Lesson 4

The Digestive and Excretory Systems

ESSENTIAL QUESTION

How do your body's digestive and excretory systems work?

By the end of this lesson, you should be able to relate the parts of the digestive and excretory systems to their roles in the human body.

Your digestive system works to get all of the nutrients out of the food you eat.

Lesson Labs

Quick Labs
- Bile Function
- Peristalsis Race
- Mechanical Digestion

S.T.E.M. Lab
- Modeling a Kidney

Engage Your Brain

1 Predict Fill in the blanks with the words that you think best complete the following sentences.

Inside your _____, food is chewed and broken down by teeth and saliva.

The _____ is a muscle inside your mouth that helps you to swallow food and liquids.

If you eat too much food too quickly, you may get a _____ache.

2 Imagine How is a blender like your stomach?

_____

_____

_____

_____

Active Reading

3 Synthesize You can often define an unknown word if you see it used in a sentence. Use the sentence below to make an educated guess about the meaning of the word *enzyme*.

Example sentence

Enzymes in the mouth, stomach, and small intestine help in the chemical digestion of food.

enzyme:

_____

_____

_____

_____

_____

Vocabulary Terms

- **digestive system**
- **enzyme**
- **esophagus**
- **stomach**
- **small intestine**
- **large intestine**
- **pancreas**
- **liver**
- **excretory system**
- **kidney**
- **nephron**
- **urine**

4 Apply As you learn the meaning of each vocabulary term in this lesson, create your own definition or sketch to help you remember the meaning of the term.

You are what you eat!

What is the digestive system?

Active Reading

5 Identify As you read, underline the ways that your body uses nutrients.

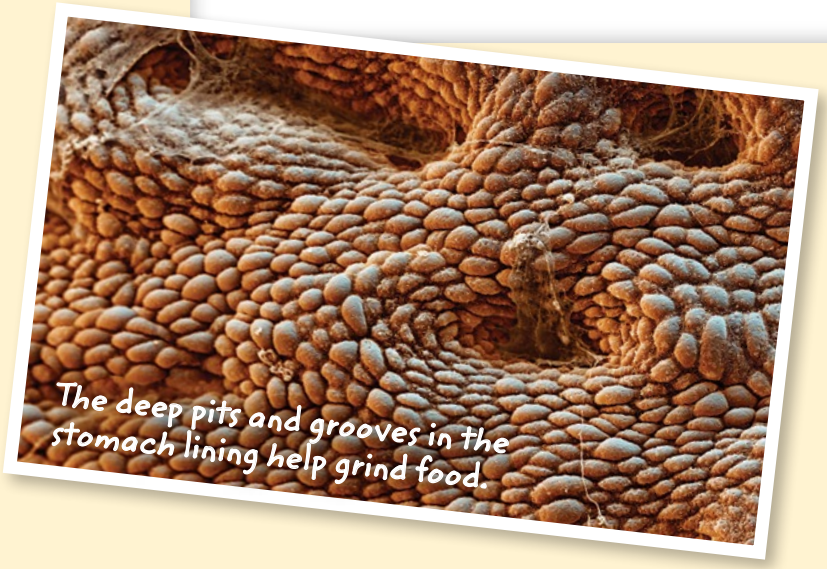
Your cells need a lot of energy for their daily activities. Cells use nutrients, which are substances in food, for energy, growth, maintenance, and repair. The **digestive system** breaks down the food you eat into nutrients that can be used as building materials and that can provide energy for cells.

The digestive system interacts with other body systems to obtain and use energy from food. Blood, part of the circulatory system, transports nutrients to other tissues. In order to extract energy from nutrients, cells need oxygen. The respiratory system is responsible for obtaining this oxygen from the environment. The nervous system controls and regulates the functioning of the digestive system.

What are the two types of digestion?

Digestion is the process of breaking down food into a form that can pass from the digestive system into the bloodstream. There are two types of digestion: mechanical and chemical.

