

LESSON 2

Moving Through the Digestive Tract

Inquiries 1
Periods 2

STUDENT OBJECTIVES

Discuss the purpose of the digestive processes.

Build a model of the digestive tract.

Explore how food moves through the digestive tract.

Explore the function of mucus in the digestive tract.

CONCEPTS

Food passes through the digestive system by the process of peristalsis.

Food must be broken down mechanically and chemically before it can pass into the bloodstream and be delivered to the cells.

The digestive tract is lined with mucus, a slippery secretion that helps food pass through the system and protects the inner walls of the digestive tract.

OVERVIEW

In Lesson 1, students discussed what they know about human body systems and the major organs of the body. In this lesson, they focus on the digestive system. They explore how food moves through the digestive tract by means of peristalsis. This inquiry provides a foundation for the next five lessons, in which students will investigate what happens to food as it moves through the mouth, esophagus, stomach, small intestine, and large intestine.

BACKGROUND

The purpose of digestion is to break foods down into a form that can be absorbed into the bloodstream and transported to the cells of the body. Digestion is not a single activity but a series of processes. These processes can be mechanical or chemical.

- **Mechanical digestive processes** include the tearing and grinding action of the teeth, the mixing and mashing action of the tongue, the churning of food by the muscles that line the walls of the digestive tract, and the breaking down of large fat droplets into smaller ones through the action of bile.
- **Chemical digestive processes** are a series of actions whose purpose is to break down the chemical bonds in nutrients so that they can be absorbed into the bloodstream. Chemical digestion is accomplished by the digestive enzymes.

The distinction between mechanical and chemical digestion is not always clear-cut. You may simply tell students that mechanical digestion prepares food for the more complex process of chemical digestion.

The human digestive tract (see Figure 2.1) is a single, convoluted tube that is about 8 to 10 meters (m) long. Its walls are composed of an inner layer of circular muscle that is surrounded by a layer of longitudinal muscle. (The stomach has a third layer composed of diagonal muscle.) These muscular layers are held together by connective tissue and are covered and protected by epithelial tissue.

The circular and longitudinal layers of muscle work together to produce wavelike motions that push food slowly through the digestive tract and help break it down into smaller and smaller particles. This wavelike motion is called **peristalsis**. Although the force of gravity has a minor role in the passage of food through the digestive tract, peristalsis provides the major push. The peristaltic contractions are so strong that food would even continue to move forward through your digestive tract if you were standing on your head!

Another muscular activity that is essential to digestion is provided by the **sphincters**. These rings of thickened muscles facilitate the passage of food from one area of the digestive tract to another. They usually ensure that food continues to move in one direction. Sphincter muscles are found at the openings of the digestive system, that is, at the lips and anus. Other sphincter muscles are located at points where two digestive organs meet (for example, between the esophagus and the stomach).

