Lesson Objectives

- Identify the functions of the excretory system.
- List the organs of the excretory system.
- Describe the parts of urinary system.
- Outline how the kidneys filter blood.
- Identify three disorders of the urinary system.

Check Your Understanding

- What are some "wastes" that must be removed from your body?
- Do your circulatory and respiratory systems remove "waste?"

Vocabulary

- excretion
- excretory system
- kidney
- kidney dialysis
- kidney failure
- nephron
- urinary bladder
- urinary system
- urinary tract infection (UTI)
- urination
- urine

The Excretory System

One of the most important ways your body maintains homeostasis is by keeping the right amount of water and salts inside your body. If you have too much water in your body, your cells can swell and burst. If you have too little water in your body, your cells can shrivel up like an old apple. Either extreme can cause illness and death of cells, tissues, and organs. The organs of your excretory system help to keep the correct balance of water and salts within your body.

Your body also needs to remove the wastes that build up from cell activity and from digestion. These wastes include carbon dioxide, urea, and certain plant materials. If these wastes are not removed, your cells can stop working and you can get very sick. The excretory system can also help to release wastes from the body. Excretion is the process of removing wastes from the body.

The organs of the excretory system are also parts of other organ systems. For example, your lungs are part of the respiratory system. Your lungs remove carbon dioxide from your body, so they are also part of the excretory system. More organs of the excretory system are listed in Table below.
### Table 1.1: Organs of the Excretory System

<table>
<thead>
<tr>
<th>Organ(s)</th>
<th>Function</th>
<th>Other Organ System of which it is Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lungs</td>
<td>Remove carbon dioxide</td>
<td>Respiratory system</td>
</tr>
<tr>
<td>Skin</td>
<td>Sweat glands remove water, salts, and other wastes</td>
<td>Integumentary system</td>
</tr>
<tr>
<td>Large intestine</td>
<td>Removes solid waste and some water in the form of feces</td>
<td>Digestive system</td>
</tr>
<tr>
<td>Kidneys</td>
<td>Remove urea, salts, and excess water from the blood</td>
<td>Urinary system</td>
</tr>
</tbody>
</table>

### Table 19.4: Organs of the Excretory System

#### Functions of the Excretory System

The excretory system controls the levels of water and salts in your body by removing wastes. This means the excretory system has an important role in maintaining homeostasis. Your body takes nutrients from food and uses them for energy, growth, and repair. After your body has taken what it needs from the food, waste products are left behind in the blood and in the large intestine. These waste products need to be removed from the body. The kidneys work with the lungs, skin, and intestines to keep the correct balance of nutrients, salts and water in your body.

#### The Urinary System

Sometimes, the urinary system is called the excretory system. But the urinary system is only one part of the excretory system. Recall that the excretory system is made up of the skin, lungs, and large intestine as well as the kidneys. The **urinary system** is the organ system that makes, stores, and gets rid of urine. It includes:

- Two kidneys.
- Two ureters.
- One bladder.
- One urethra.

The urinary system is shown in **Figure 1.1**.

![Figure 1.1](image-url)
Organs of the Urinary System

1. As you can see from Figure 1.1, the kidneys are two bean-shaped organs. **Kidneys** filter and clean the blood and form urine. They are about the size of your fists and are found near the middle of the back, just below your rib cage.

2. Ureters are tube-shaped and bring urine from the kidneys to the urinary bladder.

3. The **urinary bladder** is a hollow and muscular organ. It is shaped a little like a balloon. It is the organ that collects urine.

4. Urine leaves the body through the urethra.

What is Urine?

**Urine** is a liquid that is formed by the kidneys when they filter wastes from the blood. Urine contains mostly water, but also contains salts and nitrogen-containing molecules. The amount of urine released from the body depends on many things. Some of these include the amounts of fluid and food a person consumes and how much fluid they have lost from sweating and breathing. Urine ranges from colorless to dark yellow, but is usually a pale yellow color. Light yellow urine contains mostly water. The darker the urine, the less water it contains.

The urinary system also removes a type of waste called **urea** from your blood. Urea is a nitrogen-containing molecule that is made when foods containing protein, such as meat, poultry, and certain vegetables, are broken down in the body. Urea and other wastes are carried in the bloodstream to the kidneys, where they are removed and form urine.

How the Kidneys Filter Wastes

The kidneys are important organs in maintaining homeostasis. Kidneys perform a number of homeostatic functions.

- They maintain the volume of body fluids.
- They maintain the balance of salt ions in body fluids.
- They excrete harmful nitrogen-containing molecules, such as urea, ammonia, and uric acid.

There are many blood vessels in the kidneys, as you can see in Figure 1.2. The kidneys remove urea from the blood through tiny filtering units called nephrons. **Nephrons** are tiny, tube-shaped structures found inside each kidney. A nephron is shown in Figure 1.3. Each kidney has up to a million nephrons. Each nephron collects a small amount of fluid and waste from a small group of capillaries.

If the body is in need of more water, water is removed from the fluid inside the nephron and is returned to the blood. The fluid within nephrons is carried out into a larger tube in the kidney called a ureter, which you can see in Figure 1.3. Urea, together with water and other wastes, forms the urine as it passes through the nephrons and the kidney.

