

section ● The Respiratory System

● Before You Read

What do people mean when they say they are “out of breath”? What causes them to be out of breath?

What You’ll Learn

- the functions of the respiratory system
- how oxygen and carbon dioxide are exchanged in the body
- how air moves in and out of the lungs
- how smoking affects the respiratory system

● Read to Learn

Functions of the Respiratory System

You need to breathe air. Earth is surrounded by a layer of gases called the atmosphere (AT muh sfahr). You breathe the gases that are closest to Earth, particularly oxygen.

For thousands of years, people have known that air, food, and water are needed for life. However, people did not know that it is the gas oxygen that is necessary for life until the late 1700s. At that time, a French scientist discovered that animals breathe in oxygen and breathe out carbon dioxide. He then studied the way humans use oxygen. He measured how much oxygen a person uses when resting and when exercising. The measurements showed that the body uses more oxygen during exercise.

What is breathing?

Breathing is the movement of the chest that brings air into the lungs and removes waste gases. When you breathe in, or inhale, the air that comes into the lungs contains oxygen. The oxygen passes from the lungs into the circulatory system. Blood carries the oxygen to individual cells in the body. This process is shown in the figure on the next page.

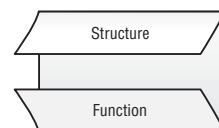
Mark the Text

Identify the Main Point

After you read each paragraph, put what you have just read into your own words. Then highlight the main idea in each paragraph.

FOLDABLES™

● **Organize** Make a shutterfold Foldable, as shown below. Use the Foldable to organize information about the structure and function of the respiratory system.

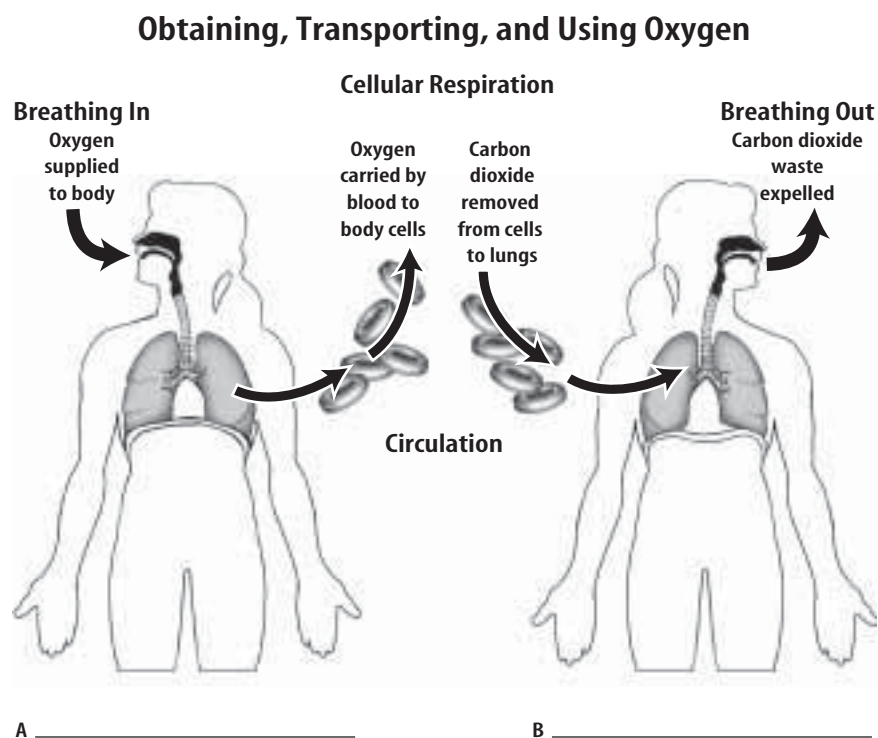


Picture This

1. **Identify** On the two lines labeled A and B, write *inhale* or *exhale*, to show which process is happening.

What is cellular respiration?

As blood is carrying oxygen to cells, the digestive system is providing glucose from digested food to the same cells. The oxygen brought to the cells is used to release energy from the glucose. This chemical reaction is called cellular respiration. Oxygen is necessary for respiration to occur. Carbon dioxide and water molecules are the waste products of cellular respiration. The blood carries the waste products back to the lungs. Breathing out, or exhaling, removes the carbon dioxide and some water molecules.



Organs of the Respiratory System

The respiratory system is made up of structures and organs that help move oxygen into the body and take waste gases out of the body. Air comes into the body through the nostrils in your nose or through the mouth. Hairs in the nostrils trap dust from the air. Air then moves through the nasal cavity. There the air is moistened and warmed by the body's thermal energy. Glands that produce sticky mucus line the nasal cavity. The mucus traps dust and other materials that were not trapped by the nasal hairs. This process helps clean the air you breathe. Cilia (SIH lee uh), tiny hair-like structures, move the mucus and trapped material to the back of the throat where it can be swallowed.

