

Respiration and Excretion



Chapter Outline

- I. The Respiratory System
 - A. The Nose and Mouth
 - B. The Pharynx
 - C. The Trachea
 - D. The Bronchi and Bronchioles
- II. Breathing
- III. Respiratory Diseases
 - A. Pneumonia
 - B. Bronchitis and Asthma
- IV. The Excretory System
 - A. The Kidneys
 - B. The Skin
- V. Excretory Problems



For a chapter planning guide, teaching strategies with performance and highlighted skills objectives, and answers for activities and features, see pages T-124-T-127.

Objectives

After you have completed this chapter, you will be able to

- 23-1 **identify** organs of the respiratory system.
- 23-1 **state** the function of the respiratory system.
- 23-2 **compare** breathing and respiration.
- 23-3 **identify** some diseases of the respiratory system.
- 23-4 **state** the function of the excretory system.
- 23-4 **name** the major organs of the excretory system.
- 23-5 **identify** some problems of the excretory system.

Science Process Skills

In this chapter, two science skills are highlighted. Symbols show some places where these skills are used.

- **Inferring:** When you infer, you form a conclusion based upon facts and not direct observation.
- ▲ **Modeling:** When you model, you use a copy or imitation of an object to help explain something.

The race is nearly over. You are breathing hard and fast as you approach the finish line. Why do you breathe so much more when you exercise? You breathe more because your body needs energy for all that activity. The energy comes from the “burning,” or breakdown, of food in your cells. This process is called **respiration**.

Respiration uses a lot of oxygen. When you breathe in, you take in oxygen-rich air from the outside. Respiration also produces carbon dioxide and water as waste products. You get rid of these waste products when you breathe out. Breathing in and out is part of the respiratory process. Breathing out is also part of the process of **excretion** (ik-SKREE-shun). Excretion is the process by which waste products are removed from the body.



23-1 The Respiratory System

Key Points

- The respiratory system consists of the lungs and the tubes and passageways through which air moves.
- The job of the respiratory system is to take oxygen into the body and get rid of carbon dioxide and water.

The membrane that surrounds each lung is called the pleura.

Study Hint

As you read about the respiratory system, list in the correct order the organs through which air passes.

The human respiratory system is made up of the lungs and the tubes and passageways through which air moves. The lungs are the main organs of the respiratory system. You have two lungs, a left lung and a right lung. Each lung is surrounded by a membrane. This membrane protects the lung and separates it from the chest cavity.

Taking oxygen into the body and removing carbon dioxide and water is the job of the respiratory system. How does oxygen from the air get into the lungs? Air passes through many tubes and passageways before it reaches the lungs.

You can trace the path air takes on its journey through the respiratory system in Figure 23-1. As you trace this pathway, keep in mind that the entire trip takes only a few seconds.

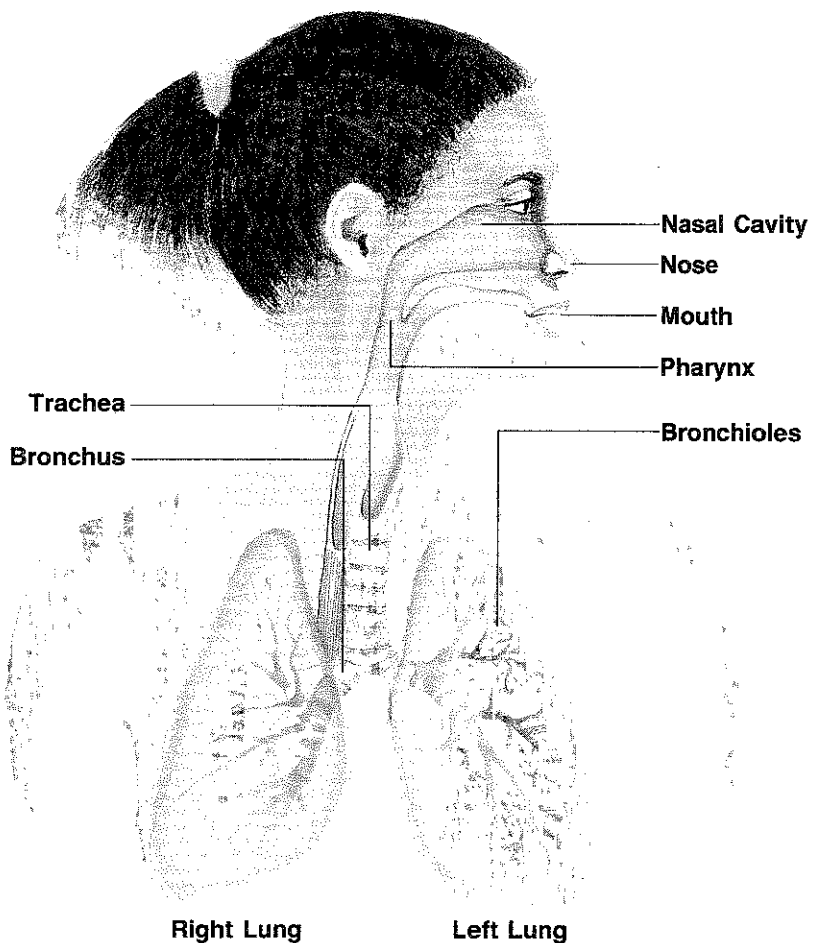


Figure 23-1 Air passes through all parts of your respiratory system every time you take a breath.

