately after birth, before milk production, and lasts for several days after the baby's arrival. Colostrum is thicker than breast milk and is yellowish or creamy in color. This protein-rich liquid fulfills an infant's nutrient needs during those early days. Although low in volume, colostrum is packed with concentrated nutrition for newborns. This special milk is high in fat-soluble vitamins, minerals, and immunoglobulins (antibodies) that pass from the mother to the baby. Immunoglobulins provide passive immunity for the newborn and protect the baby from bacterial and viral diseases.

Two to four days after birth, colostrum is replaced by transitional milk. Transitional milk is a creamy liquid that lasts for approximately two weeks and includes high fat, lactose, and water-soluble vitamins. It also contains more calories than colostrum. After a new mother begins to produce transitional milk, she typically notices a change in the volume and type of liquid secreted and increases her breasts' weight and size.

Mature milk is the final fluid that a new mother produces. In most women, it begins to secrete at the end of the second week postpartum. Two types of mature milk appear during feeding. Foremilk occurs at the beginning and includes water, vitamins, and protein. Hind-milk occurs after the initial milk release and contains higher fat levels necessary for weight gain. These two types of milk ensure that a baby receives adequate nutrients to grow and develop properly.

About 90 percent of mature milk is water, which helps an infant remain hydrated. The other 10 percent contains carbohydrates, proteins, and fats, which support energy and growth. Like cow's milk, the main carbohydrate of mature breast milk is lactose. Breast milk contains vital fatty acids, such as docosahexaenoic acid (DHA) and arachidonic acid (ARA). In terms of protein, breast milk contains more whey than casein (the reverse of cow's milk). Whey is much easier for infants to digest than casein. A complete protein, which means all essential amino acids, is also present in breast milk. Total protein includes lactoferrin, an iron-gathering compound that helps absorb iron into an infant's bloodstream.

Also, breast milk provides adequate vitamins and minerals. Although absolute amounts of some micronutrients are low, infants are more efficiently absorbed. Other essential components include digestive enzymes that help a baby digest breast milk. Human milk also provides the hormones and growth factors that help a newborn develop.

17.4: The Mother's Diet

A mother's diet can significantly impact milk production and quality. New mothers need to adjust their caloric and fluid intake to make breastfeeding possible. As is the case during pregnancy, the RDA of nearly all vitamins and minerals increases breastfeeding their babies. The RDA is 330 additional calories during the first six months of lactation and 400 extra calories during the second six months. The energy needed to support breastfeeding came from increased intake and stored fat. For example, during the first six months after her baby is born, the daily caloric cost for a lactating mother is 500 calories, with 330 calories derived from increased intake and 170 calories derived from maternal fat stores. This helps explain why breastfeeding may promote weight loss in new mothers. According to the IOM, lactating women should also drink 3.1 liters of liquids per day (about 13 cups) to maintain milk production.

During pregnancy, lactating mothers should avoid illegal substances and cigarettes. Some legal drugs and herbal products can be harmful, helping to discuss them with a healthcare provider. Some mothers may need to avoid certain things, such as spicy foods, that can produce gas in sensitive infants. Lactating women can drink alcohol, though they must avoid breastfeeding until the alcohol has completely cleared from their milk. Typically, this takes two to three hours for 12 ounces of beer, 5 ounces of wine, or 1.5 ounces of liquor, depending on a woman's body weight. Precautions are necessary because alcohol exposure can disrupt an infant's sleep schedule.

17.5: Benefits of Breastfeeding

Breastfeeding has several benefits, both for the mother and for the child. Breast milk contains immunoglobulins, enzymes, immune factors, and white blood cells. As a result, breastfeeding supports the baby's immune system and lowers diarrhea incidence, along with respiratory diseases, gastrointestinal problems, and ear infections. Breastfed babies also are less likely to develop asthma and allergies, and breastfeeding lowers the risk of sudden infant death syndrome. Also, human milk encourages the growth of healthy bacteria in an infant's intestinal tract. These benefits remain in place after an infant has been weaned from breast milk. Some studies suggest other possible long-term effects. For example, breast milk may improve an infant's intelligence and protect against Type 1 diabetes and obesity, although research is ongoing in these areas.

Breastfeeding has many other essential benefits. It is easier for babies to digest breast milk than bottle formula, which contains proteins made from cow's milk that require an adjustment period for infant digestive systems. Breastfed infants are sick less often than bottle-fed infants. Breastfeeding is more sustainable and results in less plastic waste and other trash. Breastfeeding can also save families money because it does not incur the exact cost of purchasing formula. Other benefits include that breast milk is always ready. It does not have to be mixed, heated, or prepared. Also, breast milk is sterile and is always at the right temperature.

Besides, the skin-to-skin contact of breastfeeding promotes a close bond between mother and baby, which is an essential emotional and psychological benefit. The practice also provides health benefits for the mother. Breastfeeding helps a woman's bones stay strong, protecting against fractures later in life. Studies have also shown that breastfeeding reduces the risk of breast and ovarian cancers.

17.6: Barriers to Breastfeeding

Although breast milk is ideal for almost all infants, there are some challenges that nursing mothers may face when starting and continuing to breastfeed their infants. These obstacles include painful engorgement or fullness in the breasts, sore and tender nipples, lack of comfort or confidence in public, and accommodation to breastfeed or express milk in the workplace.

One of the first challenges nursing mothers face is learning the correct technique. Improper latching can result in inadequate intake, slowing growth and development. A new mother may take a little time to help her baby correctly latch on to her nipples. However, International Board Certified Lactation Consultants (IBCLCs), OB nurses, and registered dietitians are trained to help new mothers learn the proper technique. Education, the length of maternity leave, and laws to protect public breastfeeding, among other measures, can all help to facilitate breastfeeding for many lactating women and their newborns.

17.7: Contraindications to Breastfeeding

Although there are numerous benefits to breastfeeding, there are also risks that must be considered in some cases. A new mother with HIV should not breastfeed in the developed world because the infection can be transmitted through breast milk. These women typically have access to a safe bottled formula and can be used as a replacement for breast milk. However, in developing nations where HIV infection rates are high and acceptable infant formula can be challenging to come by. Many newborns would be deprived of the nutrients they need to develop and grow. Also, inappropriate or contaminated bottle formulas cause 1.5 million infant deaths each year. As a result, the WHO recommends that women infected with HIV in the developing world nurse their infants while taking antiretroviral medications to lower the transmission risk.

Breastfeeding also is not recommended for women undergoing radiation or chemotherapy treatment for cancer. Additionally, if an infant is diagnosed with galactosemia, meaning an inability to process the simple sugar galactose, the child must be on a galactose-free diet, excluding breast milk. However, this genetic disorder is a rare condition and only affects 1 in thirty- to sixty thousand newborns. When breastfeeding is contraindicated for any reason, feeding a baby formula enables parents and caregivers to meet their newborn's nutritional needs.

17.8: Breast Milk versus Bottle Formula

Breast Milk	Bottle Formula
Antibodies and lactoferrin in breast milk protect infants.	The formula does not contain immunoprotective factors.
The iron in breast milk is absorbed more easily.	The formula contains more iron than breast milk, but it is not absorbed as easily.
The feces that babies produce do not smell because breastfed infants have different bacteria in the gut.	The feces that bottle-fed infants produce tend to have a foul-smelling odor.
Breast milk is always available and is always at the correct temperature.	The formula must be prepared, refrigerated for storage, and warmed before giving to an infant.
Breastfed infants are less likely to have constipation.	Bottle-fed infants are more likely to have constipation.
Breastfeeding is free, though purchasing a pump and bottles to express milk does require some expense.	A formula must be purchased and is expensive.
Breast milk contains DHA and ARA's fatty acids, which are vital for brain and vision development.	Some formulas contain DHA and ALA.

17.9: Infancy (Birth to Age One)

Several significant physiological changes occur during infancy. The body's trunk grows faster than the arms and legs, while the head becomes less prominent than the limbs. Organs and organ systems grow at a rapid rate. Also, during this period, countless new synapses form to link brain neurons. Two soft spots on the baby's skull, known as fontanelles, allow the skull to accommodate rapid brain growth. The posterior fontanelle closes first, by the age of eight weeks. The anterior fontanelle closes about a year later, at eighteen months on average. Developmental milestones include sitting up without support, learning to walk, teething, and vocalizing, among many others. These changes require adequate nutrition to ensure development at the appropriate rate.

