## Section 38–2

TEKS: 3C, 4D, 10A

## 1 FOCUS

### Objectives

**38.2.1** ***Identify*** the organs of the digestive system.

**38.2.2** ***Describe*** the function of the digestive system.

### Guide for Reading

### Vocabulary Preview

If students have difficulty pronouncing any of the Vocabulary words, it may interfere with their comprehension. Read each of the words to the class and have students repeat them after you. Point out that *villus* is singular and the plural is *villi*.

### Reading Strategy

Before they read, have students draw a line down the center of a piece of paper. On the left side they should write down the organs of the digestive system. Then, as they read the section, they should record important details about each organ on the right side of the paper, including the organ's location, structure, and function.

## 2 INSTRUCT

### The Mouth

#### Demonstration

Help students understand the difference between the mechanical and chemical digestion that take place in the mouth by having them observe mechanical and chemical processes. Have one student break a raw egg into a bowl and scramble it with a fork. Have another student pour the scrambled raw egg into a pan of boiling water. Have students watch as the egg solidifies in the boiling water. Ask: **Which process was mechanical, and which was chemical?** *(Breaking and scrambling the raw egg was mechanical. Cooking the raw egg was chemical.)* L1 L2

# 38–2 The Process of Digestion

TEKS FOCUS: 10A Function of digestive system; 3C Impact of research on scientific thought and society; TEKS SUPPORT: 4D Role of bacteria in maintaining health

### Guide for Reading

**Key Concepts**

- What are the organs of the digestive system?
- What is the function of the digestive system?

**Vocabulary**

amylase
esophagus
peristalsis
stomach
chyme
small intestine
pancreas
liver
villus
large intestine

**Reading Strategy: Asking Questions** Before you read, rewrite the seven blue heads in the section as *how*, *why*, or *what* questions. As you read, write brief answers to your questions.

TAKS a

TAKS 2, Bio TEKS 10A

Food presents every chordate with at least two challenges. The first is how to obtain it. Once a chordate has caught, or gathered its food, it faces a new challenge—how to break that food down into small molecules that can be passed to the cells that need them. In humans and many other chordates, this is the job of the digestive system. As food passes through the digestive system, it gets disassembled, distributing its nutrient value to the body along the way.

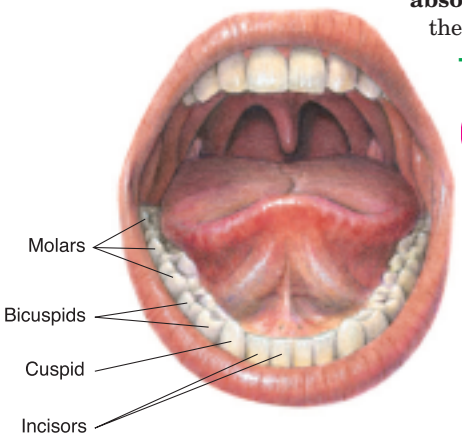
The human digestive system, like those of other chordates, is built around an alimentary canal—a one-way tube that passes through the body. **The digestive system includes the mouth, pharynx, esophagus, stomach, small intestine, and large intestine. Several major accessory structures, including the salivary glands, the pancreas, and the liver, add secretions to the digestive system.**

## The Mouth

As you take a forkful of food into your mouth, the work of the digestive system begins. The teeth, shown in **Figure 38–9**, tear and crush the food into a fine paste until it is ready to be swallowed. Chewing begins the process of mechanical digestion. Mechanical digestion is the physical breakdown of large pieces of food into smaller pieces. But there is a great deal more to it than that. As you chew your food, digestive enzymes begin the breakdown of carbohydrates into smaller molecules. This process is called chemical digestion. During chemical digestion, large food molecules are broken down into smaller food molecules. **The function of the digestive system is to help convert foods into simpler molecules that can be absorbed and used by the cells of the body.** The organs of the digestive system are shown in **Figure 38–10.**

**Teeth** The teeth are anchored in the bones of the jaw. The surfaces of the teeth are protected by a coating of mineralized enamel. Teeth do much of the mechanical work of digestion by cutting, tearing, and crushing food into small fragments.

