The digestive system breaks down food.

KEY CONCEPT

The digestive system breaks down food.

**BEFORE, you learned**
- The respiratory system takes in oxygen and expels waste
- Oxygen is necessary for cellular respiration
- The respiratory system is involved in speech and water removal

**NOW, you will learn**
- About the role of digestion in providing energy and materials
- About the chemical and mechanical process of digestion
- How materials change as they move through the digestive system

**VOCABULARY**

- nutrient p. 607
- digestion p. 608
- digestive system p. 608
- peristalsis p. 608

**EXPLORE Digestion**

**How does the digestive system break down fat?**

**PROCEDURE**

1. Using a dropper, place 5 mL of water into a test tube. Add 5 mL of vegetable oil. Seal the test tube with a screw-on top. Shake the test tube for 10 seconds, then place it in a test tube stand. Record your observations.

2. Drop 5 mL of dish detergent into the test tube. Seal the tube. Shake the test tube for 10 seconds, then place in the stand. Observe the mixture for 2 minutes. Record your observations.

**WHAT DO YOU THINK?**

- What effect does detergent have on the mixture of oil and water?
- How do you think your digestive system might break down fat?

**MATERIALS**

- water
- graduated cylinders
- test tube with cap
- vegetable oil
- test tube stand
- liquid dish detergent

The body needs energy and materials.

After not eating for a while, have you ever noticed how little energy you have to do the simplest things? You need food to provide energy for your body. You also need materials from food. Most of what you need comes from nutrients within food. **Nutrients** are important substances that enable the body to move, grow, and maintain homeostasis. Proteins, carbohydrates, fats, and water are some of the nutrients your body needs.

You might not think of water as a nutrient, but it is necessary for all living things. More than half of your body is made up of water.

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Protein is another essential nutrient; it is the material that the body uses for growth and repair. Cells in your body—such as those composing muscles, bones, and skin—are built of proteins. Carbohydrates are nutrients that provide cells with energy. Carbohydrates make up cellulose, which helps move materials through the digestive system. Another nutrient, fat, stores energy.

Before your body can use these nutrients, they must be broken into smaller substances. **Digestion** is the process of breaking down food into usable materials. Your digestive system transforms the energy and materials in food into forms your body can use.

### The digestive system moves and breaks down food.

Your **digestive system** performs the complex jobs of moving and breaking down food. Material is moved through the digestive system by wavelike contractions of smooth muscles. This muscular action is called **peristalsis** (PEHR-ih-STAWL-sihs). Mucous glands throughout the system keep the material moist so it can be moved easily, and the muscles contract to push the material along. The muscles move food along in much the same way as you move toothpaste from the bottom of the tube with your thumbs. The body has complicated ways of moving food, and it also has complicated ways of breaking down food. The digestive system processes food in two ways: physically and chemically.
Mechanical Digestion

Physical changes, which are sometimes called mechanical changes, break food into smaller pieces. You chew your food with your teeth so you are able to swallow it. Infants without teeth need an adult to cut up or mash food for them. They need soft food that they can swallow without chewing. Your stomach also breaks down food mechanically by mashing and pounding it during peristalsis.

Chemical Digestion

Chemical changes actually change food into different substances. For example, chewing a cracker produces a physical change—the cracker is broken into small pieces. At the same time, liquid in the mouth called saliva produces a chemical change—starches in the cracker are changed to sugars. If you chew a cracker, you may notice that after you have chewed it for a few seconds, it begins to taste sweet. The change in taste is a sign of a chemical reaction.

What are the two types of changes that take place during digestion?

Check Your Reading

How does saliva affect starch?

PROCEDURE

1. Cut two slices of the same thickness from the center of a potato. Lay the slices on a plate or tray.
2. Using a dropper, add 15 drops of solution A to one potato slice. Add 15 drops of water to the other potato slice. Observe both potato slices for several minutes. Record your observations.

WHAT DO YOU THINK?

- What evidence did you see that starch is being broken down?
- How would you identify the substance left by the breakdown of starch?
- What is the purpose of the water in this activity?

CHALLENGE

How could you change your experiment to model mechanical digestion? What structures in your mouth mechanically break down food?

INVESTIGATE Chemical Digestion

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What are the two types of changes that take place during digestion?
Materials are broken down as they move through the digestive tract.

