Section 2

The Digestive Process Begins

Reading Preview

Key Concepts

- What functions are carried out in the digestive system?
- What roles do the mouth, esophagus, and stomach play in digestion?

Key Terms

- digestion • absorption
- saliva • enzyme • epiglottis
- esophagus • mucus
- peristalsis • stomach

Target Reading Skill

Using Prior Knowledge Before you read, look at the section headings and visuals to see what this section is about. Then write what you know about the digestive system in a graphic organizer like the one below. As you read, continue to write in what you learn.

What You Know
1. Food is digested in the stomach. 2.

What You Learned
1. 2.

Lab zone Discover Activity

How Can You Speed Up Digestion?

1. Obtain two plastic jars with lids. Fill the jars with equal amounts of water at the same temperature.
2. Place a whole sugar cube into one jar. Place a crushed sugar cube into the other jar.
3. Fasten the lids on the jars. Holding one jar in each hand, shake the two jars gently and for equal amounts of time.
4. Place the jars on a flat surface. Observe whether the whole cube or the crushed cube dissolves faster.

Think It Over

Predicting Use the results of this activity to predict which would take longer to digest: a large piece of food or one that has been cut up into many small pieces. Explain your answer.

In 1822, a man named Alexis St. Martin was wounded in the stomach. Dr. William Beaumont saved St. Martin's life. The wound, however, left an opening in St. Martin's stomach that never healed completely. Beaumont realized that by looking through the opening in St. Martin's abdomen, he could observe what was happening inside the stomach.

Beaumont observed that food changed chemically inside the stomach. He hypothesized that chemical reactions in the stomach broke down foods into smaller particles. Beaumont removed liquid from St. Martin's stomach and analyzed it. The stomach liquid contained an acid that played a role in the breakdown of foods into simpler substances.

Functions of the Digestive System

Beaumont's observations helped scientists understand the role of the stomach in the digestive system. **The digestive system has three main functions. First, it breaks down food into molecules the body can use. Then, the molecules are absorbed into the blood and carried throughout the body. Finally, wastes are eliminated from the body.** Figure 12 shows the organs of the digestive system, which is about 9 meters long from beginning to end.

Digestion The process by which your body breaks down food into small nutrient molecules is called **digestion.** There are two kinds of digestion—mechanical and chemical. In mechanical digestion, foods are physically broken down into smaller pieces. Mechanical digestion occurs when you bite into a sandwich and chew it into small pieces.

In chemical digestion, chemicals produced by the body break foods into their smaller chemical building blocks. For example, the starch in bread is broken down into individual sugar molecules.

Absorption and Elimination After your food is digested, the molecules are ready to be transported throughout your body. **Absorption** (ab SAWRP shun) is the process by which nutrient molecules pass through the wall of your digestive system into your blood. Materials that are not absorbed, such as fiber, are eliminated from the body as wastes.

Reading Checkpoint **What is chemical digestion?**

Go Online
SCILINKS NSTA
For: Links on digestion
Visit: www.SciLinks.org
Web Code: scn-0423

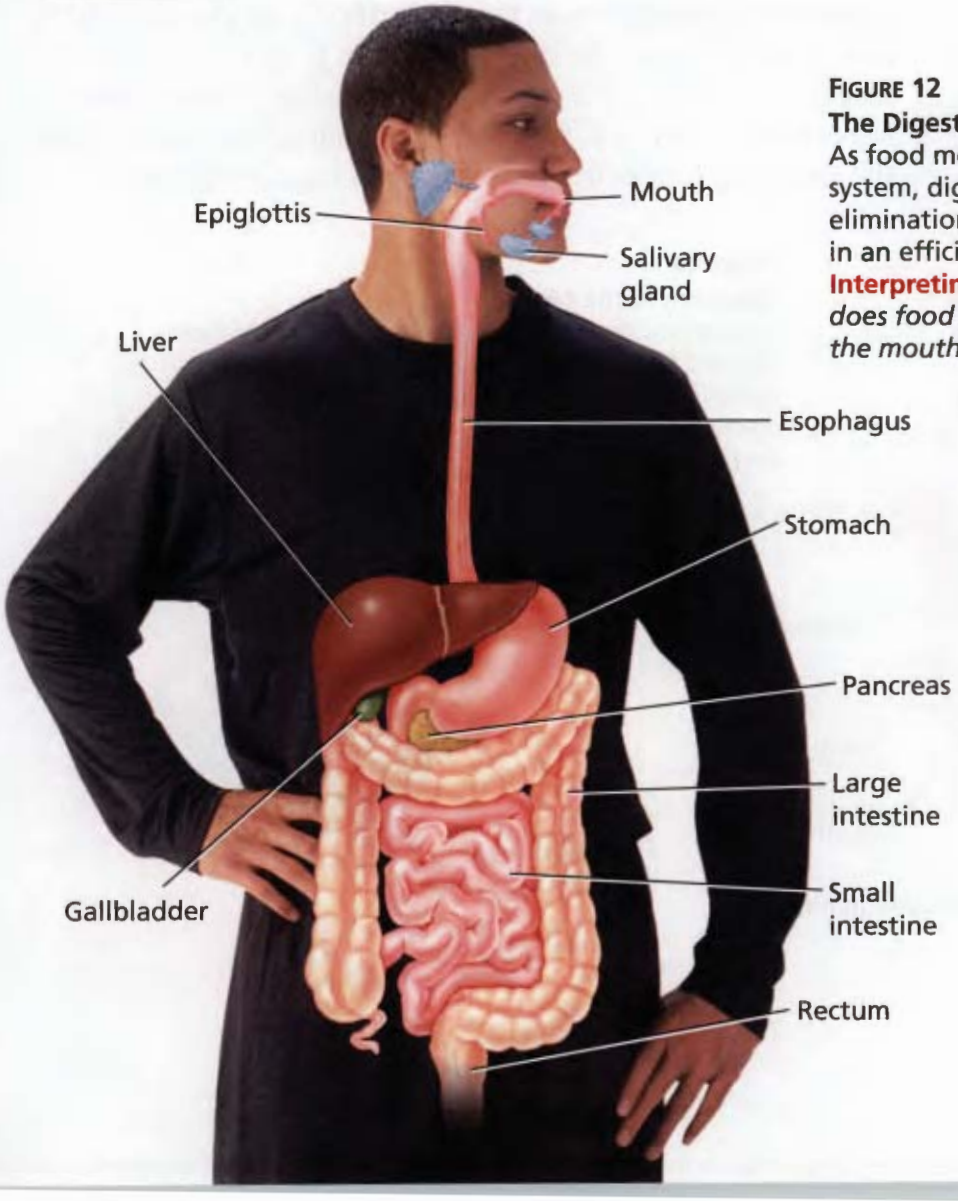


FIGURE 12
The Digestive System
As food moves through the digestive system, digestion, absorption, and elimination occur one after the other in an efficient, continuous process.
Interpreting Diagrams *Which organs does food pass through after leaving the mouth?*

The Mouth

Have you ever walked past a bakery or restaurant and noticed your mouth watering? Smelling or even just thinking about food when you're hungry is enough to start your mouth watering. This response isn't accidental. When your mouth waters, your body is preparing for the delicious meal it expects. **Both mechanical and chemical digestion begin in the mouth.** The fluid released when your mouth waters is **saliva** (suh LY vuh). Saliva plays an important role in both kinds of digestion.