The Stomach



The deep pits and grooves in the stomach lining help grind food.

Inquiry

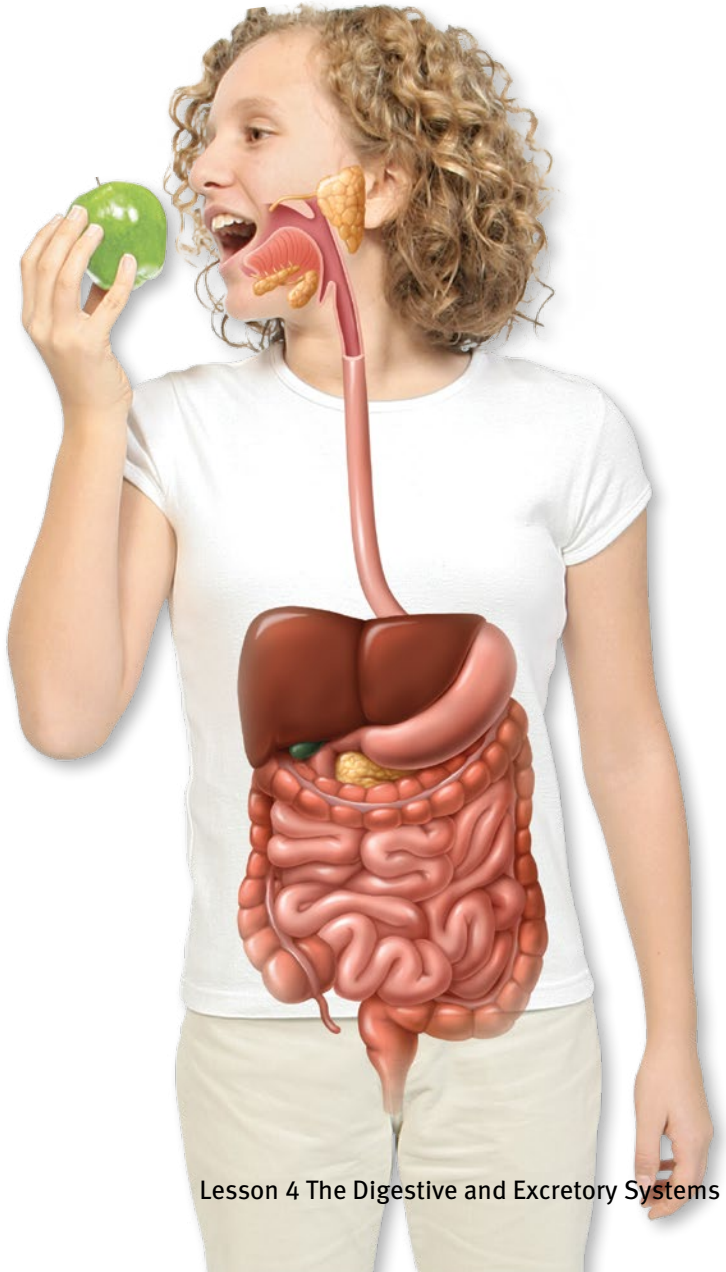
6 Infer The stomach lining is made up of deep muscular grooves. How do you think these structures help the stomach to break down food?

Mechanical Digestion

Mechanical digestion is the breaking, crushing, and mashing of food. Chewing is a type of mechanical digestion. Chewing creates small pieces of food that are easier to swallow and digest than large pieces are. Mechanical digestion increases the surface area of food for the action of chemical digestion.

Chemical Digestion

Chemical digestion is the process in which large molecules of food are broken down into smaller molecules so that they can pass into the bloodstream. An **enzyme** (EN•zym) is a chemical that the body uses to break down large molecules into smaller molecules. Enzymes act like chemical scissors. They "cut up" large molecules into smaller pieces. Mechanical digestion breaks up food and increases surface area so that enzymes can break nutrients into smaller molecules. Without mechanical digestion, chemical digestion would take days instead of hours!



