

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 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.

Main Idea			
Chemical digestion takes place in the . . .			
Detail	Detail	Detail	

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.

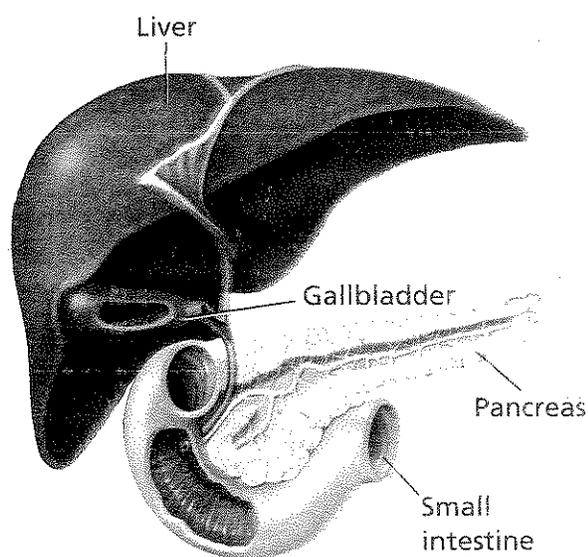
The Small Intestine

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 The liver is located in the upper right portion of the abdomen, and 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 breaks up fat particles. As you can see in Figure 18, 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 will 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 $\frac{1}{4}$ teaspoon baking soda to one of the jars.
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 18

The Liver and Pancreas

Substances produced by the liver and pancreas aid in the digestion of food.

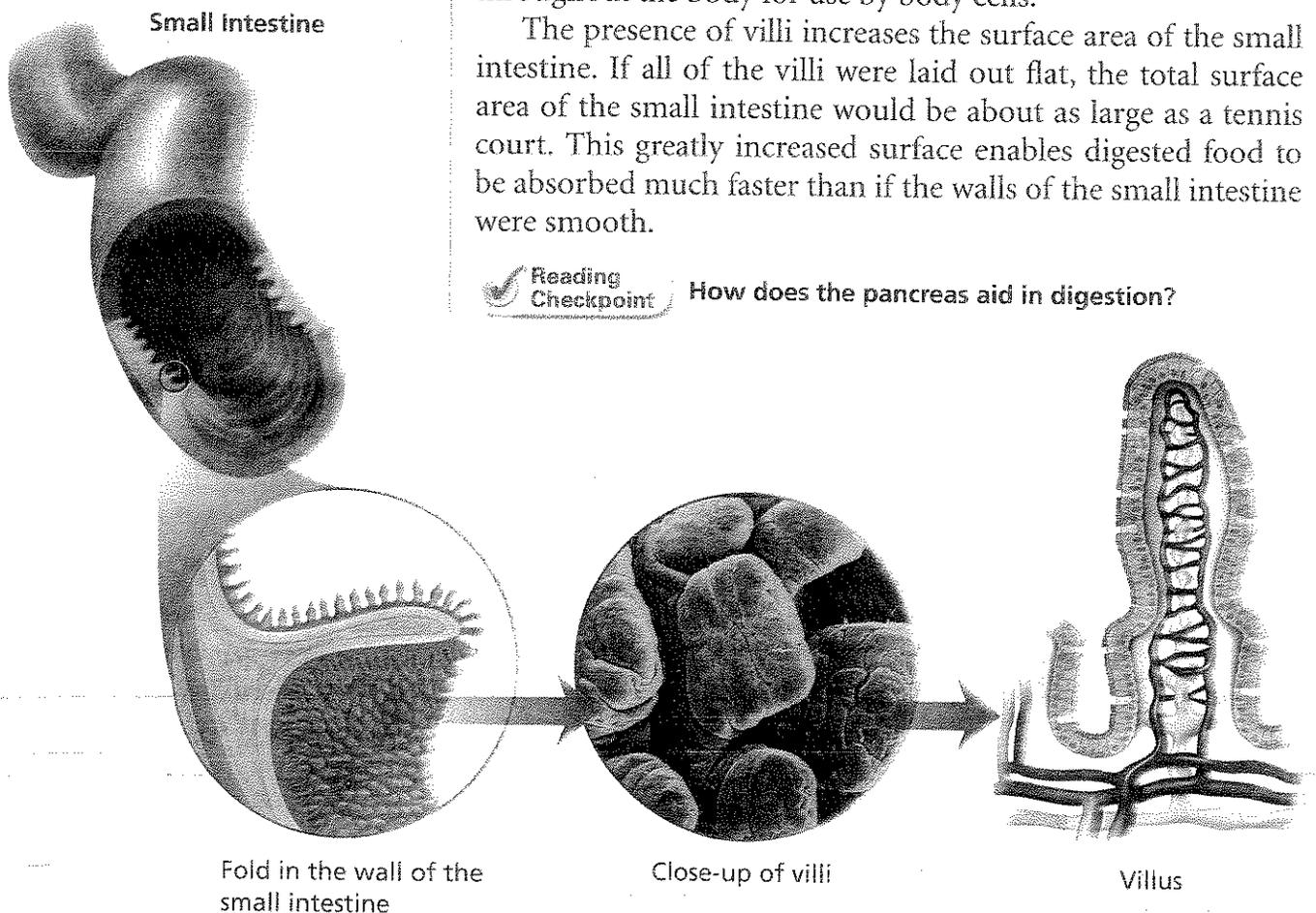
Relating Cause and Effect How would digestion be affected if the tube leading from the gallbladder to the small intestine became blocked?