CHECKPOINT *What do the teeth do?*




◀ **Figure 38–9** Human teeth include sharp incisors; cuspids and bicuspids, which grasp and tear food; and large, flat molars. **Inferring** *How do human teeth reflect an omnivorous diet?*

TIME SAVER

### SECTION RESOURCES

**Print:**

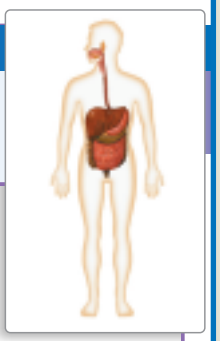
- ***Laboratory Manual B,*** Chapter 38 Lab
- ***Teaching Resources,*** Section Review 38–2, Enrichment, Chapter 38 Design an Experiment
- ***Guided Reading and Study Workbook,*** Section 38–2
- ***TAKS Success Daily Planner,*** Section 38–2

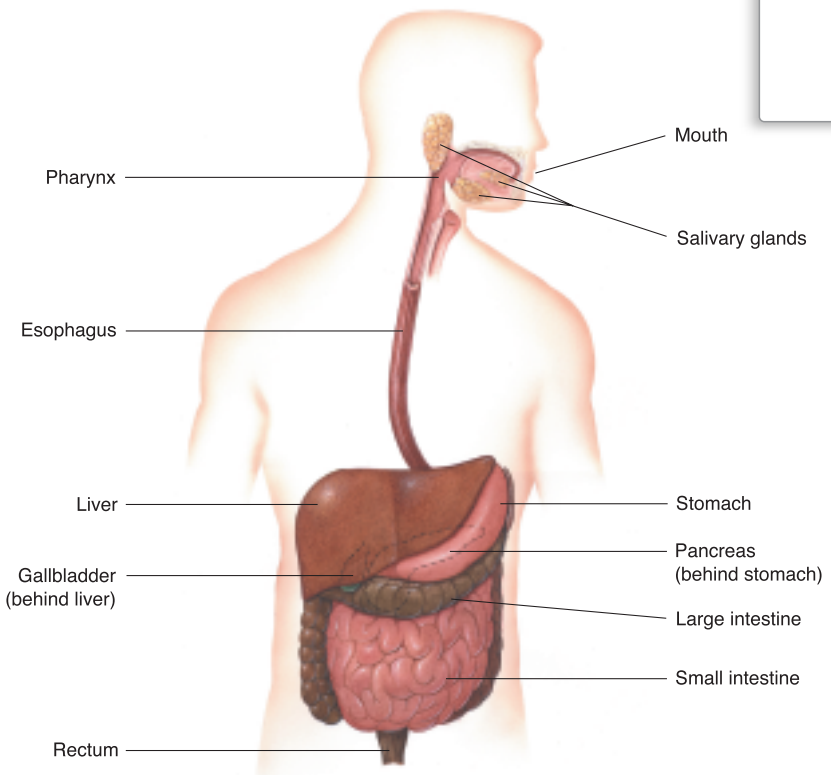
**Technology:**

- ***iText,*** Section 38–2
- ***Animated Biological Concepts Videotape Library,*** 40 Human Digestion
- ***Transparencies Plus,*** Section 38–2

## Figure 38–10 The Digestive System

**The digestive system includes the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.** Because the pancreas and most of the gallbladder are behind other organs, their locations are indicated by dotted lines.






**Saliva** As the teeth cut and grind the food, the salivary glands secrete saliva, which helps to moisten the food and make it easier to chew. The release of saliva is under the control of the nervous system and can be triggered by the scent of food—especially when you are hungry!

Saliva not only helps ease the passage of food through the digestive system but also begins the process of chemical digestion. Saliva contains an enzyme called **amylase** that breaks the chemical bonds in starches and releases sugars. If you chew on a starchy food like a cracker long enough, it will begin to taste sweet. This sweet taste is a sign that sugar has been released from starch by the action of amylase. Saliva also contains lysozyme, an enzyme that fights infection by digesting the cell walls of many bacteria that may enter the mouth with food.

TAKS a

Go Online NSTA SCILINKS
**For:** Links on digestion
**Visit:** www.SciLinks.org
**Web Code:** cbn-0382

a TAKS 2, Bio TEKS 10A

## Build Science Skills

**Using Models** Point out that different types of teeth have different mechanical functions: incisors cut, canines tear, and molars crush. Ask: **Can you think of tools that perform similar mechanical functions?** *(Scissors cut like incisors, tweezers tear like canines, and mallets crush like molars.)* L2

## Demonstration

Demonstrate how the amylase in saliva chemically breaks down food. Give each student a soda cracker. Have students chew their cracker for five seconds and record how it tastes. Have them continue chewing their cracker for five minutes and again record how it tastes. Ask: **How and why did the taste of the cracker change?** *(The cracker became sweeter as amylase broke down some of the starches into sugars.)* L1 L2

## Use Visuals

**Figure 38–10** Name each of the digestive organs. As you name each organ, have students locate it in the figure. Tell students that the liver and pancreas secrete substances that help break down food but that food does not actually pass through them. Point out the cardiac sphincter between the esophagus and stomach and the pyloric sphincter between the stomach and small intestine. Explain that they prevent food from moving backward in the system. L1 L2

Go Online NSTA SCILINKS

Download a worksheet on digestion for students to complete, and find additional teacher support from NSTA SciLinks.