The Nose and Mouth

Take a deep breath. When you breathe in, or inhale, air enters your respiratory system. Now breathe out, or exhale. When you exhale, air leaves your respiratory system.

Inhale again. How does air enter your respiratory system? In most cases, air enters the respiratory system through the nose. The nose has two openings called nostrils. The nostrils are lined with short hairs. These hairs filter, or screen, particles of dirt and dust from the air before the air enters the **nasal cavity**. The nasal cavity is a hollow opening between the nose and throat.

Air moving through the nasal cavity is filtered and moistened. How do these activities take place? The nasal cavity is lined with two kinds of cells. Each kind of cell carries out a specific job.

One kind of cell secretes a sticky substance called mucus (MYOO-kus). Mucus traps particles in the air before the air enters the lungs. Mucus also helps keep the respiratory tissues from drying out.

The second kind of cell in the nasal cavity is lined with tiny hairlike structures called cilia (SIL-ee-uh). The cilia move back and forth in a wavelike motion. As the cilia move, mucus is pushed back toward the nostrils.

Mucus that collects in the nostrils can irritate the nose. You respond to this irritation with a forceful burst of air called a sneeze. Sneezing is one way of blowing dirt and dust from the nose.

A fine network of capillaries is located just below the cells that line the nasal cavity. Blood passing through these capillaries warms air passing through the nasal cavity.

The Pharynx

Air that has passed through the nose or mouth enters the pharynx (FAR-inks), or throat. The pharynx is a pathway for both food and air. At the end of the pharynx are two tubes. These tubes are like a fork in a road. One tube, called the esophagus, is for food. You may remember that food passes through the esophagus on its way to the stomach. The other tube is the windpipe. The windpipe is a pathway for air.

Skill Builder

Modeling Making a model is one way to help you understand an idea. On a sheet of unlined white paper, sketch a drawing of a tree that has a trunk, two large branches, and many twigs. The tubes of the respiratory system are often referred to as the "bronchial tree." Turn your drawing upside-down. Which part of the respiratory system is represented by each part of your tree?



Figure 23-2 Find the cilia in these cells of the nasal cavity.

Mucus is secreted by goblet cells in the epithelium. The other cells of the nasal cavity are ciliated epithelial cells.

Study Hint

Refer to Figure 21-4 on page 366 to review the function of the epiglottis.

Health and Safety Tip

The Heimlich maneuver (HYM-lik muh-NYOO-vur) is a first aid procedure that can be used on a choking victim. You can learn how to perform the Heimlich maneuver by consulting a first aid manual.

Point out that a man's larynx is usually more pronounced than a woman's larynx. The larynx is sometimes referred to as the Adam's apple.

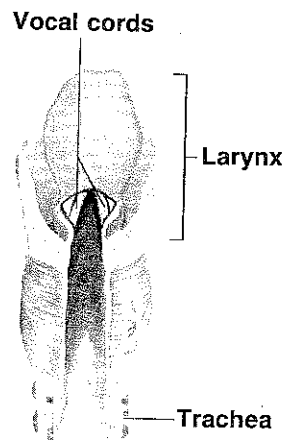


Figure 23-3 Place your fingers on your larynx and feel your vocal cords vibrate as you speak.

A flap of tissue called the epiglottis (ep-uh-GLAHT-is) is located at the place where the esophagus and windpipe meet. You may remember that the epiglottis acts as a trapdoor. When you inhale, the epiglottis raises and air moves into the windpipe. When you swallow, the epiglottis lowers and covers the windpipe. Where is food directed when the epiglottis is closed? into the esophagus (Inferring)

Have you ever had food "go down the wrong way"? When this happens, it is a sign that food has gotten past the epiglottis and into the windpipe. Food in the windpipe causes you to choke and cough. Coughing usually forces the food back into the throat. Then, the food can be swallowed.

Have a school nurse or other qualified person demonstrate the Heimlich maneuver to the class.

The Trachea

Gently place your hand on the front of your neck. Can you feel a tubelike structure? This structure is your **trachea** (TRAY-kee-uh), or windpipe. The trachea is a tube about 10 cm long. It is located in front of the esophagus.

At the top of the trachea is an organ called the **larynx** (LAR-inks). It is made of a tough, elastic tissue called cartilage. Place your hand on your neck again. Can you feel a bulge near the top of your trachea? This bulge is your larynx.

▶ The human larynx contains two thin folds of skin called vocal cords. During normal, quiet breathing, the vocal cords are relaxed. However, when you speak, your vocal cords tighten. As you breathe out, air passing over the vocal cords causes them to vibrate and produce sounds. Why do you think that you should not speak while you are eating? Food may enter the trachea if you speak while you are eating. (Inferring)

Air that has passed through the larynx enters the trachea. The trachea is made up of rings of cartilage and smooth muscle. The cartilage keeps the trachea open so air can pass through it all the time.

The trachea is lined with two kinds of cells. Like the cells in the nasal cavity, one kind of cell secretes mucus. The other cells have cilia. The mucus traps particles of dirt and dust that were not filtered in the nasal cavity. The cilia push the mucus with its trapped particles back toward the throat. Once the mucus is in the throat, the mucus can be swallowed or expelled from the body.

