Chapter 37 **Circulatory and Respiratory Systems** **Name _____**

Worksheet The Human Respiratory System

Background Information

In this section you learned that the process of respiration allows living organisms to exchange oxygen and carbon dioxide with their environment. Each time you breathe, the respiratory system takes in oxygen and gets rid of carbon dioxide, a waste material. This type of respiration is called **external respiration** because you exchange gases with your environment. Inside the cells of the body, another type of respiration is also taking place: **internal respiration**. During internal respiration, the mitochondria in the cells use the oxygen obtained during external respiration to produce large amounts of energy in the form of ATP. Carbon dioxide is produced as a waste product during internal respiration and it is then expelled from the body during external respiration.

You also learned that single-celled organisms do not need respiratory systems because gas exchange with the environment takes place across the cell membrane. Multicellular organisms have many cells that do not come into contact with the environment. But because these cells still require oxygen and produce carbon dioxide, they require a special system to carry out respiration efficiently: the respiratory system. Without an efficient respiratory system, multicellular organisms could not survive.

Procedure

Building Vocabulary Skills

1. Internal means inside; external means outside. Why are these terms used to describe the two types of respiration that occurs in the body?

2. External respiration involves an organism's respiratory system. What is the function of the respiratory system?

3. In a large multicellular organism, could internal respiration take place without external respiration? Explain your answer.

4. Why is a respiratory system not necessary in a single-celled organism?

Background Information

The respiratory system is composed of the nose, larynx, pharynx, trachea, bronchi, and lungs. The respiratory system can best be described as a series of passageways that not only direct the air that is inhaled to the lungs, where gas exchange takes place, but also constantly clean and filter out impurities that might interfere with the functioning of this important system.

In order for you to get air into the respiratory system, you inhale. When you inhale, the **diaphragm**, a large muscle located at the bottom of the rib cage, contracts and moves down. When the diaphragm moves down, the volume of the chest cavity increases. With an increase in volume, there is also a decrease in pressure. The air outside the body is still at atmospheric pressure; so to equalize the pressure inside and outside the body, air rushes into the respiratory system through the nose, pharynx, and trachea.

Once inside the nose, air from the environment is filtered by tiny hairs called **cilia** and **mucous** secretions that trap particles of dirt, germs, and other foreign objects. Because the air you breathe is often very dry, moisture is added as it passes through the nose and into the pharynx. Air then passes into the trachea for its trip into the chest cavity. Once again, mucus and cilia work together to filter out any particles still in the air. The trachea divides into two branches called **bronchi** that lead directly into the