Reading Check

2. **Describe** the purpose of nasal hairs and mucus.

What does the pharynx do?

The warmed, moistened air enters a tubelike passageway called the **pharynx** (FER ingks). Food, liquid, and air all use this passage. The epiglottis (eh puh GLAH tus) is a flap of tissue located at the lower end of the pharynx. When you swallow, the epiglottis folds down to prevent food or liquid from entering your airway.

What are the larynx and the trachea?

The air then moves from the pharynx to the larynx (LER ingks). The **larynx** is the airway to which the vocal cords are attached. Forcing air between the vocal cords causes them to vibrate. The vibration produces sounds. When you speak, muscles tighten or loosen your vocal cords, resulting in different sounds.

From the larynx, the air moves into a tube called the **trachea** (TRAY kee uh). The trachea has rings of cartilage, a tough, flexible tissue that prevents the trachea from collapsing. Mucus and cilia line the trachea where they trap dust, bacteria, and pollen. ✓

How do the bronchi and the lungs function?

Air is taken into the lungs by two short tubes called **bronchi** (BRAHN ki). Within the lungs, the bronchi branch into smaller and smaller tubes. The smallest tubes are called bronchioles (BRAHN kee ohlz). At the ends of the bronchioles are clusters of tiny, thin-walled sacs called **alveoli** (al VEE uh li). Air moves into the bronchi, then into the bronchioles, and finally into the alveoli. Lungs are masses of alveoli arranged in grapelike clusters. Capillaries, or small blood vessels, surround the alveoli.

Oxygen and carbon dioxide are exchanged between the alveoli and the capillaries. Oxygen moves through the cell membranes of the alveoli and then through the cell membranes of the capillaries into the blood. This happens easily because the walls of the alveoli and the walls of the capillaries are only one cell thick.

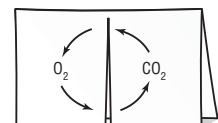
Hemoglobin (HEE muh gloh bun), a molecule in red blood cells, picks up the oxygen and carries it to all the cells of the body. Carbon dioxide and other cellular wastes leave the cells of the body through the membranes of the capillaries into the blood. In the lungs, the waste gases then move through the cell membranes of the capillaries and the alveoli. The waste gases leave the body when you exhale.

✓ Reading Check

3. **Explain** What prevents the trachea from collapsing?

FOLDABLES™

- **Describe** Make a two-tab book, as shown below. Write notes and draw diagrams to show how oxygen and carbon dioxide are exchanged in the respiratory system.



✓ Reading Check

4. **Determine** Why does your breathing rate change?

Picture This

5. **Identify** Circle the diaphragm in each figure. Label the lungs and the trachea in one of the pictures.

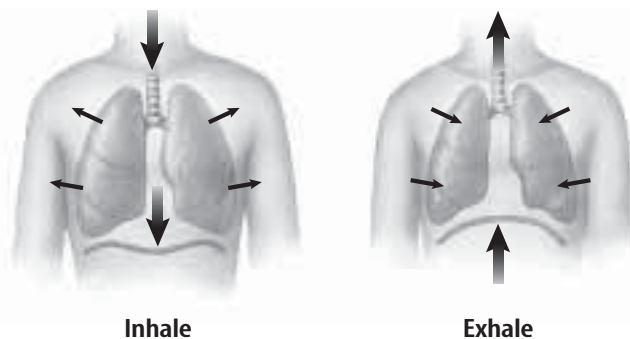
Why do you breathe?

You do not have to think about breathing. Your brain controls your breathing. Signals from your brain tell the muscles in your chest and abdomen to contract and relax. Your brain changes your breathing rate depending on the amount of carbon dioxide that is in your blood. Your breathing rate increases as the amount of carbon dioxide in your blood increases. ✓

How do you inhale and exhale?

Breathing is partly the result of changes in air pressure. Generally, a gas moves from a high-pressure area to a low-pressure area. When you squeeze an empty, soft-plastic bottle, air is pushed out. When you stop squeezing the bottle, the air pressure inside the bottle becomes less than the air pressure outside the bottle. Air comes back in and the bottle returns to its original shape.

Your lungs work much like the squeezed bottle. The **diaphragm** (DI uh fram) is a muscle below your lungs that contracts and relaxes to help move gases into and out of your lungs. The figure below shows how your lungs inhale and exhale.



