

Why do we respire?

- All living organisms are made up of small microscopic units called cells.
- These cells have different functions to perform in these organisms such as digestion, respiration, transportation, and excretion.
- The cells can perform this function only if they get the energy to do so.
- Hence, all living organisms need food which gives them the required energy.
- The energy present in the food gets released when the organisms respire or breathe.

How food helps us in gaining energy?

- As we breathe, we take in the air that contains oxygen and breathe out air that contains carbon dioxide. This oxygen when transported to our cells helps in breaking down the food and we get energy.

What is cellular respiration?

- Cellular respiration can be defined as the process in which the food that we eat is broken down inside the cells which results in the release of energy. All the cells in living organisms undergo cellular respiration.
- Cellular respiration takes place in a cell organelle called mitochondria.
- The oxygen that an organism breathes in reacts with the carbohydrates (glucose) present in the food and results in the release of carbon dioxide, water, and energy.

The release of energy during cellular respiration

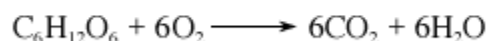


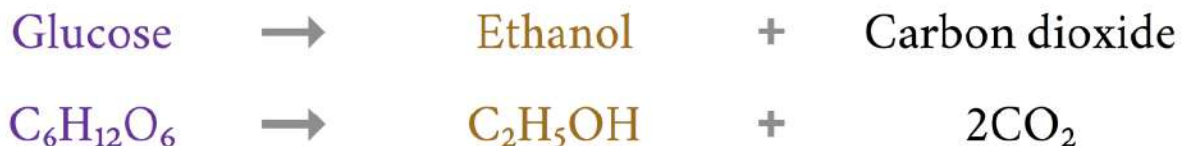
Figure 1 Cellular Respiration

Types of respiration

Aerobic Respiration	Anaerobic Respiration
1. This kind of respiration takes place in the presence of oxygen.	1. This type of respiration happens in the cells in the absence of oxygen.
2. It leads to the release of a high amount of energy in living organisms.	2. It results in a low amount of energy.
3. Human beings and many other animals undergo aerobic respiration.	3. Yeast and sometimes human beings undergo anaerobic respiration.
4. Carbon dioxide and water are also released in aerobic respiration.	4. Animal muscle cells release lactic acid and Yeasts release ethanol and carbon dioxide in anaerobic respiration.



Figure 2 Aerobic Respiration in Animals



(You might also see ethanol with the formula $\text{C}_2\text{H}_6\text{O}$. It's the same thing.)

Figure 3 Anaerobic Respiration in Yeast

Anaerobes:

- Organisms that can exist in the absence of air are called anaerobes.
- They undergo anaerobic respiration hence can get energy even without oxygen.
- For example, Yeasts. These are unicellular organisms that exist in the absence of oxygen as well.

- As a byproduct, they release ethanol and carbon dioxide. That is why they are used to making wine and beer. This is called as alcohol fermentation.

Anaerobic respiration in human beings

- Sometimes muscles of human beings can respire without oxygen.
- This generally happens when we undergo heavy exercise such as running, weightlifting, cycling, or walking for a longer duration.
- In such situations, the muscles require more energy and the supply of oxygen is not enough.
- Hence anaerobic respiration takes place in the muscles.
- As a result of muscles also produce lactic acid along with energy.
- This lactic acid accumulates in the muscles and causes cramps.
- That is why we often feel cramps while we do heavy exercises.
- In order to get relief from cramps, we can take a hot water bath or massage our muscles.
- This is so because a hot water bath or massage improves the blood circulation in the muscles.
- As a result, the oxygen reaches the cells easily which breaks on the lactic acid into carbon dioxide and water.



Figure 4 Anaerobic Respiration in Muscles Releases Lactic Acid

Breathing:

- **Breathing** can be defined as a process in which organisms, with the help of their respiratory organs, take in the oxygen-rich air present in the surroundings and release out air that contains a high amount of carbon dioxide in it. Breathing occurs continuously in the organisms.