Mechanical Digestion in the Mouth Your teeth carry out the first stage of mechanical digestion. Your center teeth, or incisors (in SY zurz), cut the food into bite-sized pieces. On either side of the incisors there are sharp, pointy teeth called canines (KAY nynz). These teeth tear and slash the food into smaller pieces. Behind the canines are the premolars and molars, which crush and grind the food. As the teeth do their work, saliva moistens the pieces of food into one slippery mass.

Chemical Digestion in the Mouth As mechanical digestion begins, so does chemical digestion. If you take a bite of a cracker and suck on it, the cracker begins to taste sweet. It tastes sweet because a chemical in the saliva has broken down the starch molecules in the cracker into sugar molecules.

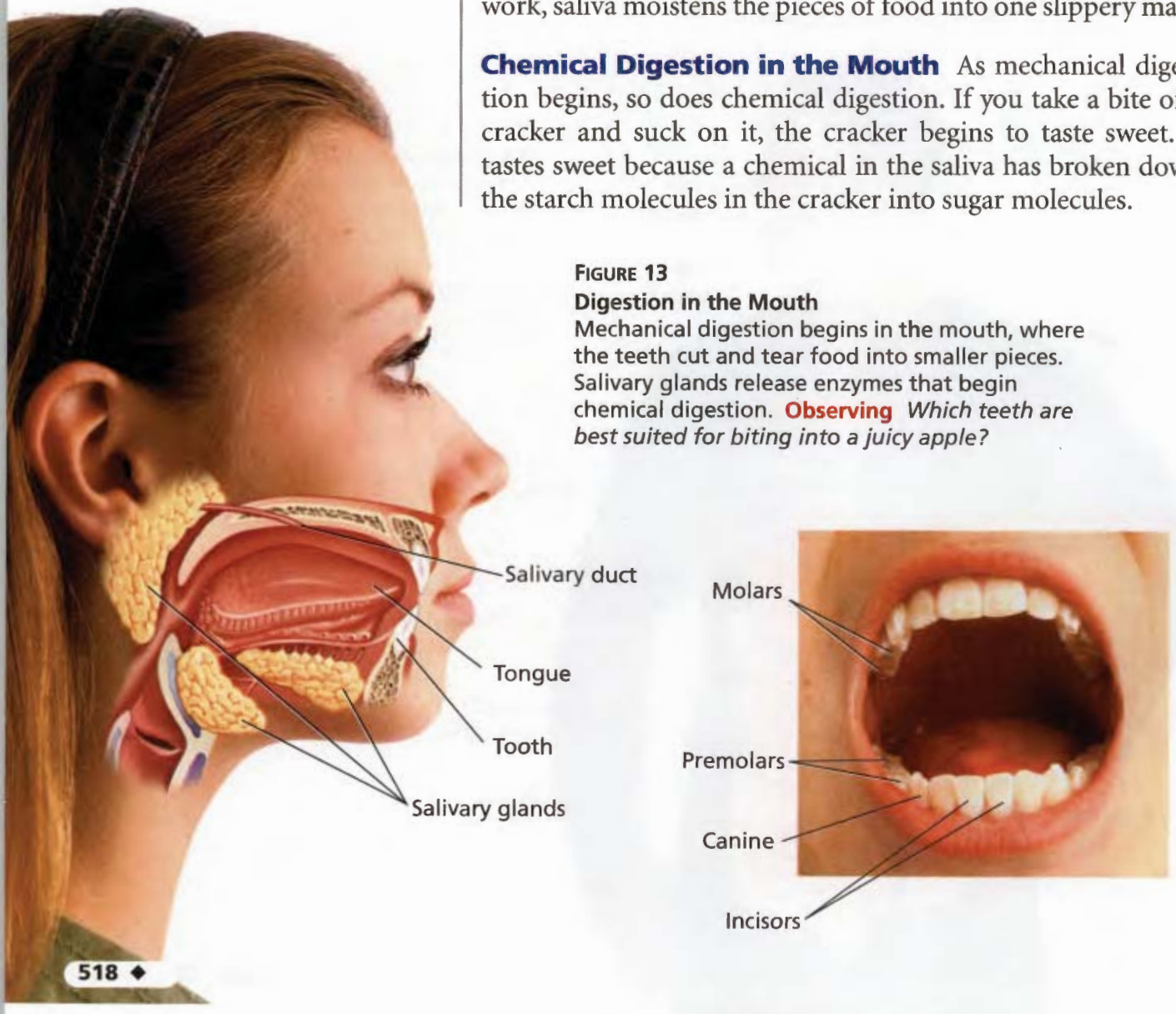
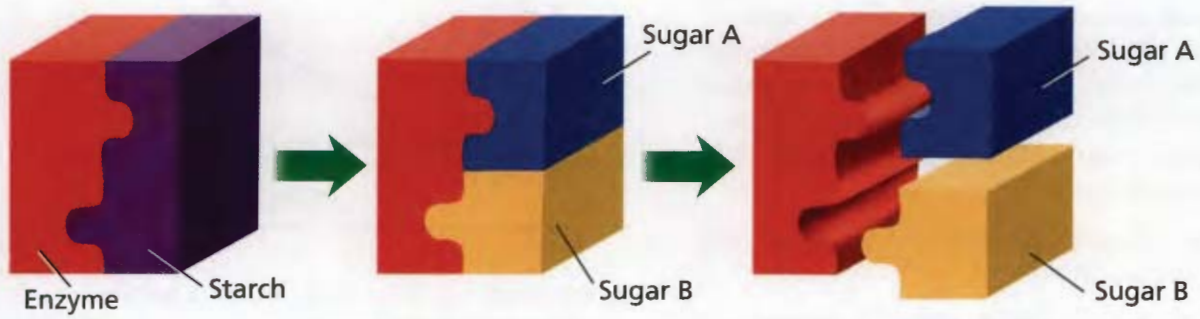


FIGURE 13
Digestion in the Mouth
Mechanical digestion begins in the mouth, where the teeth cut and tear food into smaller pieces. Salivary glands release enzymes that begin chemical digestion. **Observing** *Which teeth are best suited for biting into a juicy apple?*

FIGURE 14
How Enzymes Work
The shape of an enzyme molecule is specific to the shape of the food molecule it breaks down. Here, an enzyme breaks down a starch into sugars.



