

B The Excretory System

Reading Preview

Key Concepts

- What are the structures and functions of the excretory system?
- How do the kidneys filter wastes from the blood?
- How does excretion contribute to homeostasis?

Key Terms

- excretion • urea • kidney
- urine • ureter
- urinary bladder • urethra
- nephron

Target Reading Skill

Previewing Visuals Before you read, preview Figure 11. Then, write two questions that you have about the diagram in a graphic organizer like the one below. As you read, answer your questions.

How the Kidneys Filter Wastes

Q. Where are nephrons located?

A.

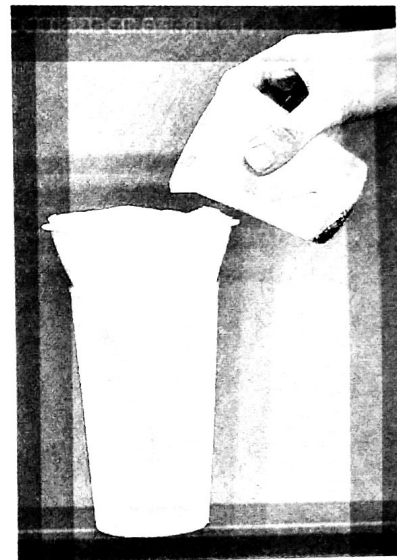
Q.

Lab
zone

Discover Activity

How Does Filtering a Liquid Change the Liquid?

1. Your teacher will give you 50 mL of a liquid in a small container. Pour a small amount of sand into the liquid.
2. Use a glucose test strip to determine whether glucose is present in the liquid.
3. Put filter paper in a funnel. Then, put the funnel into the mouth of a second container. Slowly pour the liquid through the funnel into the second container.
4. Look for any solid material on the filter paper. Remove the funnel, and carefully examine the liquid that passed through the filter.
5. Test the liquid again to see whether it contains glucose.



Think It Over

Observing Which substances passed through the filter, and which did not? How might a filtering device be useful in the body?

The human body faces a challenge that is a bit like trying to keep your room clean. Magazines, notebook paper, and CD wrappers tend to pile up in your room. You use all of these things, but sooner or later you must clean your room if you don't want to be buried in trash. Something similar happens in your body. As your cells use nutrients in respiration and other processes, wastes are created. Different organs in the body have roles for the removal of these wastes. The removal process is known as **excretion**.

If wastes were not removed from your body, they would pile up and make you sick. Excretion helps keep the body's internal environment stable and free of harmful materials. **The excretory system is the system in the body that collects wastes produced by cells and removes the wastes from the body.**

The Excretory System

Two wastes that your body must eliminate are excess water and urea. **Urea** (yoo REE uh) is a chemical that comes from the breakdown of proteins. **The structures of the excretory system that eliminate urea, water, and other wastes include the kidneys, ureters, urinary bladder, and urethra.**

Your two **kidneys**, which are the major organs of the excretory system, remove urea and other wastes from the blood. The kidneys act like filters. They remove wastes but keep materials that the body needs. The wastes are eliminated in **urine**, a watery fluid that contains urea and other wastes. Urine flows from the kidneys through two narrow tubes called **ureters** (yoo REE turz). The ureters carry urine to the **urinary bladder**, a sacklike muscular organ that stores urine. Urine leaves the body through a small tube called the **urethra** (yoo REE thruh).



**Reading
Checkpoint**

What is the role of the ureters?

Filtration of Wastes

The kidneys are champion filters. Each of your kidneys contains about a million **nephrons**, tiny filtering factories that remove wastes from blood and produce urine. **The nephrons filter wastes in stages. First, both wastes and needed materials, such as glucose, are filtered out of the blood. Then, much of the needed material is returned to the blood, and the wastes are eliminated from the body.** Follow this process in Figure 11.

