



## Stages of Respiration

There are two stages of respiration:

1. External respiration: a process in which they take in oxygen and give off carbon dioxide.

a) Breathing: it is the process of taking the required gas and giving out waste or un-required gases. It involves inhalation and exhalation, e.g. an aerobic organism such as human beings takes in oxygen and gives out carbon dioxide.

b) Gaseous exchange: it takes place between blood and alveolar air across the alveolar wall, i.e. diffusion of oxygen from lungs to blood and carbon dioxide from blood to lungs. In plants, it occurs through stomata.

2. Internal respiration: it is the gaseous exchange between arterial blood and the body cells.

## Respiration in Plants

Plants do not have any special organ to perform respiration. They exchange gases through stomata and large intercellular spaces present throughout the plant body ensure that all cells are in contact with air.

Root, stem and leaf are involved in this process

### 1. Gaseous exchange in roots:

The exchange of gases in roots of a plant takes place by the process of 'diffusion' from the air present in between the soil particles. Oxygen diffuses into the root hair and passes into the root cells from where the carbon dioxide moves out into the soil. If the root of a plant remains waterlogged for long, the plant dies.

### 2. Gaseous exchange in stem:

In woody plants, gaseous exchange occurs through the small pores in the stem called 'lenticles'. On the other hand, in herbaceous plants, stomata on the stem aid in the respiratory process.

### 3. Gaseous exchange in leaves:

In leaves, respiration takes place by diffusion of oxygen through stomata into the cells of the leaf. Stomata are the aerating pores present on the epidermis of the leaf. Each stomata pore is bordered by a pair of kidney shaped guard cells bearing chloroplasts in them. During daytime, when photosynthesis occurs, the carbon dioxide is rapidly used up, while the oxygen release is the major event. On the other hand, during nighttime, the elimination of carbon dioxide takes place.

## Respiration in Animals

In small organisms like amoeba and paramecium, exchange of gases occurs through the general surface of the body or cell membrane. In larger animals like birds, mammals etc have a special respiratory organ (organs which help in different organism to respire) with large surface area through which oxygen can diffuse. For efficient gaseous exchange, respiratory surface should be:

1. Thin walled
2. Moist for speedy diffusion
3. Large surface area
4. Rich in blood supply

## Respiration in Aquatic Animals

The rate of breathing in aquatic animals is always faster than the rate of breathing in terrestrial organisms. This happens because aquatic organisms utilize oxygen dissolved in water for respiration, where the amount of dissolved oxygen is fairly





low than the amount of oxygen in the air. The aquatic organisms breathe more rapidly to accumulate more and more oxygen. Fishes take in water through their mouths and force it past the gills where the dissolved oxygen is taken up by blood.

## Respiration in Terrestrial Animals

Terrestrial organisms use atmospheric oxygen for respiration, which is absorbed by different organs in different animals. All these organs have a structure that increase the surface area and is in contact with the oxygen rich atmosphere. Since, the exchange of oxygen and carbon dioxide has to take place across this surface, it is very fine and delicate. To protect this surface it is usually placed within the body well - protected so there are numerous passages that will take air to numerous passages that will take air to this area.

### Different Animals with their respiratory surface

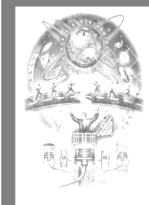
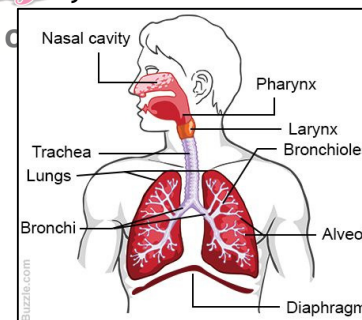
Animals	Respiratory surface
Amoeba and Paramecium	Cell membrane
Earthworm and leech	Moist skin
Fish, prawn, tadpole	Gills
Frog	Moist skin and lungs
Grasshopper, mosquito and housefly	Spiracles and air tubes
Birds, lizards and terrestrial animals	Lungs

### Exercise 2

- Q1. What is the difference between external and internal respiration?  
 Q2. How does gaseous exchange occur in plants?  
 Q3. Why does the rate of breathing in aquatic animals faster than others?  
 Q4. What is the essential feature of respiratory organ of different terrestrial animals?  
 Q5. In which organism the cell membrane acts as the respiratory surface?