1. The shape of the enzyme fits the starch molecule.
2. A chemical reaction occurs between the enzyme and starch molecule.
3. The starch molecule has been broken down into sugar molecules.

The chemical in saliva that digests starch is an enzyme. **Enzymes** are proteins that speed up chemical reactions in the body. Your body produces many different enzymes. Each enzyme has a specific chemical shape. Its shape enables it to take part in only one kind of chemical reaction. An example of enzyme action is shown in Figure 14.

The Esophagus

If you've ever choked on food, your food may have "gone down the wrong way." That's because there are two openings at the back of your mouth. One opening leads to your windpipe, which carries air into your lungs. As you swallow, a flap of tissue called the **epiglottis** (ep uh GLAHT is) seals off your windpipe, preventing the food from entering. The food goes into the **esophagus** (ih SAHF uh gus), a muscular tube that connects the mouth to the stomach. The esophagus is lined with **mucus,** a thick, slippery substance produced by the body. Mucus makes food easier to swallow and move along.

Food remains in the esophagus for only about 10 seconds. **After food enters the esophagus, contractions of smooth muscles push the food toward the stomach.** These involuntary waves of muscle contraction are called **peristalsis** (pehr ih STAWL sis). Peristalsis also occurs in the stomach and farther down the digestive system. These muscular waves keep food moving in one direction.

Reading Checkpoint **How is food prevented from entering the windpipe?**

Lab zone Try This Activity

Modeling Peristalsis

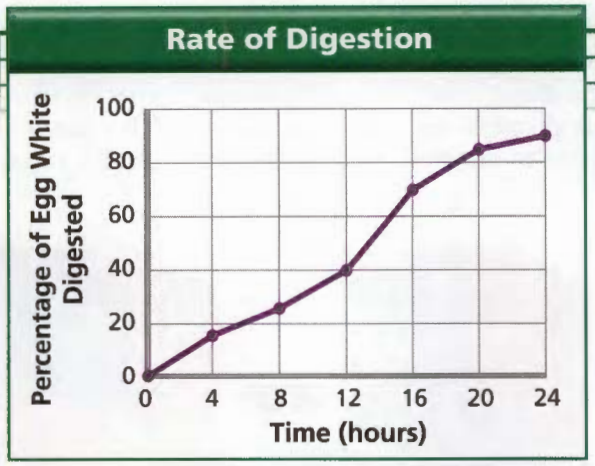
1. Obtain a clear, flexible plastic straw.
2. Hold the straw vertically and insert a small bead into the top of the straw. The bead should fit snugly into the straw. **CAUTION:** *Do not put the straw in your mouth or blow into the straw.*
3. Pinch the straw above the bead so the bead begins to move down the length of the tubing.
4. Repeat Step 3 until the bead exits the straw.

Making Models How does this action compare with peristalsis? What do the bead and the straw represent?

Math Analyzing Data

Protein Digestion

A scientist performed an experiment to determine the amount of time needed to digest protein. He placed small pieces of hard-boiled egg white (a protein) in a test tube containing hydrochloric acid, water, and the enzyme pepsin. He measured the rate at which the egg white was digested over a 24-hour period. His data are recorded in the graph.



1. **Reading Graphs** What do the values on the *y*-axis represent?
2. **Interpreting Data** After about how many hours would you estimate that half of the protein was digested?
3. **Interpreting Data** How much digestion occurred in 16 hours?
4. **Drawing Conclusions** During which 4-hour period did the most digestion take place?

The Stomach

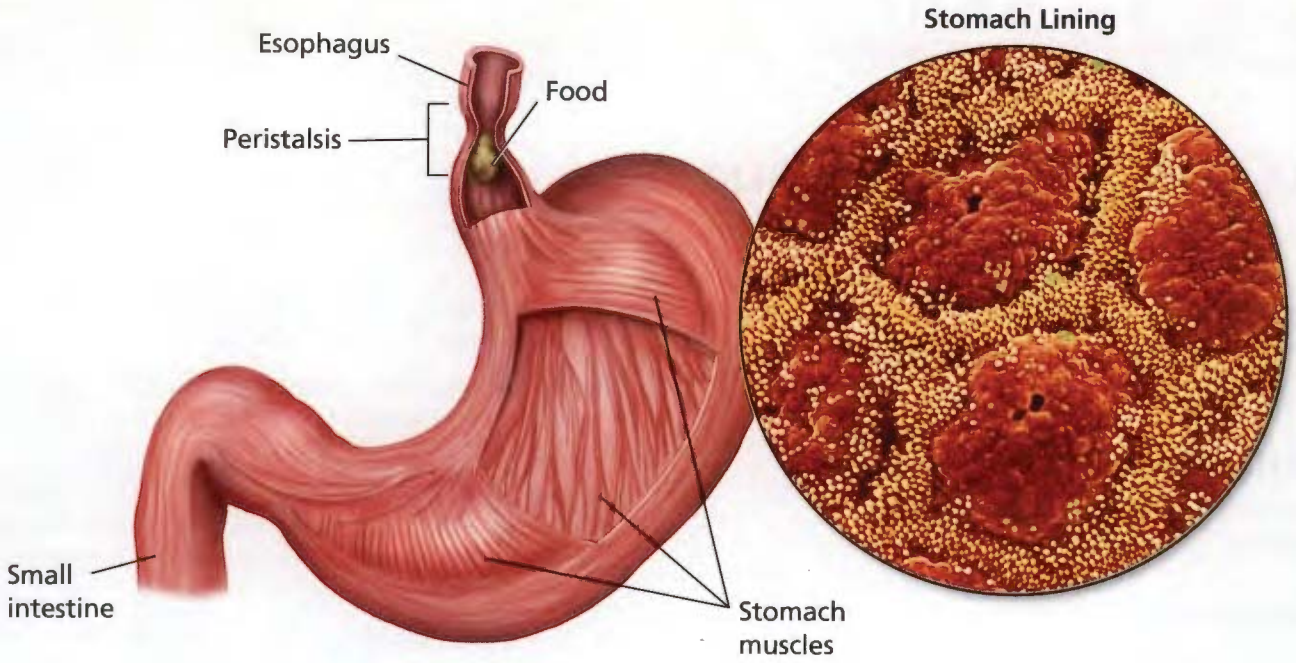
When food leaves the esophagus, it enters the **stomach,** a J-shaped, muscular pouch located in the abdomen. As you eat, your stomach expands to hold all of the food that you swallow. **Most mechanical digestion and some chemical digestion occur in the stomach.**

Mechanical Digestion in the Stomach The process of mechanical digestion occurs as three strong layers of smooth muscle contract to produce a churning motion. This action mixes the food with fluids in somewhat the same way that clothes and soapy water are mixed in a washing machine.