Visualize It!

7 Categorize Decide whether each of these steps in digestion is an example of mechanical digestion or chemical digestion. Then put a check in the correct box.

In your mouth, teeth grind food.

- ☐ mechanical
- ☐ chemical

Salivary glands release a liquid called saliva, which helps to break food down.

- ☐ mechanical
- ☐ chemical

In the stomach, muscles contract to grind food into a pulpy mixture.

- ☐ mechanical
- ☐ chemical

In the small intestine, most nutrients are broken down by enzymes.

- ☐ mechanical
- ☐ chemical

Chew on this

What are the parts of the digestive system?

Has anyone ever reminded you to chew your food? Chewing food is the first part of digestion. After food is chewed and swallowed, pieces of that food move through other organs in the digestive system, where the food is broken down even more.

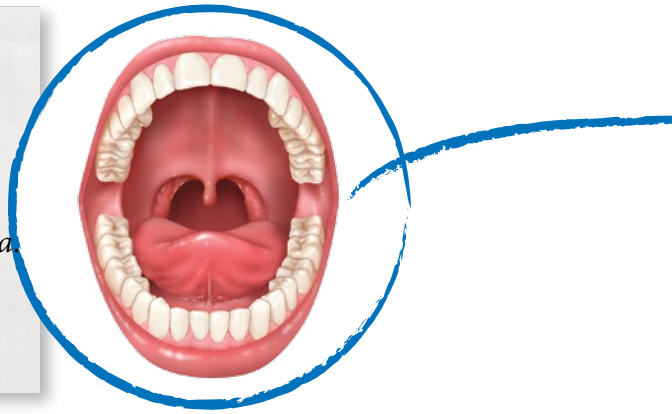
Active Reading

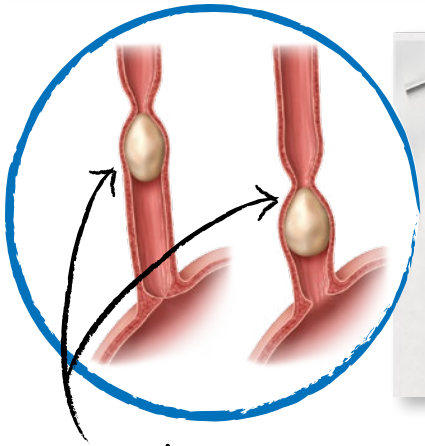
8 As you read, underline the function of each organ of the digestive system.

The Mouth

Digestion begins in the mouth with both mechanical and chemical digestion. Teeth, with the help of strong jaw muscles, break and crush food.

As you chew, food is moistened by a liquid called *saliva*. Glands in your mouth make saliva. Saliva contains many substances, including an enzyme that begins the chemical digestion of starches in food.





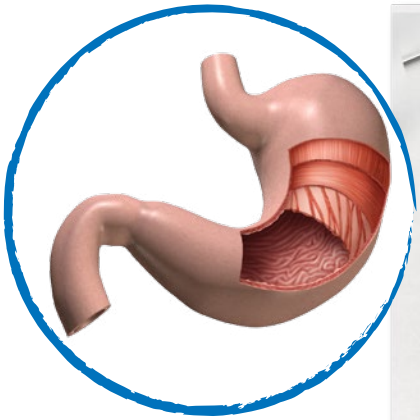
Muscles in the esophagus move this clump of food from your mouth to your stomach.

The Esophagus

Once food has been chewed, it is swallowed. The food moves through the throat and into a long tube called the **esophagus** (ih•SAWF•uh•gus). Waves of muscle contractions called *peristalsis* (per•ih•STAWL•sis) move the food into the stomach. The muscles move food along in much the same way as you move toothpaste from the bottom of the tube with your thumbs.

Visualize It!

9 Claims • Evidence • Reasoning Do you think digestion is more efficient if you are sitting up, slumped over, or lying down? To support your claim, consider the order of organs in the digestive system and their positions in the body. Explain your reasoning.