Healthy infants grow steadily but not always at an even pace. For example, during the first year of life, height increases by 50 percent, while weight triples. Physicians and other health professionals can use growth charts to track a baby's development process. Because infants cannot stand, the length is used instead of height to determine a child's growth rate. Other vital developmental measurements include head circumference and weight. These must be tracked and compared against standard measurements for an infant's age.

For infants and toddlers from birth to 24 months of age, the World Health Organization (WHO) growth charts monitor growth. These standards represent optimal growth for children at this age and track growth trends over time through percentile rankings. Growth charts may warn that a child has a medical problem or is malnourished. Insufficient weight or height gain during infancy may indicate a condition known as failure-to-thrive (FTT), characterized by poor growth. FTT can happen at any age, but it typically occurs after six months in infancy. Some causes include poverty, lack of food, inappropriate feeding foods, and excessive fruit juice intake.

17.10: Nutritional Requirements

On a per-kilogram basis, requirements for macronutrients and micronutrients are higher during infancy than at any other stage in the human life cycle. These needs are affected by the rapid cell division during growth, which requires energy and protein, and the nutrients involved in DNA synthesis. A baby's resting metabolic rate is two times that of an adult. Children are entirely dependent on their parents or other caregivers during this period to meet these needs. Breast milk is the best source for almost all infants six months or younger to fulfill nutritional requirements. An infant may require feedings eight to twelve times a day or more initially. After six months, infants can gradually consume solid foods to help meet nutrient needs.

17.11: Energy and Macronutrients

The dietary recommendations for infants are based on the nutritional content of human breast milk. Carbohydrates make up about 45 to 65 percent of the caloric content in breast milk, which amounts to an RDA of about 130 grams. Almost all carbohydrates in human milk are lactose, which infants digest and tolerate well. Lactose intolerance is practically nonexistent in infants. Protein makes up about 5 to 20 percent of breast milk's caloric content, which amounts to 13 grams per day. Infants have a high need for protein to support growth and development. However, excess protein (which is only a concern with bottle-feeding) can cause premature infants' dehydration, diarrhea, fever, and acidosis. About 30 to 40 percent of the caloric content in breast milk is fat. A high-fat diet is necessary to encourage neural pathways in the brain and other body parts. However, saturated fats and trans fatty acids inhibit this growth. Infants over the age of six months, which means they are no longer exclusively breastfed, should not consume foods high in these types of fats.

17.12: Micronutrients

Almost all of the nutrients that infants require can be met if they consume adequate breast milk. There are a few exceptions, though. Human milk is low in vitamin D, which is needed for calcium absorption and building bone, among other things. Therefore, breastfed children often need to take a vitamin D supplement in the form of drops. Infants at the highest risk for vitamin D deficiency have darker skin and no sunlight exposure. Breast milk is also low in vitamin K, required for blood clotting, and deficits could lead to bleeding or hemorrhagic disease. Babies are born with little vitamin K so supplementation may be needed initially, and some states require a vitamin K injection after birth. Also, breast milk is not high in iron, but infants absorb the iron in breast milk. However, after four to six months, an infant needs an additional iron source other than breast milk.

17.13: Fluids

Infants have a high need for fluids, 1.5 milliliters per kilocalorie consumed, then 1.0 milliliters per kilocalorie consumed for adults. This is because children have a larger body surface area per unit of body weight and a reduced perspiration capacity. Therefore, they are at greater risk of dehydration. However, parents or other caregivers can meet an infant's fluid needs with breast milk or formula. As solids are introduced, parents must ensure that young children continue to drink fluids throughout the day.

17.14: Bottle-Feeding

Most women can and should breastfeed when given sufficient education and support. However, as discussed, a small percentage of women cannot breastfeed their infants, while others choose not to. For parents who choose to bottle-feed, infant formula provides a balance of nutrients. However, not all formulas are the same, and there are important considerations that parents and caregivers must weigh. Standard formulas use cow's milk as a base. They have 20 calories per fluid ounce, similar to breast milk, with vitamins and minerals added. Soy-based formulas are usually given to infants who develop diarrhea, constipation, vomiting, colic, abdominal pain, or infants with a cow's milk protein allergy. Hypoallergenic protein hydrolysate formulas are usually given to infants allergic to cow's milk and soy protein. This type of formula uses hydrolyzed protein, which is broken down into amino acids and small peptides, making it easier to digest. Preterm infant formulas are given to low birth weight infants if breast milk is unavailable. Preterm infant formulas have 24 calories per fluid ounce and are given until they reach the desired weight.

Infant formula comes in three basic types:

1. Powder that requires mixing with water. This is the least expensive type of formula.
2. Concentrates, which are liquids that must be diluted with water. This type is slightly more expensive.
3. Ready-to-use liquids that can be poured directly into bottles. This is the most expensive type of formula. However, it requires the least amount of preparation. Ready-to-use formulas are also convenient for traveling.

Most babies need about 2.5 ounces of formula per pound of body weight each day. Therefore, the average infant should consume about 24 fluid ounces of breastmilk or formula per day. Parents and caregivers should carefully follow the safety guidelines when preparing formula since an infant has an immature immune system. All equipment used in formula preparation should be sterilized. A prepared, new formula should be refrigerated to prevent bacterial growth. Parents should not use contaminated water to mix formula to avoid foodborne illnesses. Follow the powdered and concentrated formula instructions carefully—an overly diluted formula would not provide adequate calories and protein. Simultaneously, an extremely concentrated formula provides too much protein and too little water, impairing kidney function. It is important to note that both the American Academy of Pediatrics and the WHO state that breast milk is far superior to infant formula.

17.15: Introducing Solid Foods

According to the WHO, infants should be breastfed or bottle-fed exclusively for the first six months of life. (The American Academy of Pediatrics recommends breast milk or bottle formula exclusively for at least the first four months, but ideally for six months.) Infants should not consume solid foods before six months because solids do not contain the right nutrient mix that infants need. Also, eating solids may mean drinking less breast milk or bottled formula. If that occurs, an infant may not consume the right quantities of various nutrients. If parents try to feed an infant who is too young or is not ready, their tongue will push the food out, called an extrusion reflex. After six months, the suck-swallow reflexes are not as strong, and infants can hold up their heads and move them around, both of which make eating solid foods more feasible.

Solid baby foods can be bought commercially or prepared from regular food using a food processor, blender, food mill, or grinder at home. By nine months to a year, infants can chew soft foods and eat well chopped or mashed solids. Infants fed solid foods too soon are susceptible to developing food allergies. Therefore, as parents and caregivers introduce solids, they should feed their child only one new food at a time to help identify allergic responses or food intolerances. An iron supplement is also recommended at this time.

When to Introduce Solid Foods

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Solids help your baby develop a fondness for taste and textures. Their main source of food for nutritional growth is from breast milk or formula during the first year of life.

True or False

Answer available at the end of this section.

Answers

True

17.16: Learning to Self-Feed

With the introduction of solid foods, young children learn how to handle food and feed themselves. At six to seven months, infants can use their whole hand to pick up items (this is known as the palmer grasp). They can lift larger things, but picking up smaller pieces of food is difficult. At eight months, a child might use a pincer grasp, which uses fingers to pick up objects. After one, children slowly begin to use utensils to handle their food. Unbreakable dishes and cups are essential since very young children may play with them or throw them when they become bored with their food.

17.17: Food Allergies

Food allergies impact four to six percent of young children in America. Common food allergens include peanuts, eggs, shellfish, wheat, and cow's milk. However, lactating women should not make any changes to their diets. Research shows that nursing mothers who attempt to ward off allergies in their infants by eliminating certain foods may do more harm than good. According to the American Academy of Allergy, Asthma, and Immunology, mothers who avoided certain dairy products showed decreased levels in their breast milk of an immunoglobulin specific to cow's milk. This antibody is thought to protect against the development of allergies in children. Even when an infant is at higher risk for food allergies, there is no evidence that alterations in a mother's diet make a difference. It is possible that continuing breastfeeding when introducing solid foods in the infant diet may be preventative. There is currently no scientific evidence indicating that the introduction of solid foods is preventive for delayed (after six months of age) or early (before four months of age). However, there is evidence that introducing solid foods after 17 weeks of age is associated with a decreased risk of developing food allergies.

17.18: Early Childhood Dental Caries

Primary teeth are at risk for a disorder known as early childhood caries from breast milk, formula, juice, or other drinks fed through a bottle. Early childhood caries are caused by the kinds of liquids given to an infant and the frequency and length of time that fluids are given. Liquids can build up in a baby's mouth, and the natural or added sugars lead to decay. Giving a child a bottle of juice or other sweet drinks several times each day or letting a baby suck on a bottle longer than a mealtime, either when awake or asleep, can also cause early childhood caries. Besides, this practice affects the teeth and jaw development and position. Early child caries' risk continues into the toddler years as children consume more foods with high sugar content. Therefore, parents should avoid giving their children sugary snacks and beverages.