Mucus that collects in the trachea can cause irritation. Like the nose, the trachea responds to this irritation with bursts of air. These bursts of air are coughs. Coughing gets rid of dirt and dust that is trapped in the trachea.

The Bronchi and Bronchioles

The lower end of the trachea divides into two smaller tubes called **bronchi** (BRAHN-kee). Like the trachea, the walls of the bronchi contain rings of cartilage and smooth muscle. Each bronchus extends into a lung.

Within the lung, the bronchus branches into many smaller tubes called **bronchioles** (BRAHN-kee-ohls). Unlike the bronchi and trachea, the bronchiole walls do not contain cartilage. Their walls are made only of smooth muscle.

► The bronchi and bronchioles are lined with cells that secrete mucus and have cilia. The mucus filters air passing through these organs. What do you think the cilia do?

Air Sacs and Alveoli

Bronchioles end in structures called **air sacs**, or **alveoli** (al-VEE-uh-ly). Alveoli look like bunches of grapes. Each of your lungs contains millions of alveoli.

Study Hint

The plural forms of some words do not end in "s." For example, "bronchi" is the plural form of "bronchus." "Alveoli" is the plural form of "alveolus."

Cilia in the bronchi and bronchioles push mucus with its trapped particles back toward the trachea. (Inferring/Relating concepts)

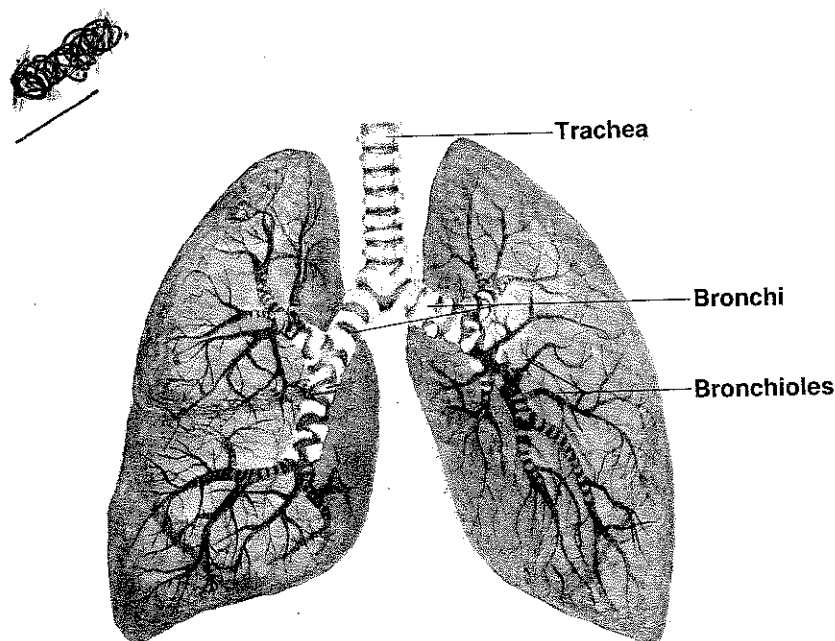


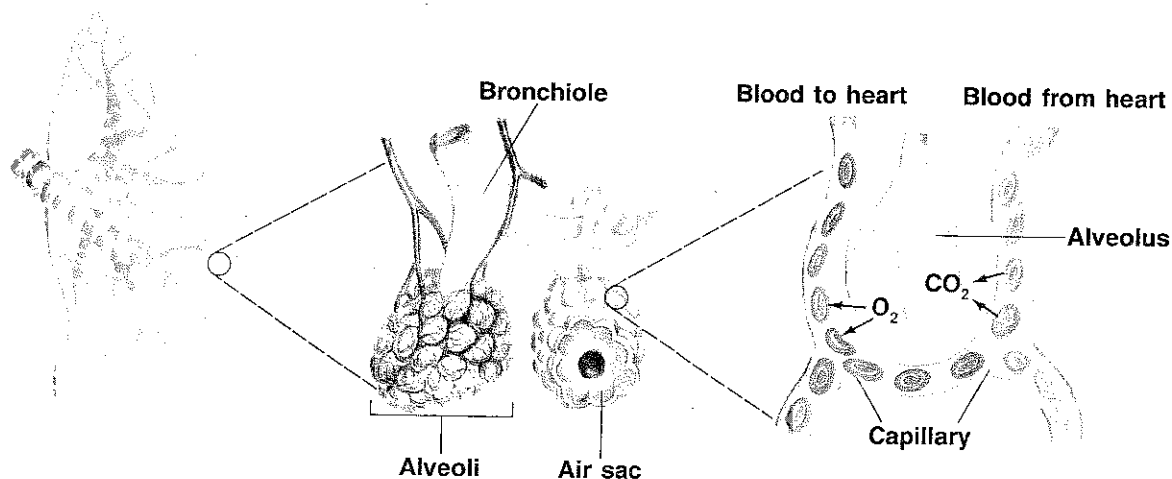
Figure 23-4 The bronchi and bronchioles make up the "bronchial tree."

Study Hint

Look up "diffusion" in the index. When diffusion occurs, substances move from areas of greater concentration to areas of lesser concentration.

Remind students that respiration takes place in the body's cells.