Filtering Out Wastes During the first stage of waste removal, blood enters the kidneys. Here, the blood flows through smaller and smaller arteries. Eventually it reaches a cluster of capillaries in a nephron. The capillaries are surrounded by a thin-walled, hollow capsule that is connected to a tube. In the capillary cluster, urea, glucose, and some water move out of the blood and into the capsule. Blood cells and most protein molecules do not move into the capsule. Instead, they remain in the capillaries.

Formation of Urine Urine forms from the filtered material in the capsule. This material flows through the long, twisting tube. As the liquid moves through the tube, many of the substances are returned to the blood. Normally, all the glucose, most of the water, and small amounts of other materials pass back into the blood in the capillaries that surround the tube. In contrast, urea and other wastes remain in the tube.

Lab
zone

Skills Activity

Classifying

A number of materials enter the kidney, where they are filtered by the nephrons.

- What materials enter a nephron?
- What materials are returned to the blood?
- What materials leave the body in urine?

Excretory System

Kidney

Ureter

Urinary bladder

Urethra



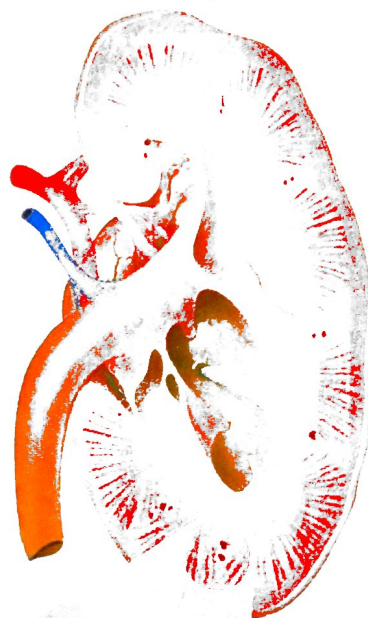
FIGURE 11

How the Kidneys Filter Wastes

The structures of the excretory system include the kidneys, urinary bladder, and urethra. Each kidney contains about a million tiny filtering units called nephrons. Urine is produced in the nephrons.

Interpreting Diagrams Where are the kidneys located?

Kidney



Nephron

1 Blood flows from an artery into a nephron in the kidney.

2 Blood reaches a cluster of capillaries. There, urea, water, glucose, and other materials are filtered out of the blood. These materials pass into a capsule that surrounds the capillaries.

3 The materials that were removed from the blood pass into a long, twisting tube. The tube is surrounded by capillaries.

4 As the filtered material flows through the tube, most of the water and glucose are reabsorbed into the blood. Most of the urea stays in the tube.

5 After the reabsorbing process is complete, the liquid that remains in the tube is called urine.



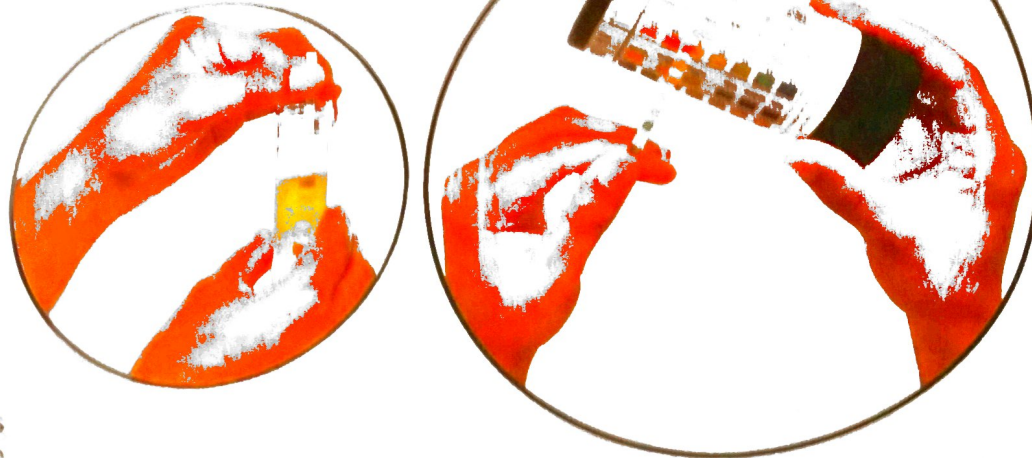


FIGURE 12

Analyzing Urine

Lab technicians can analyze urine by using a dipstick that changes color in the presence of glucose and other substances. The technician dips the dipstick into a urine sample and compares the results to a color chart.

