

The Respiratory System



🔑 What Is the Role of the Respiratory System?

🔑 How Do You Breathe?

🔑 What Happens During Gas Exchange?



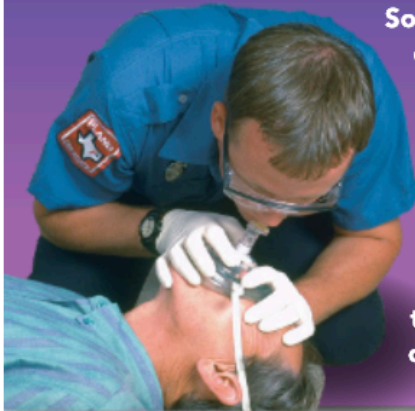
my planet DiARY

The Breath of Life

Misconception: The only gas you exhale is carbon dioxide.

Actually, about 16 percent of the air you exhale is oxygen. The air you inhale is made up of about 21 percent oxygen. Your body only uses a small portion of the oxygen in each breath, so the unused portion is exhaled.

Sometimes, this exhaled oxygen can mean the difference between life and death. If a person stops breathing, he or she needs to get more oxygen quickly. A rescuer can breathe into the person's mouth to give unused oxygen to the person. This process is called rescue breathing.



MISCONCEPTION

Read the following question. Then write your answer below.

Why would you want to learn to perform rescue breathing?

▶ **PLANET DIARY** Go to Planet Diary to learn more about the respiratory system.



Do the Inquiry Warm-Up *How Big Can You Blow Up a Balloon?*

What Is the Role of the Respiratory System?

In an average day, you may breathe 20,000 times. You breathe all the time because your body cells need oxygen, which comes from the air. 🔑 **Your respiratory system moves air containing oxygen into your lungs and removes carbon dioxide and water from your body. Your lungs and the structures that lead to them make up your respiratory system.**

Vocabulary

- cellular respiration • pharynx • trachea • cilia • bronchi
- lungs • alveoli • diaphragm • larynx • vocal cords

Skills

-  **Reading: Sequence**
-  **Inquiry: Draw Conclusions**




Respiration Your body needs the oxygen in air for cellular respiration. **Cellular respiration** is the process in which the body cells break down glucose, using oxygen and releasing the chemical energy in the glucose. During cellular respiration, carbon dioxide and water are produced. Carbon dioxide is a waste product. When you breathe out, you get rid of carbon dioxide.

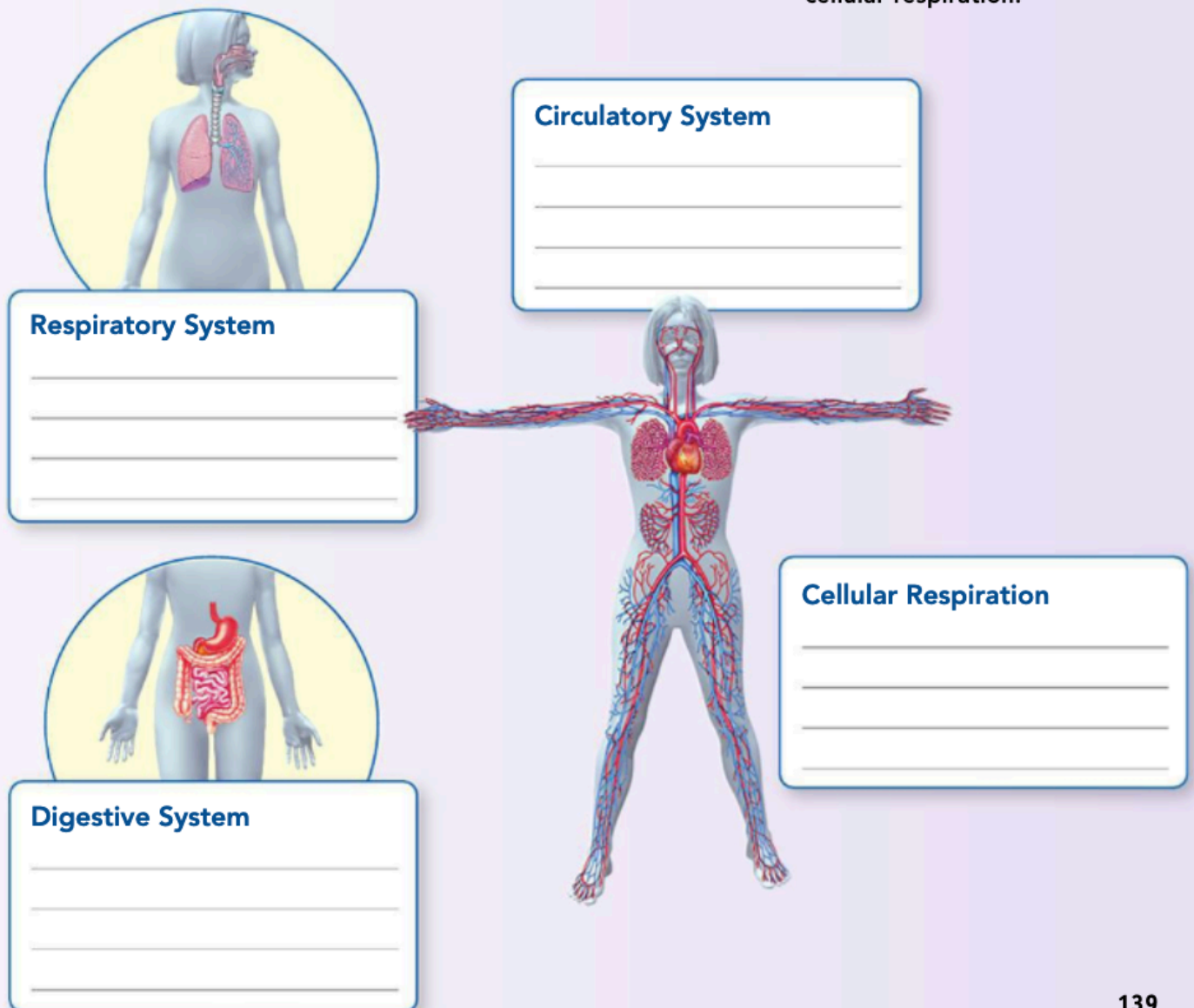
Breathing gets oxygen needed for cellular respiration into your body. However, for oxygen to get to your cells, many body systems must work together, as you can see in **Figure 1**. Blood, part of the circulatory system, carries oxygen from the respiratory system and glucose from the digestive system to the body cells for respiration.