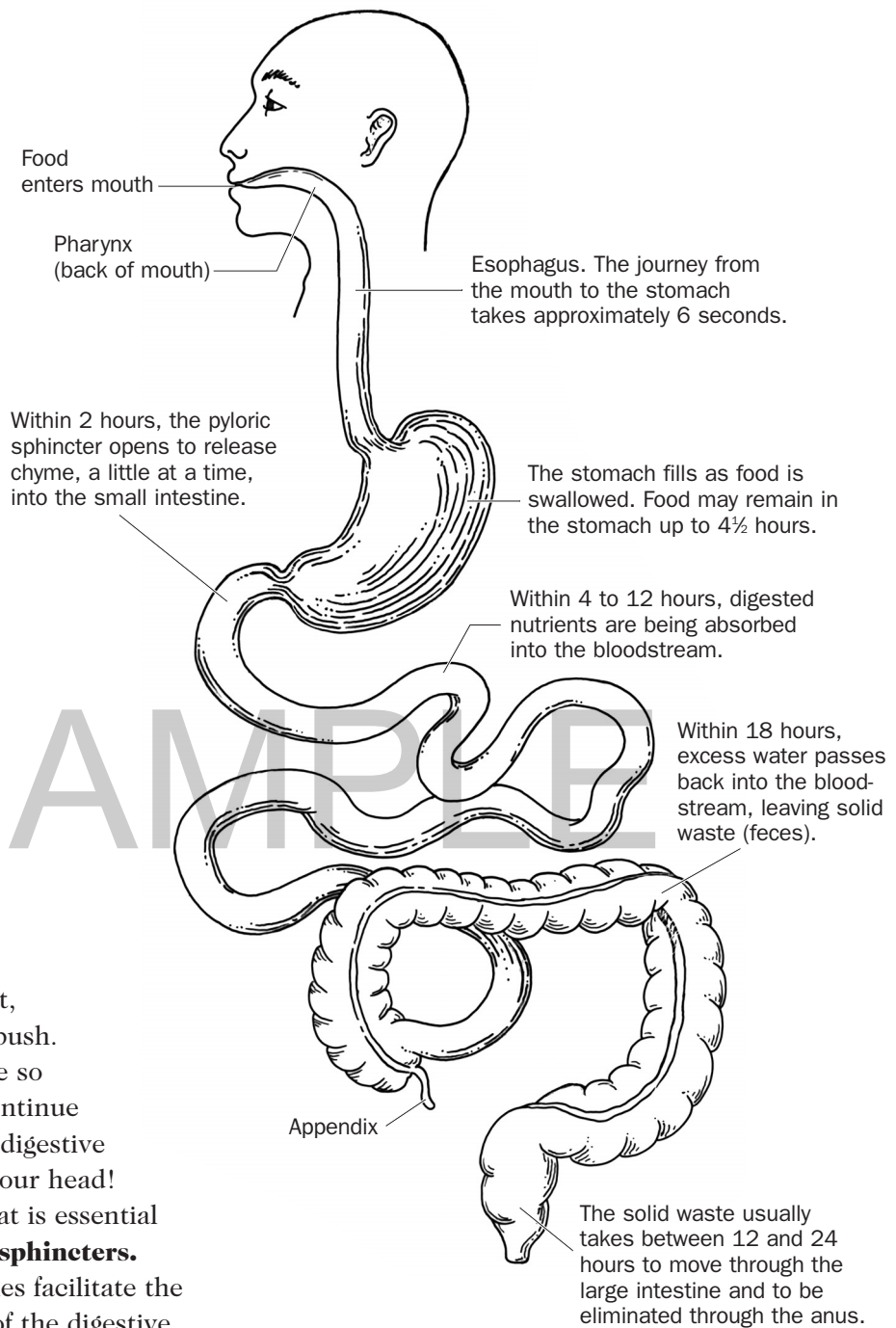


Figure 2.1 Simplified illustration of the human digestive tract and the digestive processes

The sphincters control the passage of food from one area to another. For example, the pyloric sphincter (see Figure 2.2) helps regulate the passage of food into the small intestine.

Mucus, a slippery secretion that coats the inner walls of the digestive tract, also facilitates the movement of food. In addition, mucus protects the stomach and small intestine from being damaged by acidic gastric juices and other digestive enzymes.

Most digestive activity occurs in the duodenum, the first 25 centimeters (cm) of the small intestine. The entire small intestine is about 6 to 8 m long. Many complaints about stomachaches, as well as the digestive noises we commonly refer to as “stomach growling,” are actually the result of discomfort or movement in the small intestine.

Several accessory organs (see Figure 2.3), including the liver, pancreas, and gall bladder, complement the organs of the digestive tract. The salivary glands, located in the mouth, are also accessory organs of digestion. Although students will not study these organs through inquiry in this module, they will read about them and learn about their role in digestion.

By the time food substances reach the large intestine, digestion and absorption of nutrients have already been completed. All that remains is undigested waste. When these waste materials enter the large intestine, they contain a large amount of water and electrolytes (watery solutions of acids, bases, or salts). The major activity that takes place in the large intestine is the absorption of water and electrolytes into the bloodstream.