Stomach

The **stomach** is a muscular bag that crushes food and contains acids and enzymes for killing bacteria and breaking down proteins. The walls of the stomach contain layers of muscle so the stomach walls can churn and mix food. This is the final step in the process of mechanical digestion of the food you have eaten.

Tiny glands in the stomach release a special type of acid that is so harsh that it kills most bacteria that might be swallowed with your food. A coating of thick mucus protects the stomach lining from the acid. The glands in the stomach also release enzymes that begin the process of breaking down proteins. The enzymes that break down proteins can function only in the acidic environment of the stomach.

Small Intestine

After a few hours in the stomach, food is reduced to a soupy mixture called *chyme* (kym). Chyme leaves the stomach and moves into the small intestine. The **small intestine** is a muscular tube where most chemical digestion takes place and most nutrients are absorbed.

Large Intestine

After food moves through the small intestine, it moves to the **large intestine.** In the large intestine, water and nutrients are absorbed. Most of the solid material remaining is waste, which is compacted and stored. Eventually it is eliminated from the body.

Where are nutrients absorbed?

The digestion of nutrients in the small intestine takes place with the help of three organs that attach to the small intestine. These organs are the *pancreas*, *liver*, and *gall bladder*.

The **pancreas** (PANG•kree•uhz) makes fluids that break down every type of material found in foods: proteins, carbohydrates, fats, and nucleic acids. The **liver** makes and releases a mixture called *bile* that is then stored in the gall bladder. Bile breaks up large fat droplets into very small fat droplets.

In the Small Intestine

After nutrients are broken down, they are absorbed into the bloodstream and used by the body's cells. The inside wall of the small intestine has three features that allow it to absorb nutrients efficiently: folds, villi, and microvilli.

First, the walls of the small intestine have many folds. These folds increase the surface area inside the intestine wall, creating more room for nutrients to be absorbed. Each fold is covered with tiny fingerlike projections called *villi* (VIL•eye). In turn, the villi are covered with projections called *microvilli*. Microvilli increase the surface area of the villi. Villi contain blood and lymph vessels that absorb nutrients from food as it passes through the small intestine.