### Respiration in Human Beings

- The human respiratory system consists of a pair of lungs and a series of air passages leading to the lungs. The entire respiratory tract (passages) consists of the nose, pharynx, larynx, trachea, bronchi and bronchioles.
- Air enters the nose through the nostrils. When air passes through the nose, it is warmed, moistened and filtered. The hairs present in the nose filter out particles in the incoming air. The air is moistened by the mucus present in the nose, and it is warmed by the blood flowing through the capillaries in the nose. The respiratory tract from the nose to the bronchioles is lined by mucus membranes and cilia. The mucus and cilia act as additional filters.
- Behind the nose lies the 'pharynx (throat)'. There are two passages here - one for food and the other for air. The air passes from the pharynx to the larynx, or the voice box. The opening leading to the larynx is called 'glottis'. It is protected by a lid called 'epiglottis', which prevents food from entering the passage to the lungs.
- From the larynx the air goes to the trachea, or the windpipe. The trachea is about 11cm long. It is guarded by 16 - 20 C shaped cartilage rings, which prevent





the trachea from collapsing. The trachea divides into two tubes called 'bronchi.' Each 'bronchus' divides and branches out in the form of thinner tubes called 'bronchioles'. Each bronchioles enter the lungs and divide further into finer branches called alveolar ducts. These open into extremely thin - walled, grape shaped air sacs called 'alveoli'. Each alveolus is covered by a web of blood capillaries.

- The lungs are a pair of spongy organ lying in the chest cavity formed by ribs. The actual exchange of gases between the air and the body takes place in the capillary covered alveoli inside the lungs. Here, oxygen from the air in the alveoli goes into the blood, and the carbon dioxide in the blood goes out. The oxygen binds to the haemoglobin molecules present in the red blood corpuscles and is taken to different parts of the body.
- The total surface area through which the exchange of gases can take place increases because of the millions of alveoli in the lungs. Their total surface area can be about a hundred times that of the body. The large surface area allows sufficient oxygen intake needed for releasing the large amount of energy required by us.

### Mechanism of breathing

There are two main steps in breathing: INSPIRATION and EXPIRATION

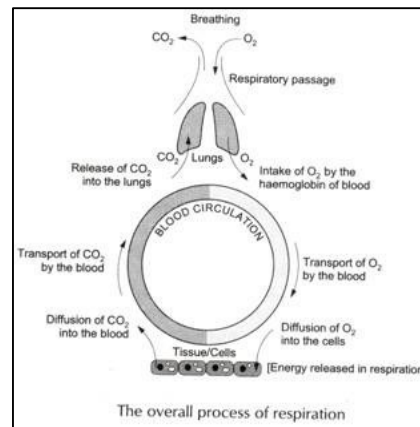
1. Inspiration: also called inhalation is the process of breathing in by which air is brought into the lungs. Inspiration involves the following steps.

The muscles attached to the ribs on their outer side contract. This causes the ribs to be pulled out expanding the chest cavity. The muscle wall between the chest cavity and the abdominal cavity called 'diaphragm', contracts and move downward to further expand the chest cavity. The abdominal muscle contract. The expansion of the chest cavity creates a partial vacuum in the chest cavity. This sucks in air into the lungs and fills the expanded alveoli.

2. Expiration: After the exchange of gases in the lungs, the air has to be expelled. Expulsion of the air from the lungs is called 'expiration'. In this process, muscles attached to the ribs on their inner side contract, and the diaphragm and the abdominal muscles relax. This leads to a decrease in the volume of the chest cavity, which increases the pressure on the lungs. The air in the lungs is pushed out and it passes out through the nose. When we breathe out not all of the air in the lungs gets expelled. Some of it remains in the lungs. This keeps the lungs from collapsing and allows more time for the exchange of gases.

### Transport of Gases

In very small organisms, there is no need to have a separate transportation system for gases because all its cells are involved directly in the exchange of gases by diffusion. However, a large multicellular organism needs a mechanism for the transport of gases for its different organs and tissues. Human beings also have a system for transportation of gases. Oxygen is carried by haemoglobin of the red blood cells. Haemoglobin has a great affinity for oxygen - each haemoglobin molecule binds to four molecules of oxygen. The oxygen 'picked up' by





haemoglobin gets transported with the blood to various tissues.

Carbon dioxide is more soluble in water than oxygen. So some of it is transported in the dissolved form in our blood. Some is also transported by haemoglobin. Not all of it is expelled from our body. Some of it reacts with water to form useful compounds.

### **Worksheet**

Q1. What is glycolysis?

Q2. How are oxygen and carbon dioxide transported in human beings?

Q3. What happens to the air as it passes through the nose?

Q4. Explain how the directions of exchange of gases in plants change with the time of the day.

Q5. Describe how the exchange of gases takes place in the lungs.