FIGURE 1

Systems Working Together

Body systems work together to get body cells the materials they need for cellular respiration.

 **Describe** In the boxes, describe how each system provides cells with materials for cellular respiration. Then explain what happens during cellular respiration.



did you know?

Some particles can irritate the lining of your nose or throat, causing you to sneeze. This powerful force shoots the particles back into the air. The wet spray from a sneeze can travel up to 160 kilometers per hour and spread more than one meter away from the sneezer!



Breathing Structures When you breathe in air and the particles it contains such as pollen and dust, the air and particles move through a series of structures that you can see on the right—the nose, pharynx, trachea, and bronchi—and into the lungs. These structures also warm and moisten the air you breathe.

Nose Air enters the body through the nose or the mouth. Hairs in the nose trap large particles. The air passes into spaces called nasal cavities. Some cells lining the nasal cavities produce mucus, a sticky material that moistens the air and traps more particles.


Pharynx and Trachea From the nose, air enters the **pharynx** (FAR ingks), or throat. Both the nose and the mouth connect to the pharynx. So air and food enter the pharynx. From the pharynx, air moves into the **trachea** (TRAY kee uh), or windpipe. When you swallow, a thin flap of tissue called the epiglottis covers the opening of the trachea to keep food out. Cells that line the trachea have **cilia** (sil ee uh; singular *cilium*), tiny hairlike extensions that can move together in a sweeping motion. The cilia, like those shown in **Figure 2**, sweep the mucus made by cells in the trachea up to the pharynx. If particles irritate the trachea, you cough, sending the particles back into the air. Find the pharynx and trachea in **Figure 3**.

Bronchi and Lungs Air moves from the trachea into the left and right **bronchi** (BRAHNG ky; singular *bronchus*). These two passages take air into the lungs. The **lungs** are the main organs of the respiratory system. Inside the lungs, the bronchi branch into smaller and smaller tubes. At the end of the smallest tubes are **alveoli** (al VEE uh ly; singular *alveolus*), tiny, thin-walled sacs of lung tissue where gases can move between air and blood.

FIGURE 2

Cilia

The photo shows a microscopic view of cilia.

 Answer the questions below.

1. **Relate Cause and Effect** How does coughing protect the respiratory system?

2. **CHALLENGE** What might happen if you did not have hairs in your nose and cilia in your trachea?