- **Inhalation** is the process of taking the air that contains oxygen inside the body.
- **Exhalation** is a process of releasing out air that contains carbon dioxide out of the body. Inhalation and exhalation take place alternatively in the breathing process.
- **Breathing rate** can be defined as the number of times a person breathes in a minute.
- A breath can be defined as an inhalation followed by an exhalation.
- The breathing rate is not always constant in human beings. We generally breathe faster when our body needs more energy for example while exercising.
- This is so because the body needs more oxygen that can break down the food and produce more energy.
- An average adult human being breathes 15 to 18 times in a minute. While exercising, this rate can change up to 25 times a minute.

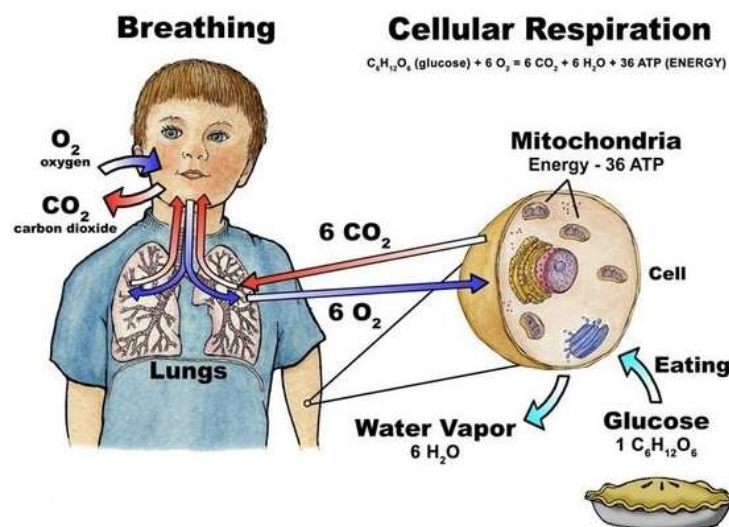


Figure 5 Relation between Breathing and Cellular Respiration

Why do we feel hungry after doing a physical activity like walking or running?

When we do a physical activity the food that is present in our body is converted into energy. Since all the food gets consumed in generating energy we start feeling hungry. Hence in order to gain more energy we need to eat more food.

The mechanism of breathing in human beings

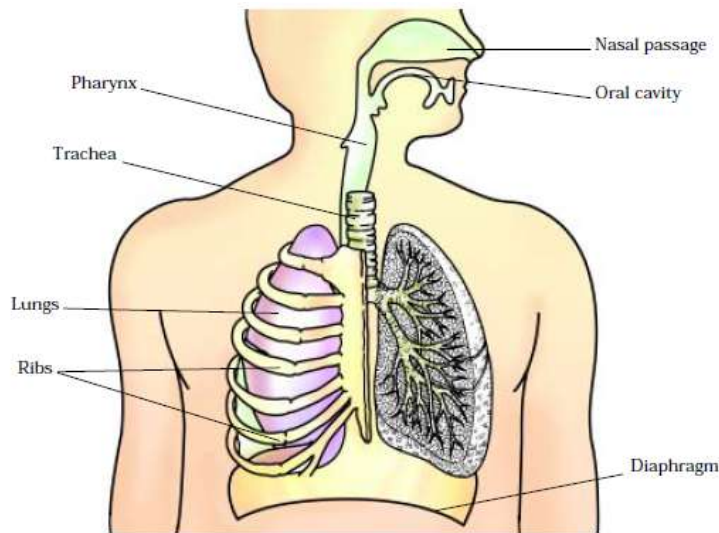


Figure 6 The Respiratory System in Humans

- We take in the air present in the environment through our nostrils which travel through the nasal cavity.
- Then it moves through the windpipe and reaches the lungs.
- The lungs are located in the chest cavity which is surrounded by the ribs.
- On the floor of the chest cavity lays a muscle sheet called a diaphragm.
- During the breathing process, the movement of the ribs and diaphragm takes place. This is so because the lungs expand and contract during breathing.
- As we take in the air it fills up the lungs. This moves the diaphragm downwards and the ribs outwards.
- The lungs when releasing out air from the body which bring back the diaphragm and the ribs to their original positions.

