7th Standard- Science

Respiration in Organisms

Each cell of an organism performs functions like nutrition, transport, excretion and reproduction for this purpose, it needs energy. Our food is stored energy which is released during respiration. Breathing is the process during which, we breathe in air having oxygen and we breathe out air rich in carbon dioxide. The air rich in oxygen is transported to all parts of the body and ultimately to each cell. This oxygen is utilised by the cell for respiration. Tbe process of breakdown of food in the cells of an organism with the release of energy is called cellular respiration.

Types of Respiration

On the basis of the presence or absence of oxygen, respiration is classified into two types:

1. Aerobic Respiration

When the breakdown of glucose occurs with the use of oxygen, it is called aerobic respiration. During aerobic respiration, glucose is completely broken down into carbon dioxide and water and energy is released. Aerobic respiration takes place in mitochondria.

It can be shown by the following equation:

Glucose(food) Oxygen−−→−−−− Carbon dioxide + Water + Energy

Aerobic respiration is seen in most of the organisms such as humans (man), dogs, cats, lions, elephants, cows, buffaloes, goats, snakes, earthworms, frogs, fishes, etc.

2. Anaerobic Respiration

When a breakdown of glucose takes place without using oxygen, it is called anaerobic respiration. The glucose is not completely broken down into carbon dioxide and water. An intermediate compound is formed with the release of less amount of energy during this process. It can be shown as follows:

Glucose Nooxygenorair–– >Alcohol + Carbon dioxide + Energy

Yeasts such as Saccharomyces cerevisiae and certain bacteria carry out anaerobic respiration. These organisms that carry out respiration in the absence of oxygen are called anaerobes.

Yeast is a single-celled organism. During anaerobic respiration (also called fermentation), yeast produces ethanol or alcohol as a byproduct which is used in making wine and beer. The carbon dioxide produced by yeast is used in the bread making industry. The C02 gas released during this process causes the bread dough to rise.

Anaerobic Respiration in Muscles

Usually, aerobic respiration takes place in humans, but under certain conditions, anaerobic respiration may also occur in our muscles for a short time, due to temporary deficiency of oxygen. When we perform a heavy exercise like running, cycling, walking, weight lifting, etc., we require a large amount of energy. To meet the energy requirement our muscle cells perform anaerobically. respiration. During this process, the glucose or food in the muscle cells is partially broken down in the absence of oxygen to form lactic acid and some extra energy is released.

The following equation shows the production of lactic acid:

Glucose(Food) Lactic acid + Energy

This ours because during vigorous physical activity, the utilisation of oxygen ours at a faster rate in the muscles that can be supplied by the blood.

When the lactic acid produced during anaerobic respiration, gets accumulated in the muscles, it causes muscle cramps. The muscle cramps can be relieved by taking a hot water bath or a massage. This improves the circulation of blood and oxygen supply to the muscle cells increases. The increased supply of oxygen results in the complete breakdown of lactic acid into carbon dioxide and water, thereby giving relief from cramps.

Differences between aerobic and anaerobic respiration

Aerobic respiration	**Anaerobic respiration**
It occurs in the presence of oxygen.	It takes place in the absence of oxygen.
The complete breakdown of food takes place in aerobic respiration.	Partial breakdown of food occurs in anaerob respiration.
End products of aerobic respiration are CO_2 and water.	End products of anaerobic respiration are alcohol and CO_2 or lactic acid (in muscles).
A large amount of energy is produced during aerobic respiration.	Less amount of energy is produced during anaerobic respiration.

Breathing

It is the process in which air rich in oxygen is taken inside and air rich in CO_2 is given out, with the help of respiratory organs. Thus, breathing involves two steps which take place alternately.

- **Inhalation:** Taking in of air rich in oxygen into our body is called inhalation.
- **Exhalation:** Giving out air rich in carbon dioxide from our body to the external environment is called exhalation.

This activity must be performed under the supervision of your teacher or parent. Close your nostrils and mouth tightly and look at a watch. Note down the time for which you could hold your breath. We will soon start feeling uneasy and cannot hold our breath for even one minute.