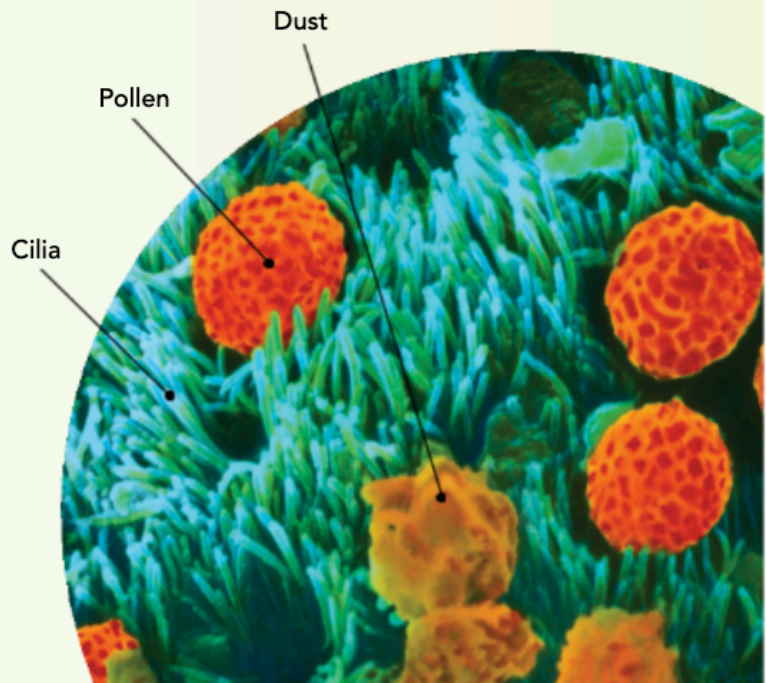

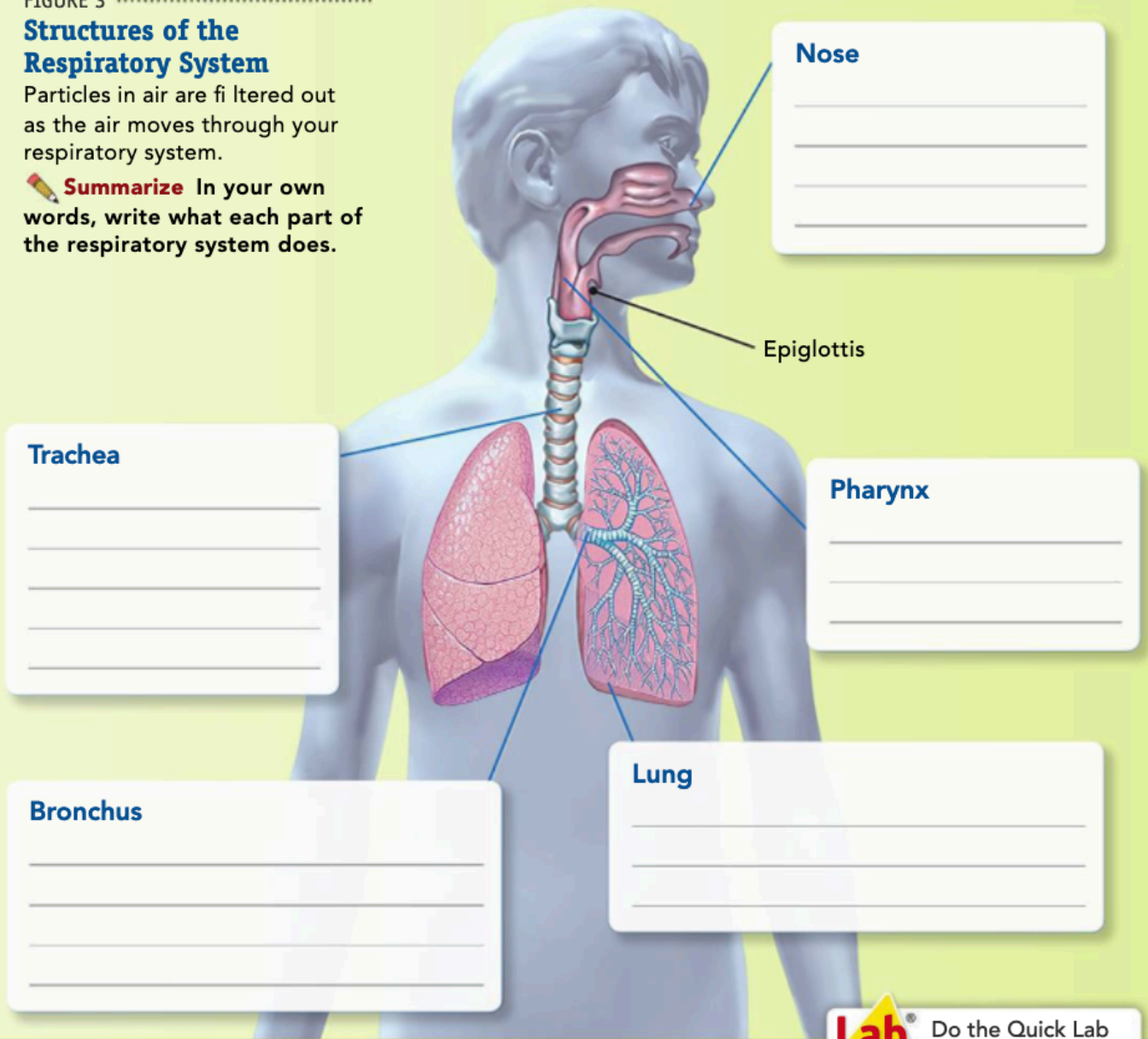


FIGURE 3

Structures of the Respiratory System

Particles in air are filtered out as the air moves through your respiratory system.

