Respiration and the Respiratory Cycle

by Sophia

WHAT'S COVERED

In this lesson, you will learn to identify the basics of respiration and the respiratory cycle. Specifically, this lesson will cover:

1. Respiration

Respiration is the process in which oxygen is delivered to cells and carbon dioxide waste is removed from the body. The respiratory system and its components all play vital roles in this process. Cells require oxygen to be able to function, and the circulatory system and respiratory system work together in order to deliver this oxygen to the cells and remove the carbon dioxide from the body.

In the process of respiration, oxygen, and carbon dioxide diffuse down a pressure gradient from high to low. A **pressure gradient** is just like a chemical concentration gradient, but specifically for gases.

> EXAMPLE If there is a lower concentration of oxygen outside versus inside, it's going to diffuse down that gradient. It will start in the atmosphere and will be pulled into the lungs following that gradient.

Hemoglobin also plays an important role in maintaining this pressure gradient. As hemoglobin collects oxygen from the lungs and carries it to the body, it removes oxygen from the lungs so more can be pulled in.

TERMS TO KNOW

Respiration

A term used to describe the movement of gases across a semipermeable membrane; in this case, it would be the gas exchange process that occurs at the respiratory membrane (alveoli and pulmonary capillaries).

Pressure Gradient

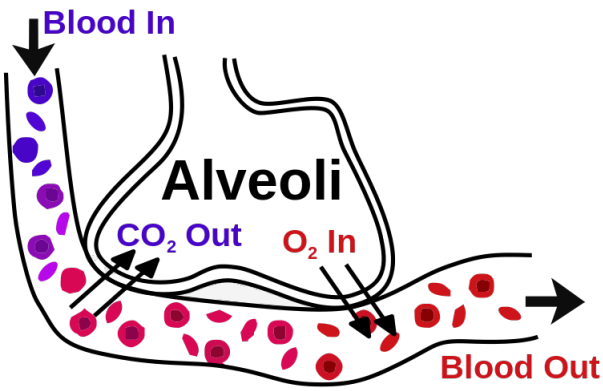
Differences in pressures created by different concentrations of air in different areas.

2. Respiratory Membrane

Alveoli are located in the lungs and are the location of gas exchange. Membranes in the alveoli and capillaries form what is called the **respiratory membranes**.

One side of the respiratory membrane is the alveoli, and the other are capillaries. The endothelium of each connects at the basement membrane between them. The respiratory membranes and capillaries allow for diffusion of gases between your blood and the air you breathe. Blood either needs to collect oxygen to carry to the rest of the body, or it needs to get rid of carbon dioxide.

When oxygen diffuses through the respiratory membrane, it goes to the red blood cells, which contain hemoglobin. Hemoglobin will then carry the oxygen away. The reverse would happen with carbon dioxide. If these red blood cells are carrying carbon dioxide, that will diffuse across the respiratory membrane to the alveoli. The carbon dioxide would then be exhaled when we breathe out.



TERMS TO KNOW

Alveoli

Microscopic air sacs located in the peripheral parts of the lungs that consist of simple squamous epithelial tissue; alveoli and pulmonary capillaries create the respiratory membrane where gas exchange occurs between atmospheric air and blood.

Respiratory Membrane

The respiratory membrane consists of alveolar air sacs and pulmonary capillaries, and is where the actual site of gas exchange occurs between atmospheric air and the blood.

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3. Role of Hemoglobin

Hemoglobin maintains the steep pressure gradient of oxygen. Hemoglobin is a protein found in our red blood cells that can bind up to four oxygen molecules at a time, and that is why it can maintain the pressure gradient. It allows blood to carry more oxygen than it otherwise would.

Whenever hemoglobin is carrying oxygen, we call it **oxyhemoglobin**. Hemoglobin can also carry away carbon dioxide. When hemoglobin is carrying carbon dioxide, it is called **carbaminohemoglobin**.