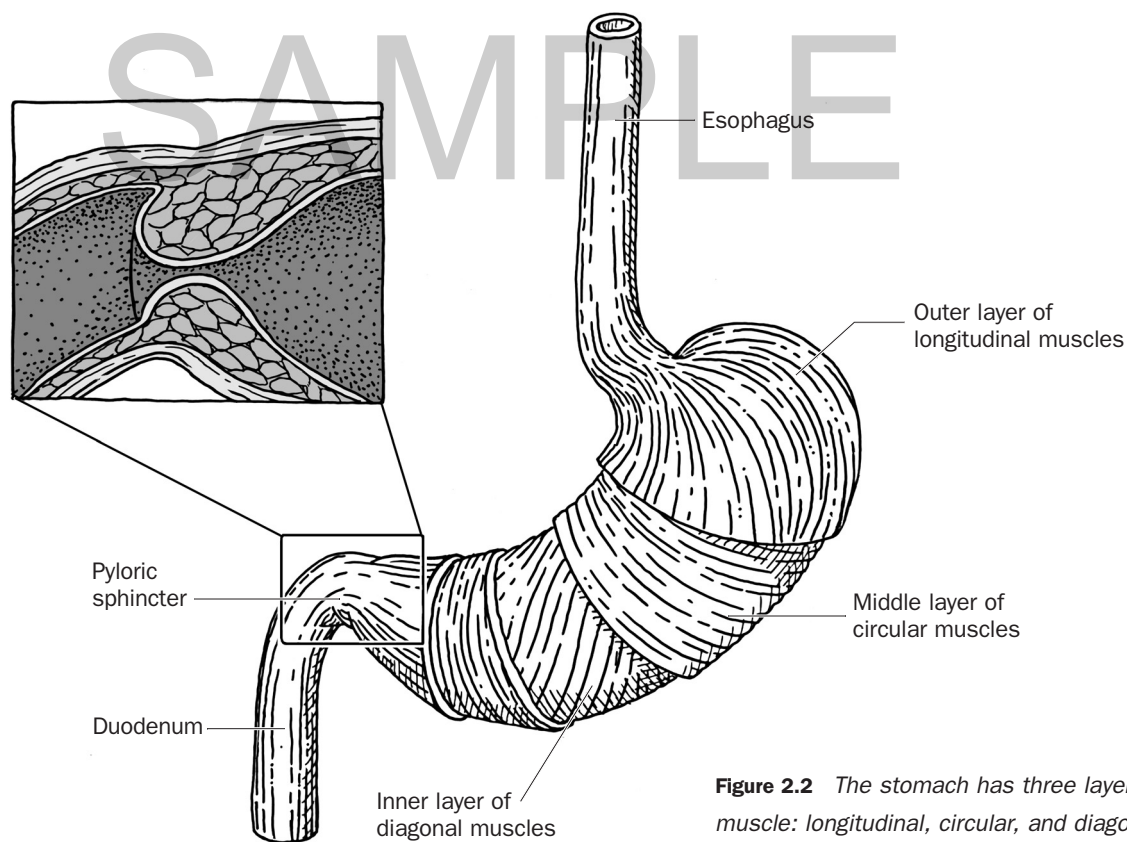
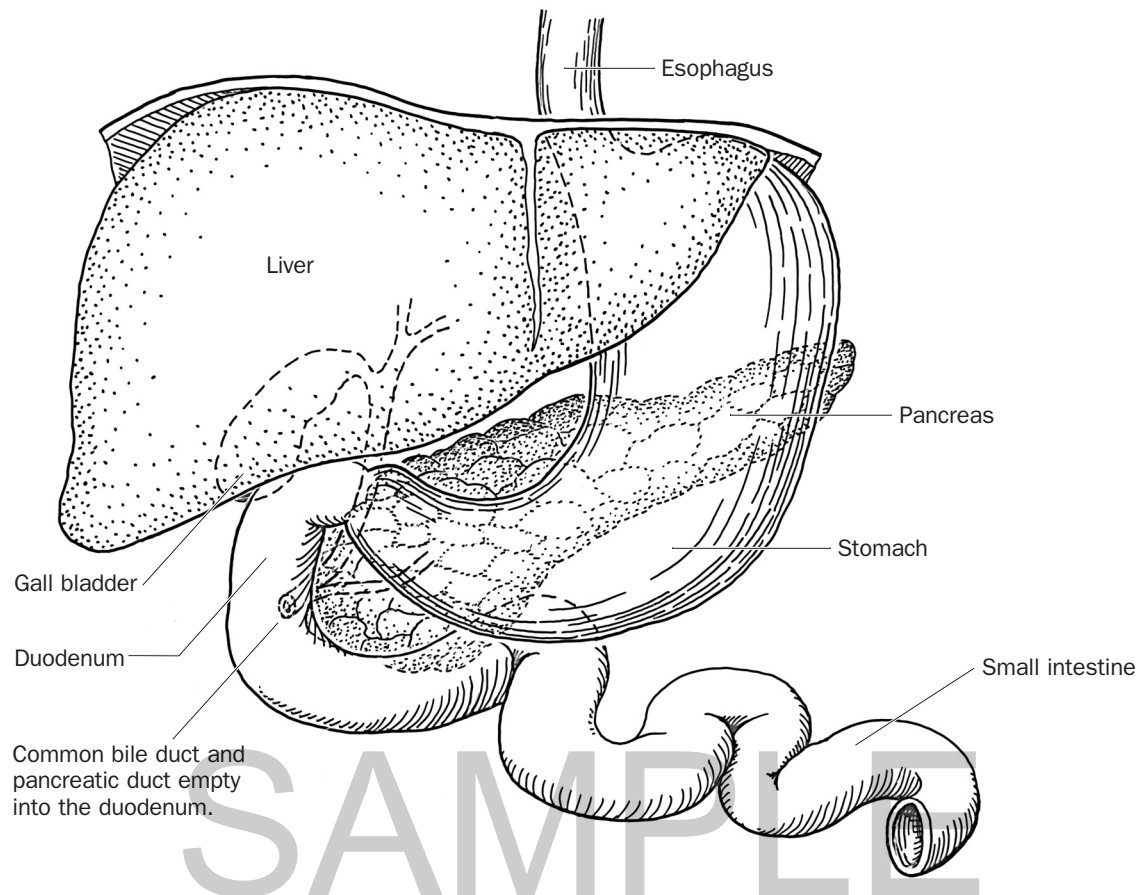


