Chapter 15

Protecting Health

15.2 The Excretory System

As cells go about their activities, they generate wastes. We already know what cells do with these wastes—they let them diffuse into the bloodstream. But where do the wastes go from there? How does the body get rid of them? This is the job of the excretory system.

The excretory system, shown in Figure 15.4, filters your blood, removing wastes while leaving useful molecules in the blood. The excretory system also controls how much water, sodium, potassium, calcium, and other substances the body keeps. Did you know that your entire blood supply moves through your kidneys 16 times a day? The end result is something we're all familiar with—about 6 cups of urine.

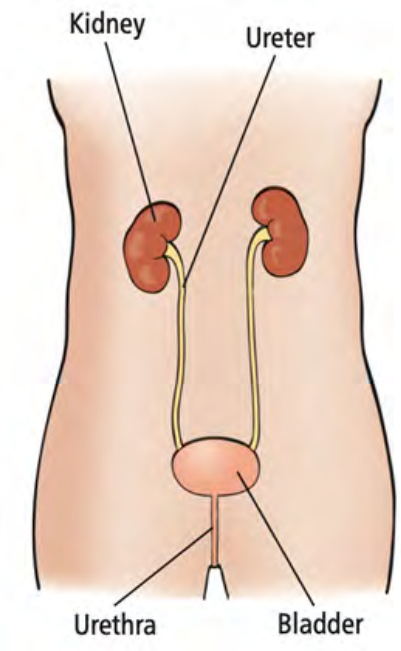


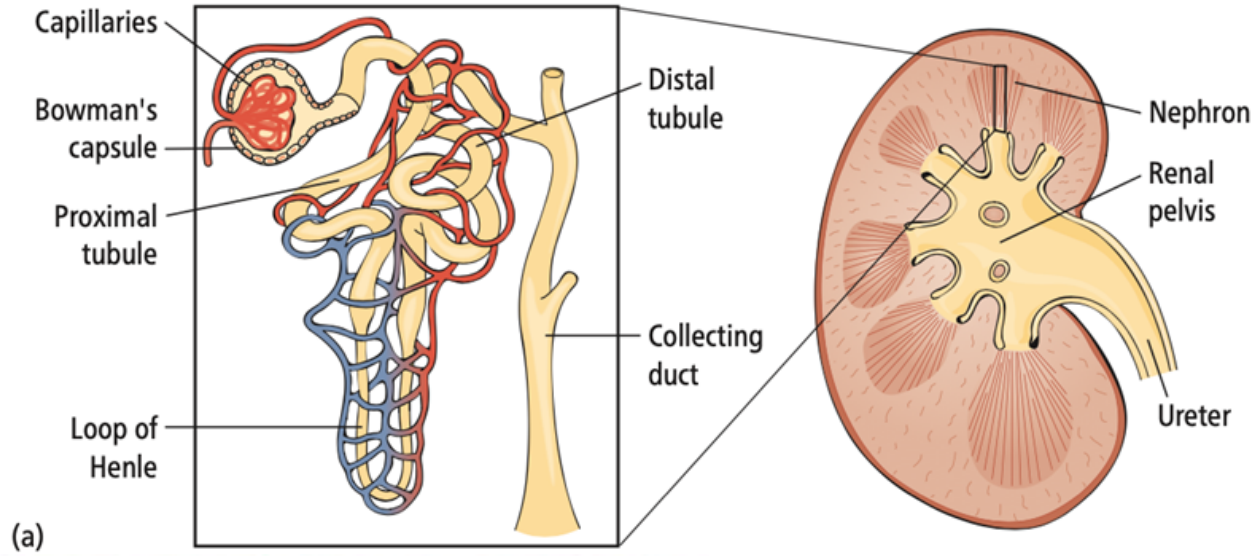
FIGURE 15.4

The excretory system consists of the kidneys, ureters, bladder, and urethra.

One of the most important wastes found in urine is *urea*. When amino acids are broken down to make ATP, ammonia, a nitrogen-containing waste, is produced. Because ammonia is highly toxic, the liver immediately converts it to urea, a less toxic waste. The liver then releases urea into the bloodstream for excretion.