 **Summarize** In your own words, write what each part of the respiratory system does.



Nose


Epiglottis

Pharynx

Lung

Trachea

Bronchus

 Do the Quick Lab Modeling Respiration.

Assess Your Understanding


1a. **Define** What is cellular respiration?

b. **Compare and Contrast** How are breathing and cellular respiration different?

got it?

I get it! Now I know that the respiratory system _____


I need extra help with _____

Go to [my science](#)  **COACH** online for help with this subject.



How Do You Breathe?

Like other body movements, breathing is controlled by muscles. The lungs are surrounded by the ribs, which have muscles attached to them. At the base of the lungs is the **diaphragm** (DY uh fram), a large, dome-shaped muscle. You use these muscles to breathe.

The Breathing Process  When you breathe, your rib muscles and diaphragm contract. As a result, your chest expands and you inhale. When these muscles relax, your chest contracts and you exhale. As shown in Figure 4, when you inhale your rib muscles contract. This tightening lifts the chest wall upward and outward. At the same time, the diaphragm contracts and flattens. These two actions make the chest cavity larger, which lowers the air pressure inside your lungs. The air pressure outside your body is now higher than the pressure inside your chest. This pressure difference causes air to rush into your lungs.

When you exhale, your rib muscles and diaphragm relax. As they relax, your chest cavity becomes smaller, making the air pressure inside your chest greater than the air pressure outside. As a result, air rushes out of your lungs.

FIGURE 4

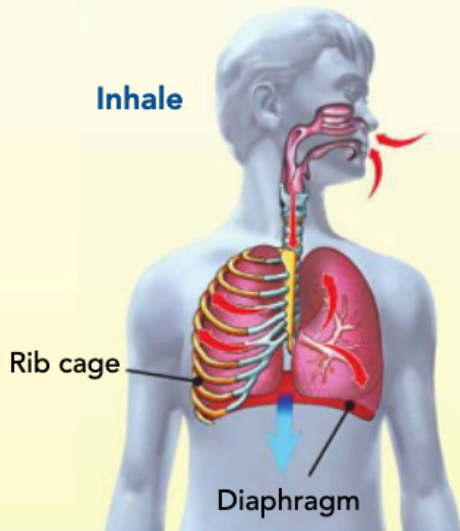
The Breathing Process

When you inhale, air is pulled into your lungs. When you exhale, air is forced out.

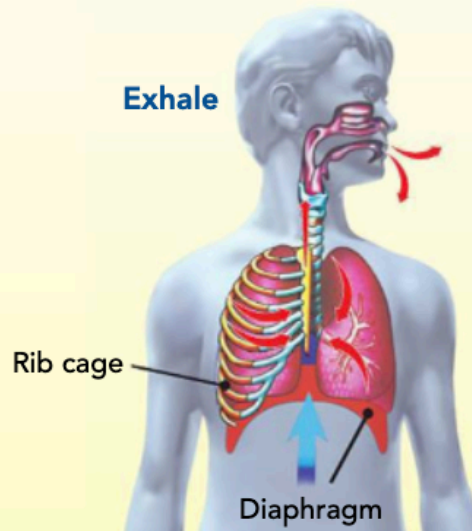
Interpret Diagrams

For each diagram, write what happens to your muscles when you breathe.

Inhale



Exhale



Rib Muscles

Diaphragm

Rib Muscles

Diaphragm



Breathing and Speaking Did you know that the air that moves out of your lungs when you breathe also helps you to speak? Your **larynx** (LAR ingks), or voice box, is located at the top of your trachea. Two **vocal cords**, which are folds of connective tissue, stretch across the opening of the larynx. When you speak, muscles make the vocal cords contract, narrowing the opening as air rushes through. Then the movement of the vocal cords makes air molecules vibrate, or move rapidly back and forth. This vibration causes a sound—your voice.



Sequence In the text, underline and number the steps involved in speaking. Then write these steps in the graphic organizer.



Step 1

↓

Step 2

↓

Step 3



Do the Lab Investigation
A Breath of Fresh Air.

Assess Your Understanding

2a. Identify Where is the larynx located?

b. Explain When you inhale, why does air rush into your lungs?

got it?

