

READING WARM-UP

Objectives

- Describe the parts and functions of the urinary system.
- Explain how the kidneys filter blood.
- Describe three disorders of the urinary system.

Terms to Learn

urinary system
kidney
nephron

READING STRATEGY

Reading Organizer As you read this section, create an outline of the section. Use the headings from the section in your outline.

urinary system the organs that produce, store, and eliminate urine

The Urinary System

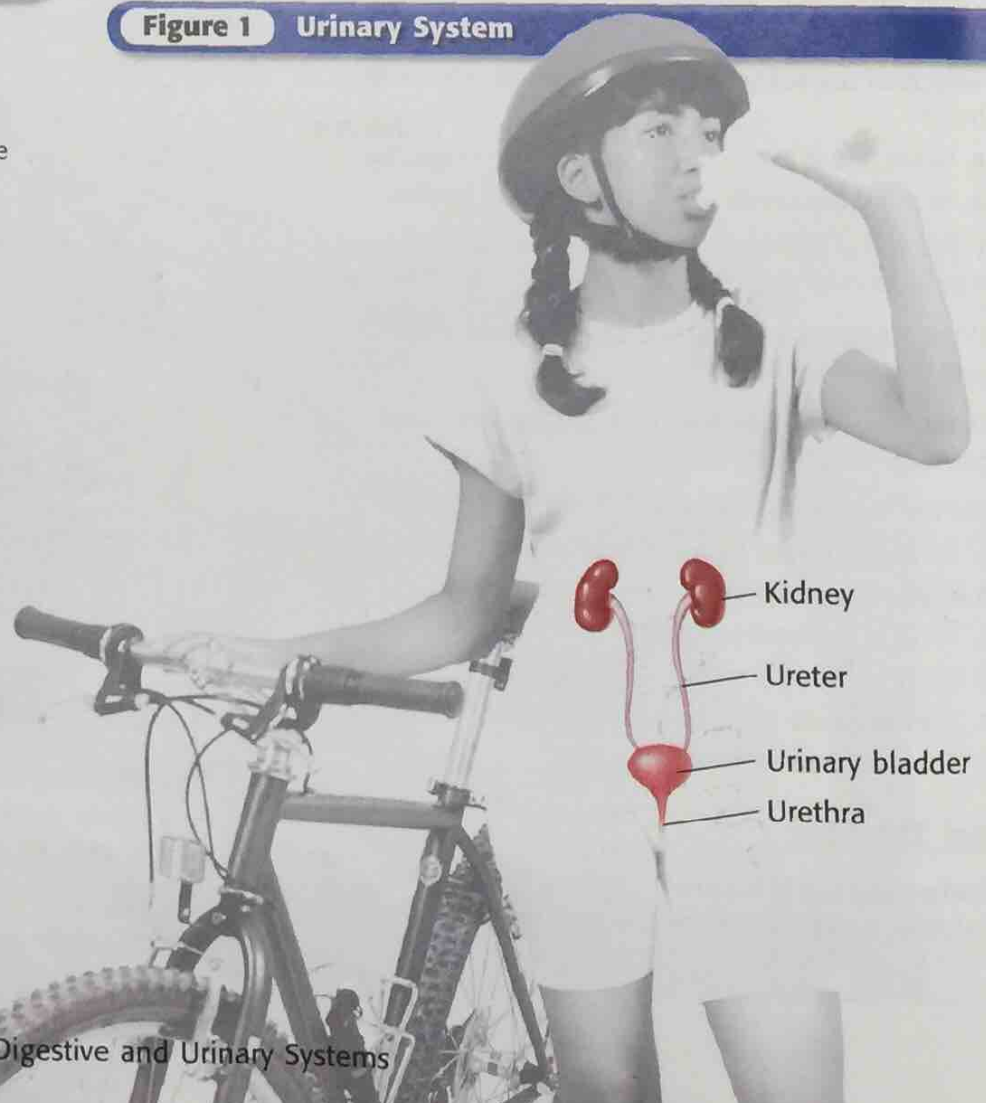
As blood travels through the tissues, it picks up waste produced by the body's cells. Your blood is like a train that comes to town to drop off supplies and take away garbage. If the waste is not removed, your body can actually be poisoned.

Excretion is the process of removing waste products from the body. Three of your body systems have a role in excretion. Your integumentary system releases waste products and water when you sweat. Your respiratory system releases carbon dioxide and water when you exhale. Finally, the **urinary system** contains the organs that remove waste products from your blood.