Chemical Digestion in the Stomach Chemical digestion occurs as the churning food makes contact with digestive juice, a fluid produced by cells in the lining of the stomach. Digestive juice contains the enzyme pepsin. Pepsin chemically digests the proteins in your food, breaking them down into short chains of amino acids.

Digestive juice also contains hydrochloric acid, a very strong acid. Without this strong acid, your stomach could not function properly. First, pepsin works best in an acid environment. Second, the acid kills many bacteria that you swallow with your food.

Why doesn't stomach acid burn a hole in your stomach? The reason is that cells in the stomach lining produce a thick coating of mucus, which protects the stomach lining. Also, the cells that line the stomach are quickly replaced as they are damaged or worn out.



Food remains in the stomach until all of the solid material has been broken down into liquid form. A few hours after you finish eating, the stomach completes mechanical digestion of the food. By that time, most of the proteins have been chemically digested into shorter chains of amino acids. The food, now a thick liquid, is released into the next part of the digestive system. That is where final chemical digestion and absorption will take place.

Reading Checkpoint **What is pepsin?**

FIGURE 15
The Stomach
The stomach has three layers of muscle that help to break down foods mechanically. The inset photo shows a microscopic view of the stomach lining. The yellow dots are mucus.
Relating Cause and Effect *What role does mucus play inside the stomach?*

Section 2 Assessment

Target Reading Skill **Using Prior Knowledge** Review your graphic organizer and revise it based on what you just learned in the section.

Reviewing Key Concepts

1. a. **Listing** What are the functions of the digestive system?
   b. **Comparing and Contrasting** Distinguish between mechanical and chemical digestion.
   c. **Inferring** Why must mechanical digestion start before chemical digestion?
2. a. **Reviewing** What key chemicals do the mouth and stomach contain?
   b. **Describing** How do pepsin and hydrochloric acid work together to digest food in the stomach?
   c. **Predicting** What could happen if your stomach didn't produce enough mucus? Explain.

Lab zone At-Home Activity

First Aid for Choking Explain to your family what happens when people choke on food. With your family, find out how to recognize when a person is choking and what to do to help the person. Learn about the Heimlich maneuver and how it is used to help someone who is choking.

Lab zone Skills Lab

As the Stomach Churns

Problem

What conditions are needed for the digestion of proteins in the stomach?

Skills Focus

interpreting data, controlling variables, drawing conclusions

Materials

- test-tube rack
- pepsin
- water
- 4 strips blue litmus paper
- cubes of boiled egg white
- 10-mL plastic graduated cylinder
- 4 test tubes with stoppers
- marking pencil
- diluted hydrochloric acid
- plastic stirrers

Procedure

1. In this lab, you will investigate how acidic conditions affect protein digestion. Read over the entire lab to see what materials you will be testing. Write a prediction stating which conditions you think will speed up protein digestion. Then, copy the data table into your notebook.
2. Label four test tubes A, B, C, and D, and place them in a test-tube rack.
3. In this lab, the protein you will test is boiled egg white, which has been cut into cubes about 1 cm on each side. Add 3 cubes to each test tube. Note and record the size and overall appearance of the cubes in each test tube. **CAUTION:** *Do not put any egg white into your mouth.*
4. Use a graduated cylinder to add 10 mL of the enzyme pepsin to test tube A. Observe the egg white cubes to determine whether an immediate reaction takes place. Record your observations under Day 1 in your data table. If no changes occur, write "no immediate reaction."
5. Use a clean graduated cylinder to add 5 mL of pepsin to test tube B. Then rinse out the graduated cylinder and add 5 mL of water to test tube B. Observe whether or not an immediate reaction takes place.
6. Use a clean graduated cylinder to add 10 mL of hydrochloric acid to test tube C. Observe whether or not an immediate reaction takes place. **CAUTION:** *Hydrochloric acid can burn skin and clothing. Avoid direct contact with it. Wash any splashes or spills with plenty of water, and notify your teacher.*

Data Table

Test Tube	Egg White Appearance		Litmus Color	
	Day 1	Day 2	Day 1	Day 2
A				
B				
C				
D				