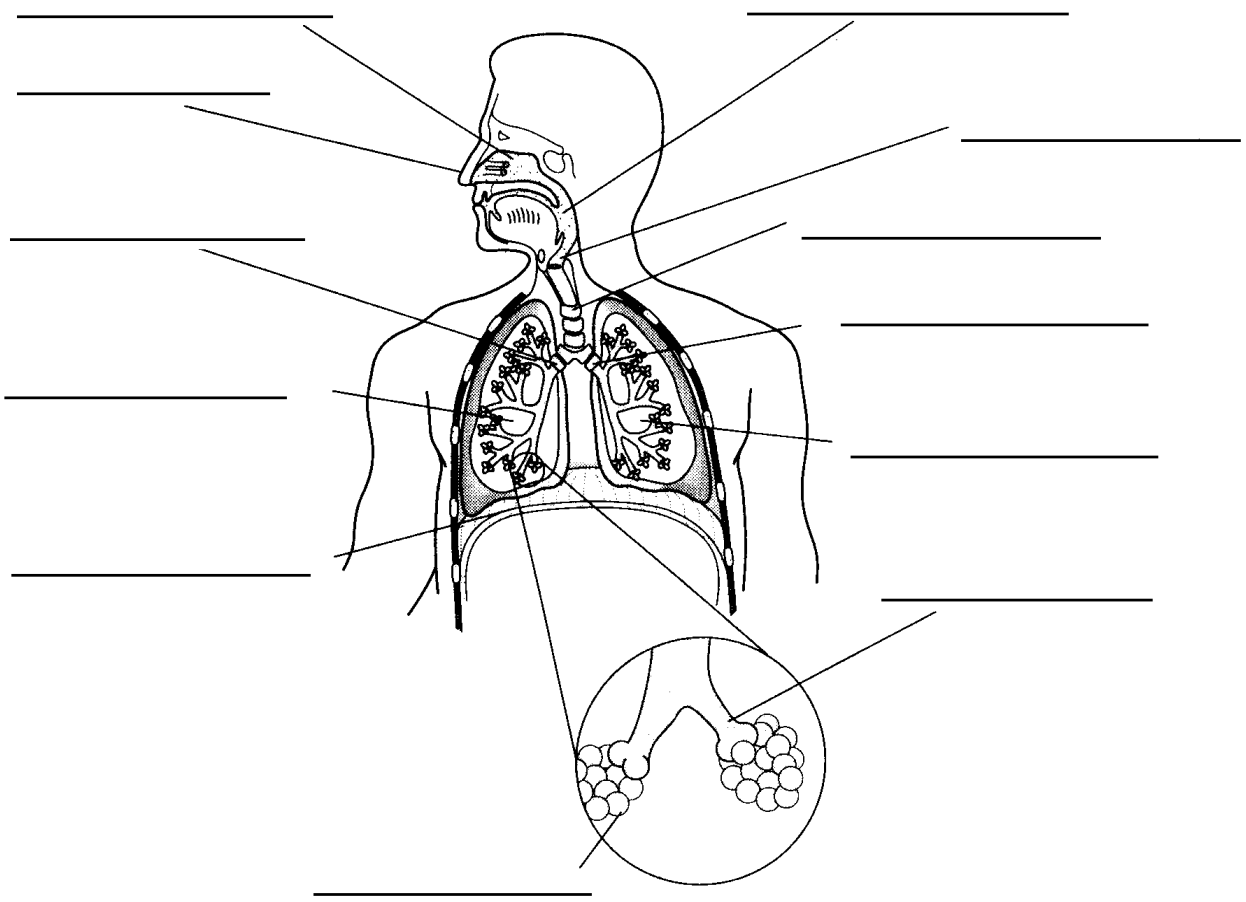
lungs. The lungs are the main organs of the respiratory system, and it is in the lungs that gas exchange actually takes place. The bronchi divide into smaller and smaller passageways called **bronchioles** that eventually lead into the hollow air sacs called **alveoli**. The alveoli are thin membranes that are covered with tiny blood vessels called capillaries. In the alveoli, the oxygen and carbon dioxide are exchanged between the air and the bloodstream.

The concentration of oxygen in the air that is inhaled is greater than the concentration of oxygen in the bloodstream. Because of the difference in concentrations of oxygen, oxygen diffuses across the thin membrane of the alveoli into the bloodstream, where it is carried to the cells in the body. A special oxygen-carrying molecule, **hemoglobin**, found in red blood cells, enables the body to carry the large amount of oxygen needed by the cells of the body. At the same time, the concentration of the waste gas carbon dioxide is greater in the bloodstream than in the air that was inhaled. Because of the difference in concentrations of carbon dioxide, carbon dioxide diffuses from the bloodstream into the air in the alveoli so that it can be exhaled from the body.

When you exhale, you force the air that now contains the waste gas carbon dioxide out of the respiratory system. When you exhale, the diaphragm relaxes and moves back into its position at the base of the rib cage. This action decreases the volume of the chest cavity and increases the pressure inside the chest. The increased pressure inside the chest cavity causes the lungs to decrease in size and to squeeze the air containing carbon dioxide out of the alveoli, the lungs, and the body.

As the exhaled air reverses its trip through the passages of the respiratory system, it rushes past the vocal cords in the larynx. When muscles cause the vocal cords to contract, the air passing between them vibrates and produces sound. The respiratory system allows the body to efficiently exchange vital gases with the environment and provides a mechanism for transferring gases into the bloodstream so that each cell of the body receives the material it needs to carry out its function.