## CUSTOMIZED INSTRUCTION

***Inclusion/Special Needs***

Help students master the main points about the digestive process by creating a flowchart showing the organs that food passes through as it is digested, starting with the mouth and ending with the large intestine. Students should read the corresponding subsection in the text to determine what happens to food as it passes through each organ and then illustrate each step in their flowchart with a sketch. L1

***English Language Learners***

Review the pronunciation and meaning of the Vocabulary terms with non-native speakers and other students who tend to have difficulty with technical terminology. Suggest that students translate the terms into their own language and write them on index cards, with the term in English on one side and in their own language on the other side. L1 L2

### Answers to . . .

CHECKPOINT *The teeth cut, tear, and crush food into smaller fragments.*

**Figure 38–9** *The different types and functions of human teeth make them well suited for eating the variety of foods in an omnivorous diet.*

## The Esophagus

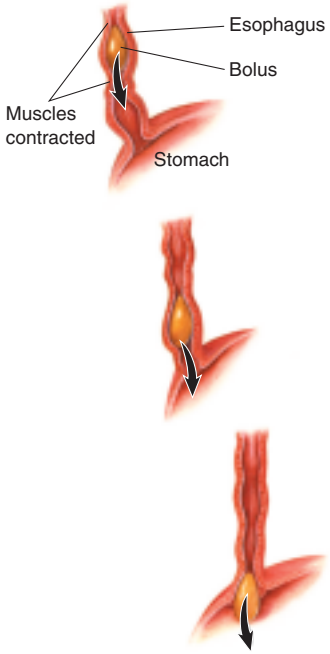
### Demonstration

Demonstrate with a simple model how peristalsis pushes food through the esophagus. Place a marble inside one end of a 25- to 30-cm length of flexible plastic or rubber tubing. With a squeezing motion of your hands, move the marble down and out the other end of the tube. Ask: **If this is a model of the esophagus, what does the tube represent and what does the marble represent?** *(The tube represents the esophagus, and the marble represents the bolus of food that is being swallowed.)* **How is peristalsis modeled?** *(By the squeezing of your hand along the tube from one end to the other)* L1 L2

## The Stomach

### Build Science Skills

**Inferring** Ask students: **How do you know when you are hungry?** *(Students probably will say that their stomach growls or hurts.)* Explain that these feelings of hunger are controlled by a center in the hypothalamus at the base of the brain, called the hunger center. The hunger center senses when blood levels of nutrients are low, and sends out nerve impulses that lead to stomach contractions. Ask: **What do you think causes the feelings of hunger to stop once you have eaten?** *(Students may infer that increasing levels of nutrients in the blood stimulate the hunger center to send out nerve impulses that stop the stomach contractions.)* You may wish to tell students, however, that satiety is tied to fat intake. L2




▲ **Figure 38–11** Muscles in the walls of the esophagus contract in waves. Each wave pushes the chewed clump of food, or bolus, in front of it. Eventually, the bolus is pushed into the stomach.
**Applying Concepts** *What kind of muscle surrounds the esophagus?*

ⓐ TAKS 2, Bio TEKS 10A

TAKS ⓐ

## The Esophagus

During swallowing, the combined actions of the tongue and throat muscles push the chewed clump of food, called a bolus, down the throat. Recall that as you swallow, a flap of connective tissue called the epiglottis closes over the opening to the trachea. This action prevents food from blocking the air passageways to the lungs.

From the throat, the bolus passes through the **esophagus,** or food tube, into the stomach. You might think that gravity draws food down through the esophagus, but this is not correct. The reason food travels through the esophagus into the stomach is that it is moved along by contractions of smooth muscle. These contractions, known as **peristalsis** (pehr-uh-STAL-sis), squeeze the food through the esophagus into the stomach. The process of peristalsis is illustrated in **Figure 38–11.**

A thick ring of muscle, called the cardiac sphincter, closes the esophagus after food has passed into the stomach and prevents the contents of the stomach from moving back up into the esophagus. Have you ever suffered from "heartburn"? Heartburn is a painful, burning sensation that feels as if it is coming from the center of the chest (by your heart), just above the stomach. The sensation is usually caused by a backflow of stomach acid. Heartburn can be caused by overeating or drinking an excess of caffeinated drinks.

## The Stomach

Food from the esophagus empties into a large muscular sac called the **stomach.** The stomach continues the mechanical and chemical digestion of food. Alternating contractions of the stomach's three smooth muscle layers thoroughly churn and mix the food you swallow.