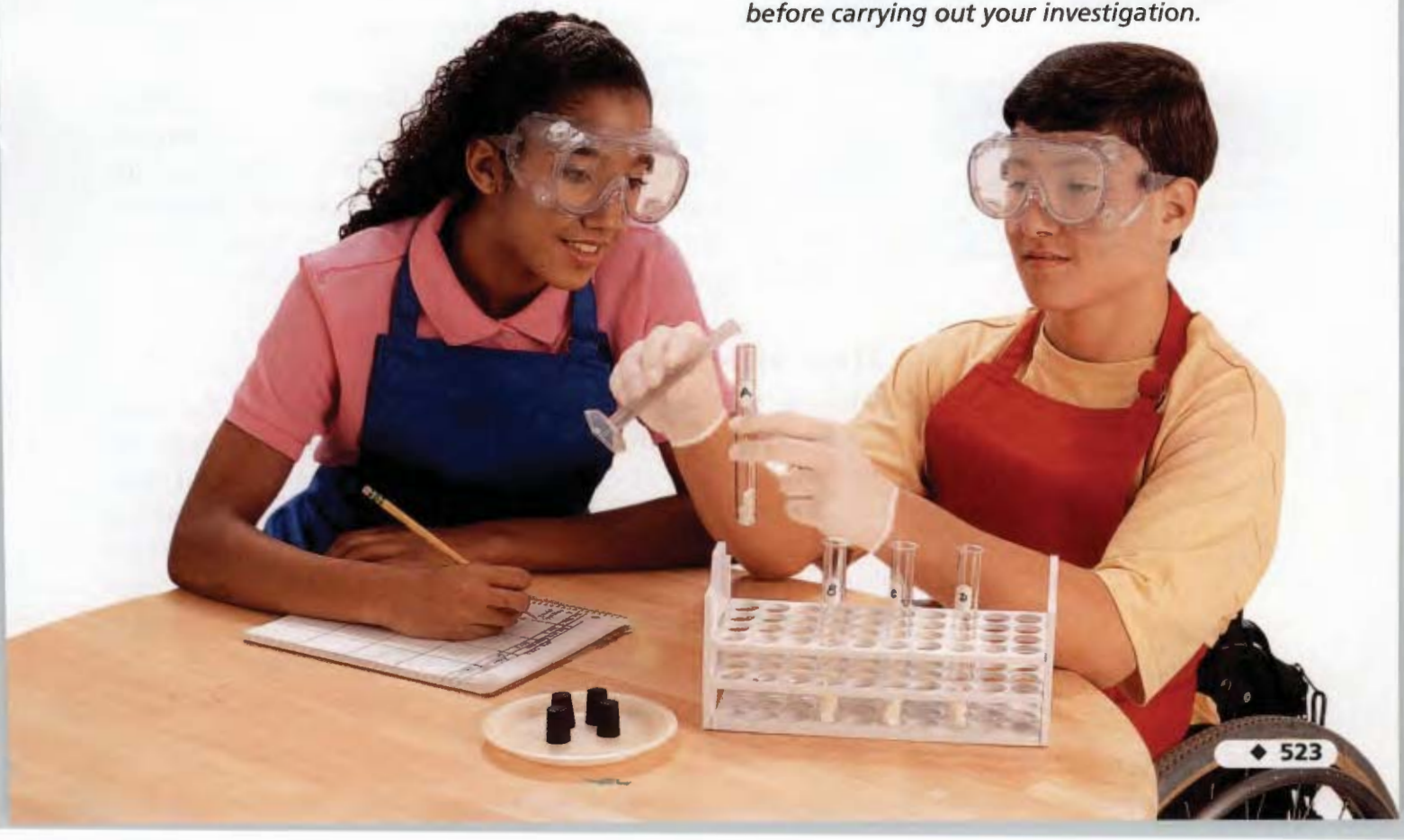
7. Use a clean graduated cylinder to add 5 mL of pepsin to test tube D. Then, rinse the graduated cylinder and add 5 mL of hydrochloric acid to test tube D. Observe whether or not an immediate reaction takes place. Record your observations.
8. Obtain four strips of blue litmus paper. (Blue litmus paper turns pink in the presence of an acid.) Dip a clean plastic stirrer into the solution in each test tube, and then touch the stirrer to a piece of litmus paper. Observe what happens to the litmus paper. Record your observations.
9. Insert stoppers in the four test tubes and store the test tube rack as directed by your teacher.
10. The next day, examine the contents of each test tube. Note any changes in the size and overall appearance of the egg white cubes. Then, test each solution with litmus paper. Record your observations in your data table.

Analyze and Conclude

1. **Interpreting Data** Which materials were the best at digesting the egg white? What observations enabled you to determine this?
2. **Inferring** Is the chemical digestion of protein in food a fast or a slow reaction? Explain.
3. **Controlling Variables** Why was it important that the cubes of egg white all be about the same size?
4. **Drawing Conclusions** What did this lab show about the ability of pepsin to digest protein?
5. **Communicating** Write a paragraph in which you describe the purpose of test tube A and test tube C as they relate to the steps you followed in the procedure.

Design an Experiment

Design a way to test whether protein digestion is affected by the size of the food pieces. Write down your hypothesis and the procedure you will follow. *Obtain your teacher's permission before carrying out your investigation.*



Section 3

Final Digestion and Absorption

Reading Preview

Key Concepts

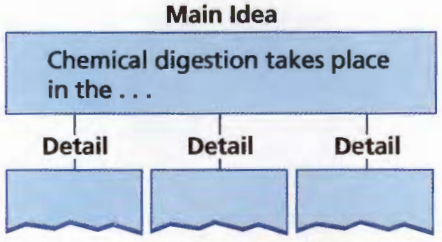
- What digestive processes occur in the small intestine, and how are other digestive organs involved?
- What role does the large intestine play in digestion?

Key Terms

- small intestine • liver • bile
- gallbladder • pancreas
- villus • large intestine
- rectum • anus

Target Reading Skill

Identifying Main Ideas As you read the section titled The Small Intestine, write the main idea in a graphic organizer like the one below. Then, write three supporting details that further explain the main idea.



Lab zone **Discover Activity**

Which Surface Is Larger?

1. Work with a partner to carry out this investigation.
2. Begin by placing your hand palm-side down on a table. Keep your thumb and fingers tightly together. Lay string along the outline of your hand. Have your partner help you determine how long a string you need to outline your hand.
3. Use a metric ruler to measure the length of that string.

Think It Over

Predicting How long would you expect your hand outline to be if you spread out your thumb and fingers? Use string to test your prediction. Compare the two string lengths.

Have you ever been part of a huge crowd attending a concert or sports event? Barriers and passageways often guide people in the right direction. Ticket takers make sure that people enter in an orderly fashion.

In some ways, the stomach can be thought of as the "ticket taker" of the digestive system. Once the food has been changed into a thick liquid, the stomach releases a little of the liquid at a time into the next part of the digestive system. This slow, smooth passage of food through the digestive system ensures that digestion and absorption can take place efficiently.

The Small Intestine

After the thick liquid leaves the stomach, it enters the small intestine. The **small intestine** is the part of the digestive system where most chemical digestion takes place. You may wonder how the small intestine got its name. After all, at about 6 meters—longer than some full-sized cars—it makes up two thirds of the length of the digestive system. The small intestine was named for its small diameter. It is from 2 to 3 centimeters wide, about half the diameter of the large intestine.

When food reaches the small intestine, it has already been mechanically digested into a thick liquid. But chemical digestion has just begun. Starches and proteins have been partially broken down, but fats haven't been digested at all. **Almost all chemical digestion and absorption of nutrients takes place in the small intestine.** As the liquid moves into the small intestine, it mixes with enzymes and secretions that are produced by the small intestine, the liver, and the pancreas. The liver and the pancreas deliver their substances to the small intestine through small tubes.

The Liver As you can see in Figure 16, the **liver** is located in the upper right portion of the abdomen. It is the largest organ inside the body. The liver is like an extremely busy chemical factory and plays a role in many body processes. For example, it breaks down medicines, and it helps eliminate nitrogen from the body. **The role of the liver in the digestive system is to produce bile.**

Bile is a substance that breaks up fat particles. Bile flows from the liver into the **gallbladder,** the organ that stores bile. After you eat, bile passes through a tube from the gallbladder into the small intestine.

Bile is not an enzyme. It does not chemically digest foods. It does, however, physically break up large fat particles into smaller fat droplets. You can compare the action of bile on fats with the action of soap on a greasy frying pan. Soap physically breaks up the grease into small droplets that can mix with the soapy water and be washed away. Bile mixes with the fats in food to form small fat droplets. The droplets can then be chemically broken down by enzymes produced in the pancreas.

Lab zone **Try This Activity**

Break Up!

You can model the breakup of fat particles in the small intestine.