5. Label the organs of the respiratory system in the diagram below. Use the following terms: alveolus, bronchioles, diaphragm, right and left lung, right and left bronchus, larynx, pharynx, nasal cavity, trachea, and nose.



6. Identify the organs of the respiratory system that perform the following functions:

   a) Passageway for air from the environment into the respiratory system _____

   b) Clean and filter the air from the environment _____

   c) Contain the alveoli _____

   d) Specific location of gas exchange _____

   e) Moisture is added to the air _____

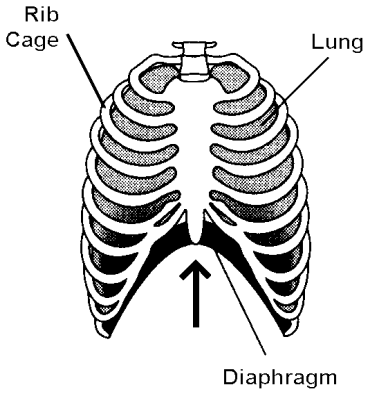
   f) Contains the vocal cords _____

   g) Muscle used for inhalation _____

   h) Place where exhaled air leaves the respiratory system _____

Interpreting Illustrations: The Mechanics of Breathing

1. In the space to the right of each diagram, identify and describe the process illustrated by each diagram.



Process: _____

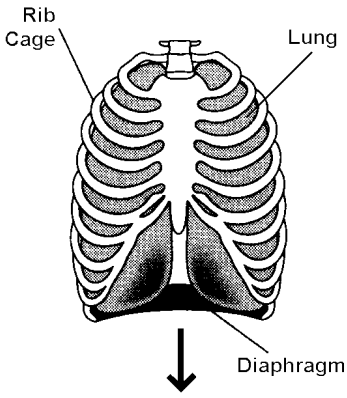
Description: _____

_____

_____

_____

_____ .



Process: _____

Description: _____

_____

_____

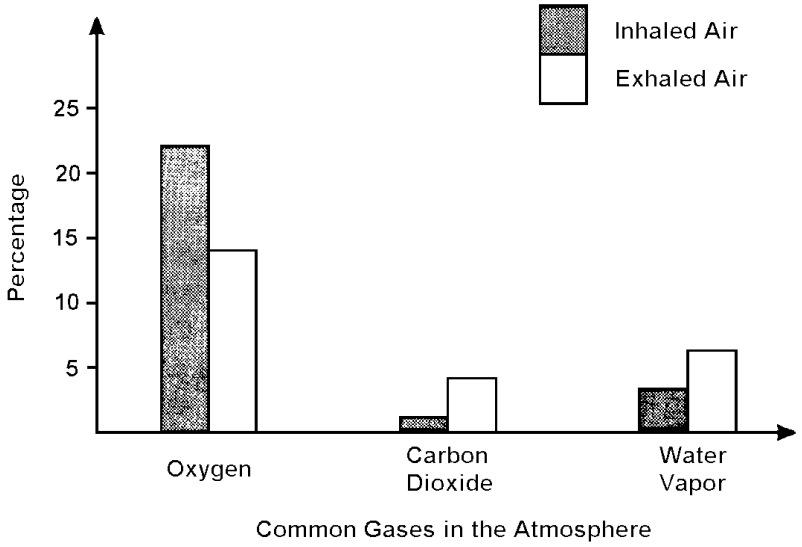
_____

_____ .

2. Draw an arrow indicating the direction of air flow through the trachea in each illustration.

Graphing Data

A chemical analysis of the gases that are inhaled and exhaled is illustrated in the graph below.



1. Based on the graph, describe what happens to the air that is inhaled.

2. Where in the respiratory system does each of the events described in your answer to question 1 occur?

Relating Structure and Function: Using the Main Ideas

1. How do the cilia and mucus found in the nose, pharynx, and trachea help these structures perform their functions?

2. The trachea is made of strong rings of tough cartilage. What would happen if the trachea did not contain cartilage?

3. Alveoli are made of elastic fibers that stretch during inhalation and pull back during exhalation. How does the structure of the alveoli help the respiratory system carry out gas exchange?