17.19: End Chapter

Learning Objectives

- Identify the nutrient needs of an infant. (MCCCD Competency 9)
- Explain the benefits of breastfeeding.(MCCCD Competency 5)
- Discuss the use of bottled formulas(MCCCD Competency 5)
- Learn when to introduce solid foods to your infant. (MCCCD Competency 8)
- Learn how to identify food allergies. (MCCCD Competency 4)
- Identify which foods create dental caries. (MCCCD Competency 4)

18: NUTRITION THROUGH THE LIFECYCLE – TODDLER (AGES 1-3)

- 18.1: Introduction
- 18.2: Nutritional Requirements
- 18.3: Learning How to Handle Food
- 18.4: Feeding Problems in the Toddler Years
- 18.5: Picky Eaters
- 18.6: Toddler Obesity
- 18.7: Early Childhood Dental Caries
- 18.8: Iron-Deficiency Anemia
- 18.9: End Chapter

18.1: Introduction

Learn

- Nutrient needs of toddlers
- How to feed picky eaters
- Obesity epidemic
- Dental caries
- Anemia

Significant physiological changes continue into the toddler years. Unlike in infancy, the limbs grow much faster than the trunk, which gives the body a more proportionate appearance. By the end of the third year, a toddler is taller and more slender than an infant, with a more erect posture. As the child grows, bone density increases and bone tissue gradually replaces cartilage. This process, known as ossification, is not completed until puberty.

How toddlers act, speak, learn, and eat offers important clues about their development. Developmental milestones include running, drawing, toilet training, and self-feeding. By the age of two, children have advanced from infancy and are on their way to becoming school-aged children. Their physical growth and motor development are slow compared to their progress as infants. However, toddlers experience enormous intellectual, emotional, and social changes. Of course, food and nutrition play an essential role in a child's development. The diet completely shifts from breastfeeding or bottle-feeding to solid foods, healthy juices, and other liquids during this stage. Parents of toddlers also need to be mindful of specific nutrition-related issues that may crop up during this stage of the human life cycle. For example, fluid requirements relative to body size are higher in toddlers than in adults because children are at greater risk of dehydration. The toddler years pose exciting challenges for parents or other caregivers, as children learn how to eat independently and begin to develop personal preferences. However, with the proper diet and guidance, toddlers can continue growing and developing at a healthy rate.

18.2: Nutritional Requirements

A toddler's serving size should be approximately one-quarter of an adult's. One way to estimate serving sizes for young children is one tablespoon for each year of life. For example, a two-year-old child would be served two tablespoons of fruits or vegetables at a meal, while a four-year-old would be given four tablespoons or a quarter cup. Here is an example of a toddler-sized meal:

- 1 ounce of meat or chicken, or 2 to 3 tablespoons of beans
 - One-quarter slice of whole-grain bread
 - 1 to 2 tablespoons of cooked vegetable
 - 1 to 2 tablespoons of fruit
- The energy requirements for ages two to three are about 1,000 to 1,400 calories a day. However, the recommended caloric intake varies with each child's activity level. Toddlers require small, frequent, nutritious snacks and meals to satisfy energy requirements. The amount of food a toddler needs from each food group depends on daily calorie needs.

For carbohydrate intake, the Acceptable Macronutrient Distribution Range (AMDR) is 45 to 65 percent of daily calories (113 to 163 grams for 1,000 daily calories). Toddlers' needs increase to support their body and brain development. Brightly-colored unrefined carbohydrates, such as peas, orange slices, tomatoes, and bananas, are not only nutrient-dense, they also make a plate look more appetizing and appealing to a young child. The RDA of protein is 5 to 20 percent of daily calories (13 to 50 grams for 1,000 daily calories). The AMDR for fat for toddlers is 30 to 40 percent of daily calories (33 to 44 grams for 1,000 daily calories). Essential fatty acids are vital for the development of the eyes and nerve and other types of tissue. However, toddlers should not consume high amounts of trans fats and saturated fats. Instead, young children require the equivalent of 3 teaspoons of healthy oils, such as canola oil, each day.

MICRONUTRIENTS

As a child grows bigger, the demands for micronutrients increase. These needs for vitamins and minerals can be met with a balanced diet, with a few exceptions. According to the American Academy of Pediatrics, toddlers and children of all ages need 600 international vitamin D units per day. Vitamin D-fortified milk and cereals can help to meet this need. However, toddlers who do not get enough of this micronutrient should receive a supplement. Pediatricians may also prescribe a fluoride supplement for toddlers who live in areas with fluoride-poor water. Iron deficiency is also a significant concern for children between two and three. You will learn about iron-deficiency anemia later in this section.

Use MyPlate as a Guide for Your Toddler's Diet

www.choosemyplate.gov/browse-by-audience/view-all-audiences/children/health-and-nutrition-information/how-much-does-my-preschooler-need

18.3: Learning How to Handle Food

As children grow older, they enjoy taking care of themselves, including self-feeding. During this phase, it is essential to offer children foods that they can handle independently, which helps them avoid choking and other hazards. Examples include fresh fruits that have been sliced into pieces, orange or grapefruit sections, peas or potatoes that have been mashed for safety, a cup of yogurt, and whole-grain bread or bagels cut into pieces. Even with careful preparation and training, the learning process can be messy. As a result, parents and other caregivers can help children learn how to feed themselves by providing the following:

- small utensils that fit a young child's hand
- small cups that will not tip over easily
- plates with edges to prevent food from falling off
- small servings on a plate
- high chairs, booster seats, or cushions to reach a table

18.4: Feeding Problems in the Toddler Years

During the toddler years, parents may face many problems related to food and nutrition. Possible obstacles include difficulty helping a young child overcome a fear of new foods or fights over messy habits at the dinner table. Even in the face of problems and confrontations, parents and other caregivers must ensure their preschooler has nutritious choices at every meal. For example, even if a child stubbornly resists eating vegetables, parents should continue to provide them. Before long, the child may change their mind and develop a taste for foods once abhorred. It is important to remember this is the time to establish or reinforce healthy habits.

Nutritionist Ellyn Satter states that feeding is a split responsibility between parent and child. According to Satter, parents are responsible for what their infants eat, while infants are responsible for how much they eat. In the toddler years and beyond, parents are responsible for what children eat, when they eat, and where they eat, while children are responsible for how much food they eat and whether they eat. Satter states that the role of a parent or a caregiver in feeding includes the following:

- selecting and preparing food
- providing regular meals and snacks
- making mealtimes pleasant
- showing children what they must learn about mealtime behavior
- avoiding letting children eat in between meal- or snack-times

18.5: Picky Eaters

The parents of toddlers are likely to notice a sharp drop in their child's appetite. Children at this stage are often picky about what they want to eat. They may turn their heads away after eating just a few bites. Or, they may resist coming to the table at mealtimes. They also can be unpredictable about what they want to consume for specific meals or at particular times of the day. Although it may seem as if toddlers should increase their food intake to match their activity level, there is a good reason for picky eating. A child's growth rate slows after infancy, and toddlers ages two and three do not require as much food.

Discover the Issues Associated with Childhood Obesity

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18.6: Toddler Obesity

Another potential problem during the early childhood years is toddler obesity. According to the US Department of Health and Human Services, obesity rates have more than doubled for all children in the past thirty years, including infants and toddlers. Almost 10 percent of infants and toddlers weigh more than they should, and slightly more than 20 percent of children ages two to five are overweight or obese.

Obesity during early childhood tends to linger as a child matures and causes health problems later in life. There are several reasons for this growing problem. One is a lack of time. Parents and other caregivers who are constantly on the go may find it difficult to fit home-cooked meals into a busy schedule. They may turn to fast food and other conveniences that are quick and easy but not nutritionally sound. Another contributing factor is the lack of access to fresh fruits and vegetables. This is a problem, particularly in low-income neighborhoods where local stores and markets may not stock fresh produce or have limited options. Physical inactivity is also a factor, as toddlers who live a sedentary lifestyle are more likely to be overweight or obese. Another contributor is the lack of breastfeeding support. Children who were breastfed as infants show lower rates of obesity than children who were bottle-fed.