The digestive system contains several organs. Food travels through organs in the digestive tract: the mouth, esophagus, stomach, small intestine, and large intestine. Other organs, such as the pancreas, liver, and gall bladder, release chemicals that are necessary for chemical digestion. The diagram on page 611 shows the major parts of the entire digestive system.

Mouth and Esophagus Both mechanical and chemical digestion begin in the mouth. The teeth break food into small pieces. The lips and tongue position food so that you can chew. When food is in your mouth, salivary glands in your mouth release saliva, which softens the food and begins chemical digestion. The tongue pushes the food to the back of the mouth and down the throat while swallowing.

When you swallow, your tongue pushes food down into your throat. Food then travels down the esophagus to the stomach. The muscle contractions of peristalsis move solid food from the throat to the stomach in about eight seconds. Liquid foods take about two seconds.

Stomach Strong muscles in the stomach further mix and mash food particles. The stomach also uses chemicals to break down food. Some of the chemicals made by the stomach are acids. These acids are so strong that they could eat through the stomach itself. To prevent this, the cells of the stomach’s lining are replaced about every three days, and the stomach lining is coated with mucus.

Small Intestine Partially digested food moves from the stomach to the small intestine. There, chemicals released by the pancreas, liver, and gallbladder break down nutrients. Most of the nutrients broken down in digestion are absorbed in the small intestine. Structures called villi are found throughout the small intestine. These structures contain folds that absorb nutrients from proteins, carbohydrates, and fats. Once absorbed by the villi, nutrients are transported by the circulatory system around the body. You will read more about the circulatory system in Chapter 18.

Large Intestine In the large intestine, water and some other nutrients are absorbed from the digested material. Most of the solid material then remaining is waste material, which is compacted and stored. Eventually it is eliminated through the rectum.
As food moves through the digestive tract, structures of the digestive system break it down and absorb necessary materials.

1. The mechanical stage of digestion begins when food is chewed in the **mouth**.

2. **Salivary glands** release saliva, which begins to chemically digest food.

3. The **stomach** breaks down food mechanically and also produces chemicals for digestion.

4. Most of the nutrients broken down in digestion are absorbed by the **small intestine**.

5. In the **large intestine**, water and minerals are absorbed and waste material is stored. Solid waste is eliminated through the rectum.
Other organs aid digestion and absorption.

The digestive organs not in the digestive tract—the liver, gallbladder, and pancreas—also play crucial roles in your body. Although food does not move through them, all three of these organs aid in chemical digestion by producing or concentrating important chemicals.

**Liver** The liver—the largest internal organ of the body—is located in your abdomen, just above your stomach. Although you can survive losing a portion of your liver, it is an important organ. The liver filters blood, cleansing it of harmful substances, and stores unneeded nutrients for later use in the body. It produces a golden yellow substance called bile, which is able to break down fats, much like the way soap breaks down oils. The liver also breaks down medicines and produces important proteins, such as those that help clot blood if you get a cut.

**Gallbladder** The gallbladder is a tiny pear-shaped sac connected to the liver. Bile produced in the liver is stored and concentrated in the gallbladder. The bile is then secreted into the small intestine.

**Pancreas** Located between the stomach and the small intestine, the pancreas produces chemicals that are needed as materials move between the two. The pancreas quickly lowers the acidity in the small intestine and breaks down proteins, fats, and starch. The chemicals produced by the pancreas are extremely important for digesting and absorbing food substances. Without these chemicals, you could die of starvation, even with plenty of food in your system. Your body would not be able to process and use the food for energy without the pancreas.

**CHECK YOUR READING** How does the pancreas aid in digestion?

Bile is transferred from the liver to the gallbladder and small intestines through the bile duct.

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**KEY CONCEPTS**

1. List three of the functions of the digestive system.
2. Give one example each of mechanical digestion and chemical digestion.
3. How does your stomach process food?

**CRITICAL THINKING**

4. Apply Does an antacid deal with mechanical or chemical digestion?
5. Apply You have just swallowed a bite of apple. Describe what happens as the apple moves through your digestive system. Include information about what happens to the material in the apple.

**CHALLENGE**

6. Compare and Contrast Describe the roles of the large and the small intestines. How are they similar? How are they different?