**Chemical Digestion** The lining of the stomach contains millions of microscopic gastric glands that release a number of substances into the stomach. Some of these glands produce mucus, a fluid that lubricates and protects the stomach wall. Other glands produce hydrochloric acid, which makes the contents of the stomach very acidic. The acid activates pepsin, an enzyme that begins the digestion of protein and is secreted by a third set of stomach glands. Pepsin works best under the acidic conditions present in the stomach. The combination of pepsin and hydrochloric acid begins the complex process of protein digestion. Pepsin breaks proteins into smaller polypeptide fragments. While pepsin requires the acidic environment of the stomach in order to function, other enzymes such as amalyse are denatured by the stomach acid. As a result, chemical digestion of carbohydrates stops when food enters the stomach and does not resume until the food passes into the small intestine. Not all enzymes that aid in digestion are released by the stomach. Other enzymes that help in digestion are shown in **Figure 38–12.**

CHECKPOINT *What is the role of pepsin?*

BIO INSIGHTS

### FACTS AND FIGURES

***Not just heartburn***

Most people have experienced heartburn, the burning sensation in the chest that is caused by stomach acids entering the esophagus. In about 25 to 35 percent of people, heartburn becomes chronic and signals a more serious disorder, called gastroesophageal reflux disease, or GERD. In addition to heartburn, symptoms of GERD may include regurgitation and difficulty swallowing. There is no single cause of GERD, but factors such as defects in the lower esophageal sphincter, slower-than-normal emptying of the stomach, and decreased secretion of bicarbonate by the esophagus may all play a role. Complications of GERD include esophagitis, or inflammation of the esophagus, and Barrett's esophagus, a precancerous condition in which abnormal cells replace normal cells in the esophagus. Treatment of GERD includes lifestyle changes, medications to control stomach acids, and, in severe cases, surgery.

**Mechanical Digestion** As digestion proceeds, stomach muscles contract to churn and mix stomach fluids and food, gradually producing a mixture known as **chyme** (KYM). After an hour or two, the pyloric valve, which is located between the stomach and small intestine, opens and chyme begins to flow into the small intestine.

## The Small Intestine

As chyme is pushed through the pyloric valve, it enters the duodenum (doo-oh-DEE-num). The duodenum is the first of three parts of the **small intestine,** and it is where almost all of the digestive enzymes enter the intestine. Most of the chemical digestion and absorption of the food you eat occurs in the small intestine. As chyme enters the duodenum from the stomach, it mixes with enzymes and digestive fluids from the pancreas, the liver, and even the lining of the duodenum itself. The pancreas and liver are shown in **Figure 38–13.**

**Accessory Structures of Digestion** Just behind the stomach is the **pancreas.** The pancreas is a gland that serves three important functions. One function is to produce hormones that regulate blood sugar levels. Within the digestive system, the pancreas plays two key roles. It produces enzymes that break down carbohydrates, proteins, lipids, and nucleic acids. The pancreas also produces sodium bicarbonate, a base that neutralizes stomach acid so that these enzymes can be effective. Why is this neutralization necessary? Recall that enzymes are proteins. Stomach acid can change the shapes of protein molecules. If the shape of an enzyme's active site does not match the shape of its substrate, the enzyme will not be effective.

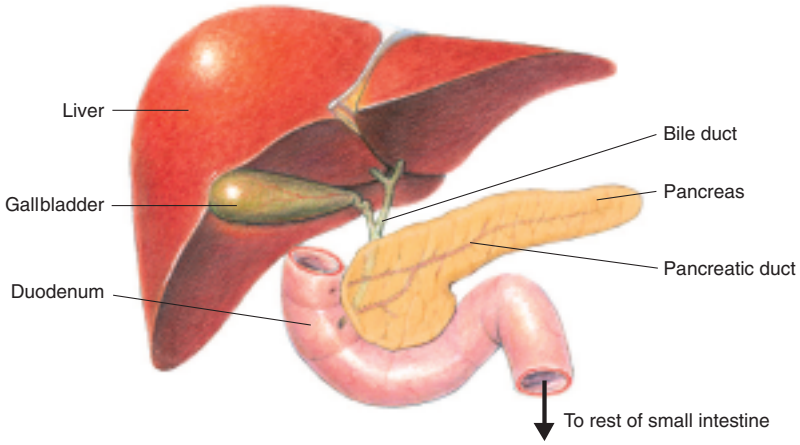
TAKS a

**Effects of Digestive Enzymes**

| Active Site | Enzyme | Effect on Food |
|---|---|---|
| Mouth | Salivary amylase | Breaks down starches into disaccharides |
| Stomach | Pepsin | Breaks down proteins into large peptides |
| Small intestine (from pancreas) | Amylase | Continues the breakdown of starch |
| | Trypsin | Continues the breakdown of protein |
| | Lipase | Breaks down fat |
| Small intestine | Maltase, sucrase, lactase | Breaks down remaining disaccharides into monosaccharides |
| | Peptidase | Breaks down dipeptides into amino acids |