To prevent or address toddler obesity, parents and caregivers can do the following:

- Eat at the kitchen table instead of in front of a television to monitor what and how much a child eats.
- Offer a child healthy portions. The size of a toddler's fist is an appropriate serving size.
- Plan time for physical activity, about sixty minutes or more per day. Toddlers should have no more than sixty minutes of sedentary activity per day, such as watching television.

18.7: Early Childhood Dental Caries

Early childhood caries remain a potential problem during the toddler years. The risk of early childhood caries continues as children consume more foods with high sugar content. According to the National Health and Nutrition Examination Survey, children between the ages of two and five consume about 200 calories of added sugar per day. Therefore, parents with toddlers should avoid processed foods, such as snacks from vending machines, and sugary beverages, such as soda. Parents also need to instruct a child on brushing their teeth to help toddlers develop healthy habits and avoid tooth decay

18.8: Iron-Deficiency Anemia

An infant who switches to solid foods, but does not eat enough iron-rich foods, can develop iron-deficiency anemia. This condition occurs when an iron-deprived body cannot produce enough hemoglobin, a protein in red blood cells that transports oxygen throughout the body. The inadequate supply of hemoglobin for new blood cells results in anemia. Iron deficiency anemia causes many problems, including weakness, pale skin, shortness of breath, and irritability. It can also result in intellectual, behavioral, or motor problems. In infants and toddlers, iron-deficiency anemia can occur as young children are weaned from iron-rich foods, such as breast milk and iron-fortified formula. They begin to eat solid foods that may not provide enough of this nutrient. As a result, their iron stores become diminished when this nutrient is critical for brain growth and development.

There are steps that parents and caregivers can take to prevent iron-deficiency anemia, such as adding more iron-rich foods to a child's diet, including lean meats, fish, poultry, eggs, legumes, and iron-enriched whole-grain bread and cereals. A toddler's diet should provide 7 to 10 milligrams of iron daily. Although milk is critical for the bone-building calcium it provides, intake should not exceed the RDA to avoid displacing foods rich with iron. Children may also be given a daily supplement, using infant vitamin drops with iron or ferrous sulfate drops. If iron-deficiency anemia does occur, treatment includes a dosage of 3 milligrams per kilogram once daily before breakfast, usually in the form of a ferrous sulfate syrup. Consuming vitamin C, such as orange juice, can also help to improve iron absorption.

18.9: End Chapter

Test Your Knowledge

An infant who switches to solid foods, but does not eat enough iron-rich foods, can develop iron-deficiency anemia.

True or False

Answer available at the end of this section.

Learning Objectives

- Identify the nutrient needs in early childhood.
- Learn approaches to encourage picky eaters.
- Discuss the obesity epidemic in children.
- Identify how to prevent dental caries in children.
- Learn the causes, symptoms, and treatment of anemia in children.

Answers

Test Your Knowledge

True

19: NUTRITION THROUGH THE LIFECYCLE – EARLY CHILDHOOD (AGES 4-8)

19.1: Introduction

19.2: Energy

19.3: Macronutrients

19.4: Micronutrients

19.5: Factors Influencing Intake

19.6: Children and Malnutrition

19.7: The National School Lunch Program

19.8: Food Allergies and Food Intolerance

19.9: The Threat of Lead Toxicity

19.10: End Chapter

19.1: Introduction

Learn

- Nutrient Needs in Early Childhood
- Cultivating Healthy Food Attitudes
- Childhood Malnutrition
- Lead Poisoning

Early childhood encompasses infancy and the toddler years, from birth through age three. The remaining part of childhood is when children enter the school from ages four through eight. Several critical physiological and emotional changes take place during the life stage from childhood through adolescence. Children's attitudes and opinions about food deepen. They begin taking their cues about food preferences from family members and peers, and the larger culture.

Parents also significantly impact their child's nutritional choices. This time in a child's life provides parents and other caregivers an opportunity to reinforce good eating habits and introduce new foods into the diet while remaining mindful of their preferences. Parents should also serve as role models for their children, who will often mimic their behavior and eating habits. Parents must continue to help their school-aged children and adolescents establish healthy eating habits and attitudes toward food. Their primary role is to bring a wide variety of health-promoting foods into the home so that their children can make good choices.

Nutritional needs change as children leave the toddler years. From ages four to eight, school-aged children grow consistently but slower than infants and toddlers. They also experience the loss of deciduous, or "baby," teeth and the arrival of permanent teeth, which typically begins at age six or seven. As new teeth come in, many children have some malocclusion, or malposition, of their teeth, which can affect their ability to chew food. Other changes that affect nutrition include the influence of peers on dietary choices and the kinds of foods offered by schools and afterschool programs, making up a sizable part of a child's diet. Food-related problems for young children can include tooth decay, food sensitivities, and malnourishment. Also, excessive weight gain early in life can lead to obesity in adolescence and adulthood.

A healthy diet facilitates physical and mental development at this life stage and helps maintain health and wellness. School-aged children experience steady, consistent growth, with an average growth rate of 2–3 inches in height and 4.5–6.5 pounds per year. Besides, the extremities' growth rate is faster than for the trunk, which results in more adult-like proportions. Long-bone growth stretches muscles and ligaments, which results in many children experiencing "growing pains" at night, in particular.

19.2: Energy

Children's energy needs vary, depending on their growth and level of physical activity. Energy requirements also vary according to gender. Girls ages four to eight require 1,200 to 1,800 calories a day, while boys need 1,200 to 2,000 calories daily, and, depending on their activity level, maybe more. Also, recommended intakes of macronutrients and most micronutrients are higher relative to body size than nutrient needs during adulthood. Therefore, children should be provided nutrient-dense food at meal- and snack time. However, it is important not to overfeed children, leading to childhood obesity, discussed in the next section.

19.3: Macronutrients

For carbohydrates, the Acceptable Macronutrient Distribution Range (AMDR) is 45–65 percent of daily calories (which is a recommended daily allowance of 135–195 grams for 1,200 daily calories). Carbohydrates high in fiber should make up the bulk of intake. The AMDR for protein is 10–30 percent of daily calories (30–90 grams for 1,200 daily calories). Children have a high need for protein to support muscle growth and development. High levels of essential fatty acids are needed to support growth (although not as high as in infancy and the toddler years). As a result, the AMDR for fat is 25–35 percent of daily calories (33–47 grams for 1,200 daily calories). Children should get 17–25 grams of fiber per day.

19.4: Micronutrients

Micronutrient needs should be met with foods first. Parents and caregivers should select various foods from each food group to meet nutritional requirements. Because children grow rapidly, they require high iron, such as lean meats, legumes, fish, poultry, and iron-enriched cereals. Adequate fluoride is crucial to support strong teeth. One of the essential micronutrient requirements is sufficient calcium and vitamin D intake during childhood. Both are needed to build dense bones and a strong skeleton. Children who do not consume adequate vitamin D should be given a supplement recommended by their pediatrician.

19.5: Factors Influencing Intake

Several factors can influence children's eating habits and attitudes toward food. Family environment, societal trends, taste preferences, and messages in the media all impact children's emotions with their diet. Television commercials can entice children to consume sugary products, fatty fast foods, excess calories, refined ingredients, and sodium. Therefore, it is critical that parents and caregivers direct children toward healthy choices.

One way to encourage children to eat healthy foods is to make the meal and snack-time fun and interesting. Parents should include children in food planning and preparation, such as selecting items while grocery shopping or preparing part of a meal, like making a salad. At this time, parents can also educate children about kitchen safety. It might be helpful to cut sandwiches, meats, or pancakes into small or interesting shapes. Parents should also offer nutritious desserts, such as fresh fruits, instead of calorie-laden cookies, cakes, salty snacks, and ice cream. Also, studies show that children who eat family meals frequently consume more nutritious foods.

Create Positive Mealtimes for your Child

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Select all the following that can influence children's eating habits.

- a. media messages
- b. family environment
- c. crispy fried foods
- d. societal trends
- e. taste preferences

Answer available at the end of this section.

Answers

a, b, d, e

19.6: Children and Malnutrition

Malnutrition is a problem many children face in both developing nations and the developed world. Even with the wealth of food in North America, many children grow up malnourished or hungry. The US Census Bureau characterizes households into the following groups:

- food secure
- food insecure without hunger
- food insecure with moderate hunger
- food insecure with severe hunger

Millions of children grow up in food-insecure households with inadequate diets due to available food and food quality. In the United States, about 20 percent of families with children are food insecure to some degree. In half of those, only adults experience food insecurity. In contrast, in the other half, both adults and children are considered food insecure, which means that children do not have access to adequate, nutritious meals at times.^[3]

Growing up in a food-insecure household can lead to many problems. Deficiencies in iron, zinc, protein and vitamin A can result in stunted growth, illness, and limited development. Federal programs, such as the National School Lunch Program, the School Breakfast Program, and Summer Feeding Programs, address the risk of hunger and malnutrition in school-aged children. They help fill the gaps and provide children living in food-insecure households with greater access to nutritious meals.