1. Fill two plastic jars half full of water. Add a few drops of oil to each jar.
2. Add about $\frac{1}{4}$ spoonful of baking soda to one jar.
3. Stir the contents of both jars. Record your observations.

Observing In which jar did the oil begin to break up? What substance does the baking soda represent?

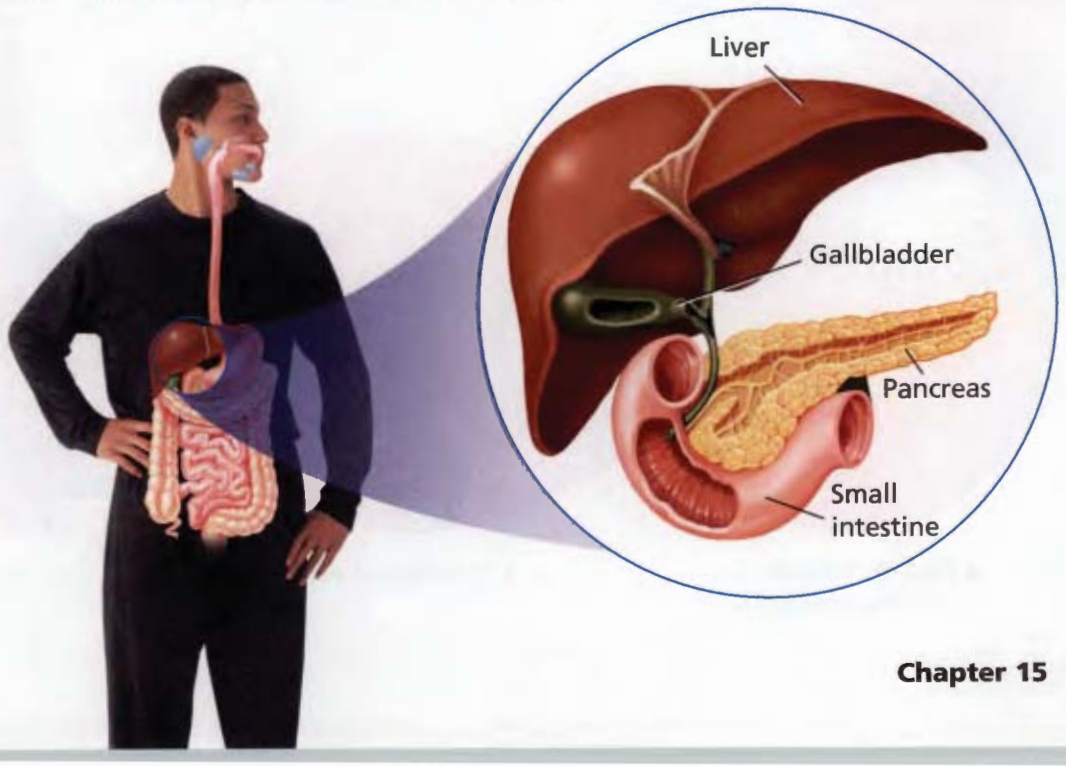


FIGURE 16
The Liver and Pancreas
Substances produced by the liver and pancreas aid in digestion.
Predicting *How would digestion be affected if the tube leading from the gallbladder to the small intestine became blocked?*

Go Online
PHSchool.com
For: More on the digestive system
Visit: PHSchool.com
Web Code: ced-4024

The Pancreas The **pancreas** is a triangular organ that lies between the stomach and the first part of the small intestine. Like the liver, the pancreas plays a role in many body processes. **As part of the digestive system, the pancreas produces enzymes that flow into the small intestine and help break down starches, proteins, and fats.**

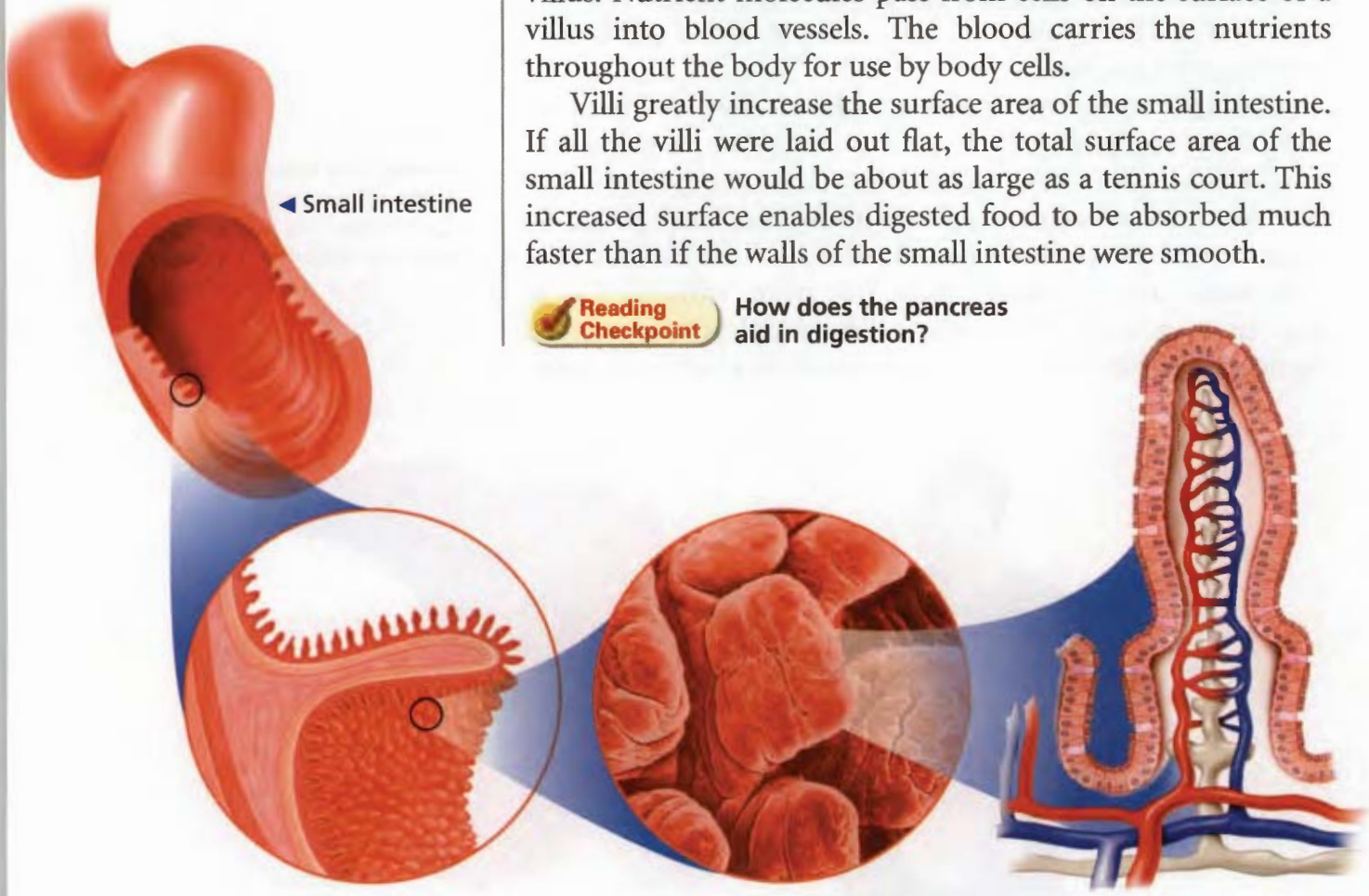
Digestive enzymes do not break down all food substances. Recall that the fiber in food isn't broken down. Instead, fiber thickens the liquid material in the intestine. This thickening makes it easier for peristalsis to push the material forward.