▲ **Figure 38–12** Digestive enzymes break down foods and make nutrients available to the body. **Using Tables and Graphs** *Where in the body does the digestion of carbohydrates begin?*

a TAKS 2, Bio TEKS 10A




◀ **Figure 38–13** Accessory structures, including the liver and pancreas, add secretions to the digestive system. The pancreas secretes enzymes that help break down carbohydrates, proteins, and fats.

### Use Visuals

**Figure 38–12** Guide students in interpreting the information in the table. Remind them that food passes through each of the organs listed in the table and that the pancreas is a gland that secretes digestive enzymes into the small intestine. Ask: **Which enzymes break down proteins?** *(Pepsin, trypsin, and peptidase)* **Where are these enzymes found?** *(Pepsin is found in the stomach; trypsin and peptidase are found in the small intestine.)* **Where does the breakdown of starch into simpler carbohydrates take place?** *(The mouth and small intestine)* **Which nutrients do enzymes secreted by the pancreas help digest?** *(Starch, protein, and fat)* L1

## The Small Intestine

### Use Visuals

**Figure 38–13** Point out in Figure 38–10 where the liver and pancreas are located. Explain that the role of the gallbladder is to store bile produced in the liver. Ask: **Where does the bile go after it leaves the gallbladder?** *(To the small intestine)* L1 L2

### Make Connections

**Chemistry** Pour 100 mL of 0.5 percent hydrochloric acid into a beaker and measure its acidity with pH paper. Then, stir 2 mL of sodium bicarbonate solution into the acid and test the pH again. Continue adding small amounts of sodium bicarbonate as needed until the solution has a neutral pH of 7. Ask: **Where in the digestive system is sodium bicarbonate produced?** *(In the pancreas and secreted into the small intestine)* **What is the result of its production?** *(It neutralizes hydrochloric acid so it will not break down pancreatic digestive enzymes.)* L2

BIO INSIGHTS

### HISTORY OF SCIENCE

***Watching as the stomach churns***

In 1822, a U.S. army surgeon named William Beaumont was called upon to treat a gunshot wound in the stomach of a Canadian fur trapper. The wound eventually healed, but it left a permanent hole to the outside in the man's stomach. Beaumont saw this as a rare opportunity to study the role of the stomach in digestion. With his patient's reluctant permission, Beaumont inserted bits of food tied to strings into the stomach through the hole. Then, he withdrew them periodically to see the extent of digestion. Beaumont also siphoned off gastric secretions and had their chemical composition analyzed. He learned that digestion is primarily a chemical process and that gastric secretions consist mostly of hydrochloric acid. These and other results of Beaumont's innovative research still remain valid today.

***Answers to . . .***

CHECKPOINT *To break proteins into smaller polypeptide fragments*

**Figure 38–11** *Smooth muscle*

**Figure 38–12** *In the mouth*

# Absorption in the Small Intestine

## Quick Lab

**Objective** Students will be able to apply the concept that folding increases surface area. L2

**Skills Focus** Applying Concepts, Inferring

**Materials** 2 paper towels, scissors, 3 cardboard tubes, metric ruler, 30-mL graduated cylinder, 2 plastic cups

**Time** 20 minutes

**Advance Prep** Ask students to bring in cardboard tubes from rolls of paper towels, aluminum foil, or plastic wrap to use for the lab.

**Strategy** You may wish to calculate class averages for the data before students answer the questions so that all the students are working with the same numbers.

**Expected Outcome** Students should observe that the tubes containing folded paper towels retain more water.

**Analyze and Conclude**

**1.** Students' calculations will vary; however, the folded model (Step 4) will have a far greater surface area than the flat model (Step 2).

**2.** The folded paper towel in tube 3 has more surface area, which enables it to absorb more water. Students may have predicted correctly that the folded towel would absorb more water.

**3.** Folds and projections increase the area of the surface and its ability to absorb substances. Villi increase the surface area of the small intestine, which increases its ability to absorb nutrients.

**4.** Dividing the flow of blood among many small structures increases the surface area through which wastes can be removed.