- I get it! Now I know that I breathe when my muscles _____

- I need extra help with _____

Go to **my science** **COACH** online for help with this subject.



What Happens During Gas Exchange?

Take a closer look at the structure of the lungs. Air's final stop in its journey through the respiratory system is an alveolus in the lungs. An alveolus has thin walls and is surrounded by many thin-walled capillaries. **Figure 5** shows some alveoli.

How Gas Exchange Occurs Imagine that you are a drop of blood. You are traveling through a capillary that wraps around an alveolus. You have a lot of carbon dioxide and a little oxygen. As you move through the capillary, oxygen attaches to the hemoglobin in your red blood cells. Carbon dioxide moves into the alveolus. By the end of the alveolus, you are rich in oxygen and poor in carbon dioxide.



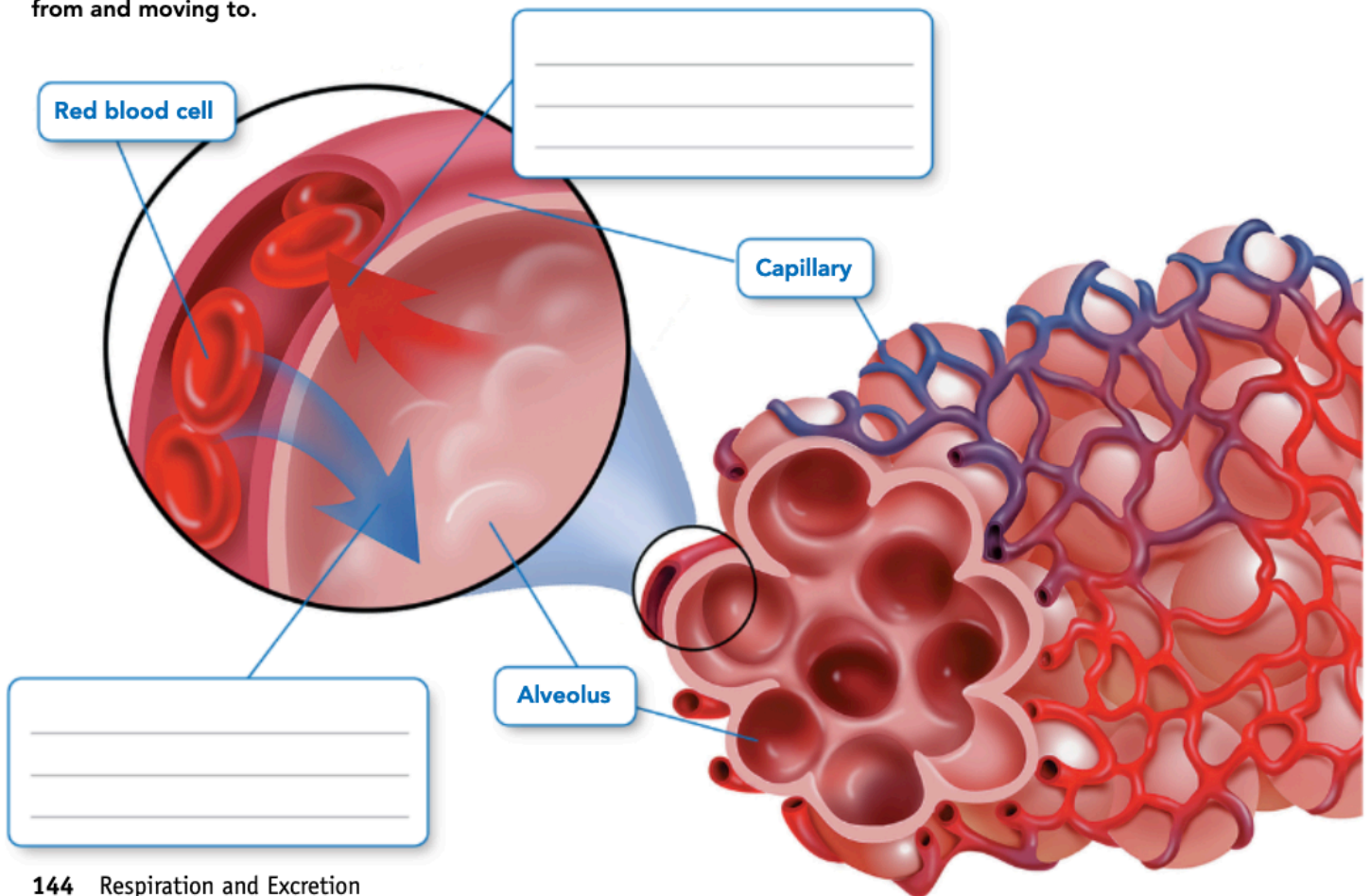
Because the alveoli and the capillaries have very thin walls, certain materials can pass through them easily.  After air enters an alveolus, oxygen passes through the wall of the alveolus and then through the capillary wall into the blood. Similarly, carbon dioxide and water pass from the blood into the air in the alveolus. This whole process is called gas exchange.