Figure 2.2 The stomach has three layers of muscle: longitudinal, circular, and diagonal. The inset at the left shows a transverse view of the pyloric sphincter.

Figure 2.3 The accessory organs of digestion



As more water is absorbed, the undigested waste in the large intestine becomes more concentrated. Dead bacteria make up about one-third of these semisolid remains, or **feces**. Other living bacteria feed on the undigested wastes and often produce intestinal gases, called **flatus**. The feces remain in the rectum until they are eliminated through the anus.

In this lesson, students simulate the peristaltic action of the digestive tract by moving an oiled tennis ball through a 10-m plastic tube. The oil on the tennis ball simulates the effect of the mucus.

At the end of Lesson 2 in the Student Guide is a reading selection entitled “Spies: All Systems Go!” This is the first episode of a serial reader that recounts the adventures of Peppi and Bollo, two imaginary creatures who have

been dispatched to planet Earth by scientists in another galaxy. The spies’ job is to learn as much as they can about human anatomy and physiology.

Peppi and Bollo can shrink or expand in size at will, and they take advantage of this remarkable trait to enter the body of a human. During their journey, they discuss what they see; Peppi is the teacher and Bollo is an eager learner.

Episodes of “Spies” appear periodically throughout this module. The story reinforces and supplements many of the concepts your students will investigate and discuss in class. Please help students understand that although the story reads like science fiction, the information it presents about the human body is based on facts.

MATERIALS FOR LESSON 2**For the teacher**

- 1 trash bag (large)
- 1 container of vegetable oil
- 2 pieces of newsprint or transparencies*
- 1 black marker

For each group of 4 students

- 1 plastic box with lid
- 1 polyvinyl tubing, 9.3 m
- 1 pair of scissors
- 1 black marker
- 1 tennis ball (soaked in vegetable oil and placed in a small plastic storage bag with fold-and-close top)
- 1 plastic storage bag with fold-and-close top
- 1 measuring tape, 150 cm
- 1 plastic resealable storage bag, large, 22.9 × 30.5 cm (9" × 12")

PREPARATION

1. Prepare a transparency of Figure 2.2 in the Student Guide (SG). The figure depicts how to mark the plastic tube.
2. Write the following questions on newsprint. Leave space under each question to enter students' responses.

A. How do you think food moves through the digestive tract?

B. What do you think happens to food as it moves along the digestive tract?

C. Why do you think the digestive tract gets narrower at some places?

NOTE This inquiry takes about 90 minutes to complete. Regardless of whether your students will complete it in one 90-minute period or two 45- to 50-minute class periods, you should

probably not plan any administrative tasks during this lesson. If your class period is 45 to 50 minutes long, decide on a cutoff point for the first half of the inquiry. For example, you may find that students will be able to complete the brainstorming and to mark their plastic tubing during a 45- or 50-minute class.

Getting Started

1. Direct students' attention to the questions you have recorded on newsprint. Tell students to take a few minutes to brainstorm answers to these questions. They should record their answers on a new page in their science notebooks.
2. Ask a spokesperson from each group to share the group's responses with the class. Record all answers on newsprint. The class will take a second look at these questions at the end of the lesson.

**Inquiry 2.1
Moving Right Along****PROCEDURE**

1. Ask students to follow along as you review the Procedure for this inquiry in the Student Guide. Emphasize the following points:
 - A. The numbers in Table 2.1 of their guide indicate the length of each organ, *not* the cumulative length of the organs. For example, the esophagus is 25 cm long and the stomach is 22 cm long. Students should place the first mark 11 cm from the opening of the tube. Using that mark as a starting point, they should then measure 25 cm and make a second mark

*Needed, but not supplied

for “Esophagus.” Beginning at the mark they have made for the esophagus, they should then move on to “Stomach.” They should continue this process until they have made the mark for the end of the rectum.