How does excretion happen? The process begins in the **kidneys**, paired excretory organs that filter blood and produce urine. Each kidney contains about a million structures called nephrons. The **nephron** is the functional unit of the kidney. What goes into the nephron is more or less blood plasma, and what comes out is urine. Let's look at how this happens.

Each nephron is associated with a cluster of capillaries (Figure 15.5). The first part of the nephron, a cup-shaped structure called *Bowman's capsule*, surrounds the capillaries. Blood pressure pushes fluid out of the capillaries and into Bowman's capsule. The fluid that enters Bowman's capsule is called the *filtrate*. At this point, the filtrate is very similar to blood plasma.



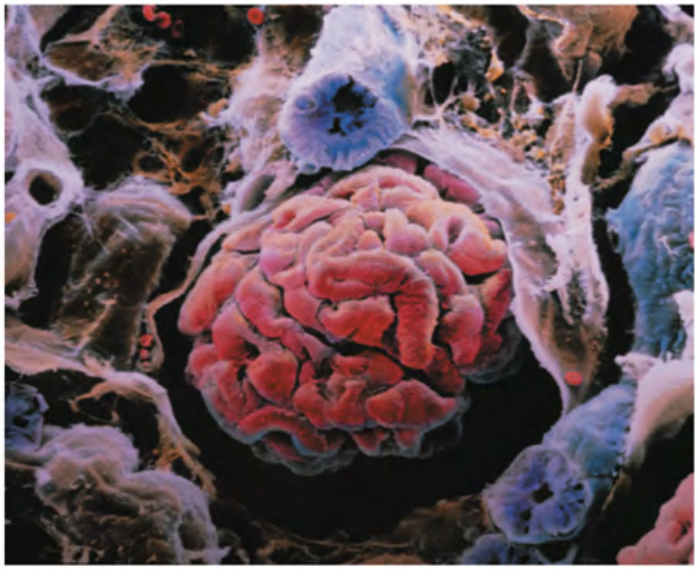


FIGURE 15.5

(a) The kidney is made up of about a million functional units called nephrons.

(b) This photo shows part of a nephron. The cluster of capillaries is shown in red, and Bowman's capsule, in brown, surrounds it to the right. The purple structures are cut sections of the tubules.

From Bowman's capsule, the filtrate enters the *proximal tubule*. The proximal tubule is like a sorting machine. "Good" molecules in the filtrate—such as ions, glucose, vitamins, and amino acids—are transported back into the blood so that the body can keep them. "Bad" waste molecules are transported from the blood to the filtrate. The movement of specific molecules into and out of the proximal tubule occurs through active transport, a process that requires energy. This is one of the reasons excretion requires a significant amount of energy.

After moving through the proximal tubule, the filtrate enters the *loop of Henle*, a hairpin-shaped loop. In the loop of Henle, water is absorbed from the filtrate. This helps the body save water. From the loop of Henle, the filtrate moves into the *distal tubule*. In the distal tubule, more wastes are transported into the filtrate.

Finally, the filtrate moves down the *collecting duct*. In the collecting duct, more water is absorbed from the filtrate. How much water is absorbed depends on whether antidiuretic hormone is present in the bloodstream. If antidiuretic hormone is present, more water is absorbed and kept by the body. As a result, urine becomes more concentrated.

The filtrate—which is now urine—flows from the collecting duct into the *renal pelvis* (see Figure 15.5). The renal pelvis is like a giant funnel that catches the drippings of a million nephrons. From the renal pelvis, urine goes down a tube called the *ureter* to the bladder. The *bladder* is a stretchy sac where urine is temporarily stored. When the bladder is emptied, urine flows down the *urethra* and out the body.

READING CHECK

Which organ systems provide the raw materials for making ATP (such as glucose and oxygen)? Which organ systems get rid of the wastes (such as carbon dioxide and urea)?

CHECK YOUR ANSWER

Glucose—as well as other organic molecules that can be broken down to make ATP—comes from the digestive system, which breaks down the food you eat. Oxygen is brought into the body by the respiratory system. Carbon dioxide is removed from the body through the work of the respiratory system as well. Urea and other wastes are removed by the excretory system. The circulatory system is involved every step of the way—the circulatory system transports the raw materials and wastes to their destinations in the body.

You can read more about the excretory system at the following website:

https://www.cliffsnotes.com/study-guides/biology/biology/excretion-and-homeostasis/human-excretory-system