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## Why Do I Breathe?

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### WHY DO I BREATHE?

Take a deep breath of air. How long can you hold it? Thirty seconds? One minute? Then you must breathe again. Most of the time you breathe without even thinking about it. Have you ever wondered: Why do I breathe?

#### THE AIR YOU BREATHE

Air is all around you. You can not see it, but you can feel it when it moves. If you hold your hand close to your nose and mouth, you can feel the warm air every time you exhale.

Air is a mixture of invisible gases. Most of it (almost four-fifths) is nitrogen. About one-fifth of the air is oxygen. There are also small amounts of other gases, like carbon dioxide and water vapor, plus dust, dirt, pollen and pollution.

Like everything else around you, gases are made of very tiny particles called molecules. These molecules are always moving. They continually bump into each other and nearby objects. The push, or force, from the moving air molecules is called air pressure.

#### WHY DO YOU BREATHE?

All living things need oxygen. The oxygen reacts (or combines) with food you eat to make energy. You need energy for everything you do: for moving, eating, growing, fixing injuries, keeping warm, and even thinking. You can only live for about three minutes without fresh oxygen.

The reactions that make energy also make a waste gas called carbon dioxide. Too much carbon dioxide can be harmful to you.

The reason living things breathe is to get the oxygen they need, and to get rid of carbon dioxide waste. Plants and animals breathe in many different ways. (More about that later.) People breathe using their "respiratory system."

#### THE RESPIRATORY SYSTEM

The respiratory system has many parts, all working together. Air is inhaled (or breathed in) through the nose and mouth. This air goes down a tube called the trachea, or windpipe. The trachea splits into two tubes, which go to the lungs. Inside the lungs, the tubes split into smaller and smaller branches. At the ends of these small tubes are bunches of tiny balloon-like sacs. The sacs are called alveoli.

The respiratory system brings oxygen into the lungs. Where does the oxygen go from there?

The reactions that make energy from food take place in your cells. Cells are like little factories. They turn food into energy, and manufacture materials the body needs to live and grow. Every living thing is made of cells. Some plants and animals are just one single cell. Your body is made of trillions of cells. They all have different jobs to do, but they work together as a team.

Your circulatory system delivers oxygen from your lungs to all your cells. Your heart, blood, veins and arteries are all parts of your circulatory system. Red blood cells carry the oxygen. Each red blood cell is packed with special oxygen-holding molecules called hemoglobin.

The smallest blood vessels are called capillaries. They are so small that the red blood cells must travel through them in single-file. The alveoli in your lungs are surrounded by capillaries. The walls of the alveoli and capillaries are very thin. Oxygen moves from the air in your lungs, through the thin walls, and into your blood.

The capillaries leaving your lungs join together into larger blood vessels. These go to your heart. Your heart is a strong muscle which pumps blood through your body. The arteries leaving your heart branch off into smaller and smaller blood vessels. The blood soon reaches tiny capillaries surrounding your cells. Oxygen leaves the blood. It moves through the walls of the capillaries and into your cells.

At the same time, the cells get rid of their waste. Carbon dioxide gas is picked up by the blood. It is carried to the alveoli, where it moves out into the lungs, and is exhaled (breathed out.)

#### HOW DOES THE AIR MOVE IN AND OUT?

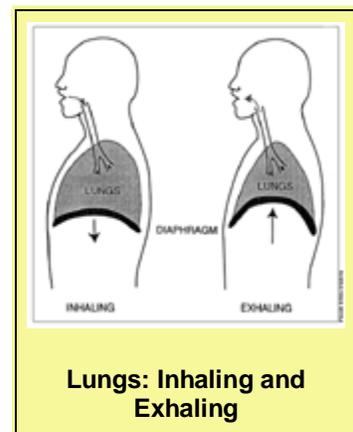
Your lungs and heart are in your chest, surrounded and protected by ribs and muscles. Below the lungs is a large, strong, dome-shaped muscle. It is called the diaphragm.

Most of the time you don't think about breathing. It is controlled automatically by your brain. When there is not enough oxygen or too much carbon dioxide in your blood, your brain sends a signal to the muscles in your chest. These muscles contract (become shorter.) They pull the ribs up and out. The diaphragm muscle flattens and moves downward. The chest and lungs expand (get bigger.)

#### [\(See picture, "Lungs: Inhaling and Exhaling."\)](#)

As the lungs expand, the air molecules move farther apart. Air pressure inside the lungs becomes lower than the air pressure outside. Air moves into the lungs, until the inside and outside pressures are equal again.

Inhaling takes work. The brain sends signals, the muscles contract and the lungs stretch. Exhaling is different. The muscles just relax. The ribs move in and down and the diaphragm curves up. As the chest become smaller, pressure inside the lungs increases. Air is forced out until the inside and outside pressures are equal again.



Some air always stays in the lungs, even between breaths. If the lungs emptied completely, the alveoli would collapse. It would be much harder to inhale the next breath. (Think about blowing up a balloon. It is very hard to begin inflating it, but easier after it has started to expand.) Also, because there is always oxygen in the lungs, the red blood cells never waste a trip.

#### HOW DO OTHER ANIMALS BREATHE?

All plants and animals need oxygen, but they have different ways of getting it.

Tiny single-cell organisms, like bacteria, absorb oxygen through their cell surface. Some worms breathe through their skin.

Plants have many small holes in their leaves, called stomata. Air flows in and out, carrying oxygen and carbon dioxide with it.

Insects have small holes in their bodies, called spiracles. The holes lead to tracheal tubes, which carry air deep inside them.

Spiders have "book lungs," made of thin membranes like the pages of a book. The lungs are inside slits in their abdomen. As air flows in and out of the lungs, oxygen is absorbed into their blood.