FIGURE 5

ART IN MOTION Gas Exchange

Gases move across the thin walls of both alveoli and capillaries.

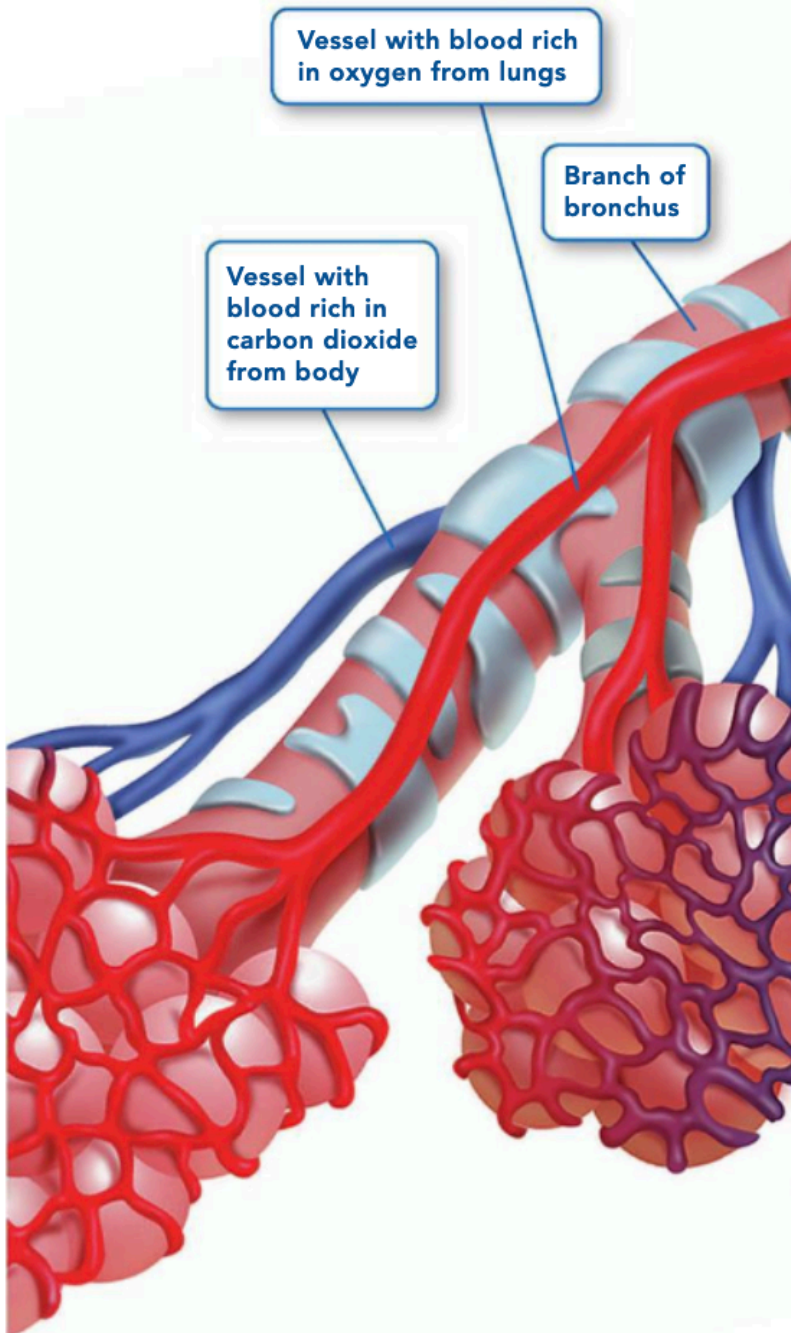
 **Relate Text and Visuals**
Label each arrow with the gas being exchanged and describe where it is coming from and moving to.





Surface Area for Gas Exchange Your lungs can absorb a large amount of oxygen because of the surface area of the alveoli. An adult's lungs have about 300 million alveoli. As a result, the alveoli provide a huge amount of surface area for exchanging gases. Therefore, healthy lungs can supply all the oxygen that a person needs—even when the person is very active.