Cleaning the Blood

As your body performs the chemical activities that keep you alive, waste products, such as carbon dioxide and ammonia, are made. Your body has to get rid of these waste products to stay healthy. The urinary system, shown in **Figure 1**, removes these waste products from the blood.

Figure 1 Urinary System



The Kidneys as Filters

The **kidneys** are a pair of organs that constantly clean the blood. Your kidneys filter about 2,000 L of blood each day. Your body holds only 5.6 L of blood, so your blood cycles through your kidneys about 350 times per day!

Inside each kidney, shown in **Figure 2**, are more than 1 million nephrons. **Nephrons** are microscopic filters in the kidney that remove wastes from the blood. Nephrons remove many harmful substances. One of the most important substances removed by nephrons is urea (yoo REE uh), which contains nitrogen and is formed when cells use protein for energy.

Reading Check How are nephrons related to the function of kidneys? (See the Appendix for answers to Reading Checks.)

kidney one of the pair of organs that filter water and wastes from the blood and that excrete products as urine

nephron the unit in the kidney that filters blood

Figure 2 How the Kidneys Filter Blood

- 1 A large artery brings blood into each kidney.
- 2 Tiny blood vessels branch off the main artery and pass through part of each nephron.
- 3 Water and other small substances, such as glucose, salts, amino acids, and urea, are forced out of the blood vessels and into the nephrons.
- 4 As these substances flow through the nephrons, most of the water and some nutrients are moved back into blood vessels that wrap around the nephrons. A concentrated mixture of waste materials is left behind in the nephrons.
- 5 The cleaned blood, which has slightly less water and much less waste material, leaves each kidney in a large vein to recirculate in the body.
- 6 The yellow fluid that remains in the nephrons is called *urine*. Urine leaves each kidney through a slender tube called the *ureter* and flows into the *urinary bladder*, where urine is stored.
- 7 Urine leaves the body through another tube called the *urethra*. *Urination* is the process of expelling urine from the body.

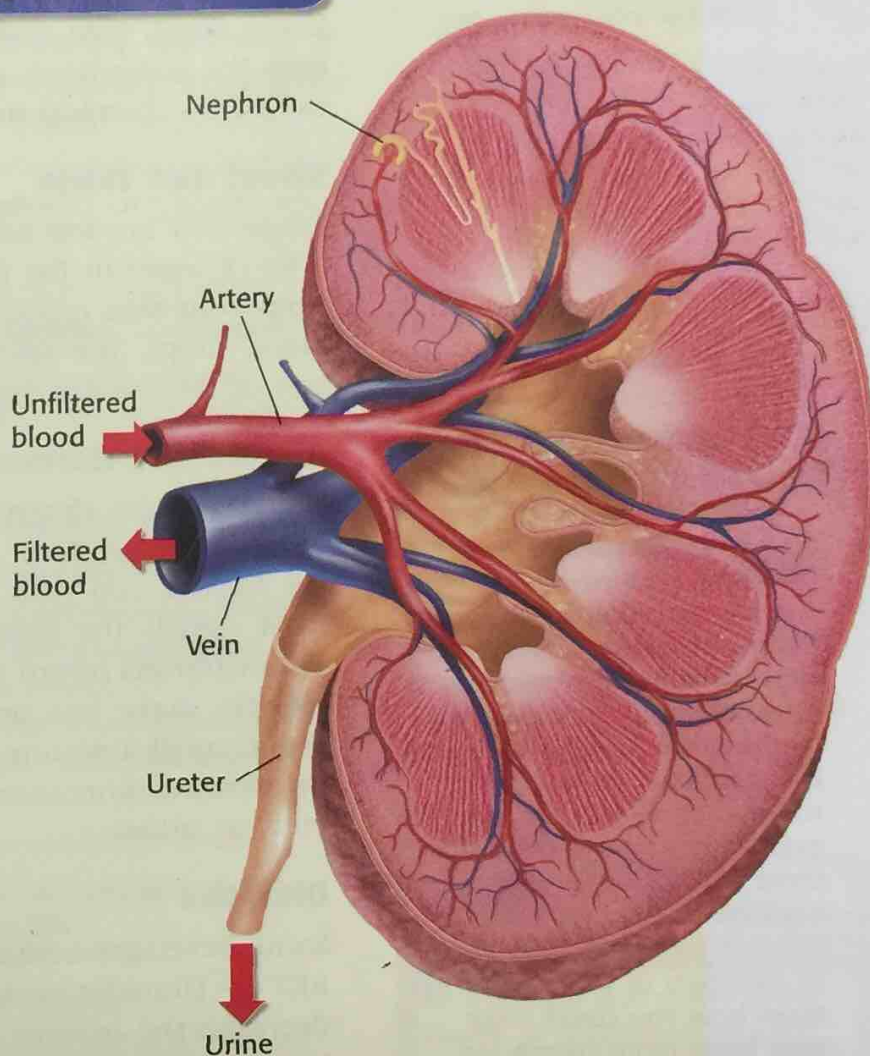


Figure 3 Drinking water when you exercise helps replace the water you lose when you sweat.