Breathing Rate

The number of times a person breathes in a minute is termed as breathing rate. An adult human being can inhale and exhale 15-18 times in a minute. It is the average breathing rate of an adult human being.

The breathing rate of a person is not always constant. It changes according to the oxygen requirement of the body. Breathing rate is somewhat faster in

women than in men and in children, it is higher (20-30 times/min) than adults. Breathing rate is slowest while sleeping (as less energy is required) while maximum during heavy exercise like running, weight lifting, etc. (much energy is required).

Increased breathing rate provides a greater amount of air entry into the lungs, hence blood can absorb oxygen at a faster rate. Faster breathing supplies more oxygen to the body cell for producing more energy, required for heavy exercises.

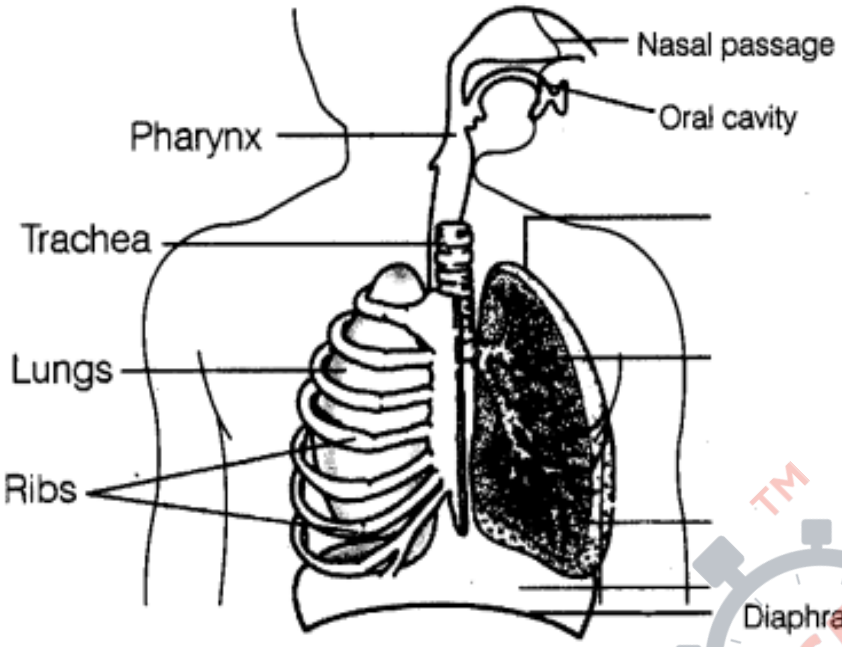
During heavy exercise, the breathing rate can increase to 25 times per minute. Because of this, food gets broken down at a faster rate and thus make us feel hungry.

When we feel drowsy, sleepy or tired, we yawn (i.e. open our mouth wide to take a long and deep breath, of air), because our breathing rate slows down and the body does not receive sufficient oxygen.

Mechanism of Breathing

The mechanism of breathing can be understood by the following points:

- Normally, we take in air through our nostrils. When we inhale air, it passes through our nostrils into the nasal cavity.
- From the nasal cavity, the air reaches our lungs through the windpipe.
- Lungs are present in the chest cavity. This cavity is surrounded by ribs on the sides.
- A large, muscular sheet called diaphragm forms the floor of the chest cavity.