Figure 23-5 Gas exchange in the lungs takes place between capillaries and alveoli.



A network of capillaries surrounds the alveoli, as shown in Figure 23-5. Both the alveoli and the capillaries have walls that are only one cell thick. These thin walls allow oxygen and carbon dioxide to pass easily between the alveoli and the capillaries.

Gas Exchange in the Alveoli

The most important part of the respiratory process is the exchange of the gases oxygen (O_2) and carbon dioxide (CO_2). Within the lungs, these gases are exchanged between the alveoli and the bloodstream. Oxygen moves into the bloodstream. At the same time, carbon dioxide moves into the alveoli. How does this exchange of gases take place? *diffusion (Inferring) greater concentration to lesser concentration*

Air entering the alveoli has a high level of oxygen and a low level of carbon dioxide. Blood in the capillaries surrounding the alveoli is low in oxygen. This blood has a high level of carbon dioxide.

When air enters your lungs, the oxygen from the air dissolves in the mucus within the alveoli. The dissolved oxygen then diffuses out of the alveoli and into the capillaries. At the same time, carbon dioxide in the capillaries diffuses into the alveoli. Figure 23-5 shows the exchange of oxygen and carbon dioxide between the alveoli and the capillaries.

Transport and Gas Exchange

For respiration to occur, every cell of your body must have oxygen. Do you recall the job of red blood cells? Oxygen from the lungs is carried by red blood cells to the

heart. The heart then pumps this oxygen-rich blood to the rest of the body.

When oxygen-rich blood reaches the body cells, the oxygen diffuses out of the blood and into the body cells. At the same time, carbon dioxide produced during respiration diffuses out of the body cells. This carbon dioxide is picked up by the red blood cells. The carbon dioxide is then carried by the blood back to the alveoli in the lungs.

Carbon dioxide cannot be removed from your body until it moves from the capillaries into the alveoli. At the same time, blood in the capillaries picks up fresh oxygen. The carbon dioxide leaves your body when you exhale. What happens to the oxygen that is picked up by the blood? Red blood cells carry oxygen. Oxygen from the lungs is carried by the blood to the heart. The heart then pumps this oxygen-rich blood to the rest of the body. (Relating concepts)

Think & Discuss

1. Define respiration.
2. What is the scientific name for the windpipe?
3. Name and describe three organs of the respiratory system.
4. By what process does carbon dioxide move from body cells to the blood?
- ★ 5. How do mucus and cilia help the body fight infection?

23-2 Breathing

Breathing and respiration are related, but they are not the same process. Respiration is a chemical process. Breathing is a mechanical process that is only part of the respiratory process. Breathing is the process by which air enters and leaves the body. Together, your lungs can hold between 5 and 6 L of air.

How often do you breathe? You breathe in and out about 18 times each minute. The organs that make breathing possible are the ribs, the rib muscles, and the diaphragm (DY-uh-fram). The diaphragm is a sheetlike muscle located between the chest cavity and the abdomen.

Study Hint

Look up "red blood cells" in the Glossary to find out their function.

1. the process by which oxygen combines with food to produce energy
2. trachea (Building vocabulary)
3. Answers will vary. Accept all accurate descriptions of the nose, nasal cavity, pharynx, trachea, bronchi, bronchioles, lungs, air sacs, or alveoli.
4. diffusion (Relating concepts)
5. Mucus traps disease-causing organisms along with dirt and dust. Cilia push these particles back toward the nose and mouth, where they can be expelled from the body. (Applying concepts)

Key Points

- Breathing is the process by which air enters and leaves the body.
- Respiration is the process by which oxygen combines with food to produce energy.

Place your hand on your ribs and take a deep breath. What do you observe? As you take in air, your chest expands, or gets larger. Why?

When you inhale, your rib muscles contract, or tighten. Your ribs move upward and outward. At the same time, your diaphragm contracts and moves downward. The movement of the ribs and diaphragm increases the space, or volume, of the chest cavity.

▲ As the volume of the chest cavity increases, the air pressure within the chest cavity decreases. The air pressure inside the chest cavity becomes much lower than the air pressure outside the body. Air rushes in to fill the lungs, as shown in Figure 23-6. The lungs stop filling with air when the air pressure inside the chest cavity is equal to the air pressure outside the body.

Take a second deep breath. Now, watch your chest as you exhale. What happens? As you exhale, your chest becomes smaller.

When you exhale, your rib muscles relax. Your ribs move inward and downward. Your diaphragm relaxes and moves upward. The movement of the ribs and diaphragm decreases the volume inside the chest cavity.

As the volume of the chest cavity decreases, more air pressure is exerted on the lungs. The air pressure within the chest cavity becomes greater than the air pressure outside the body. The increased air pressure in the chest

Health and Safety Tip

To breathe correctly, you should inhale through your nose and exhale through your mouth.

Study Hint

The amount of force on a unit of area is called pressure. The weight of all the air around you causes pressure. Air moves from areas of high air pressure to areas of low air pressure.