19.7: The National School Lunch Program

Beginning with preschool, children consume at least one of their meals in a school setting. Many children receive both breakfast and lunch outside the home. Therefore, schools need to provide nutritionally sound meals. More than thirty-one million children from low-income families are given meals provided by the National School Lunch Program. This federally-funded program offers low-cost or free lunches to schools and snacks to afterschool facilities. School districts that participate receive subsidies from the US Department of Agriculture (USDA) for every meal they serve. School lunches must meet the 2015 Dietary Guidelines for Americans and need to provide one-third of the RDAs for protein, vitamin A, vitamin C, iron, and calcium. However, local authorities decide what foods to serve and how they are prepared.

The Healthy School Lunch Campaign works to improve the food served to children in school and promote children's short- and long-term health by educating government officials, school officials, food-service workers, and parents. Sponsored by the Physicians Committee for Responsible Medicine, this organization encourages schools to offer more low-fat, cholesterol-free options in school cafeterias and vending machines.

19.8: Food Allergies and Food Intolerance

As discussed previously, the development of food allergies is a concern during the toddler years. Recent studies show that three million children under age eighteen are allergic to at least one food type. This remains an issue for school-aged children.

Some of the most common allergenic foods include peanuts, milk, eggs, soy, wheat, and shellfish. An allergy occurs when a protein in food triggers an immune response, which results in the release of antibodies, histamine, and other defenders that attack foreign bodies. Possible symptoms include itchy skin, hives, abdominal pain, vomiting, diarrhea, and nausea. Symptoms usually develop within minutes to hours after consuming a food allergen. Children can outgrow a food allergy, especially wheat, milk, eggs, or soy allergies.

19.9: The Threat of Lead Toxicity

There is a danger of lead toxicity, or lead poisoning, among school-aged children. Lead is found in plumbing in old homes, lead-based paint, and occasionally soil. Contaminated food and water can increase exposure and result in hazardous lead levels in the blood. Children under age six are especially vulnerable. They may consume items tainted with lead, such as chipped, lead-based paint. Another everyday exposure is lead dust in carpets, with the dust flaking off of paint on walls. When children play or roll around on carpets coated with lead, they are in jeopardy. Lead is indestructible, and once it has been ingested, it is difficult for the human body to alter or remove it. It can quietly build up in the body for months, or even years, before the onset of symptoms. Lead toxicity can damage the brain and central nervous system, resulting in impaired thinking, reasoning, and perception.

Treatment for lead poisoning includes removing the child from the source of contamination and extracting lead from the body. Extraction may involve chelation therapy, which binds with lead to be excreted in the urine. Another treatment protocol, EDTA therapy, involves administering a drug called ethylenediaminetetraacetic acid to remove lead from the bloodstream of patients with levels greater than 45 mcg/dL. Fortunately, lead toxicity is highly preventable. It involves identifying potential hazards, such as lead paint and pipes, and removing them before children are exposed to them.

19.10: End Chapter

Learning Objectives

- Identify the nutrient needs in early childhood. (MCCCD Competency 9)
- Learn how to cultivate healthy food attitudes in children(MCCCD Competency 3)
- Discuss the impact of childhood malnutrition. (MCCCD Competency 4)
- Identify how children get lead poisoning and discuss the long-term health implications. (MCCCD Competency 4)

20: NUTRITION THROUGH THE LIFECYCLE – PUBERTY – ADOLESCENCE

20.1: Introduction

20.2: The Onset of Puberty (Ages 9 through 13 years)

20.3: Energy and Macronutrients

20.4: Micronutrients

20.5: Iron Requirements

20.6: Energy and Macronutrients

20.7: Micronutrients

20.8: Eating Disorders

20.9: Childhood and Adolescent Obesity

20.10: Avoiding Added Sugars

20.11: End Chapter

20.1: Introduction

Learn

- Nutrient needs during puberty & adolescence
- Changes that occur in the body during puberty & adolescence
- Impact of eating disorders and obesity

The onset of puberty is the beginning of adolescence and is the bridge between the childhood years (9-13) and young adulthood (14-18). Some of the critical physiological changes that occur during this stage include the development of primary sex characteristics, reproductive organs, and the onset of menstruation in females. This life stage is also characterized by secondary sex characteristics, such as the growth of facial and body hair, the development of breasts in girls, and the deepening of boys' voices. Other physical changes include rapid growth and alterations in body proportions.

20.2: The Onset of Puberty (Ages 9 through 13 years)

This period of physical development is divided into two phases. The first phase involves height increases from 20 to 25 percent. Puberty is second to the prenatal period in rapid growth as the long bones stretch to their final adult size. Girls grow 2–8 inches taller, while boys grow 4–12 inches taller. The second phase involves weight gain related to bone, muscle, and fat tissue development. Also, amid puberty, sex hormones trigger the development of reproductive organs and secondary sexual characteristics, such as pubic hair. Girls also develop “curves,” while boys become broader and muscular.

20.3: Energy and Macronutrients

The energy requirements for preteens differ according to gender, growth, and activity level. Girls should consume about 1,400 to 2,200 calories per day for ages nine to thirteen, and boys should consume 1,600 to 2,600 calories per day. Physically active preteens who regularly participate in sports or exercise need to eat many calories to increase energy expenditures.

The AMDR is 45 to 65 percent of daily calories for carbohydrates, a recommended daily allowance of 158–228 grams for 1,400–1,600 daily calories. Carbohydrates that are high in fiber should make up the bulk of intake. The AMDR for protein is 10 to 30 percent of daily calories 35–105 grams for 1,400 daily calories for girls and 40–120 grams for 1,600 daily calories for boys. The AMDR for fat is 25 to 35 percent of daily calories, 39–54 grams for 1,400 daily calories for girls, and 44–62 grams for 1,600 daily calories for boys, depending on caloric intake and activity level.

20.4: Micronutrients

Essential vitamins needed during puberty include vitamins D, K, and B12. Adequate calcium intake is critical for building bone and preventing osteoporosis later in life. Young females need more iron at the onset of menstruation, while young males need additional iron to develop lean body mass. Almost all of these needs should be met with dietary choices, not supplements; however, iron is an exception, and supplementation may be necessary as recommended by the doctor or dietitian.

20.5: Iron Requirements

Age	Boys	Girls
9-13	8 mg/day	8 mg/day
14-18	11 mg/day	15 mg/day

After puberty, the rate of physical growth slows down. Girls stop growing taller around age sixteen, while boys grow taller until ages eighteen to twenty. One of the psychological and emotional changes that occur during this life stage includes the desire for independence as adolescents develop individual identities apart from their families. As teenagers make more and more of their dietary decisions, parents or other caregivers and authority figures should guide them toward appropriate, nutritious choices. One way that teenagers assert their independence is by choosing what to eat. They have their own money to purchase food and eat more meals away from home. Older adolescents can also be curious and open to new ideas, including trying new food and experimenting with their diet. For example, teens will sometimes skip a main meal and snack instead. That is not necessarily problematic. Their choice of food is more important than the time or place.

However, too many poor choices can make young people nutritionally vulnerable. Teens should be discouraged from eating fast food, high fat and sugar content, or frequent convenience stores and using vending machines, which typically offer poor nutritional selections. Other challenges that teens may face include obesity and eating disorders. At this life stage, young people still need guidance from parents and other caregivers about nutrition-related matters. It can help explain to young people how healthy eating habits can support activities they enjoy, such as athletics, skateboarding, or dancing.

During puberty, growth and development during adolescence differ in males than in females. Both primary and secondary sex characteristics have fully developed, and the growth rate slows with the end of puberty. Fat assumes a more significant percentage of body weight in teenage girls, while teenage boys experience more substantial muscle and bone increases. Also, the motor functions of an older adolescent are comparable to those of an adult.

20.6: Energy and Macronutrients

Adolescents have increased appetites due to increased nutritional requirements. Nutrient needs are more significant in adolescence than at any other time in the life cycle, except during pregnancy. The energy requirements for ages fourteen to eighteen are 1,800 to 2,400 calories for girls and 2,000 to 3,200 calories for boys, depending on activity level. The extra energy required for physical development during the teenaged years should be obtained from foods that provide nutrients instead of “empty calories.” Also, teens who participate in sports must meet their increased energy needs.