Water In, Water Out

You drink water every day. You lose water every day in sweat and urine. You need to get rid of as much water as you drink. If you don't, your body will swell up. So, how does your body keep the water levels in balance? The balance of fluids is controlled by chemical messengers in the body called *hormones*.

Sweat and Thirst

When you are too warm, as the boy in **Figure 3** is, you lose a lot of water in the form of sweat. The evaporation of water from your skin cools you down. As the water content of the blood drops, the salivary glands produce less saliva. This is one of the reasons you feel thirsty.

Antidiuretic Hormone

When you get thirsty, other parts of your body react to the water shortage, too. A hormone called *antidiuretic hormone* (AN tee DIE yoo RET ik HAWR MOHN), or ADH, is released. ADH signals the kidneys to take water from the nephrons. The nephrons return the water to the bloodstream. Thus, the kidneys make less urine. When your blood has too much water, small amounts of ADH are released. The kidneys react by allowing more water to stay in the nephrons and leave the body as urine.

Diuretics

Some beverages contain caffeine, which is a *diuretic* (DIE yoo RET ik). Diuretics cause the kidneys to make more urine, which decreases the amount of water in the blood. When you drink a beverage that contains water and caffeine, the caffeine increases fluid loss. So, your body gets to use less of the water from the caffeinated beverage than from a glass of water.

 **Reading Check** What are diuretics?

CONNECTION TO Language Arts

WRITING SKILL Beverage Ban

During football season, a football coach insists that all members of the team avoid caffeinated beverages. Many of the players are upset by the news. Pretend that you are the coach. Write a letter to the members of the team explaining why it is better for them to drink water than to drink beverages that contain caffeine. Read the letter aloud to members of your family. Ask them how you could make your letter more convincing.

Urinary System Problems

The urinary system regulates body fluids and removes wastes from the blood. Any problems with water regulation can become dangerous for your body and disrupt homeostasis. Some common urinary system problems are described below.

- **Bacterial Infections** Bacteria can get into the bladder and ureters through the urethra and cause painful infections. Infections should be treated early, before they spread to the kidneys. Infections in the kidneys can permanently damage the nephrons.
- **Kidney Stones** Sometimes, salts and other wastes collect inside the kidneys and form kidney stones like the one in **Figure 4**. Some kidney stones interfere with urine flow and cause pain. Most kidney stones pass naturally from the body, but sometimes they must be removed by a doctor.
- **Kidney Disease** Damage to nephrons can prevent normal kidney functioning and can lead to kidney disease. If a person's kidneys do not function properly, a kidney machine can be used to filter waste from the blood.



Figure 4 This kidney stone had to be removed from a patient's urinary system.

SECTION Review

Summary

- The urinary system removes liquid waste as urine. The filtering structures in the kidney are called *nephrons*.
- Most of the water in the blood is returned to the bloodstream. Urine passes through the ureter, into the bladder, and out of the body through the urethra.
- Disorders of the urinary system include infections, kidney stones, and kidney disease.

Using Key Terms

1. In your own words, write a definition for the term *urinary system*.

Understanding Key Ideas

2. Which event happens first?
 - a. Water is absorbed into blood.
 - b. A large artery brings blood into the kidney.
 - c. Water enters the nephrons.
 - d. The nephron separates water from wastes.
3. How do kidneys filter blood?
4. Describe three disorders of the urinary system.

Math Skills

5. A study has shown that 75% of teenage boys drink 34 oz of soda per day. How many 12 oz cans of soda would a boy drink in a week if he drank 34 oz per day?

Critical Thinking

6. **Applying Concepts** Which of the following contains more water: the blood going into the kidney or the blood leaving it?
7. **Predicting Consequences** When people have one kidney removed, their other kidney can often keep their blood clean. But the remaining kidney often changes. Predict how the remaining kidney may change to do the work of two kidneys.

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