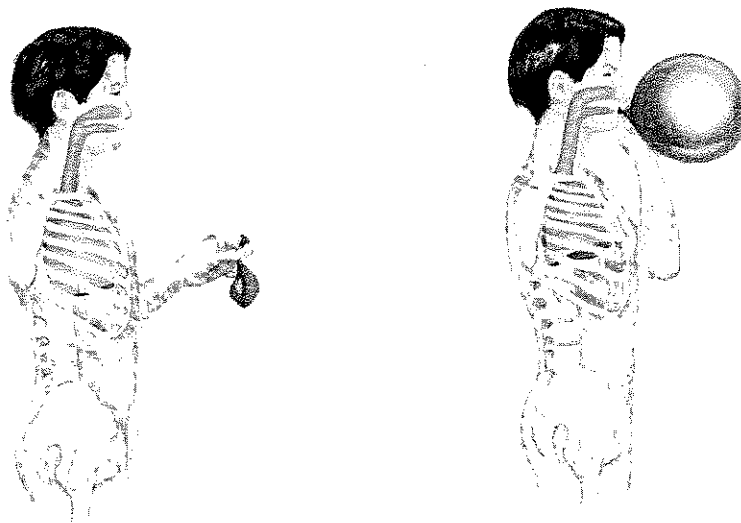


Figure 23-6 Notice the different positions of the diaphragm when you inhale (left) and exhale (right).

the brain (Inferring)

6. the mechanical process by which air enters and leaves the body
7. Breathing provides the body with the oxygen needed to carry out respiration. Breathing also provides the body with a way to get rid of the waste products of respiration. (Relating concepts)
8. nose, nasal cavity, pharynx, trachea, lungs (bronchi and bronchioles), trachea, pharynx, nasal cavity, and nose. Accept also mouth in place of nose and nasal cavity. (Sequencing)

Key Point

- Pneumonia, bronchitis, and asthma are diseases of the respiratory system.

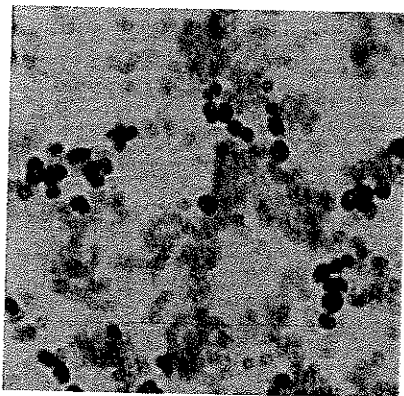


Figure 23-7 The pneumonia bacteria, colored blue in this photograph, are cocci.

forces air out of the lungs. Air stops leaving the lungs when the air pressure inside the chest cavity is equal to the air pressure outside the body.

You do not have to think about breathing to have it happen. Breathing is an involuntary action. What body organ controls breathing? Twenty-four hours a day, every day, your rib muscles and diaphragm contract and relax. In most cases, you do not notice these muscles working. However, sometimes the diaphragm can have a spasm (SPAZ-um). A spasm is a sudden contraction of a muscle. Have you ever had the hiccups? Hiccups are caused by spasms of your diaphragm.

Think & Discuss

6. Define breathing.
7. How are breathing and respiration related?
8. List the organs through which air travels during inhalation and exhalation in the proper order.

23-3 Respiratory Diseases

The job of the respiratory system is to take oxygen into the body and to get rid of carbon dioxide and water. You know that air contains oxygen. Air also contains substances that can be harmful to the body. Some of these substances can cause diseases of the respiratory system. What harmful substances can you name that are found in the air? Answers will vary, but may include carbon monoxide, dust, sulfur dioxide, industrial wastes and so on. (Relating concepts)

Pneumonia

One of the most common diseases of the respiratory system is **pneumonia** (nyoo-MOH-nyuh). Pneumonia is an inflammation (in-fluh-MAY-shun) of the lungs that usually is caused by bacteria. Figure 23-7 shows the bacteria that cause pneumonia.

Viruses can cause pneumonia, too. In both bacterial and viral pneumonia, the disease-causing “germ” invades the lungs. As a result, fluid develops in the alveoli. This fluid prevents the exchange of oxygen and carbon dioxide

between the alveoli and the capillaries. When the exchange of these gases is prevented, the cells of the body do not get enough oxygen.

Pneumonia is a very serious disease. Symptoms of pneumonia include fever and chills, fatigue, coughing, and a tightness in the chest while breathing. A person with pneumonia usually needs to be hospitalized. While in the hospital, the person may be given antibiotics and oxygen.

Bronchitis and Asthma

Particles of dirt and dust are in the air that you breathe. If these particles are not filtered in the nasal cavity and trachea, they can enter the bronchioles. **Bronchitis** (brahn-KYT-us) and **asthma** (AZ-muh) are two diseases of the respiratory system that are caused by dirt and dust in the bronchioles.

Bronchitis is an inflammation of the bronchioles. One symptom of bronchitis is a bad, lasting cough. Bronchitis also can cause difficulty in breathing. If either of these symptoms appear, it is necessary to see a doctor. A doctor can prescribe antibiotics to help fight the infection.

In some people, dirt and dust can cause the muscular walls of the bronchioles to contract. This condition is called asthma. The contraction of the walls of the bronchioles causes the bronchioles to become narrow. As a result, there is less room for air to pass through, and breathing becomes difficult.

Asthma often is treated with medications that cause the muscles in the walls of the bronchioles to relax. When these muscles relax, the breathing passages open wide. Air can then pass through the bronchioles. Doctors are not sure why some people react to dirt and dust in the air more than others. Many doctors, however, think asthma may be a kind of allergy.