In the Large Intestine

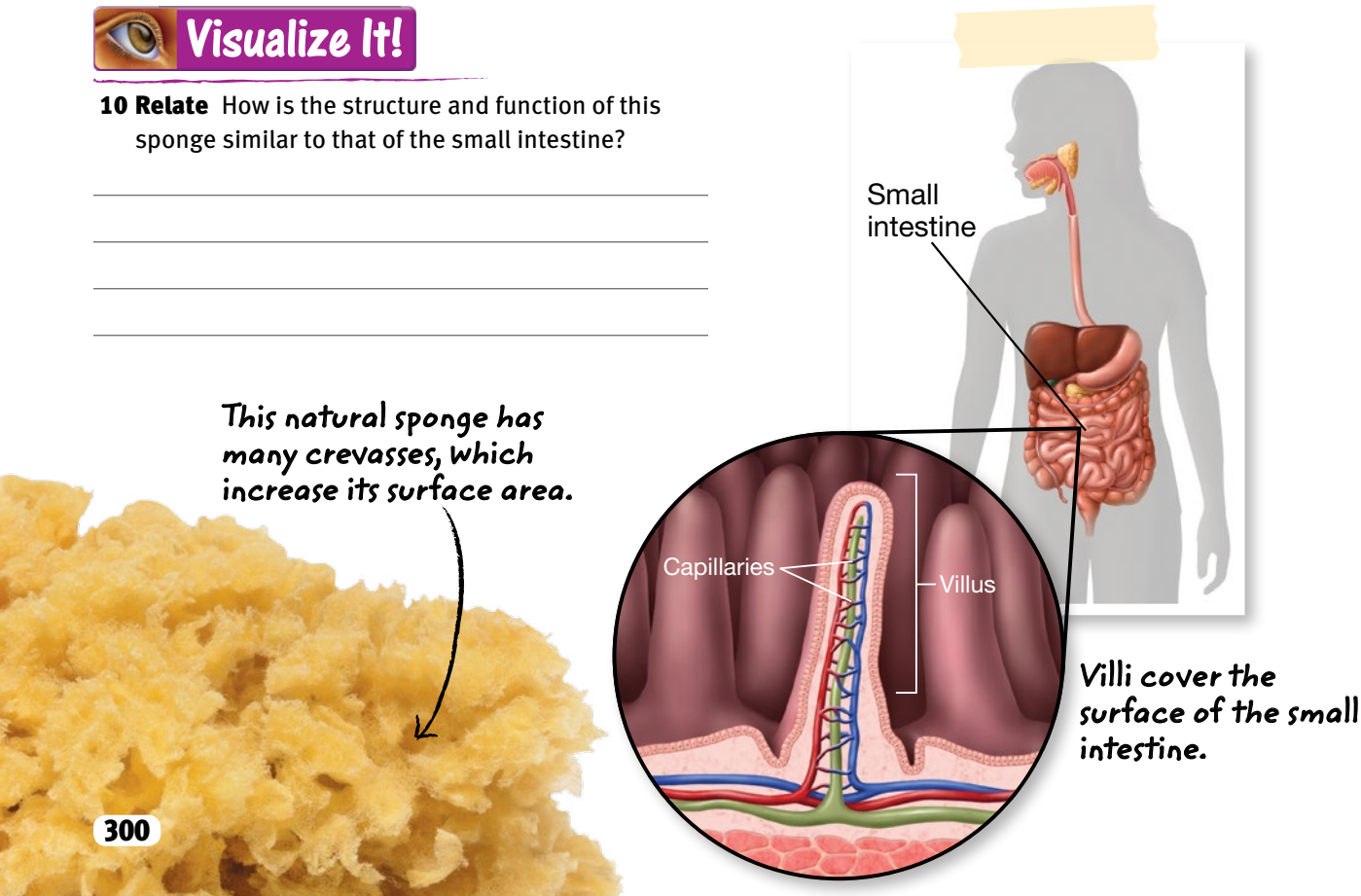
The large intestine removes water from mostly-digested food, absorbs vitamins, and turns food waste into semi-solid waste called *feces*.

Some parts of food, such as the cell walls of plants, cannot be absorbed by the body. Bacteria live in the large intestine that feed off of this undigested food. The bacteria produce vitamins that are absorbed by the large intestine along with most of the water in the undigested food.

The *rectum* is the last part of the large intestine. The rectum stores feces until they can be expelled. Feces pass to the outside of the body through an opening called the *anus*. It takes about 24 hours for a meal to make the full journey through a person's digestive system.

Visualize It!

10 Relate How is the structure and function of this sponge similar to that of the small intestine?



Toxic Waste!

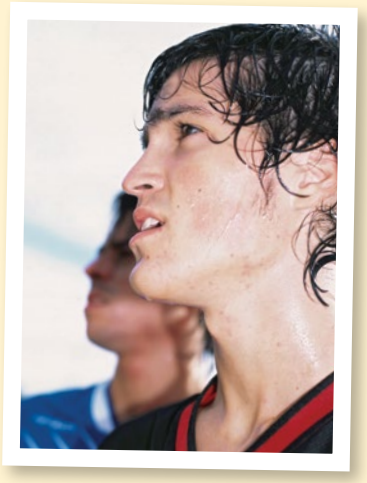
What are the functions of the excretory system?

You have toxic waste in your body! As your cells perform the chemical activities that keep you alive, waste products, such as carbon dioxide and ammonia, are made. These waste products are toxic to cells. If waste builds up in a cell, homeostasis will be disrupted and the cell may die. The **excretory system** eliminates cellular wastes from the body through the lungs, skin, kidneys, and digestive system.