Older adolescents are more responsible for their dietary choices than younger children, but parents and caregivers must ensure that teens continue to meet their nutrient needs. The AMDR is 45 to 65 percent of daily calories (203–293 grams for 1,800 daily calories) for carbohydrates. Adolescents require more grain servings than younger children and eat whole grains, such as wheat, oats, barley, and brown rice. The Institute of Medicine recommends higher protein intake for growth in adolescents. The AMDR for protein is 10 to 30 percent of daily calories (45–135 grams for 1,800 daily calories), and lean proteins, such as meat, poultry, fish, beans, nuts, and seeds, are excellent ways to meet those nutritional needs.

The AMDR for fat is 25 to 35 percent of daily calories (50–70 grams for 1,800 daily calories), and the AMDR for fiber is 25–34 grams per day, depending on daily calories and activity level. Young athletes and other physically active teens need to intake enough fluids because they are at a higher risk of becoming dehydrated.

20.7: Micronutrients

Micronutrient recommendations for adolescents are mostly the same as for adults. However, children this age need more minerals to promote bone growth (e.g., calcium and phosphorus, iron and zinc for girls). Again, vitamins and minerals should be obtained from food first, supplementing certain micronutrients only (iron).

The most important micronutrients for adolescents are calcium, vitamin D, vitamin A, and iron. Adequate calcium and vitamin D are essential for building bone mass. The recommendation for calcium is 1,300 milligrams for both boys and girls. Low-fat milk and cheeses are excellent sources of calcium and help young people avoid saturated fat and cholesterol. It can also help adolescents consume products fortified with calcium, such as breakfast cereals and orange juice. Iron supports the growth of muscle and lean body mass. Adolescent girls also need to ensure sufficient iron intake before menstruating. Girls ages twelve to eighteen require 15 milligrams of iron per day. Increased amounts of vitamin C from orange juice and other sources can aid in iron absorption. Also, adequate fruit and vegetable intake allow for meeting vitamin A needs.

20.8: Eating Disorders

Many teens struggle with an eating disorder, which can have a detrimental effect on diet and health. These disorders are more prevalent among adolescent girls but have increased among adolescent boys in recent years. Because eating disorders often lead to malnourishment, adolescents with an eating disorder are deprived of the crucial nutrients their still-growing bodies need. Eating disorders stem from stress, low self-esteem, and other psychological and emotional issues. Parents need to watch for signs and symptoms of these disorders, including sudden weight loss, lethargy, vomiting after meals, and the use of appetite suppressants. Eating disorders can lead to severe complications or be fatal if left untreated. Treatment includes cognitive, behavioral, and nutritional therapy.

20.9: Childhood and Adolescent Obesity

Children need adequate caloric intake for growth, and it is important not to impose very restrictive diets. However, exceeding caloric requirements regularly can lead to childhood obesity, which has become a significant problem in North America. Nearly one in three US children and adolescents are overweight or obese.

There are several reasons for this problem, including:

- larger portion sizes
- limited access to nutrient-rich foods
- increased access to fast foods and vending machines
- lack of breastfeeding support
- declining physical education programs in schools
- insufficient physical activity and a sedentary lifestyle
- media messages encouraging the consumption of unhealthy foods

Children who suffer from obesity are more likely to become overweight or obese adults. Obesity has a profound effect on self-esteem, energy, and activity level. It is a significant risk factor for many diseases later in life, including cardiovascular disease, Type 2 diabetes, stroke, hypertension, and certain cancers.

A percentile for body mass index (BMI) specific to age and sex determines if a child is overweight or obese. This is more appropriate than the BMI categories used for adults because children's body composition varies as they develop and differs between boys and girls. If a child gains weight inappropriate to grow, parents and caregivers should limit energy-dense, nutrient-poor snack foods. It is also highly beneficial to increase a child's physical activity and limit sedentary activities, such as watching television, playing video games, or surfing the Internet.

Programs to address childhood obesity can include behavior modification, exercise counseling, psychological support or therapy, family counseling, and family meal-planning advice. For most, the goal is not weight loss but instead allowing height to catch up with weight as the child grows. Rapid weight loss is not recommended for preteens or younger children due to the risk of deficiencies and stunted growth.

20.10: Avoiding Added Sugars

One major contributing factor to childhood obesity is the consumption of added sugars. Added sugars include sugar added to food at the table and ingredients in bread, cookies, cakes, pies, jams, and soft drinks. The added sugar in store-bought items may be white, brown sugar, high-fructose corn syrup, honey, malt syrup, maple syrup, molasses, anhydrous dextrose, crystal dextrose, and concentrated fruit juice. (Not included are sugars that occur naturally in foods, such as the lactose in milk or the fructose in fruits.) Besides, sugars are often “hidden” in items added to foods after preparation, such as ketchup, salad dressing, and other condiments. The primary offenders are processed and packaged foods, soda, and other beverages. These foods are not only high in sugar; they are also light in terms of nutrients and often take the place of healthier options.

20.11: End Chapter

Knowledge Check

Children who suffer from obesity are more likely to become overweight or obese adults.

True or False

Answer available at the end of this section.

Learning Objectives

- Recognize nutrient needs during puberty & adolescence. (MCCCD Competency 4)
- Discuss changes that occur in the body during puberty & adolescence. (MCCCD Competency 4)
- Describe the health challenges with obesity during this life stage. (MCCCD Competency 9)
- Explain why iron needs increase during this life stage. (MCCCD Competency 9)

Answers

Knowledge Check

True

21: NUTRITION THROUGH THE LIFECYCLE – YOUNG ADULthood – MIDDLE AGE

- 21.1: Introduction
- 21.2: Young Adulthood
- 21.3: Middle Age
- 21.4: Energy and Macronutrients
- 21.5: Micronutrients
- 21.6: Preventive Nutrition
- 21.7: Menopause
- 21.8: Obesity
- 21.9: End Chapter

21.1: Introduction

Learn

- Nutrient Needs in Young Adulthood
- Nutrient Needs in Middle Age
- Preventative nutrition to ward off disease
- Changes that occur in the body during menopause

Adulthood begins at the end of adolescents and continues until the end of one's life. The human body will reach maximum cardiac output during adulthood, specifically between ages twenty and thirty. Bone and muscle mass also reach optimal levels, and physical activity improves muscle strength, endurance, and tone. Besides physical activity, nutrition also plays an essential role in maintaining health through adulthood. As you've already learned, a healthful diet includes a variety of nutrient-dense foods. Consuming diets high in fruits and vegetables offers health benefits such as a reduced risk for heart disease and protection against certain cancers.

21.2: Young Adulthood

Young adulthood is the period from ages nineteen to thirty years. Physical growth has been completed, and all organs and body systems are fully developed. Typically, an active young adult has reached their physical peak and is excellent. For example, vital capacity, or the maximum amount of air that the lungs can inhale and exhale, is peaked between twenty and forty. During this life stage, it is important to continue to practice good nutrition. An adult's body does not need to devote its energy and resources to support the rapid growth and development that characterizes youth. However, the choices made during those formative years can have a lasting impact. Eating habits and preferences developed during childhood and adolescence influence health and fitness into adulthood. Some adults have gotten a healthy start and have established a sound diet and regular activity program, which helps them remain in good condition from young adulthood into the later years. Others carry childhood obesity into adulthood, which adversely affects their health. However, it is not too late to change course and develop healthier habits and lifestyle choices.

Energy and Macronutrients

Young men typically have higher nutrient needs than young women. Women's energy requirements are 1,800 to 2,400 calories and 2,400 to 3,000 calories for men, depending on activity level, for ages nineteen to thirty. These estimates do not include pregnant or breastfeeding women who require a higher energy intake. For carbohydrates, the AMDR is 45 to 65 percent of daily calories. All adults, young and old, should eat fewer energy-dense carbohydrates and incredibly refined, sugar-dense sources, particularly those who lead a more sedentary lifestyle. The AMDR for protein is 10 to 35 percent of total daily calories and should include a variety of lean meat and poultry, eggs, beans, peas, nuts, and seeds. The guidelines also recommend that adults eat two 4-ounce servings (or one 8-ounce serving) of seafood per week.