Think & Discuss

9. What is pneumonia?
10. Why is breathing difficult for a person with asthma?
- ★ 11. Explain why a person with pneumonia often is tired.

Pneumonia is caused by both bacteria and viruses. Students may recall from Chapter 6 that viruses are protected by a tough protein coat called the capsid. Discuss with students how the capsid of the pneumonia virus makes it difficult for doctors to treat this disease. Doctors do not yet have a drug that can penetrate the capsid of the pneumonia virus.

9. an inflammation of the lungs caused by bacteria or viruses
10. During an asthma attack, the muscular walls of the bronchioles contract, restricting the passage of air. As a result, breathing becomes difficult.
11. Answers may vary. Less oxygen in the body cells will result in less energy being produced for the body. As a result, the individual with pneumonia feels tired. (Relating concepts/Inferring)

23-4 The Excretory System

Many chemical changes take place in your cells. As these chemical changes occur, waste products are formed. For example, you have read that carbon dioxide and water are waste products of respiration. Other waste products made by your body cells are salts, nitrogen compounds, and heat.

Waste products can be harmful if they build up and collect in the body. Removing waste products from the body is the job of the excretory system.

You know that the lungs are part of the respiratory system. The lungs also are part of the excretory system. What two waste products do the lungs excrete from the body? The other major organs of the excretory system are the **kidneys** and the skin.

The Kidneys

Humans have two kidneys. Your kidneys are located just above your waistline. One kidney is behind the stomach; the other is behind the liver.

The main job of the kidneys is to remove waste products from the blood. Each minute, about 1 L of blood passes through your kidneys. In a single day, your kidneys remove waste products from over 1400 L of blood.

Millions of tiny tubelike structures called **nephrons** (NEF-ronz) are located inside each of your kidneys. Nephrons are the filtering structures of the kidneys.

As blood flows through the nephrons, excess water, salts, and a nitrogen compound called **urea** (yoo-REE-uh) are filtered from the blood. At the same time, the nephrons also remove nutrients from the blood. Table 23-1 lists the substances that the blood carries into the kidneys. What useful substances are carried by the blood?

nutrients such as water, sugar, and minerals (Reading tables)

Table 23-1 Substances Carried by the Blood	
NUTRIENTS THE BODY NEEDS	WASTE PRODUCTS
Water	Excess water
Sugar	Salts
Minerals	Urea

Key Points

- The function of the excretory system is to remove waste products from the body.
- The lungs, kidneys, and skin are the main organs of the excretory system.

carbon dioxide and water (Relating concepts)



Figure 23-8 Make a fist. Each of your kidneys is about the size of a fist.

Study Hint

Before you read about how the nephron works, find these structures on Figure 23-9: the cluster of capillaries, the cuplike structure, and the collecting tube.

The cluster of capillaries in the nephron is called the glomerulus. The cuplike structure surrounding the glomerulus is called Bowman's capsule.

Skill Builder

Sequencing When you sequence events, you put the events in the order in which they took place. Trace the movement of urine through the urinary system by listing the organs through which urine passes in the proper order.

The kidneys secrete an average of 1.2 to 1.5 L of urine in one day.

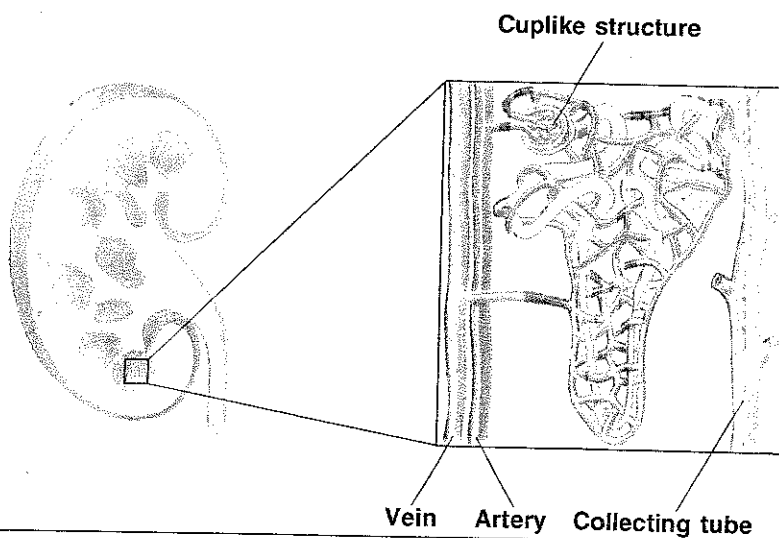
Figure 23-9 Trace the flow of blood through this enlarged nephron.

The nutrients that are removed by the nephrons are needed by the body. As blood passes through the kidneys, it is filtered a second time. During this second filtering process, the nutrients are separated from the waste products. The nutrients are then returned to the blood before the blood leaves the kidneys.

▲ How do the nephrons filter waste products and nutrients from the blood? How are nutrients returned to the blood? The processes that occur in the nephrons can be explained in steps. As you read each step, look at the nephron in Figure 23-9.