TAKS a

Assisting the pancreas is the **liver,** a large organ located just above and to the right of the stomach. The liver produces bile, a fluid loaded with lipids and salts. Bile acts like a detergent, dissolving and dispersing the droplets of fat found in fatty foods. This action makes it possible for enzymes to reach the smaller fat molecules and break them down. Bile is stored in a small, pouchlike organ called the gallbladder.

CHECKPOINT *What is bile?*

## Absorption in the Small Intestine

TAKS a

The duodenum is much shorter than the remaining parts of the small intestine—the jejunum and the ileum, which together average about 6 meters long. By the time chyme enters these parts of the small intestine, much of the chemical digestion has been completed. The chyme is now a rich mixture of medium and small nutrient molecules.

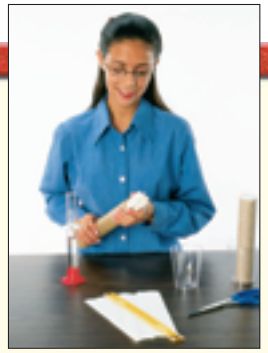
The small intestine is specially adapted for the absorption of nutrients. The folded surfaces of the small intestine are covered with fingerlike projections called **villi** (VIL-eye; singular: villus).

a TAKS 2, Bio TEKS 10A

## Quick Lab

### How do villi help the small intestine absorb nutrients?

**Materials** 2 paper towel sheets, scissors, 3 cardboard tubes, metric ruler, 30-mL graduated cylinder, 2 plastic cups



**Procedure**

1. Cut cardboard tube 1 lengthwise, and flatten it. **CAUTION:** *Scissors are sharp.* Lay paper towel sheet 1 over the flattened cardboard. Cut sheet 1 to the same size as the cardboard tube.
2. Determine the area of the flattened sheet with a ruler (area = width x length). Record the measurements.
3. Roll sheet 1 lengthwise until the sides meet but do not overlap. Insert rolled sheet 1 inside tube 2. The tube represents the small intestine, and the sheet represents an intestinal lining without villi.
4. Fold uncut sheet 2 back and forth in a zigzag pattern, as for a fan. Determine the area of sheet 2 and record the measurement. Roll sheet 2 until the sides meet, and insert it in tube 3. The folds represent an intestinal lining with villi.
5. **Predicting** Predict which model will absorb more water.
6. Stand each tube in a plastic cup. Slowly pour 30 mL of water down the inside of each tube. Remove the tubes. Then, measure and record the quantity of water in each cup.

**Analyze and Conclude**

1. **Calculating** Use your calculations in steps 2 and 4 to show which model had more surface area.
2. **Applying Concepts** How does surface area affect the ability to absorb substances? Was your prediction in step 5 correct?
3. **Applying Concepts** How do folds and fingerlike projections affect the area of an absorbing surface? How do villi help the intestine absorb nutrients?
4. **Inferring** Your kidneys contain about 1 million microscopic structures that filter waste products from your blood. What advantage does this arrangement have over filtering the waste products out of one large blood vessel?