Vocabulary Identify Related Word Forms The verb *absorb* means "to take in." Use this meaning to write a sentence using the noun *absorption*.



do the math! Sample Problem

Surface area includes the area of all the surfaces of a three-dimensional object, such as a cube or a sphere. An alveolus is a sphere. The formula for finding the surface area of a sphere is $4\pi r^2$. The symbol π is pi (pie) and represents the number 3.14. In the formula, r stands for radius which is the distance from the center of the sphere to the edge. The steps below show you how to find the surface area of a sphere with a 2-cm radius.

$$\begin{aligned} \text{Surface area} &= 4\pi r^2 \\ &= 4 \times \pi \times r \times r \\ &= 4 \times 3.14 \times 2 \text{ cm} \times 2 \text{ cm} \\ &= 50.24 \text{ cm}^2 \end{aligned}$$



The surface area of the sphere is 50.24 cm².

1 Calculate Find the surface area of a baseball with a radius of 4 cm.

2 CHALLENGE The surface area of all the alveoli in an adult's lung is about the same as a sphere with a radius of 236 cm. Find the surface area of all the alveoli. Use a calculator if you have one.



A Breath of fresh Air

How do you breathe?

FIGURE 6

INTERACTIVE ART Many body parts work together to enable you to breathe.

Complete the tasks using what you've learned about breathing.

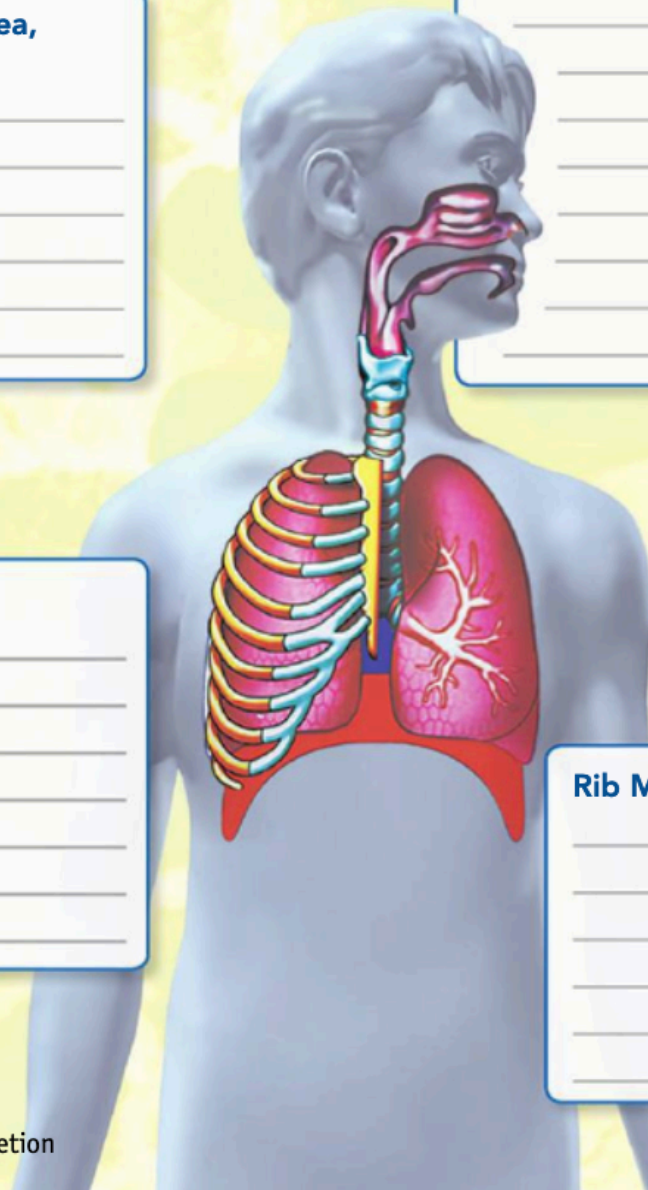
- 1. Summarize** In the boxes below, describe the function of each group of respiratory structures. Also, explain what changes occur in your chest cavity when you inhale and exhale.
- 2. Compare and Contrast** In the Venn diagram on the next page, write how an alveolus and a capillary are alike and different.