Formation of Urine

The process of urine formation is as follows:

1. Blood flows into the kidney through the renal artery, shown in Figure 1.3. The renal artery connects to capillaries inside the kidney. Capillaries and nephrons lie very close to each other in the kidney.

2. The blood pressure within the capillaries causes water, salts, sugars, and urea to leave the capillaries and move into the nephron.

3. The water and salts move along through the tube-shaped nephron to a lower part of the nephron.

4. The fluid that remains in the nephron at this point is called urine.

5. The blood that leaves the kidney in the renal vein has much less waste than the blood that entered the kidney.

6. The urine is collected in the ureters and is moved to the urinary bladder, where it is stored.
FIGURE 1.2
Structures of the kidney; fluid leaks from the capillaries and into the nephrons where the fluid forms urine then moves to the ureter and on to the bladder.

FIGURE 1.3
The location of nephrons in the kidney. The fluid collects in the nephron tubules, and moves to the bladder through the ureter.

Nephrons filter about $\frac{1}{4}$ cup of body fluid per minute. In a 24-hour period, nephrons filter 180 liters of fluid, and 1.5 liters of the fluid is released as urine. Urine enters the bladder through the ureters. Similar to a balloon, the walls of the bladder are stretchy. The stretchy walls allow the bladder to hold a large amount of urine. The bladder can hold about $1\frac{1}{2}$ to $2\frac{1}{2}$ cups of urine, but may also hold more if the urine cannot be released immediately.

How do you know when you have to urinate? Urination is the process of releasing urine from the body. Urine leaves the body through the urethra. Nerves in the bladder tell you when it is time to urinate. As the bladder first fills
with urine, you may notice a feeling that you need to urinate. The urge to urinate becomes stronger as the bladder continues to fill up.

**Brain Control**

The kidneys never stop filtering waste products from the blood, so they are always producing urine. The amount of urine your kidneys produce is dependent on the amount of fluid in your body. Your body loses water through sweating, breathing, and urination. The water and other fluids you drink every day help to replace the lost water. This water ends up circulating in the blood because blood plasma is mostly water.

The filtering action of the kidneys is controlled by the pituitary gland. The pituitary gland is about the size of a pea and is found below the brain, as shown in Figure 1.4. The pituitary gland is also part of the endocrine system. The pituitary gland releases hormones, which help the kidneys to filter water from the blood.

The movement of water back into blood is controlled by a hormone called antidiuretic hormone (ADH). ADH is released from the pituitary gland in the brain. One of the most important roles of ADH is to control the body’s ability to hold onto water. If a person does not drink enough water, ADH is released. It causes the blood to reabsorb water from the kidneys. If the kidneys remove less water from the blood, what will the urine look like? It will look darker, because there is less water in it.

When a person drinks a lot of water, then there will be a lot of water in the blood. The pituitary gland will then release a lower amount of ADH into the blood. This means less water will be reabsorbed by the blood. The kidneys then produce a large volume of urine. What color will this urine be?

**Excretory System Problems**

The urinary system controls the amount of water in the body and removes wastes. Any problem with the urinary system can also affect many other body systems.

**Kidney Stones**

In some cases, certain mineral wastes can form kidney stones, like the one shown in Figure 1.5. Stones form in the kidneys and may be found anywhere in the urinary system. They vary in size. Some stones cause great pain, while others cause very little pain. Some stones may need to be removed by surgery or ultrasound treatments.
Kidney failure

**Kidney failure** happens when the kidneys cannot remove wastes from the blood. If the kidneys are unable to filter wastes from the blood, the wastes build up in the body. Homeostasis is disrupted because the fluids in the body are out of balance. Kidney failure can be caused by an accident that injures the kidneys, the loss of a lot of blood, or by some drugs and poisons. Kidney failure may lead to permanent loss of kidney function. But if the kidneys are not seriously damaged, they may recover.

Chronic kidney disease is the slow decrease in kidney function that may lead to permanent kidney failure. A person who has lost kidney function may need to get kidney dialysis. **Kidney dialysis** is the process of filtering the blood of wastes using a machine. A dialysis machine (also called a hemodialyzer) filters the blood of waste by pumping it through a fake kidney. The filtered blood is then returned to the patient’s body. A dialysis machine is shown in Figure 1.6.

**Urinary tract infections (UTIs)**

**Urinary tract infections** (UTIs) are bacterial infections of any part of the urinary tract. When bacteria get into the bladder or kidney and produce more bacteria in the urine, they cause a UTI. The most common type of UTI is a bladder infection. Women get UTIs more often than men. UTIs are often treated with antibiotics.

**Lesson Summary**

- The excretory system controls the chemical make-up of liquids found in the body.
- The organs of the excretory system remove wastes. They also maintain the proper levels of water, salts, and nutrients in the body.
- The lungs, skin, kidneys, and large intestine are all organs in the excretory system.
- The urinary system is made up of the kidneys, the ureters, the bladder, and the urethra.
- The filtering parts of the kidneys are the nephrons.
- Water and waste molecules move out of the blood capillaries and into the nephrons. Most of the water returns to the blood.
- Urine collects in the nephron and moves to the urinary bladder through the ureters.
- The filtering action of the kidneys is controlled by the pituitary gland.
- ADH is the hormone released by the pituitary gland and controls the how water is reabsorbed by the blood from the kidneys.
- Disorders of the urinary system include kidney stones, kidney disease, and urinary tract infections.