Background Information

As a child, did you ever try to hold your breath until you got your way? You could not do it for long! The respiratory system is under the direct control of the **medulla oblongata** in the lower part of the brain. Motor and sensory neurons are constantly monitoring the breathing muscles, as well as the amount of certain gases in the blood, to make sure that the cells of the body are getting the oxygen they need.

Special sensory receptors in important arteries monitor the **acidity** of the blood to determine the amount of oxygen getting to the cells. The acidity of the blood increases when there is too much carbon dioxide and not enough oxygen to allow cells to carry out their functions. When the acidity of the blood gets too high, the medulla oblongata takes over and directs your breathing - even if you wanted to hold your breath, you could not! The control of the respiratory system by the medulla oblongata ensures that you do not "forget" to breathe!

The lungs hold approximately 6 liters of air. Under normal conditions, you probably breathe 12 to 15 times a minute and exchange only about 0.6 liter of air with each breath. But the rate at which you breathe and the amount of air exchanged is related to the type of activities you are performing. During periods of heavy activity, the breathing rate and the amount of air exchanged with each breath increases to meet the body's demand for oxygen. The maximum amount of air that you can move into and out of your lungs is called **vital capacity**.

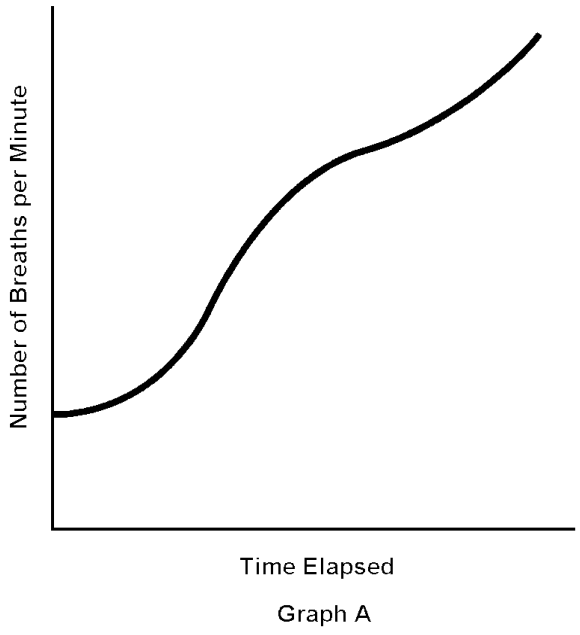
Holding Your Breath

1. What part of the body controls the respiratory system? Why?

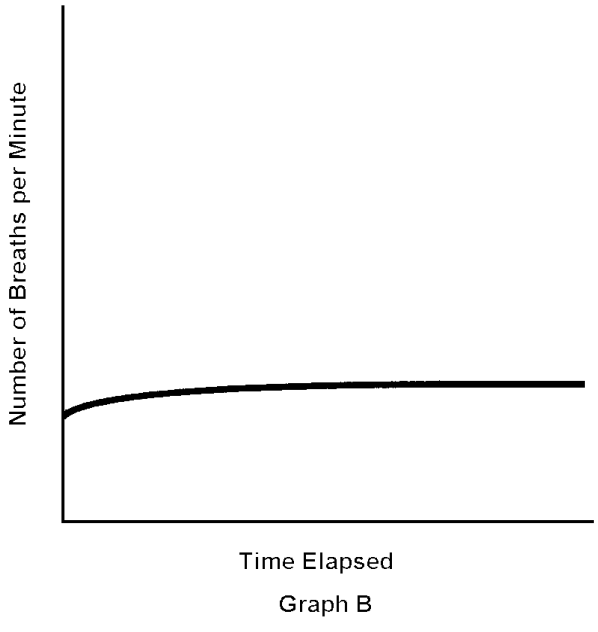
2. What important blood factor determines how long you can hold your breath?

3. Athletes who participate in synchronized swimming have to be able to hold their breath for long periods of time. Since the body must have a certain amount of oxygen in order to function, how have these athletes trained their bodies to meet their need for oxygen and yet be able to hold their breath for extended periods of time?

4. Which graph represents a person's breathing rate at rest? Explain your answer.



Graph A



Graph B