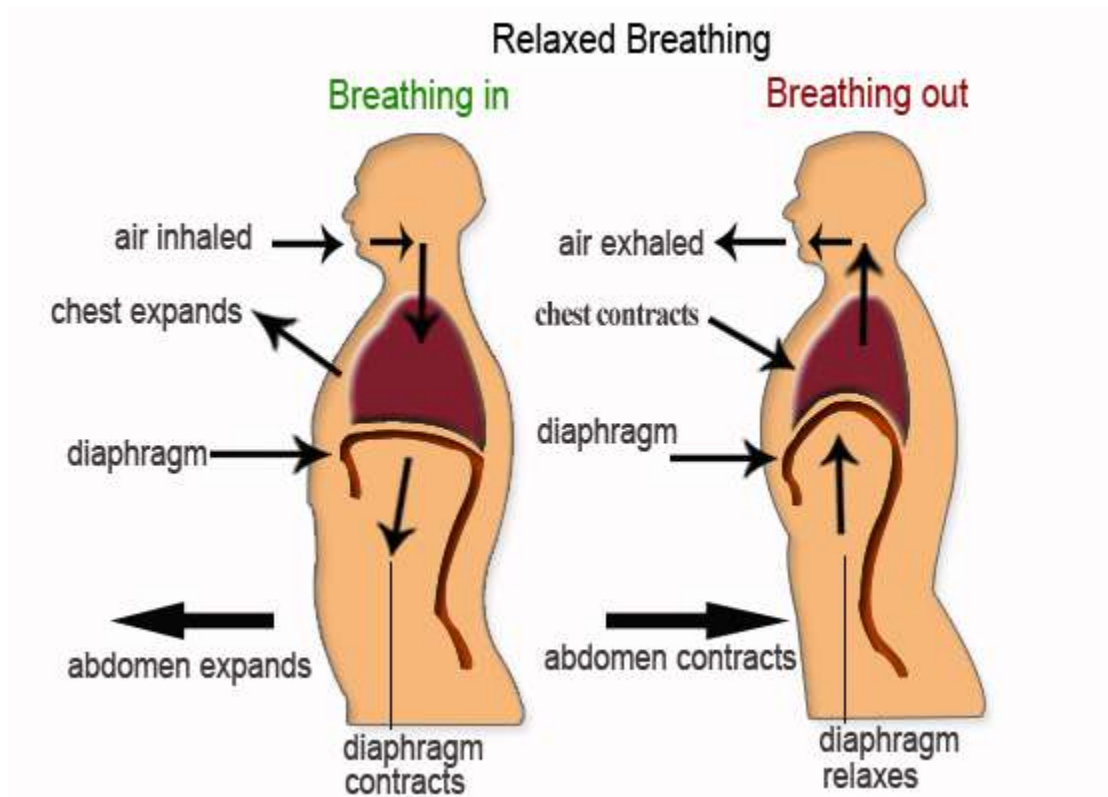


Figure 7 Breathing

Why do we sneeze?

- As we inhale the air present in the surroundings sometimes various unwanted elements such as smoke and dust are also included in it.
- However, they get stuck in the hair in our nostrils but some of them can get through the nasal cavity.
- They thus cause irritation in the nasal cavity which makes us sneeze.
- This helps in getting rid of the unwanted particles out of the nasal cavity.

What do we breathe out?