Land animals, including reptiles, birds and mammals, have lungs for breathing. Birds have lungs about twice as big as those of a similar size mammal. Flying takes a lot of energy, so they use a lot more food and oxygen.

Many animals live in the water. Like other animals, they need oxygen. Oxygen from the air dissolves in lakes, rivers and oceans. Some animals, like fish, crabs and clams, have gills. Gills let animals use the dissolved oxygen. Gills are thin membranes (or tissues) surrounded by tiny blood vessels. As water passes over the gills, the oxygen is absorbed into their blood.

Mammals that live in the water, like dolphins and whales, have lungs. They can not breathe under water. Although many can hold their breath for a long time, they must surface for air or they will drown.

Amphibians spend part of their life in the water, and part on land. Frogs start as tadpoles, living in the water and breathing with gills. When they become adult frogs, they grow lungs and breathe air. Frogs can also absorb some oxygen through their skin.

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## FUN FACTS

### THE CARBON CYCLE

If every living thing uses oxygen, why isn't it all used up? And what happens to the carbon dioxide we exhale?

Plants make their own food by photosynthesis. They take carbon dioxide from the air and water from the soil. Using energy from sunlight, they make a sugar called glucose. Plants use glucose for energy. They also combine it with nutrients from the soil to make everything they need to live and grow.

Photosynthesis also makes oxygen. Like all living things, plants need oxygen, but they make much more than they use. The extra oxygen is given off into the air.

Animals can not make their own food. Instead, they eat plants or other animals. The food they eat is combined with oxygen from the air to make energy. These reactions also make carbon dioxide and other wastes. These wastes are returned to the air and Earth.

The cycle begins again when plants use the carbon dioxide and wastes as food. It is repeated over and over. All living things are linked together in this "carbon cycle." Living things keep the gases in the air in balance.

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## MORE FUN FACTS

1) While awake, the average adult breathes

- A) 19
- B) 14
- C) 8 times per minute.

2) While asleep, the average adult breathes

- A) 7
- B) 10
- C) 13 times per minute.

3) During exercise or stress, you may breathe

- A) 60
- B) 80
- C) 100 times per minute.

4) Average adult lungs hold a total of about:

- A) 1 liter (about 1 quart)
- B) 2 liters (about 2 quarts)
- C) 4 liters (about 4 quarts)

5) Air is about 21% oxygen. Artificial respiration (or rescue breathing) works because exhaled air still has:

- A) 4
- B) 9
- C) 16 percent oxygen.

6) An average size breath is about:

- A) 500 ml (about 1 pint)
- B) 1 liter (about 1 quart)
- C) 2 liters (about 2 quarts)

7) If flattened out, the total surface area of an adult's lungs would be about:

- A) 15 square meters (160 square feet)
- B) 90 square meters (970 square feet)
- C) 140 square meters (1500 square feet)

8) The Heimlich maneuver is

- A) a kind of football play.
- B) used when someone is choking.

9) Carbon monoxide is:

- A) used by plants in photosynthesis.
- B) what gives soda pop its fizz.
- C) deadly to warm-blooded animals.

10) Why do earthworms come out of the ground when it rains?

- A) to eat
- B) to swim
- C) to breathe

11) Do all animals have red blood?

- A) yes
- B) no

**IMPORTANT NOTE:**

Measurement conversions are approximate.

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**ANSWERS TO MORE FUN FACTS**

- 1) B--The average adult breathes 10-16 times per minute while awake.
- 2) A--While sleeping, an adult breathes 6-8 times per minute.
- 3) C--During exercise or stress, you may take up to 100 breaths per minute. Breathing faster helps bring in the extra oxygen your body needs.
- 4) C--An adult's lungs can hold from 3.3 liters to 4.9 liters (about 3.5 to 5.2 quarts)
- 5) C--Exhaled air contains about 16% oxygen, which is enough to keep someone alive, and about 4.5% carbon dioxide. The concentration of carbon dioxide in the air is only 0.03%.
- 6) A--An average size breath is about 500 ml (about 1 pint)
- 7) B--The total surface area of an adult's lungs is about 85 to 90 square meters (about 900 to 1000 square feet). Compare this to the total area of your skin, which is about 2 square meters (about 20 square feet.)



[\(See picture, "Heimlich Maneuver."\)](#)

8) B--The Heimlich maneuver is a type of abdominal thrust used to clear airway obstructions when someone is choking. The universal sign for choking is clutching at the throat with one or both hands. (The American Red Cross no longer recommends patting or pounding on the back of a choking victim. Patting the back can make the obstruction fall further down the airway. It's a good idea for everyone to learn first aid, including rescue breathing and the Heimlich maneuver.)

9) C--Carbon monoxide is a colorless, odorless gas. It is produced whenever carbon-containing materials are burned, especially when there is little air or oxygen available. Carbon monoxide is poisonous; it combines with the hemoglobin in your blood, blocking the absorption of oxygen.

Being exposed to as little as one fifth of one percent for 30 minutes can be deadly. Carbon monoxide is very dangerous because it causes only mild symptoms at first, like headache or nausea, which are easily ignored. These symptoms are followed by unconsciousness, then death.

10) C--Earthworms breathe through their skin. Their oxygen comes from air that is normally in between the particles of soil. During a hard rain, water fills these small holes, and the worms must come to the surface to breathe.

11) B--The color of blood depends on what kind of molecules carry the oxygen. All vertebrates (animals with backbones) use hemoglobin, so their blood is red. Many invertebrates also use hemoglobin, but some use other molecules, which gives their blood a green or blue color.

IMPORTANT NOTE: THE UNIT MEASUREMENT CONVERSIONS USED HERE ARE APPROXIMATE, NOT EXACT.