Diseases and Disorders of the Respiratory System

Many diseases of the respiratory system are related to smoking. The nicotine and tars in tobacco are poisons that can destroy cells. The high temperatures, smoke, and carbon monoxide produced when tobacco burns also damage a smoker's cells. The respiratory systems of nonsmokers can be harmed by inhaling secondhand smoke from tobacco products. In addition to smoking, polluted air, coal dust, and asbestos (as BES tus) have been linked to various respiratory diseases.

What causes respiratory infections?

Bacteria and viruses can cause infections of the respiratory system. The common cold virus generally affects the upper part of the respiratory system—from the nose to the pharynx. The cold virus also can affect the larynx, trachea, and bronchi. The cilia that line the trachea and bronchi can be damaged. However, cilia usually heal rapidly. 

A virus that causes the flu can affect the organs of the respiratory and other body systems. The virus multiplies in the cells lining the alveoli and damages them. Pneumonia is an infection in the alveoli. It can be caused by bacteria, viruses, or other microorganisms. Antibiotics (an ti bi AH tihks) are used to treat bacterial pneumonia. Before antibiotics were available, many people died from bacterial pneumonia.

What is chronic bronchitis?

Bronchitis (brahn KI tus) develops when bronchial tubes are irritated and swell and too much mucus is produced. Sometimes bronchitis is caused by bacteria and can be treated with antibiotics.

Most cases of bronchitis clear up within a few weeks. Sometimes, however, the disease lasts for a long time. This is called chronic (KRAH nihk) bronchitis. A person with this condition must cough often to clear mucus from the airway. But the more a person coughs, the more the cilia and bronchial tubes can be damaged. When cilia are damaged, they do not move mucus, bacteria, and dirt out of the lungs well. Then harmful substances build up in the airways. Sometimes, scar tissue forms and the respiratory system cannot work properly.

What is emphysema?

A disease in which the alveoli in the lungs enlarge is called **emphysema** (em fuh SEE muh). When cells in the alveoli are swollen, an enzyme that causes the walls of the alveoli to break down is released. As a result, alveoli cannot push the air out of the lungs and less oxygen moves into the bloodstream from the alveoli. When the blood has too little oxygen and too much carbon dioxide, shortness of breath occurs.

Some people with emphysema need extra oxygen. People with emphysema may develop heart problems because the heart has to work harder to supply oxygen to body cells.

Reading Check

- 6. List** What are two causes of respiratory infections?



Think it Over

- 7. Compare** What is the difference between bronchitis and chronic bronchitis?

● **Describe** Use a quarter-sheet of notebook paper as shown below, to take notes on the effects of smoking on the respiratory system.



Picture This

8. **Determine** Who has a higher risk of developing lung cancer, males or females?

What causes lung cancer?

Cigarette smoking increases the risk of several diseases, as shown in the table below. Cigarette smoking is a major cause of lung cancer. More than 85 percent of all lung cancer is related to smoking.

Tar and other substances found in smoke act as carcinogens (kar SIH nuh junz) in the body. Carcinogens are substances that can cause an uncontrolled growth of cells. In the lungs, this is called lung cancer. Lung cancer is not easy to detect in its early stages. Smoking also has been linked to the development of cancers of the mouth, esophagus, larynx, pancreas, kidneys, and bladder.

Smokers' Risk of Death from Disease

Disease	Smokers' Risk Compared to Nonsmokers' Risk
Lung cancer	23 times higher for males, 11 times higher for females
Chronic bronchitis and emphysema	5 times higher
Heart disease	2 times higher

What is asthma?

Asthma (AZ muh) is a lung disorder that can cause shortness of breath, wheezing, or coughing. During an asthma attack, the bronchial tubes contract quickly. To treat an asthma attack, a person inhales medicine that relaxes the bronchial tubes.

Asthma often is an allergic reaction. An allergic reaction occurs when the body overreacts to a foreign substance. An asthma attack can happen when a person breathes certain substances such as cigarette smoke, eats certain foods, or experiences stress.

● After You Read

Mini Glossary

alveoli: clusters of thin-walled sacs at the end of each bronchiole that are surrounded with capillaries; where the exchange of oxygen and carbon dioxide takes place

asthma: a lung disorder that results in shortness of breath, wheezing, or coughing

bronchi: two short tubes that carry air into the lungs

diaphragm: muscle beneath the lungs that contracts and relaxes to help move gases into and out of the lungs

emphysema: disease in which the alveoli in the lungs enlarge

larynx: airway to which the vocal cords are attached

pharynx: tubelike passageway that is used by food, liquid, and air

trachea: air-conducting tube lined with mucus membranes and cilia

1. Review the terms and their definitions in the Mini Glossary. Choose one of the organs of the respiratory system and write a sentence that describes the organ and explains its function.

2. Choose one of the question headings in the Read to Learn section. Write the question in the space below. Then write your answer to that question on the lines that follow.

Write your question here.