All adults should limit total fat to 20 to 35 percent of their daily calories and keep saturated fatty acids to less than 10 percent of total calories by replacing them with monounsaturated and polyunsaturated fatty acids. It is also important to replace proteins high in trans fats and saturated fat with lower solid fats and calories. Avoid trans fats by limiting foods that contain synthetic sources, such as partially hydrogenated oils. Soluble fiber may help improve cholesterol and blood sugar levels, while insoluble fiber can help prevent constipation. The AMDR for fiber is 22 to 28 grams per day for women and 28 to 34 grams per day.

Micronutrients

Micronutrient needs in adults differ slightly according to sex. Males need more vitamins C and K, along with thiamine, riboflavin, and niacin. Young men and women who are very athletic and perspire a great deal also require extra sodium, potassium, and magnesium. Females require extra iron due to menstruation. Therefore, it can be beneficial for some young adults to follow a daily multivitamin regimen to help meet nutrient needs. But as always, it is important to remember “food first, supplements second.”

21.3: Middle Age

Middle age is defined as the period from age thirty-one to fifty. The early period of this stage is very different from the end. For example, many women experience pregnancy, childbirth, and lactation during the early years of middle age. In the latter part of this life stage, women face perimenopause, a transition period leading up to menopause or the end of menstruation. Several physical changes occur in the middle-aged years, including the loss of bone mass in women due to dropping estrogen levels during menopause. In both men and women, visual acuity declines, and by age forty, there can be a decreased ability to see objects at a close distance, a condition known as presbyopia. During this stage of the human life cycle, adults begin to experience the first outward signs of aging. Wrinkles start to appear, joints ache after a highly active day, and body fat accumulates. There is also a loss of muscle tone and elasticity in the connective tissue. In their late thirties and their forties, many people notice a decline in endurance, the onset of wear-and-tear injuries (such as osteoarthritis), and changes in the digestive system. Wounds and other injuries also take longer to heal. Body composition changes due to fat deposits in the trunk. To maintain health and wellness during the middle-aged years and beyond, it is important to:

- maintain a healthy body weight
- consume nutrient-dense foods
- drink alcohol in moderation
- don't smoke
- engage in moderate physical activity at least 150 minutes per week

21.4: Energy and Macronutrients

The energy requirements for ages thirty-one to fifty are 1,800 to 2,200 calories for women and 2,200 to 3,000 calories for men, depending on activity level. These estimates do not include women who are pregnant or breastfeeding. Middle-aged adults must rely on healthy food sources to meet these needs. Following the middle-aged years,' dietary guidelines provide adequate but not excessive energy, macronutrients, vitamins, and minerals. Typical dietary patterns in many parts of North America do not match the recommended guidelines.

The AMDRs for carbohydrates, protein, fat, fiber, and fluids remain the same from young adulthood into middle age. It is important to avoid putting on excess pounds to help prevent cardiovascular disease, diabetes, and other chronic conditions.

21.5: Micronutrients

There are some differences, however, regarding micronutrients. For men, magnesium's recommendation increases to 420 milligrams daily, while middle-aged women should increase their magnesium intake to 320 milligrams per day. Other essential vitamins needed during the middle-aged years include folate and vitamins B6 and B12 to prevent the elevation of homocysteine, a byproduct of metabolism that can damage arterial walls and lead to atherosclerosis, a cardiovascular condition. Again, it is essential to meet nutrient needs with food first, then supplementation, such as a daily multivitamin, if you can't meet your needs through food.

21.6: Preventive Nutrition

Preventive nutrition is defined as dietary practices that reduce disease and promote health and well-being. During the middle-aged years, preventive nutrition can promote wellness and help organ systems to function optimally throughout aging. Healthy eating in general—such as eating unrefined carbohydrates instead of refined carbohydrates and avoiding trans fats and saturated fats—promotes wellness. However, there are also some things that people can do to target specific concerns. One example is consuming foods high in antioxidants, such as strawberries, blueberries, and other colorful fruits and vegetables, reducing cancer risk.

Phytochemicals are also great nonessential nutrients that may promote body wellness. For example, carotenoids, which are found in carrots, cantaloupes, sweet potatoes, and butternut squash, may protect against cardiovascular disease by preventing the oxidation of cholesterol in the arteries. According to the American Cancer Society, some studies suggest that a phytochemical found in watermelons and tomatoes called lycopene may protect against stomach, lung, and prostate cancer, although more research is needed.

Omega-3 fatty acids can help to prevent coronary artery disease. These crucial nutrients are found in oily fish, including salmon, mackerel, tuna, herring, cod, and halibut. Other beneficial fats vital for healthy functioning include monounsaturated fats found in plant oils, avocados, peanuts, and pecans.

21.7: Menopause

In the middle-aged years, women undergo a specific change that significantly affects their health. They begin the process of menopause, typically in their late forties or early fifties. The ovaries slowly cease to produce estrogen and progesterone, which results at the end of menstruation. Menopausal symptoms can vary, including hot flashes, night sweats, and mood changes. The hormonal changes during menopause can lead to many physiological changes, including alterations in body composition, such as weight gain in the abdominal area. Bone loss is another common condition related to menopause due to losing female reproductive hormones. Bone thinning increases the risk of fractures, affecting mobility and the ability to complete everyday tasks, such as cooking, bathing, and dressing.

Recommendations for women experiencing menopause or perimenopause (the stage just before the end of the menstruation) include:

- consuming a variety of whole grains and other nutrient-dense foods
- maintaining a diet high in fiber, low in fat, and low in sodium
- avoiding caffeine, spicy foods, and alcohol to help prevent hot flashes
- eating foods rich in calcium, or taking physician-prescribed calcium supplements and vitamin D
- incorporating stretching exercises to improve balance and flexibility and reduce the risk of falls and fractures

Learn the difference between perimenopause and menopause

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21.8: Obesity

Obesity remains a primary concern in young adulthood. A BMI above 25 is considered overweight for adults, and a BMI of 30 or higher is obese. By that measurement, about two-thirds of all adults in the United States are overweight or obese, with 35.7 percent considered obese. Physical inactivity and poor dietary choices during childhood and adolescence are significant contributors to obesity in adulthood. Therefore, it is important to limit unrefined carbohydrates and processed foods.

21.9: End Chapter

Knowledge Check

Which of the following will help you maintain health and wellness during the middle-aged years and beyond?

- a. consume nutrient-dense foods
- b. don't smoke
- c. maintain a healthy body weight
- d. engage in moderate physical activity at least 50 minutes per week
- e. drink alcohol in moderation

Answer available at the end of this section.

Learning Objectives

- Summarize nutrient requirements during young adulthood. (MCCCD Competency 4)
- Summarize nutrient requirements during middle age. MCCCD Competency 4)
- Identify changes that take place in the body during young adulthood and middle age. (MCCCD Competency 4)
- Discuss menopause and summarize how to ease menopausal symptoms. (MCCCD Competency 9)
- Explain how obesity impacts health during young adulthood and middle age. (MCCCD Competency 9)

Answers

Knowledge Check

a, b, c, e

22: NUTRITION THROUGH THE LIFECYCLE - OLDER ADULTS

22.1: Introduction

22.2: Older Adults

22.3: End Chapter

22.1: Introduction

Learn

- Nutrient needs for older adults
- How aging impacts your body
- Special nutrient concerns in older adults

The right foods provide numerous benefits at every stage of life. The foods you consume in your younger years influence your health as you age. Good nutrition and regular physical activity can help you live longer and healthier. Conversely, poor nutrition and a lack of exercise can shorten your life and lead to medical problems.

22.2: Older Adults

The older adult or senior years are from age fifty-one until the end of life. Elderly typically refers to adults between the ages of 65-74 years. Several physiological and emotional changes take place during this life stage. For example, many older adults face serious health challenges, such as cancer, heart disease, diabetes, or dementia. Both men and women experience a loss of hormone production, muscle mass, and strength and change body composition. Fat deposits build up in the abdominal area, which increases the risk of Type 2 diabetes and cardiovascular disease. The skin becomes thinner and may take longer to heal after an injury. Around age seventy, men begin to experience bone loss when estrogen and testosterone levels decline. The heart has to work harder in the later years because it does not pump as efficiently. Kidneys are ineffective in excreting metabolic products such as sodium, acid, and potassium, altering water balance and increasing the risk of over- or underhydration. Besides, immune function decreases, and there is lower efficiency in absorbing vitamins and minerals.

Also, disorders of the nervous system can have profound effects. Dementia is the umbrella term for changes in the regular activity of the brain. Elderly adults with dementia may experience memory loss, agitation, and delusions. One in eight people over age sixty-four, and almost half of all people over eighty-five, suffer from brain disorder Alzheimer's disease, the most common form of dementia. Neurological disorders and psychological conditions, such as depression, can influence attitudes toward food, along with the ability to prepare or ingest food. They might lead some adults to overindulge to compensate for stress or emotions that are difficult to handle. Other adults might eat less or pay less attention to their diet and nutritional needs. Older adults may also need guidance from dietitians and healthcare professionals to make the best dietary choices for this stage of life.