Waste Removal

To Sweat

Your skin is part of the excretory and the integumentary systems. Waste products, such as excess salts, are released through your skin when you sweat.



After you read the text, answer the associated questions below.

11 Identify Sweat releases wastes through your _____.

To Exhale

Your lungs are part of the excretory and respiratory systems. Lungs release water and toxic carbon dioxide when you exhale.

12 List Two waste products that are released when you exhale are _____ and _____.

To Produce Urine and Feces

Kidneys, part of the urinary system, remove all types of cellular waste products from your blood. Your digestive system eliminates feces from your body.

13 Identify The urinary system filters waste out of your _____.

Cleanup crew

What organs are in the urinary system?

The urinary system collects cellular waste and eliminates it from the body in the form of liquid waste. Waste products enter the urinary system through the kidneys.

Active Reading

14 Identify As you read, underline the functions of the organs in the urinary system.

Kidneys

The **kidney** is one of a pair of organs that remove waste from the blood. Inside each kidney are more than 1 million microscopic structures called **nephrons** (NEF•rahnz). Fluid is filtered from the blood into the nephron through a structure called the *glomerulus* (gloh•MEHR•yuh•luhs). Filtered blood leaves the glomerulus and circulates around the tubes that make up the nephron. These structures return valuable salts and ions to the blood. Tubes in the kidneys collect the wastes from the nephrons. Water and the wastes filtered out of the blood form a liquid known as **urine.**

Ureters

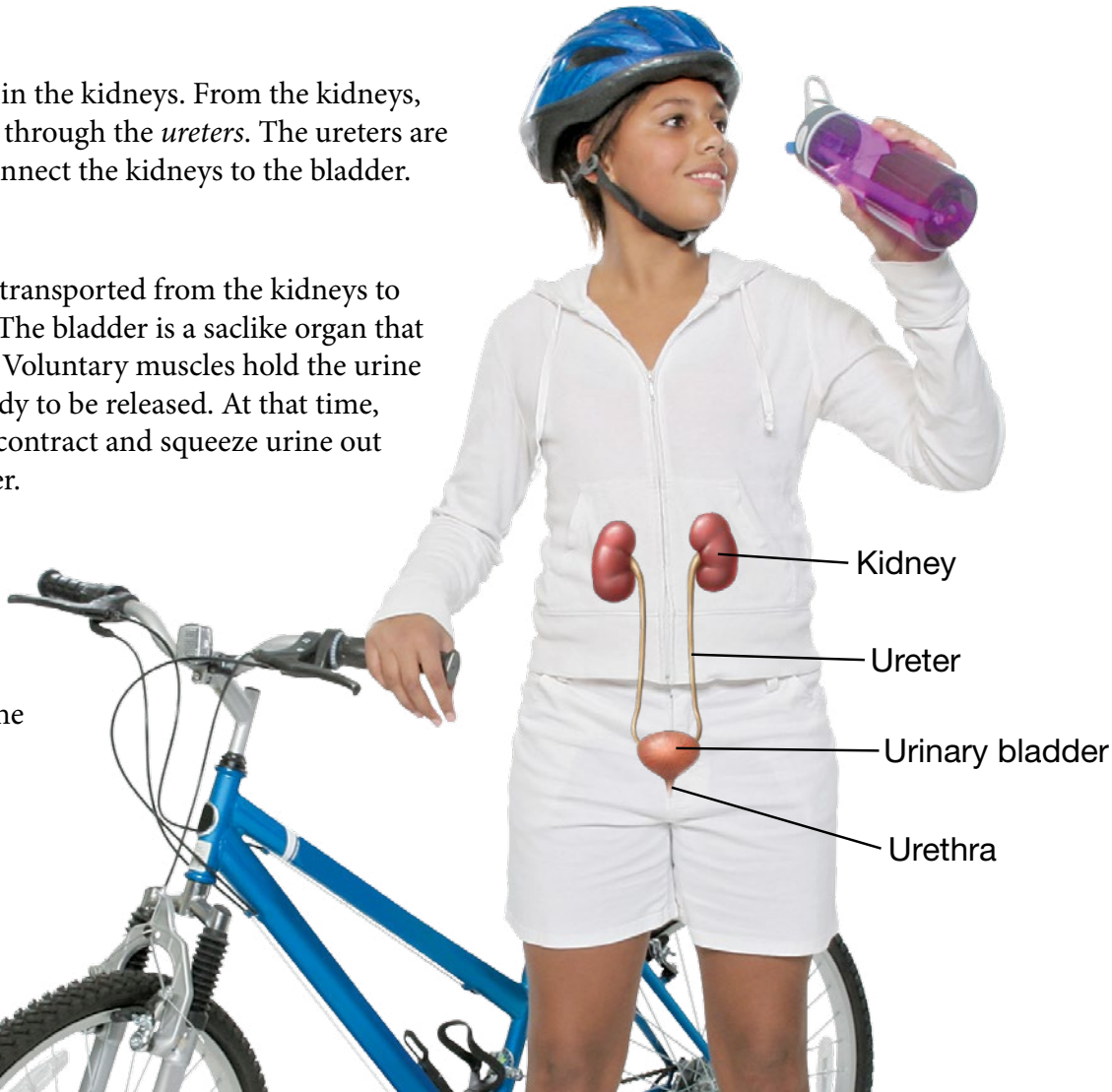
Urine forms in the kidneys. From the kidneys, urine travels through the *ureters*. The ureters are tubes that connect the kidneys to the bladder.