Absorption in the Small Intestine After chemical digestion takes place, the small nutrient molecules are ready to be absorbed by the body. The structure of the small intestine makes it well suited for absorption. The inner surface, or lining, of the small intestine looks bumpy. Millions of tiny finger-shaped structures called **villi** (VIL eye) (singular *villus*) cover the surface. The villi absorb nutrient molecules. Notice in Figure 17 that tiny blood vessels run through the center of each villus. Nutrient molecules pass from cells on the surface of a villus into blood vessels. The blood carries the nutrients throughout the body for use by body cells.

Villi greatly increase the surface area of the small intestine. If all the villi were laid out flat, the total surface area of the small intestine would be about as large as a tennis court. This increased surface enables digested food to be absorbed much faster than if the walls of the small intestine were smooth.

Reading Checkpoint **How does the pancreas aid in digestion?**

FIGURE 17
The Small Intestine
Tiny finger-shaped projections called villi line the inside of the small intestine. Blood vessels in the villi are covered by a single layer of cells.
Relating Cause and Effect *How does the structure of the villi help them carry out their function?*



▲ Fold in the wall of the small intestine

▲ Close-up of villi

▲ Villus

The Large Intestine

By the time material reaches the end of the small intestine, most nutrients have been absorbed. The remaining material moves from the small intestine into the large intestine. The **large intestine** is the last section of the digestive system. It is about 1.5 meters long—about as long as the average bathtub. It runs up the right-hand side of the abdomen, across the upper abdomen, and then down the left-hand side. The large intestine contains bacteria that feed on the material passing through. These bacteria normally do not cause disease. In fact, they are helpful because they make certain vitamins, including vitamin K.

The material entering the large intestine contains water and undigested food. **As the material moves through the large intestine, water is absorbed into the bloodstream. The remaining material is readied for elimination from the body.**

The large intestine ends in a short tube called the **rectum.** Here, waste material is compressed into a solid form. This waste material is eliminated from the body through the **anus,** a muscular opening at the end of the rectum.

Reading Checkpoint **What role do bacteria play in the large intestine?**

FIGURE 18
The Large Intestine
As material passes through the large intestine, most of the water is absorbed by the body. The remaining material will be eliminated from the body.

Section 3 Assessment

Target Reading Skill

Identifying Main Ideas Use your graphic organizer to help you answer Question 1 below.

Reviewing Key Concepts

1. a. **Reviewing** What two digestive processes occur in the small intestine?
   b. **Explaining** Explain how bile produced by the liver and enzymes produced in the pancreas function in the small intestine.
   c. **Relating Cause and Effect** Some people are allergic to a protein in wheat. When these people eat foods made with wheat, a reaction destroys the villi in the small intestine. What problems would you expect these people to experience?
2. a. **Identifying** Which key nutrient is absorbed in the large intestine?
   b. **Describing** What happens as food moves through the large intestine?
   c. **Applying Concepts** Diarrhea is a condition in which waste material that is eliminated contains too much water. How might diarrhea upset homeostasis in the body? How could a person reduce the effects of diarrhea on the body?

Writing in Science

Sequence of Events Describe the journey of a bacon, lettuce, and tomato sandwich through a person's digestive system, starting in the mouth and ending with absorption. Include where digestion of fats, carbohydrates, and proteins take place. Use words like *first*, *next*, and *finally* in your writing.

Chapter 15 Study Guide

The BIG Idea **Structure and Function** The digestive system breaks food down into small nutrient molecules that are then absorbed into the blood and carried throughout the body.

1 Food and Energy

Key Concepts

- Food provides the body with raw materials and energy.
- Carbohydrates provide energy as well as the raw materials to make cell parts.
- Fats provide energy and form part of the cell membrane. Fatty tissue protects and insulates the body.
- Proteins are needed for tissue growth and repair. They also play an important part in chemical reactions within cells.
- Vitamins and minerals are needed in small amounts to carry out chemical processes.
- Water is the most important nutrient because the body's vital processes take place in water.
- The USDA guidelines provide a personalized way to help people make healthy food choices based on their age, sex, and amount of physical activity.

Key Terms

nutrient
calorie
carbohydrate
glucose
fat
protein
amino acid
vitamin
mineral
Percent Daily Value
Dietary Reference Intakes (DRIs)

2 The Digestive Process Begins

Key Concepts

- The digestive system breaks down food into molecules the body can use. Then, the molecules are absorbed into the blood and carried throughout the body. Finally, wastes are eliminated.
- Both mechanical and chemical digestion begin in the mouth.
- In the esophagus, contractions of smooth muscles push the food toward the stomach.
- Most mechanical digestion and some chemical digestion occur in the stomach.

Key Terms

• digestion • absorption • saliva • enzyme • epiglottis • esophagus • mucus • peristalsis • stomach

3 Final Digestion and Absorption

Key Concepts

- Almost all chemical digestion and absorption of nutrients takes place in the small intestine.
- The liver produces bile, which breaks up fats.
- The pancreas produces enzymes that help break down starches, proteins, and fats.
- In the large intestine, water is absorbed into the bloodstream. The remaining material is readied for elimination.

Key Terms

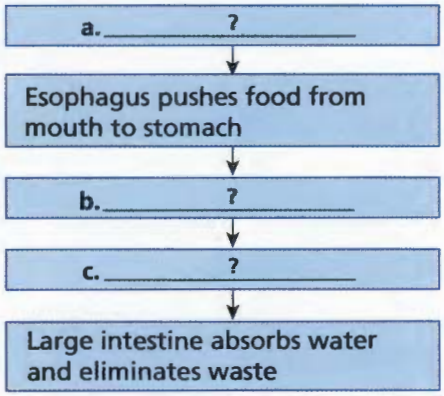
• small intestine • liver • bile • gallbladder • pancreas • villus • large intestine • rectum • anus

Review and Assessment

Go Online
PHSchool.com
For: Self-Assessment
Visit: PHSchool.com
Web Code: cha-3150

Organizing Information

Sequencing Copy the flowchart about digestion onto a separate sheet of paper. Then, complete it and add a title. (For more on Sequencing, see the Skills Handbook.)