At age fifty-one, requirements change once again and relate to older people's nutritional issues and health challenges.

After age sixty, blood pressure rises, and the immune system may have more difficulty battling invaders and infections. The skin becomes more wrinkled, and hair has turned gray or white or fallen out, resulting in thinning. Older adults may gradually lose an inch or two in height. Also, short-term memory might not be as keen as it once was. Being either underweight or overweight is also a significant concern for the elderly. However, many older adults remain in relatively good health and stay active in their golden years. Good nutrition is often the key to maintaining health later in life. Besides, the fitness and nutritional choices made earlier in life set for continued health and happiness. Older adults should continue to consume nutrient-dense foods and remain physically active. However, deficiencies are more common after age sixty, primarily due to reduced intake or malabsorption. The loss of mobility among frail, homebound elderly adults also impacts their access to healthy, diverse foods.

ENERGY AND MACRONUTRIENTS

Due to reductions in lean body mass and metabolic rate. The energy requirements for people ages fifty-one and over are 1,600 to 2,200 calories for women and 2,000 to 2,800 calories for men, depending on activity level. The decrease in physical activity typical of older adults also influences nutritional requirements. The AMDRs for carbohydrates, protein, and fat remain from middle age into old age. Older adults should substitute more unrefined carbohydrates for refined ones, such as whole grains and brown rice. Fiber is essential in preventing constipation and diverticulitis and may also reduce the risk of colon cancer. Protein should be lean, and healthy fats, such as omega-3 fatty acids, are part of any good diet.

MICRONUTRIENTS

An increase in certain micronutrients can help maintain health during this life stage as the recommendations for calcium increase to 1,200 milligrams per day for both men and women to slow bone loss. Also, to help protect bones, vitamin D recommendations increase to 10–15 micrograms per day for men and women. Vitamin B₆ recommendations rise to 1.7 milligrams per day for older men and 1.5 milligrams per day for older women to help lower homocysteine levels and protect against cardiovascular disease. As adults age, stomach acid production can decrease and the overgrowth of bacteria in the small intestine. This can affect the absorption of vitamin B₁₂ and cause a deficiency. As a result, older adults need more B₁₂ than younger adults and require an intake of 2.4 micrograms per day, promoting healthy brain functioning. Higher iron levels are no longer required postmenopause for older women, and recommendations decrease to 8 milligrams per day. People over age fifty should eat foods rich in all of these micronutrients.

NUTRITIONAL CONCERNS FOR OLDER ADULTS

Dietary choices can help improve health during this life stage and address some of the nutritional concerns many older adults face. Also, specific concerns related to nutrition affect adults in their later years. They include medical problems, such as disability and disease, impacting diet and activity level. Decreased intake may be due to disability like arthritis, where the person cannot stand at the stove, open a jar/can, or use a knife to chop foods. Also, many older adults skip at least one meal each day. As a result, some older adults cannot even meet reduced energy needs. Additionally, older adults have a decreased thirst response, and the kidneys have a reduced ability to concentrate urine, both of which can lead to dehydration.

SENSORY ISSUES

At about age sixty, taste buds decrease in size and number. As a result, the taste threshold is higher in older adults, meaning more of the same flavor must detect the taste. Many older adults lose the ability to distinguish between salty, sour, sweet, and bitter flavors. This can make food seem less appealing and decrease appetite. An intake of foods high in sugar and sodium can increase due to an inability to discern those tastes. The sense of smell also decreases, which impacts attitudes toward food. Sensory issues may also affect digestion because the taste and smell of food stimulate digestive enzymes' secretion in the mouth, stomach, and pancreas.

LOSS OF TEETH

Dental problems can lead to chewing and swallowing difficulties, making it hard to maintain a healthy diet. The use of dentures or the preparation of pureed or chopped foods can help solve this problem.

DIFFICULTY SWALLOWING FOODS

Some older adults have difficulty getting adequate nutrition because of dysphagia, which impairs swallowing. Any damage to the brain's parts that control swallowing can result in dysphagia; therefore, stroke is a common cause. Dysphagia is also associated with advanced dementia because of overall brain function impairment. To assist older adults suffering from dysphagia, it can be helpful to alter food consistency. For example, solid foods can be pureed, ground, or chopped to allow a more successful and safe swallow. This decreases the risk of aspiration, which occurs when food flows into the respiratory tract and can result in pneumonia. Typically, speech therapists, physicians, and dietitians work together to determine the appropriate diet for dysphagia patients.

VISION PROBLEMS

Many older people suffer from vision problems and a loss of vision. Age-related macular degeneration is the leading cause of blindness in Americans over age sixty. This disorder can make food planning and preparation extremely difficult, and people who suffer from it often must depend on caregivers for their meals. Self-feeding also may be difficult if an older adult cannot see their food. Friends and family members can help older adults with shopping and cooking. Food-assistance programs for older adults (such as Meals on Wheels) can also be helpful.

Diet may help to prevent macular degeneration. Consuming colorful fruits and vegetables increases the intake of lutein and zeaxanthin, and several studies have shown that these antioxidants protect the eyes. Lutein and zeaxanthin are green, leafy vegetables such as spinach, kale, collard greens, corn, peaches, squash, broccoli, Brussels sprouts, orange juice, and honeydew melon.

ANEMIA

Iron-poor diets and chronic diseases can lead to anemia in older adults. Other health issues like ulcers, decreased stomach acid, or intrinsic factors to properly absorb vitamin B12 can also contribute.

Signs and Symptoms of Anemia

- Fatigue
- Shortness of breath
- Feeling cold
- Confusion
- Depression
- Dizziness or weakness
- Brittle or spoon-shaped nails
- Experience a change in how foods taste
- Headache
- Sore tongue
- Pale colored skin
- Dry and easily bruised skin
- Restless legs syndrome
- Fast heartbeat

Eating iron-rich foods like red meat, pork, poultry, seafood, beans, dark leafy green vegetables can help maintain iron stores in the body.

CONSTIPATION

According to the National Institute of Health, in people aged 65, about 26% of women and 16% of men suffer from constipation. The rate continues to increase as we age. For 84 years and older, rates rise to 34% for women and 26% for men. Constipation can be a side effect of medication, low fluid intake, low activity, or a low fiber diet, and many times it is a mix of some or all of these issues. If not adequately addressed, these issues can lead to intestinal blockage.

OSTEOPOROSIS

The importance of having adequate calcium stores early in life impacts our risk of fractures later in our elderly years. Many elderly with osteoporosis who fall and break a hip never recover fully. Approximately 15% die within one year due to complications as their health further declines due to the injury. The elderly need to continue participating in strength-bearing exercises and get adequate amounts of Vitamin D and calcium to help support bone health.

POLYPHARMACY

The use of five or more prescription drugs per day is called polypharmacy. Most older adults average 2-9 medications per day. With each medication comes side effects such as decreased appetite, dizziness, fatigue, taste alterations, excretion of specific vitamins and minerals. Additionally, the elderly are at a higher risk for drug interactions due to their body's ability to metabolize and clear the drugs from their body.

OBESITY

Obesity is a concern for the elderly. Adults over age sixty are more likely to be obese than young or middle-aged adults. Being overweight or obese increases the risk of cardiovascular disease, the leading cause of death in the United States. Type 2 diabetes causes about seventy thousand deaths in the United States annually. Obesity is also a contributing factor for many other conditions, including arthritis.

For older adults who are overweight or obese, dietary changes to promote weight loss should be combined with an exercise program to protect muscle mass. This is because dieting reduces muscle and fat, exacerbating muscle mass loss due to aging. Although weight loss among the elderly can be beneficial, it is best to be cautious and consult with a healthcare professional before beginning a weight-loss program.

22.3: End Chapter

Knowledge Check

Age-related macular degeneration is the leading cause of blindness in Americans over age sixty

True or False

Answer available at the end of this section.

Learning Objectives

- Identify critical nutrients for older adults. (MCCCD Competency 4)
- Explain age-related changes within the body that could negatively impact health. (MCCCD Competency 4)
- Discuss special nutritional concerns associated with older adults. (MCCCD Competency 3)

Answers

Knowledge Check

True

Appendix

This is where you can add appendices or other back matter.

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GLOSSARY

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