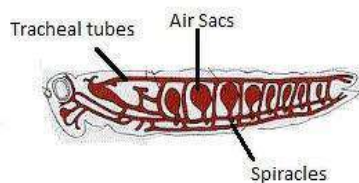
	Inhaled air	Exhaled air
Oxygen	Contains 21% oxygen (more oxygen than exhaled air)	Contain 16% oxygen (less oxygen than inhaled air)

Carbon Dioxide	Contain 0.03% carbon dioxide (less carbon dioxide than exhaled air)	Contains about 4% carbon dioxide (more carbon dioxide than inhaled air)
Water vapour	Contain less water vapour	Contain more water vapour

Figure 8 What do we Inhale and Exhale

Breathing in other organisms

- Many animals have just cavities in their bodies just like human beings for example lions, elephants, goats, cows, snakes, and birds.
- **Breathing in cockroach:**
 - Many insects like Cockroaches have small openings called spiracles present on the sides of the bodies.
 - Also, they have an air tube-like structure called the trachea that allows the exchange of gases in these insects.
 - The air enters the body through the spiracles and diffuses in the cells via the trachea.
 - Similarly, the air from the cells enters the trachea and moves out of the body through spiracles.



Respiratory system of cockroach

Figure 9 Respiratory system of Cockroach

- **Breathing in earthworms:**
 - Earthworms have soft, slimy, and moist skin.
 - Hence the gases can easily pass in and out of the earthworm through its skin.

- o Similarly, frogs also have slippery and moist skin that can help in breathing. However, frogs contain lungs too.

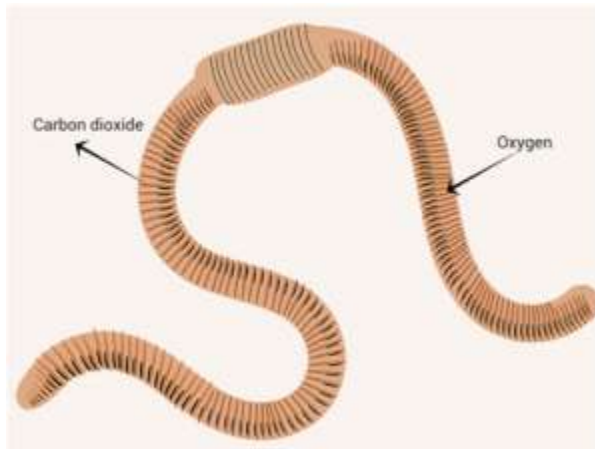


Figure 10 Respiration in Earthworms

- **Breathing underwater**

- o Animals that live underwater have special respiratory organs called gills.
- o They are a comb-like structure present on the skin of these animals.
- o Gills allow the exchange of gases between animals and the water easily.
- o Some animals called the amphibians can breathe on land by lungs and through moist skin underwater. For example frogs and toads.

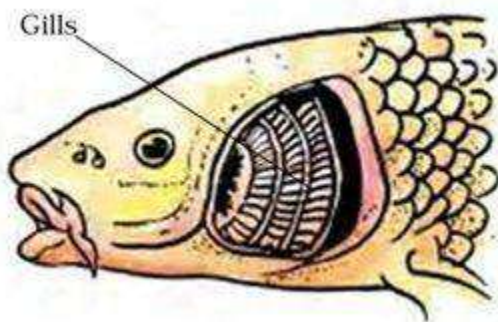


Figure 11 Respiration through Gills in Fishes

Respiration in plants

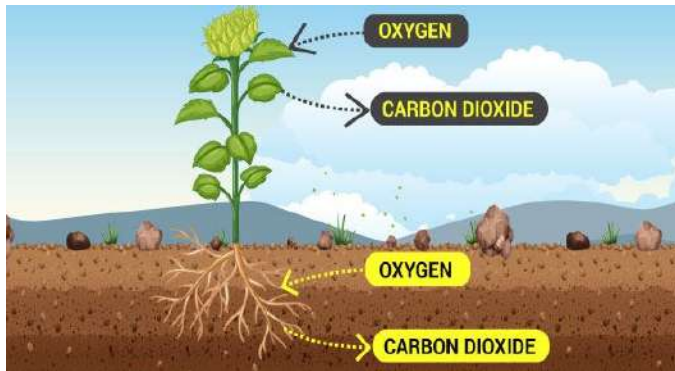
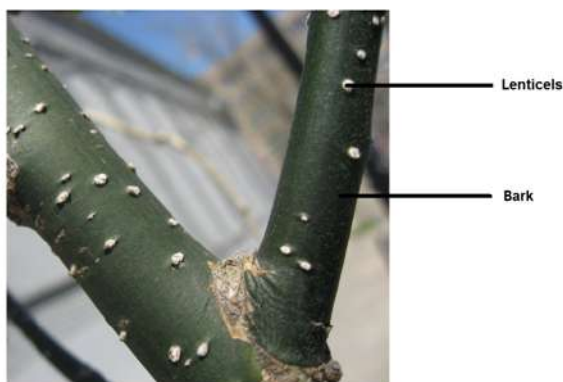