Reviewing Key Terms

Choose the letter of the best answer.

1. The building blocks of proteins are
   a. vitamins.
   b. minerals.
   c. amino acids.
   d. fats.
2. Which of the following groups of nutrients is a major source of energy for the body?
   a. proteins
   b. vitamins
   c. minerals
   d. carbohydrates
3. The enzyme in saliva chemically breaks down
   a. fats.
   b. proteins.
   c. glucose.
   d. starches.
4. Most mechanical digestion takes place in the
   a. liver.
   b. esophagus.
   c. stomach.
   d. small intestine.
5. Bile is produced by the
   a. liver.
   b. pancreas.
   c. small intestine.
   d. large intestine.

If the statement is true, write *true*. If it is false, change the underlined word or words to make the statement true.

6. Proteins that come from animal sources are incomplete proteins.
7. Vitamins are nutrients that are not made by living things.
8. To determine which of two cereals supplies more iron, check the Percent Daily Value on the food label.
9. Absorption moves food through the digestive system.
10. Most materials are absorbed into the bloodstream in the large intestine.

Writing in Science

Information Sheet You are a nutritionist assigned to work with a family trying to eat a more healthful diet. Write an instruction sheet outlining what kinds of foods they should eat. Provide some examples of each kind of food.

Discovery Channel School

Food and Digestion
Video Preview
Video Field Trip
▶ Video Assessment

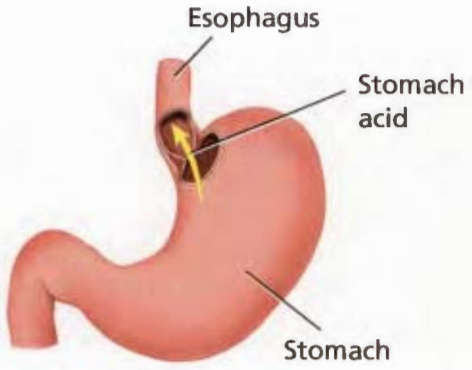
Review and Assessment

Checking Concepts

11. How does a person's level of physical activity affect his or her daily energy needs?
12. Why is fiber necessary in a person's diet?
13. In what order are the ingredients listed on a food label?
14. Describe the function of the epiglottis.
15. Explain the role of peristalsis.
16. What is the function of the pancreas in the digestive process?
17. What is the function of villi?

Thinking Critically

18. **Applying Concepts** Before winter, animals that hibernate often prepare by eating foods high in fat. How is this behavior helpful?
19. **Predicting** Suppose a medicine killed all the bacteria in your body. How might this affect vitamin production in your body?
20. **Inferring** Why is it important for people to chew their food thoroughly before swallowing?
21. **Relating Cause and Effect** How does the condition illustrated in the diagram below affect the esophagus?



22. **Comparing and Contrasting** The digestive system is sometimes said to be "an assembly line in reverse." Identify some similarities and some differences between your digestive system and an assembly line.

Math Practice

23. **Percentage** Your aunt eats 250 Calories of protein and 1,800 Calories total for the day. Did she get enough protein on that particular day? Show your calculations.

Applying Skills

Use the table to answer Questions 24–27.

Comparing Nutrient Data

Food (1 cup)	Calcium (% Daily Value)	Calories	Calories From Fat
Chocolate milk	30	230	80
Low-fat milk	35	110	20
Plain yogurt	35	110	35

24. **Classifying** To which group in a food pyramid do the foods in the chart belong? How does the body benefit from calcium in the diet?
25. **Interpreting Data** How many cups of low-fat milk provide 100% of the day's Daily Value for calcium?
26. **Calculating** Which of the foods meet the recommendation that no more than 30 percent of a food's Calories come from fat? Explain.
27. **Making Judgments** Which of the foods would be the most healthful choice for an afterschool snack? Explain your reasoning.

Lab zone Chapter Project

Performance Assessment Write a summary of what you've learned from keeping a food log. How close were your eating patterns to those recommended in your USDA MyPyramid Plan? How successful were you in making changes in your diet to match the MyPyramid Plan?

Standardized Test Prep

Test-Taking Tip

Watching for Qualifiers

You may be asked to answer a question that uses a qualifying word such as *most, least, best,* or *except for.* For example, you may be asked what the *best* conclusion is according to experimental data. When you see this type of question, read the answer choices very carefully. More than one choice may be partially correct. Look for the answer choice that offers the best or most complete answer.

Sample Question

According to the USDA guidelines, the *most* healthful diet includes limiting one's intake of

A sugar and fats.
B water.
C grains.
D fruits and vegetables.

Answer

Choice **A** is correct because sugars and fats should be eaten sparingly, as recommended by the USDA guidelines. Choice **B** is incorrect because the body cannot function without water. Choices **C** and **D** are incorrect because the USDA guidelines recommend eating these foods more often.

Choose the letter of the best answer.

1. Which of the following parts of the digestive system is *best* paired with its function?

A esophagus—digests carbohydrates
B stomach—digests fats
C small intestine—absorbs water
D liver—produces bile

2. A food label on a cereal box gives you the following information: a serving size equals one cup and there are 110 Calories per serving. You measure the amount of cereal you plan to eat and find that it measures 1 1/2 cups. How many Calories will you consume?

F 110 Calories
G 165 Calories
H 220 Calories
J 1,100 Calories

Use the table below and your knowledge of science to answer Questions 3 and 4.

Length of Time Food Stays in Organ

Organ	Time
Mouth	Less than 1 minute
Esophagus	Less than 1 minute
Stomach	1–3 hours
Small Intestine	1–6 hours
Large Intestine	12–36 hours

3. If a meal is eaten at noon, what is happening to the food at 1 P.M.?

A Saliva is breaking down starch into sugar.
B Proteins are being digested into short chains of amino acids.
C Fats are being digested.
D Digested food is being absorbed into the blood.

4. For food eaten at noon, absorption cannot have begun by

F 1 P.M.
G 7 P.M.
H 9 P.M.
J noon the next day.

5. Which of the following organs is *not* just a digestive organ?

A stomach
B liver
C small intestine
D large intestine

Constructed Response

6. Compare the processes of mechanical and chemical digestion. How are they similar? How are they different? In what parts of the digestive system do the two processes take place? How do the processes occur?