- B.** When putting the ball in the tube, students should not touch the ball directly with their fingers. They should manipulate the ball through the bag. If their fingers get greasy, they will find it very hard to squeeze the ball through the tube.
 - C.** Students should keep the tube horizontal at all times.
 - D.** Each student in a group of four should squeeze the ball through approximately 2 m of the tube. This will give everyone an opportunity to participate.
 - E.** The student at the far end of the tube should have a plastic bag into which to squeeze the ball.
- 2.** Explain the cleanup procedures.
 - A.** At the end of a 45- or 50-minute class, have students put the tubing in the large plastic storage bag. Have them write their names on the bag with the marker, give the bag to you, and return their plastic boxes to the materials center.
 - B.** At the end of the inquiry, have students dispose of the plastic tubing in the large trash bag and return their other supplies to the materials center.
 - 3.** Have a volunteer from each group pick up materials for the inquiry.
 - 4.** Have students start the inquiry, beginning with Step 2 in the Procedure of the Student Guide. Remind them to discuss

the questions in Procedure Step 7 as they proceed.

NOTE Consider displaying one of the tubes on a wall in your classroom. Encourage students to refer to it as they progress through this part of the module. Make sure the organs are clearly labeled. The opportunity to see the tube gives students an appreciation of the length of the digestive tract.

REFLECTIONS

- 1.** Discuss the answers to the two sets of questions that appear in “Getting Started” and Procedure Step 7 of the Student Guide.

SG “Getting Started”

A. How do you think food moves through the digestive tract? (Food moves through the digestive tract by the squeezing action of circular and longitudinal muscles. Students may suggest that they simulated this squeezing action because their hands squeezed not only down the tube but also around it.)

B. What do you think happens to food as it moves through the digestive tract? (The food is broken down into smaller and smaller particles. The breakdown is caused by digestive juices as well as by the squeezing action of the muscles.)

C. Why do you think the digestive tract gets narrower at some places? (These narrow places are called sphincters. They are muscles that control the passage of food through the digestive system. They also help make sure that food moves through the system in only one direction. Sphincter muscles are found between organs. They are also found at the two openings of the digestive tract, the lips and the anus.)

SG Procedure Step 7

A. *What does the tennis ball represent?*
(The tennis ball represents swallowed food.)

B. *Why do you think the tennis ball was soaked in oil?* (The vegetable oil simulates mucus, a slippery substance that coats the lining of the walls of the digestive tract. Mucus permits food to move more easily and protects the lining of the digestive tract from the digestive enzymes.)

2. Ask students how the tennis ball is different from food as it moves through the digestive tract. (The ball stays the same size. Food particles would get smaller, and their chemical composition would change.)
3. Ask students to think about what they would like to learn about digestive processes, the organs of digestion, and food and nutrition. Have them write the questions in their science notebooks. Note that you will revisit the lists at the end of this part of the module.

HOMEWORK**Period 1**

Ask students to read “Spies: All Systems Go!” at the end of Lesson 2 in the Student Guide.

Period 2

Ask students to read the first section of “Nutrients: You Just Can’t Live Without ’Em,” on page 20 in Lesson 3 of the Student Guide.

EXTENSIONS■ **Language Arts**

1. Have students research the derivations and meanings of the names of the digestive organs. For example, the word “esophagus”

comes from the Greek words *osein* (meaning “to be going to carry”) and *phagein* (meaning “to eat”). Then have them try to find other words in English that contain the root words.

■ **Science**

2. Have students find out why snakes can ingest and swallow objects whose diameter greatly exceeds their own. Have them include images where possible.

■ **Health** ■ **Science**

3. Ask students to research how laxatives and antidiarrhetics work.

■ **Science**

4. Ask students to devise a means of adding simulated sphincters to the model of the digestive tube that they used during Inquiry 2.1. What common household or office objects could they use to narrow the passages between organs?

ASSESSMENT

Because this is an introductory lesson, it is recommended that you grade students on the basis of how well they contributed to the class discussion, how they cooperated in their groups, and how much effort they made to answer the written questions.

PREPARATION FOR LESSON 3

Directions for preparing and distributing chemicals may be found in the materials kit. Check the Materials List and Preparation section for Lesson 3 and prepare the containers of foods and chemicals you will need. Label any containers that are not already marked.

SAMPLE