Human respiratory system

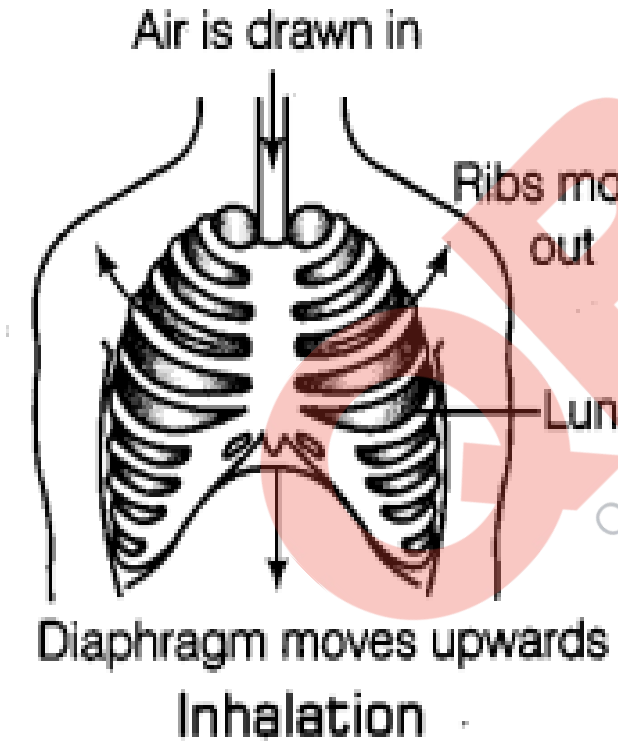
Smoking

Lungs are very delicate organs and essential for breathing, thus beeping us alive. Smoking tobacco in the form of beedi, cigarette or cigar damages our lungs gradually and causes ill health. While smoking, smoke along with chemicals present in tobacco enters our body. These chemicals present in tobacco damages the lungs in many ways like breathing becomes difficult causes lung cancer, heart diseases, etc. Smoking also affects people around smokers as they also inhale air containing tobacco. This is called passive smoking.

The mechanism of breathing involves the movement of the diaphragm and ribcage. The complete process of breathing can be discussed as follows:

Breathing In or Inhalation

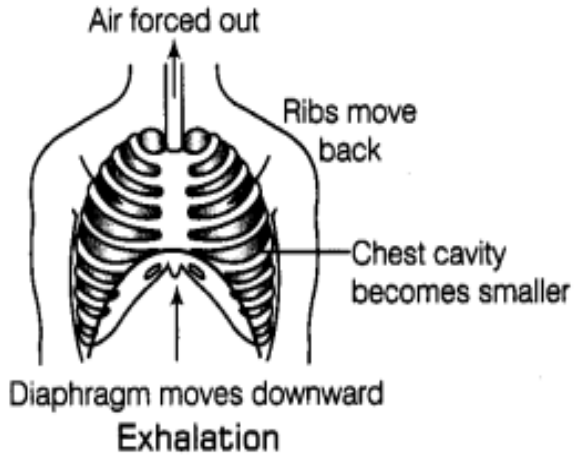
When we breath air in (or inhale) two processes occur together, i.e. the muscles between the ribs contract causing the ribcage to move upward and outward, while the diaphragm contracts and moves downwards. This upward and downward movement of ribcage and diaphragm respectively increases the space in the chest cavity and makes it larger. As the chest cavity becomes larger, it sucks air from outside the lungs and lungs get filled up with air and expand.



Breathing Out or Exhalation

When we breath air out or exhale the reverse process takes place, i.e. the muscles of the ribs release causing the ribcage to move downward and inward, while diaphragm releases and moves upward.

This downward movement of the rib cage and upward movement of diaphragm decreases the space in our chest cavity and makes it smaller. When the chest cavity becomes smaller, the air is pushed out of the lungs.



Sneezing

The air we inhale contains various types of unwanted particles like smoke, dust, pollen, etc. Their particles are allergens. During inhalation, these particles get trapped in the hair present in our nasal cavity. They cause irritation in the lining of the nasal cavity, as a result of which we sneeze. Sneezing expels the foreign particles from the inhaled air so that dust-free, clean air may enter into the lungs.

We should take care while sneezing in that we must cover our nose so that foreign particles expelled during sneezing may not be inhaled by another person nearby us.

Exhaled Air Contains Carbon Dioxide

The air is a mixture of gases like nitrogen, oxygen, carbon dioxide and water vapour, etc. The difference between inhaled air and exhaled air is that the inhaled air contains more oxygen

while exhaled air contains more carbon dioxide. Besides oxygen and carbon dioxide, the air also contains more water vapour. Exhaled air contains more water vapour than the inhaled air.