FIGURE 19

The Small Intestine

Tiny finger-shaped projections called villi line the inside of the small intestine. In the diagram, you can see that the blood vessels in the villi are covered by a single layer of cells.

Interpreting Diagrams How does the structure of the villi help them carry out their function?

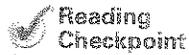


The Pancreas The pancreas is a triangular organ that lies between the stomach and the first part of the small intestine. Like the liver, the pancreas plays a role in many body processes. As part of the digestive system, the pancreas produces enzymes that flow into the small intestine and help break down 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 19 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.

The presence of villi increases the surface area of the small intestine. If all of the villi were laid out flat, the total surface area of the small intestine would be about as large as a tennis court. This greatly 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?

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.

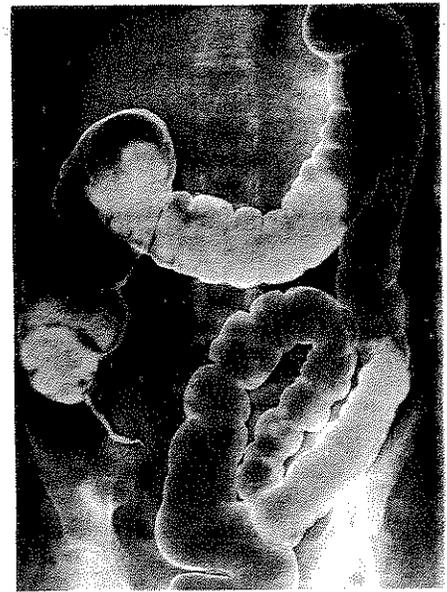
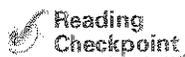


FIGURE 20

The Large Intestine

Notice the shape of the large intestine. As material passes through this structure, most of the water is absorbed by the body.



Reading
Checkpoint

What two structures at the end of the digestive system eliminate wastes from the body?

Section 4 Assessment

Target Reading Skill

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

Reviewing Key Concepts

- 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?
- 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

Summarizing Imagine that you are a bacon, lettuce, and tomato sandwich. Describe your journey through a person's digestive system, starting in the mouth and ending with absorption. *Hint:* Include where digestion of fats, carbohydrates, and proteins take place.