Nose, Pharynx, Trachea, and Bronchus

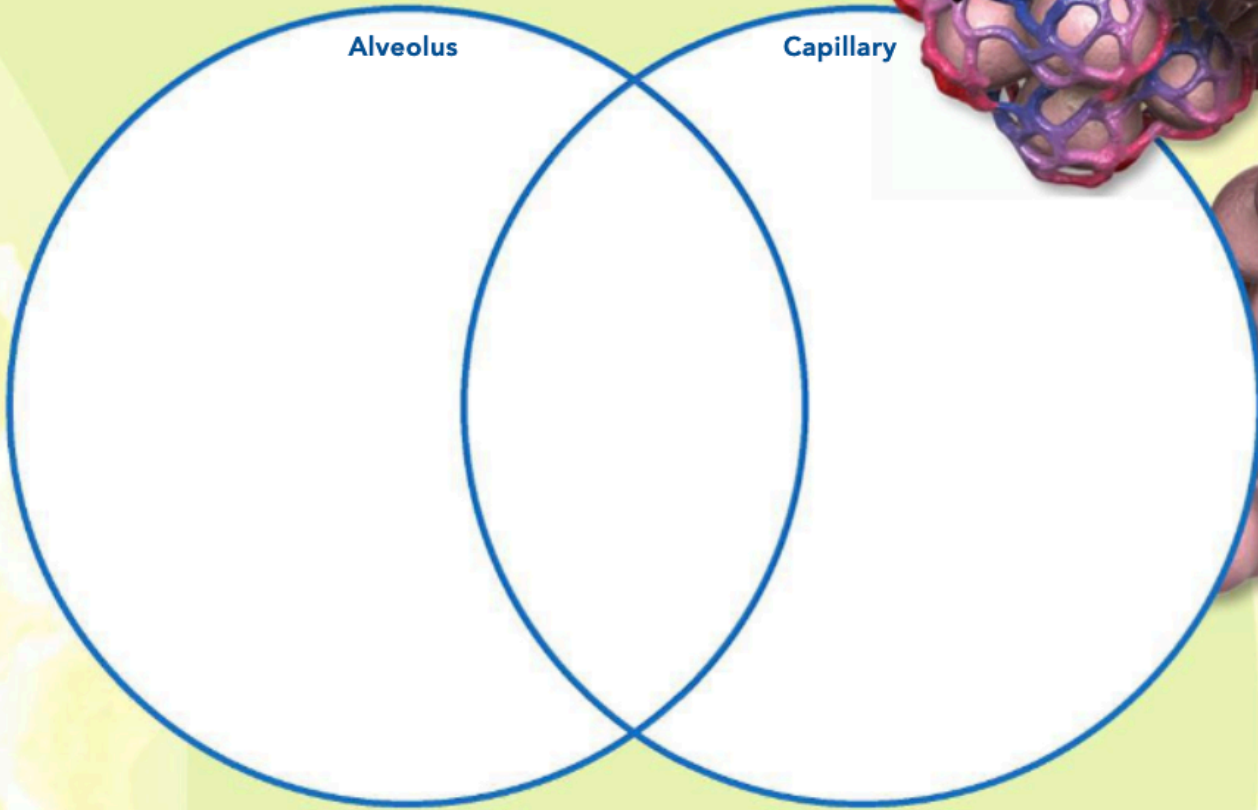
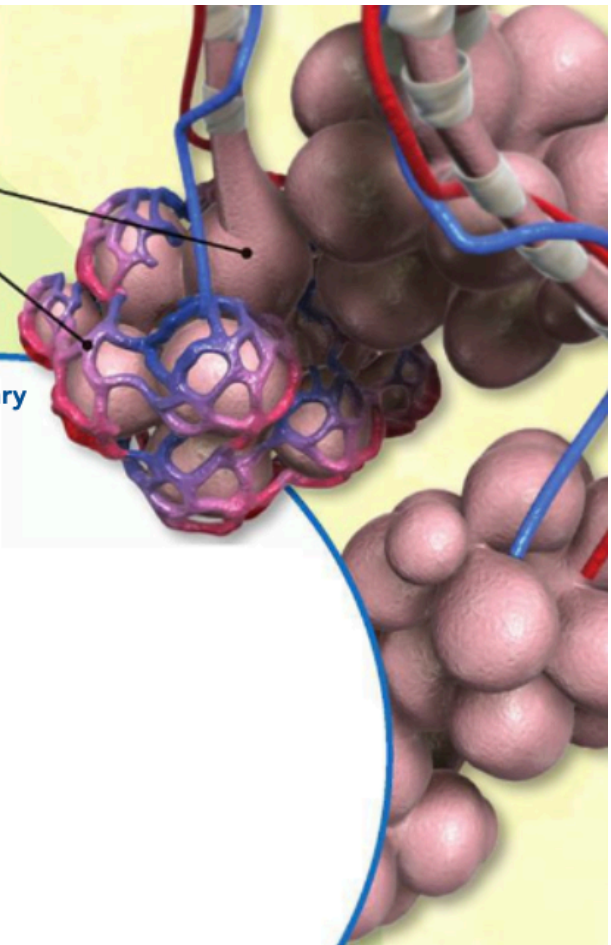
Inhale and Exhale

Alveoli

Rib Muscles and Diaphragm





Alveoli
Capillary



Lab[®]
zone Do the Quick Lab
What Do You Exhale?

Assess Your Understanding


3a.  **Draw Conclusions** How do the alveoli enable people to be very active?

b.  **ANSWER** How do you breathe?

got it?

I get it! Now I know that during gas exchange _____

I need extra help with _____

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