The air which we inhale and exhale is a mixture of gases and water vapours. The inhaled air is rich in oxygen while exhaled air is rich in carbon dioxide. The percentage of O_2 and CO_2 in inhaled and exhaled air can be shown as follows:

	Percentage of O_2	**Percentage of CO_2**
Inhaled air	21%	0.04%
Exhaled air	16.4%	4.4%

Breathing in Other Animals

Different animals possess different organs for the exchange of oxygen and carbon dioxide. Animals such as elephants, lions, cows, goats, frogs, lizards, snakes, birds have lungs in their chest cavities like humans for respiration. The smaller animals like cockroaches, earthworms, fishes, ants and mosquitoes do not have lungs. Therefore, respiration in these animals takes place by other means.

Cockroach

Insects like the cockroach, grasshopper, etc., have tiny holes on the sides of their body. Their openings are called spiracles. The spiracles on the body of insects are connected to a network of thin air tubes called tracheae which; spreads into the whole body of the insect, where the exchange of gases takes place. Air rich in oxygen rushes through spiracles into the tracheal tubes, diffuses into the body tissue and reaches every cell of body. Similarly, CO_2 from the cells enters into tracheal tubes and moves out through spiracles.

The blood in these animals do not contain haemoglobin and is not red in colour. They cannot carry oxygen to all the parts of the body. Therefore, transport of air takes place through the spiracles in these organisms. The tracheal system or spiracles are only seen in insects, not in any other group of animals.

Earthworm

Earthworms and leeches absorb the atmospheric oxygen through their moist and slimy skin because gases can easily pass through the moist and slimy skin. They absorb the atmospheric oxygen through their moist skin and transport it through the blood to all the cells.

Frog

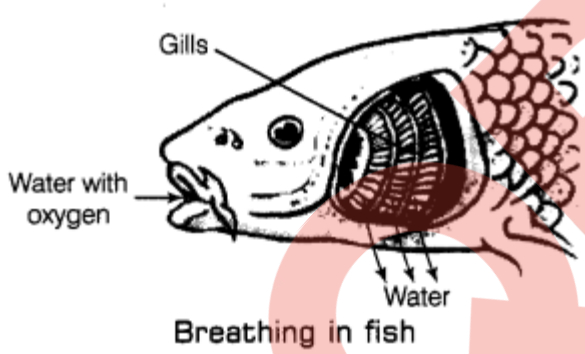
A frog-like human possesses a pair of lungs but when they are in the water, they breathe through their moist and slippery skin. When they are on land they breathe through their nostrils and a pair of lungs.

Breathing Under Water

There are many organisms which live in water. They do also breathe underwater. Some of them given below:

Fish

Fishes are the aquatic animals that live in water. These have a special organ for breathing called gills. The oxygen dissolved in water enters through the gills. Gills are actually the projections of skin and have blood vessels for the exchange of respiratory gases. The fishes breathe by taking in water through its mouth and sending it over the gills. The oxygen dissolved in the water is extracted by the gills and the extracted oxygen is absorbed by the blood.



Breathing in fish

This oxygen is then carried to all the parts of fishes for respiration. The carbon dioxide produced during respiration is brought back by the blood into the gills and expelled into the surrounding water.

Dolphins and Whales

Sea animals like dolphins and whales live in water but unlike fishes, they do not possess gills for respiration. These possess nostrils which are called blowholes. Their blowholes are located on the upper parts of their heads. These animals breathe in through their nostrils and lungs. Dolphins and whales come to the surface of sea-water from time to time to breathe in air,

sometimes whales release a function of water that moves upwards like a spray. This is because when a whale breathes air out of its blowhole it appears as a spray or mist, also called a spot. It can be seen from many miles away. Blowholes are surrounded by muscles that keep the holes closed when the whales or dolphins are underwater and open it when the animal is at the surface and needs to breathe.

The human cannot survive underwater because they do not possess any gills to make use of oxygen dissolved in water for breathing. When we go underwater we have to take oxygen gas cylinders for breathing.