BIO INSIGHTS

## FACTS AND FIGURES

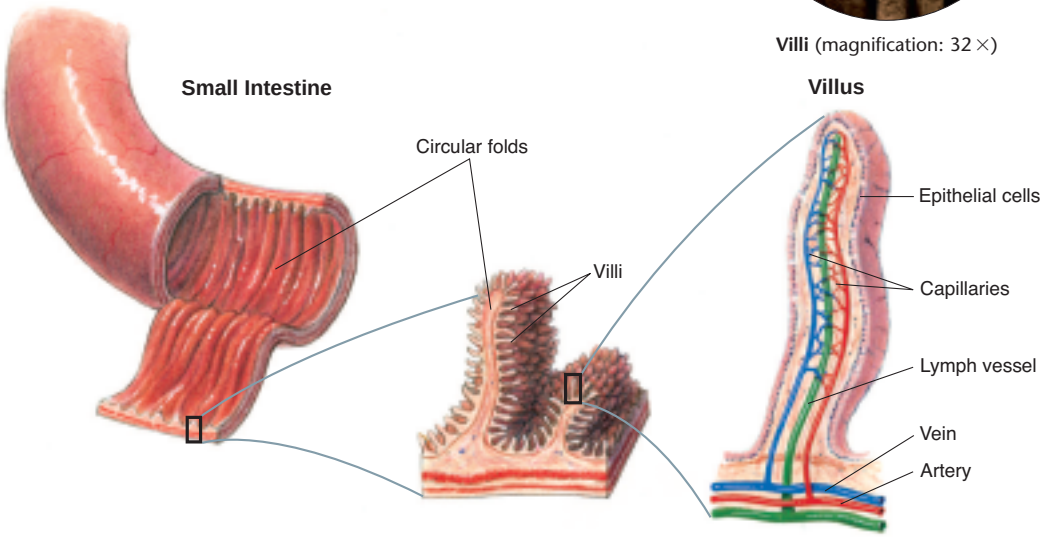
***The gallbladder examined***

Located just beneath the liver, the gallbladder is a pear-shaped sack about 9 cm long that concentrates and stores liver bile until it is needed to help digest fats. The gallbladder can store up to 50 mL of concentrated bile. When the bile is needed for digestion, it travels from the gallbladder to the small intestine through the bile duct, which also transports digestive enzymes from the pancreas to the small intestine. In some people, mineral salts in the gallbladder harden to form gallstones. Some of these may lodge in the bile duct and block it, causing pain as well as preventing the bile duct from transporting bile and pancreatic enzymes to the small intestine. Ultrasound is often used to break up the stones so they can pass out of the body, although in severe cases removal of the gallbladder may be necessary.

## FIGURE 38–14 THE SMALL INTESTINE

The lining of the small intestine consists of folds that are covered with tiny projections called villi. Within each villus there is a network of blood capillaries and lymph vessels that absorb and carry away nutrients.
**Applying Concepts** ***How do the folds in the small intestine help in absorption?***

**Villi** (magnification: 32×)




The villi are illustrated in **Figure 38–14.** The surfaces of the cells of the villi are covered with thousands of fingerlike projections known as microvilli. These folds and projections provide an enormous surface area for the absorption of nutrient molecules. Slow, wavelike contractions of smooth muscles move the chyme along this surface.

Nutrient molecules are rapidly absorbed into the cells lining the small intestine. Most of the products of carbohydrate and protein digestion are absorbed into the capillaries in the villi. Molecules of undigested fat and some fatty acids are absorbed by lymph vessels.

By the time food is ready to leave the small intestine, it is basically nutrient-free. The complex organic molecules have been digested and absorbed, leaving only water, cellulose, and other undigestible substances behind.

As the water, cellulose, and other undigestible substances leave the small intestine and enter the large intestine, they pass by a small saclike organ called the appendix. In humans, the appendix appears to do little to promote digestion. In other mammals, the appendix is used to store cellulose and other materials that the digestive enzymes cannot break down. The only time you may pay attention to the appendix is when it becomes clogged and inflamed, causing appendicitis. The only remedy for appendicitis is to remove the infected organ by surgery—as quickly as possible.

TAKS a

ⓐ TAKS 2, Bio TEKS 10A

### BIO INSIGHTS FACTS AND FIGURES

***Beneficial bacteria***

There are enough bacteria in your large intestine to fill a soup can. The relationship between you and the bacteria is mutualistic because both of you benefit: the bacteria provide you with vitamins and help your digestion, while you provide the bacteria with a warm, moist environment and plenty of nutrients. The environment is also a safe one for the bacteria—unless you take antibiotics for an infection. Antibiotics kill beneficial as well as harmful bacteria. If too many beneficial bacteria are killed, you may develop vitamin deficiencies and form light-colored stools, both caused by the absence of bacteria.

## Address Misconceptions

Students may have the mistaken impression that the duodenum is the most important part of the small intestine because the bulk of chemical digestion takes place there. Point out that about 3 meters of the small intestine are devoted to absorption, whereas only about 25 centimeters are involved in digestion. Ask: **What percent of the small intestine is involved in absorbing nutrients?** *(About 92 percent)* **What is the value of its length?** *(The small intestine's great length adds more absorbing surface area, which is critical to digestion and absorption.)* L2

## Use Visuals

**Figure 38–14** Make sure students understand how the different parts of the figure are related. Call attention to the many capillaries in each villus, and describe their role in the absorption of nutrients. Also, help students relate the figure to the information in the text by asking them to complete the following analogy: **Villi are to the small intestine as _____ are to villi.** *(Microvilli)* L1 L2

## Demonstration

Give students an opportunity to feel how small and densely distributed villi are. Pass a piece of velvet fabric around the room, and have students run their hands over the napped surface. Tell them that the tiny projections on the surface of the cloth are similar in size and density to the villi lining the small intestine. L1

### Answers to . . .

CHECKPOINT *Bile is a fluid produced by the liver that dissolves and disperses the droplets of fat found in fatty foods.*

**Figure 38–14** *The folds increase the surface area for the absorption of nutrients.*

## The Large Intestine

### Make Connections

**Mathematics** Challenge students to estimate the surface area of the large intestine based on its diameter (6 cm) and length (150 cm), using the formula for the area of a cylinder: $2\pi r(r+h)$. *(The surface area is about 2800 cm².)* Explain that, because of villi, the surface area of the small intestine is far greater, at about 8,000,000 cm². L2 L3

## Digestive System Disorders

### Build Science Skills

**Applying Concepts** Ask students: **Why do disorders of the large intestine often cause diarrhea?** *(The main function of the large intestine is to remove water from waste. If the large intestine is not working properly because of illness, too little water may be removed, causing diarrhea.)* L1 L2

## 3 ASSESS

### Evaluate Understanding

Have students make a table with the headings: *Mouth, Stomach, Small Intestine, Pancreas*. Have them list the enzymes found in or produced by each organ and the nutrients that the enzymes help break down.