Bladder

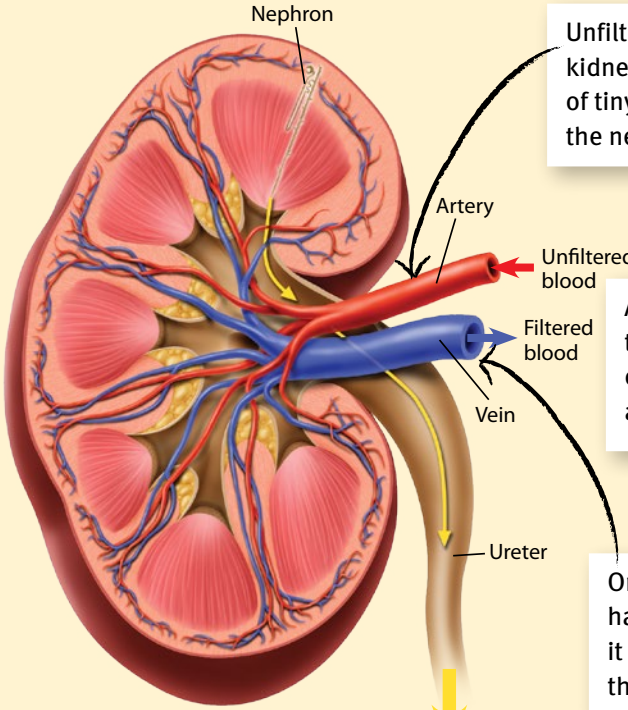
The urine is transported from the kidneys to the *bladder*. The bladder is a saclike organ that stores urine. Voluntary muscles hold the urine until it is ready to be released. At that time, the muscles contract and squeeze urine out of the bladder.

Urethra

Urine exits the bladder through a tube called the *urethra*.



Filtering Blood



Unfiltered blood enters the kidney and flows into millions of tiny capillaries attached to the nephrons.

As blood flows through the capillaries, wastes are drawn out of the blood and into the nephron.

Once the blood has been filtered, it flows back out of the kidney.

Urine is collected from all of the nephrons and then flows out of the kidney through the ureter.

Visualize It!

15 Identify After blood enters the kidneys, name the two paths the fluid takes.

How does the urinary system maintain homeostasis?