BIG IDEA

When you breathe in oxygen, that oxygen is going to be delivered by the hemoglobin in your blood to the left side of your heart. It's going to be pumped through the left side of your heart to the cells throughout your body. Your body cells are going to use that oxygen, causing the red blood cells to be oxygen-lacking. They will now carry carbon dioxide away from the cells of your body back up to the right side of your heart. The right side of the heart is going to pump it back up to your lungs. There, the hemoglobin in your red blood cells will then collect more oxygen that will go through this process again.

TERMS TO KNOW

Hemoglobin

A quaternary protein found on red blood cells, hemoglobin is primarily used to transport oxygen and some carbon dioxide throughout the blood.

Oxyhemoglobin

The term used to describe when oxygen is bound to hemoglobin; oxygen + hemoglobin = oxyhemoglobin.

Carbaminohemoglobin

A term used to describe when carbon dioxide is bound to hemoglobin; something to note is that oxygen and carbon dioxide do not compete with each other when binding to hemoglobin; carbon dioxide + hemoglobin = carbaminohemoglobin.

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4. Respiratory Cycle

The **respiratory cycle** is the process of breathing in and out. When you breathe in, it is called inhalation, and your lungs are expanding. Exhalation, or breathing out, is the part of the cycle when your lungs deflate.

During **exhalation**, several events are going on that aid in exhalation:

- The diaphragm, which is a muscle that separates your chest cavity from your abdominal cavity, is going to relax. When that happens, it moves upwards slightly.
- The intercostal rib muscles are going to be in a resting position.

These two events cause pressure in your chest cavity to increase relative to the pressure in the atmosphere. This pressure gradient is going to cause air to be pushed out of the lungs as you exhale, causing your lungs to deflate.
During **inhalation**, the opposite thing is happening:

- The diaphragm is going to contract, moving downward slightly.
- The intercostal rib muscles are going to lift your ribcage up and out.

The pressure in the chest cavity is decreased and will be less than the atmospheric pressure around you, causing the lungs to inflate.
Tidal volume is the amount of air that enters your lungs in a normal breath. That's an average of about two cups per person or about 500 milliliters. **Vital capacity** is the maximum amount of air you exhale after the deepest breath possible. Tidal volume and vital capacity are going to vary a little bit from person to person, depending on the person's size and how in shape they are. People who are more athletic can hold more air in their lungs on average.

TERMS TO KNOW

Respiratory Cycle

The events that occur during one breath; inhalation + exhalation = one respiratory cycle.

Exhalation

The events that occur to drive air flow out of the lungs; when the diaphragm relaxes and the

thoracic cage collapses putting a positive pressure on the lungs, driving air out.

Inhalation

The events that occur to drive air flow into the lungs; when the diaphragm contracts to expand the thoracic cage and decrease the pressure inside of the chest.

Tidal Volume

The volume of air we breathe in per breath; the average tidal volume is 500 mL/breath.

Vital Capacity

The maximum amount of air you move during one breathing cycle.

SUMMARY

Respiration is the exchange of gases that occurs at the alveoli in your lungs. Oxygen and carbon dioxide move across the **respiratory membranes**, which are composed of the alveoli and capillaries. The pressure gradient of oxygen and carbon dioxide is what causes this diffusion to take place. The **role of hemoglobin** is to maintain this pressure gradient. Hemoglobin is a protein in the red blood cells that oxygen can bind to.

The **respiratory cycle** includes inhalation and exhalation. Exhalation is when the diaphragm and the intercostal rib muscles relax. This increases the pressure in the chest cavity compared to atmospheric pressure and causes air to move out from the lungs. The lungs deflate. Inhalation is when these muscles contract and cause the pressure in the chest cavity to decrease. Air moves into the lungs and they inflate. Tidal volume is the volume of air we breathe in, and vital capacity is the maximum amount of air you move in one breathing cycle.

Keep up the learning and have a great day!

ATTRIBUTIONS

- Alveoli | **Author:** Wikipeda | **License:** Creative Commons

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