- Blood enters the nephron.
- In the nephron, the blood passes into a cluster of capillaries that are surrounded by a cuplike structure.
- Water, salts, urea, and nutrients are forced out of the capillaries and into the cuplike structure.
- The water, salts, urea, and nutrients leave the cuplike structure and pass into a long tube.
- In the coiled part of the tube, the nutrients pass back into the blood. Excess water, salts, and urea remain in the last part of the tube, called the collecting tube.
- The filtered blood returns to the heart. The water, salts, and urea are carried out of the kidney.

Waste products leave the collecting tube as a liquid. This liquid is called **urine** (YOOR-in). Urine is a liquid waste made up of water, salts, and urea.



Excretion is not complete until the urine is removed from the body. Remember, excretion is the removal of waste products from the body. The job of the urinary (YOOR-uh-ner-ee) system is to remove liquid wastes from the body. This system is part of the excretory system. The urinary system is shown in Figure 23-10.

How is urine removed from the body? Urine leaves each kidney through a tube. This tube is called the **ureter** (YOUR-et-uhr). One ureter from each kidney carries urine to the **urinary bladder**. The urinary bladder is a muscular sac that stores urine until the urine is removed from the body.

The urinary bladder stores urine for only a short period of time. When the urinary bladder is filled, muscles of the bladder contract. Urine is then forced out of the urinary bladder and passes into a tube called the **urethra** (you-REETH-ruh). The urethra carries urine to the outside of the body. The urinary bladder has a storage capacity of slightly more than 500 mL.

The Skin

In the skin are small structures called sweat glands. Sweat glands excrete waste products in the form of perspiration (pur-spuh-RAY-shun). Perspiration is a liquid waste made up of water, salts, and a small amount of urea. What other organs remove water, salts, and urea from the body?

Each sweat gland has a small tube that leads to the surface of the skin. The tiny opening at the surface of the skin is called a **pore**. You have millions of pores in your skin. Sweat produced in the sweat glands leaves your body through these pores.

Sweat that reaches the skin's surface quickly evaporates. The evaporation of sweat cools the body. Excess heat is removed from the body as it is cooled. The removal of excess heat helps to regulate your body temperature. Regulating body temperature also is a function of the skin.

Skin serves four major functions: protection, sensation (touch), excretion, and temperature regulation.

Think & Discuss

12. What is excretion?
13. What is the excretory system?
- ★ 14. How is the skin like an air-conditioning system?

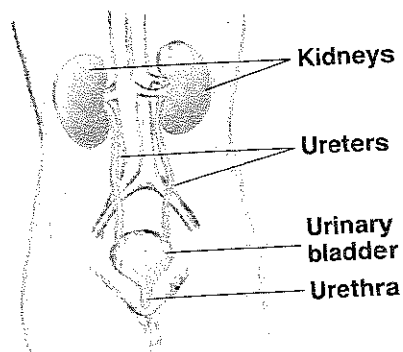


Figure 23-10 The urinary system (shown here) is a subsystem of the excretory system.

Sweat glands are located in the dermis. Other structures in the dermis include oil glands, nerve endings, blood vessels, and smooth muscle tissue.

the kidneys (Relating facts)

12. the process by which wastes are removed from the body
13. the body system that removes wastes from the body
14. The skin provides the body with a means of cooling itself much like an air-conditioning system that serves to cool an enclosed area. (Relating concepts/Comparing)

Key Point

- Kidney stones and acne are problems of the excretory system.

Health and Safety Tip

People suffering from severe acne should see a doctor.

Medical treatment can help prevent scarring caused by acne.

Table 23-2 Controlling Acne

- Wash your face several times a day with soap and water.
- Apply a drying lotion to the skin after washing.
- Avoid oily cosmetics.
- Remove all cosmetics before going to bed.
- Eat a well-balanced diet.
- Get plenty of rest and exercise.

15. a blackhead that has become infected with bacteria.
16. medication, surgical removal, or breaking stones apart with sound waves
17. Over-the-counter medications help to dry up oils on the skin. Some medications also clean the skin. (Applying concepts/Inferring)

23-5 Excretory Problems

Calcium compounds and nitrogen wastes that are not excreted by the body can build up and form kidney stones. Small kidney stones can pass through the ureter. However, the passage of these small stones can cause great pain. Larger kidney stones cannot pass through the ureter. In fact, these stones can block the ureter completely. When this happens, urine backs up into the kidney. If urine stays in the kidney, waste products in the urine can quickly destroy kidney cells.

Large kidney stones must be removed to prevent kidney damage. How are these stones removed? Doctors often prescribe medications that cause kidney stones to dissolve or break apart. If the kidney stones break into small enough pieces, they can pass easily through the ureter.

Unfortunately, medications used to break apart kidney stones do not always work. Until recently, kidney stones that could not be dissolved with medications had to be removed surgically. Doctors now have a new way to break kidney stones apart. This new treatment uses sound waves to blast kidney stones apart. Sound waves also are used to break apart gallstones.

How do doctors use sound to break apart kidney stones? Doctors carefully aim sound waves at the kidney stone. Sound waves strike the particles making up the stone and cause them to vibrate. The kidney stone soon breaks apart. The small pieces of kidney stone can then pass through the ureter with the urine.