### Reteach

Describe the functions of the digestive organs, and have students identify them from their functions.

**TAKS Tune-up**

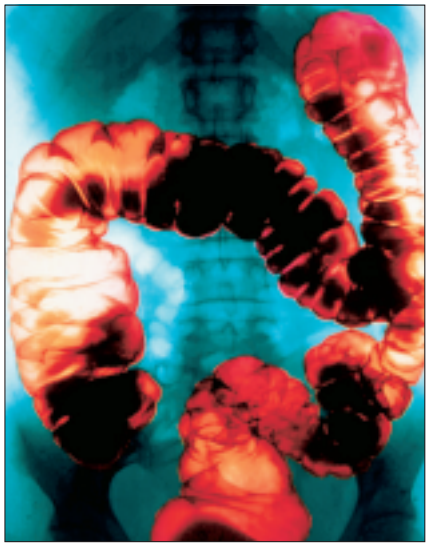
The approximate absorptive area of the small intestine is 1,980,000 cm² (3300 cm² × 600) or about 200m².

**iText**

If your class subscribes to the iText, use it to review Section 38–2.

***Answer to . . .***

**Figure 38–15** *To remove water from undigested material*



▲ **Figure 38–15** This barium X-ray shows the large intestine. **Applying Concepts** ***What is the role of the large intestine?***

## The Large Intestine

TAKS a

When the chyme leaves the small intestine, it enters the large intestine, or colon. The large intestine is shown in **Figure 38–15.** The primary function of the **large intestine** is to remove water from the undigested material that is left. Water is absorbed quickly across the wall of the large intestine, leaving behind the undigested materials. Rich colonies of bacteria present in the large intestine produce compounds that the body is able to use, including vitamin K. When large doses of antibiotics are given to fight an infection, they can destroy these bacteria and a vitamin K deficiency can occur. The concentrated waste material that remains after the water has been removed passes through the rectum and is eliminated from the body.

## Digestive System Disorders

TAKS b

The powerful acids released into the stomach sometimes damage the organ's own lining, producing a hole in the stomach wall known as a peptic ulcer. For years, physicians hypothesized that the primary cause of ulcers was too much stomach acid. They prescribed drugs that suppressed acid production and recommended bland, easily digested diets. Scientists have since discovered that most peptic ulcers are caused by the bacterium *Helicobacter pylori*. Doctors now know that many peptic ulcers are caused by an infectious disease that can be cured. Thanks to powerful antibiotics, cure rates for peptic ulcers are as high as 90 percent.

Other digestive system disorders include diarrhea and constipation. When something happens that interferes with the removal of water by the large intestine, you usually become aware of it right away. If not enough water is absorbed a condition known as diarrhea occurs. If too much water is absorbed from the undigested materials, a condition known as constipation occurs.

ⓐ TAKS 2, Bio TEKS 4D, 10A

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## 38–2 Section Assessment

1. **Key Concept** List the organs of the digestive system and give the function of each.
2. **Key Concept** Explain the function of the digestive system.
3. How do mechanical and chemical digestion work together to break down foods?
4. How does bile help in the digestion of fats?
5. **Critical Thinking Inferring** What can you infer about the diet of an animal that has a large appendix?

**TAKS Tune-up**

**Mathematics 9**
**Proportional Relationships**
Without the villi, the small intestine would have a surface area of about 3300 cm². The villi increase this surface by a factor of about 600. What is the approximate absorptive area of the small intestine?

## 38–2 Section Assessment

1. Mouth: begins mechanical digestion, begins chemical digestion of starch; esophagus: moves food to stomach; stomach: continues mechanical digestion, begins chemical digestion of protein; small intestine: completes chemical digestion of starch and protein, chemical digestion of fats; large intestine: removes water from undigested food.
2. To help convert foods into simple molecules that can be absorbed and used by cells
3. Mechanical digestion physically breaks down food into smaller pieces, which makes it easier for enzymes to chemically break down large food molecules into smaller molecules.
4. Bile dissolves and disperses fat droplets, making it easier for enzymes to reach and further break down fats.
5. The diet probably contains a lot of cellulose.