Applying Concepts What are two substances for which urine can be tested?

Analyzing Urine for Signs of Disease When people go to a doctor for a medical checkup, they usually have their urine analyzed. A chemical analysis of urine can be useful in detecting some medical problems. Normally, urine contains almost no glucose or protein. If glucose is present in urine, it may indicate that a person has diabetes, a condition in which body cells cannot absorb enough glucose from the blood. Protein in urine can be a sign that the kidneys are not functioning properly.



Reading Checkpoint

What could it mean if there is glucose in the urine?

Excretion and Homeostasis

Eliminating wastes, such as urea, excess water, and carbon dioxide, is important for maintaining homeostasis. **Excretion maintains homeostasis by keeping the body's internal environment stable and free of harmful levels of chemicals. In addition to the kidneys, organs of excretion that maintain homeostasis include the lungs, skin, and liver.**

Kidneys As the kidneys filter blood, they help to maintain homeostasis by regulating the amount of water in your body. Remember that as urine is being formed, water passes from the tube back into the bloodstream. The exact amount of water that is reabsorbed depends on conditions both outside and within the body. For example, suppose that it's a hot day. You've been sweating a lot, and you haven't had much to drink. In that situation, almost all of the water in the tube will be reabsorbed, and you will excrete only a small amount of urine. If, however, the day is cool and you've drunk a lot of water, less water will be reabsorbed. Your body will produce a larger volume of urine.

Go Online

SCILINKS_{SM}

For: Links on organs of excretion

Visit: www.Scilinks.org

Web Code: scn-0443

Lungs and Skin Most of the wastes produced by the body are removed through the kidneys. However, the lungs and skin remove some wastes from the body as well. When you exhale, carbon dioxide and some water are removed from the body by the lungs. Sweat glands in the skin also serve an excretory function because water and urea are excreted in perspiration.

Liver Have you ever torn apart a large pizza box so that it could fit into a wastebasket? If so, then you understand that some wastes need to be broken down before they can be excreted. The liver performs this function. For example, urea, which comes from the breakdown of proteins, is produced by the liver. The liver also converts part of the hemoglobin molecule from old red blood cells into substances such as bile. Because the liver produces a usable material from old red blood cells, you can think of the liver as a recycling facility.



Reading Checkpoint What substances are excreted in perspiration?



FIGURE 13

Excretion Through the Lungs

Your lungs function as excretory organs. When you exhale on a cold morning, you can see the water in your breath.

Section

Assessment

Target Reading Skill **Previewing Visuals**

Compare your questions and answers about Figure 11 with those of a partner.

Reviewing Key Concepts

1. a. **Reviewing** What is the role of the excretory system in the body?
b. **Sequencing** Name the structures of the excretory system in order of their roles in producing and eliminating urine. Describe the function of each structure.
2. a. **Reviewing** What are the two main stages of waste removal by the kidneys?
b. **Describing** What happens as wastes are filtered in a nephron?
c. **Relating Cause and Effect** Why is protein in the urine a sign that something could be wrong with the kidneys?

3. a. **Identifying** What is the role of excretion in maintaining homeostasis?
b. **Explaining** How do the kidneys help maintain homeostasis?
c. **Predicting** On a long bus trip, a traveler does not drink any water for several hours. How will the volume of urine she produces that day compare to the volume on a day when she drinks several glasses of water? Explain.

Writing in Science

Explanation Write a paragraph explaining how wastes are filtered in the kidneys. To help you with your writing, first make two lists—one that includes materials removed from the blood in the kidneys and one that includes materials returned to the blood.