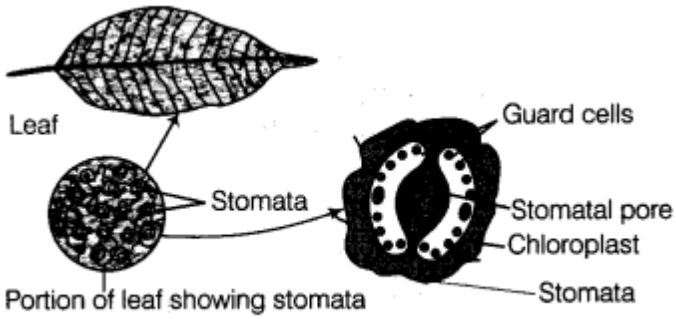
Respiration in Plants

All the organism in the world respires whether it is an animal or a plant. Plants also take in oxygen from the air and give out carbon dioxide. They also breakdown glucose into C02 and water and releases energy to perform other functions. The respiration in plants differs from the animal because in plants, respiration occurs through leaves and roots, etc. They carry out respiration independently, i.e. each plant part can independently take in oxygen from the air, utilise it to obtain energy and give out CO_2.

Respiration in Leaves

The leaves of the plants have tiny pores on their surface which are called stomata. The exchange of gases, i.e. O_2 and CO_2 in the leaves takes place through stomata during respiration. The oxygen from air enters into a leaf through stomata and reaches inside all the cells of the leaf through diffusion

while CO_2 produced during respiration also diffuses from the leaf to the atmosphere through the stomata.

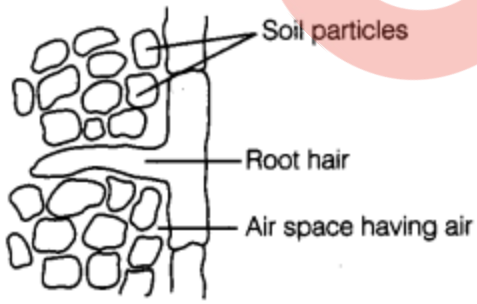


Respiration in leaves

Respiration in Roots

Root cells of the plants respire under the ground. They also need oxygen to carry out respiration and releases energy for their own use. Root cells get oxygen from the air present in the spaces between the soil particles.

Plant roots have a large number of tiny hairs on them which are called root hairs. Oxygen from the air present in soil particles diffuses into root hair and reaches to the cells of the root where it is utilised for respiration.



Respiration in plant roots

Note: If a potted plant is over watered for a long time, the plants die. This is because the water molecules fill the space between soil particles and push the air out.

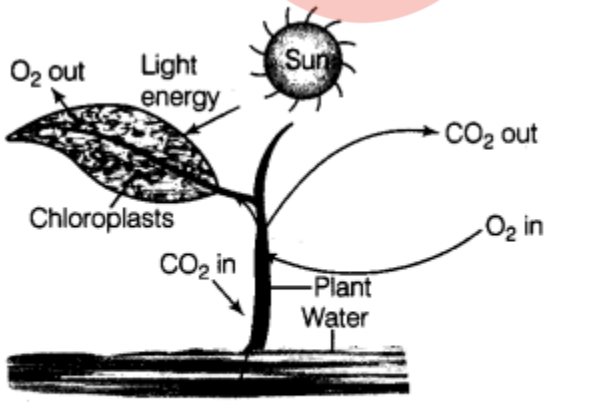
Due to this reason, the oxygen is not available to the roots for aerobic respiration and plants die. Due to the production of alcoholic products as a result of undergoing anaerobic respiration. It is not wise to sleep under a tree during the night because in the night, plants do not photosynthesis and plants are unable to use CO_2. So, a person will suffer from suffocation and feel the excess weight on the chest.

Exchange of Gases

The exchange of gases takes place in the plants all the time, but it is increased during day time. The leaves are more actively involved in photosynthesis during the day time in the presence of sunlight. The CO_2 released during respiration is utilised by the plant during photosynthesis to produce its food.

During photosynthesis, the O_2 is released by plants which are taken up during respiration in plants. Therefore, a balance between CO_2 and O_2 is maintained by the plants.

Respiration thus provides continuous energy to plants to perform all its functions regardless of time.



Plant showing intake and release of O_2 and CO_2 during photosynthesis and respiration