Figure 12 Respiration in plants

1. We know that plants also respire. They take in the carbon dioxide present in the atmosphere and use it in the process of photosynthesis to produce food. As a result of photosynthesis in plants, they release out oxygen into the environment.
2. All the parts of the plants can independently respire that is they can take in the carbon dioxide and release oxygen on their own.
3. The leaves of the plants have stomata present upon them which are small pore-like structures. They allow gases exchange in leaves.
4. The woody stems of the plants also respire. This is because of the presence of special tissue called Lenticels. The cells of this tissue have large intercellular spaces. They exist as dead cells on woody plants and roots and allow the exchange of gases. The bark of trees although is impermeable to gases hence these tissues serve an important purpose of respiration in the stems. As the name suggests, lenticels have a lens-like shape.



Lenticels in plants

5. The roots of the plants have hair-like structures on them. Hence they can absorb the air present in the soil.

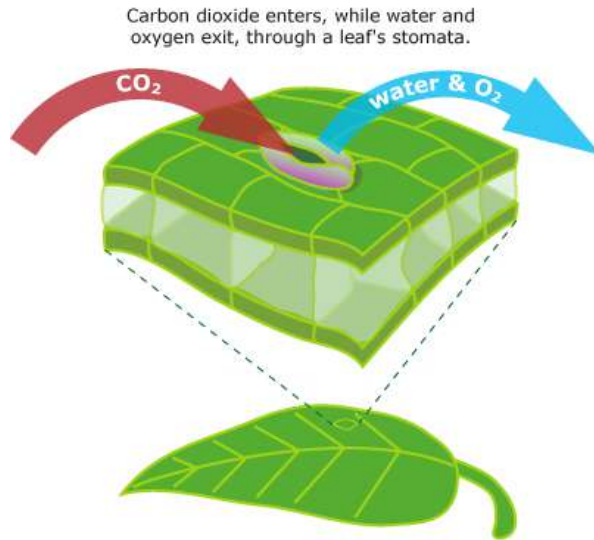


Figure 13 Respiration in Leaves through Stomata

Why plants can die if overwatered?

- We know that the roots get oxygen from the soil.
- We also understand that the air in the soil is present between the soil particles.
- Along with the air, soil also contains some water or moisture.
- If we over-water the plants the spaces between the soil particles get clogged.
- As a result, the roots will not be able to get enough air and the plant can die.

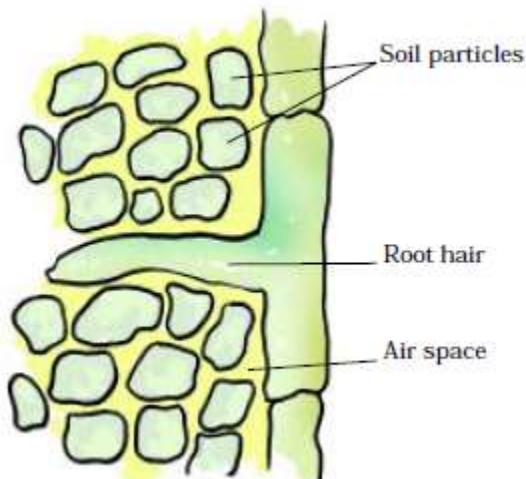


Figure 14 Roots can absorb air from the soil