Acne is a combination of skin diseases. The symptoms of acne include whiteheads, blackheads, and pimples. Whiteheads and blackheads develop when oil clogs the pores at the surface of your skin. A pimple forms when a blackhead is infected with bacteria. Why would washing your face several times each day help control acne?

Washing the face regularly helps remove excess oils from the skin, helping to prevent clogged pores. (Inferring)

Think & Discuss

15. What is a pimple?
16. Name three methods of treatment for kidney stones.
17. How do you think over-the-counter acne medications help control acne?

Chapter Review

CHAPTER SUMMARY

23-1 The Respiratory System

- The respiratory system is made up of the nose, mouth, pharynx, trachea, bronchi, lungs, bronchioles, air sacs, and alveoli.
- The respiratory system takes oxygen into the body and excretes carbon dioxide and water.

23-2 Breathing

- Breathing is the mechanical process by which air enters and leaves the body.
- The organs that make breathing possible are the ribs, rib muscles, and diaphragm.
- Respiration is the chemical process by which oxygen is combined with food to produce energy.

23-3 Respiratory Diseases

- Pneumonia is a respiratory disease that most often is caused by bacteria.
- Bronchitis and asthma are diseases caused by dirt and dust in the lungs.

23-4 The Excretory System

- Excretion is the process by which waste products are removed from the body.
- Removing wastes from the body is the function of the excretory system.

23-5 Excretory Problems

- Kidney stones are a problem of the urinary system.
- Acne is a problem of the skin.

VOCABULARY LIST

air sacs (401)
alveoli (401)
asthma (407)
bronchi (401)
bronchioles (401)

bronchitis (407)
excretion (397)
kidneys (409)
larynx (400)
nasal cavity (399)

nephrons (409)
pneumonia (406)
pore (411)
respiration (397)
trachea (400)

urea (409)
ureter (411)
urethra (411)
urinary bladder (411)
urine (410)

VOCABULARY REVIEW

Matching Write the word or term from the Vocabulary List that best matches each description.

1. storage sac for urine urinary bladder
2. filtering units of the kidneys nephrons
3. carries air from trachea to both lungs bronchi
4. energy-producing process of the body respiration
5. inflammation of the bronchi bronchitis
6. nitrogen waste excreted by skin and kidneys urea
7. carries urine from kidney to bladder ureter
8. organ used for speaking larynx pneumonia
9. disease of the lungs caused by bacteria
10. carries urine to the outside of the body urethra

Identifying Relationships Identify the word or term in each group that does not belong. Explain why it does not belong with the group.

Accept all logical answers.

1. kidneys, pore, urine
2. air sacs, alveoli, kidneys
3. bronchioles, asthma, nasal cavity
4. asthma, respiration, excretion
5. respiration, energy, urine
6. pneumonia, trachea, bronchitis
7. cilia, nasal cavity, air sacs
8. bronchioles, trachea, cartilage
9. skin, alveoli, pore
10. excretion, oxygen, nutrients

CONTENT REVIEW

Completion Write the word or words that best complete each sentence.

1. Cells with cilia line the nasal cavity, _____, bronchi, and bronchioles. *trachea*
2. Respiration is a _____ process. *chemical*
3. The main organs of the respiratory system are the _____. *lungs*
4. Nephrons remove salts, _____, water, and nutrients from the blood. *urea*
5. Breathing is difficult for a person with asthma because the _____ become narrow. *bronchioles*
6. Carbon dioxide and _____ are excreted by the lungs. *water*
7. The ribs, rib muscles, and _____ make breathing possible. *diaphragm*
8. The flap of tissue that prevents food from entering the trachea is the _____. *epiglottis*
9. The urinary system is responsible for removing _____ waste. *liquid*

Finding the Main Ideas Use the section number to find the sentence that answers each question. Then, write the sentence.

1. What is the function of the respiratory system? (23-1)
2. Where does respiration take place? (23-1)
3. What happens to your rib muscles and diaphragm when you inhale? (23-2)
4. What causes hiccups? (23-2)
5. What two groups of organisms can cause pneumonia? (23-3)
6. How is asthma often treated? (23-3)
7. What is the main function of the kidneys? (23-4)
8. How is urine removed from the body? (23-4)
9. What are kidney stones? (23-5)
10. What are the symptoms of acne? (23-5)
11. How is sound used to break apart kidney stones? (23-5)

CONCEPT REVIEW

For answers, see page T-127

Writing for Understanding One way to find out if you understand something is to write a brief summary of the information in your own words. Reread Section 23-4, The Excretory System, on pages 409-411, and write a brief summary of the information.

Critical Thinking Answer each of the following in complete sentences.

1. Is the air you inhale the same as the air you exhale? Explain your answer.

2. Explain why the human larynx often is called the voice box.
3. What function do the rings of cartilage in the bronchi serve?
4. Urea is poisonous to the body. Predict what would happen if urea was not removed from the blood by the kidneys.
5. When you exercise, your breathing rate increases because your body cells need more oxygen. Explain why exercise also causes your heart rate to increase.

EXTENSIONS

1. Emphysema, black lung disease, and pleurisy are diseases of the respiratory system. Look up each of these diseases in an encyclopedia. Then prepare a table listing the cause and symptoms of each disease.
2. Using this book as a reference, draw a diagram of the urinary system. Label the parts in the diagram. Include a caption that lists the organs through which urine passes in the proper order.