Your cells have to maintain a certain level of water and salt in order to function properly. The excretory system interacts with the endocrine system to help maintain homeostasis and carry out life processes. Chemical messengers called *hormones* signal the kidneys to filter more or less water or salt, depending on the levels of water and salt in the body. For example, when you sweat a lot, the water content of your blood can drop. When this happens, a hormone is released that signals the kidneys to conserve more water and make less urine. When your blood has too much water, less of the hormone is released. As a result, the nephrons conserve less water, and more urine is produced by the kidneys.

Household or environmental toxins that enter the body through the skin, lungs, or mouth eventually end up in the bloodstream. When the kidneys are damaged, many toxins can accumulate in the blood. Infections can also affect the kidneys. Bacterial infections can occur when bacteria around the opening of the urethra travel up to the bladder and possibly the kidneys.

Active Reading

16 Explain How does exercise affect the balance of salt and water in your body? Synthesize evidence to support your claim.

Visual Summary

To complete this summary, fill in the blanks with the correct word or phrase. Then, use the answer key to check your answers. You can use this page to review the main concepts of the lesson.

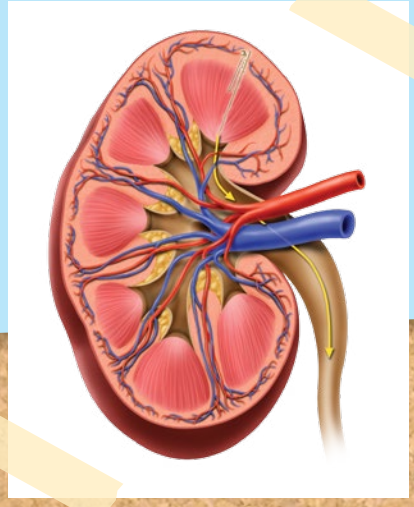
The digestive system breaks down the food you eat into nutrients that provide energy and building materials for cells.

17 The two types of digestion that take place in the mouth are _____ and _____.

Digestion and Excretion

The excretory system removes waste from the body.

18 The _____ remove waste from the blood.



The digestive and excretory systems interact to process the food that you eat.

19 To process this salad, food is broken down by the _____ _____ and wastes are removed by the _____.

Answers: 17 mechanical, chemical; 18 kidneys; 19 digestive system, excretory system

20 Summarize What types of wastes does the excretory system remove?

Lesson Review

Vocabulary

Fill in the blank with the term that best completes the following sentences.

1 The _____ system helps the body maintain homeostasis by giving it the nutrients it needs to perform different functions.

2 The _____ system eliminates cellular waste through the lungs, skin, and kidneys.

3 The _____ is the name for the hollow muscular organ that stores urine.

Key Concepts

4 Compare What is the difference between mechanical digestion and chemical digestion in the mouth?

5 Describe Starting with the mouth, describe the pathway that food takes through the digestive system.

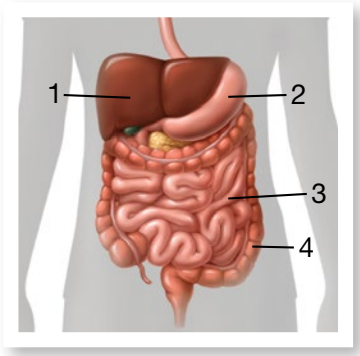
6 Explain How does the circulatory system interact with the digestive system?

7 Identify Where does urine go after it exits the kidneys?

8 Summarize How do kidneys interact with other body systems to maintain homeostasis?

Use the diagram to answer the following question.

9 Apply Identify the organs numbered below.



Critical Thinking

10 Relate How would damaged kidneys affect your health? Explain your reasoning.

11 Claims • Evidence • Reasoning Suppose a person has a small intestine that has fewer villi than normal. Would the person most likely be overweight or underweight? State your claim. Summarize evidence to support your claim and explain your reasoning.

My Notes