# 6 Respiration in Organisms

0758CH10

One day Boojho was eagerly waiting to meet his grandparents who were coming to the town after a year. He was in a real hurry as he wanted to receive them at the bus-stop. He ran fast and reached the bus-stop in a few minutes. He was breathing rapidly. His grandmother asked him why he was breathing so fast. Boojho told her that he came running all the way. But the question got stuck in his mind. He wondered why running makes a person breathe faster. The answer to Boojho's question lies in understanding why we breathe. Breathing is a part of respiration. Let us learn about respiration.

## 6.1 Why do We Respire?

In Chapter 2 you learnt that all organisms are made of small microscopic units called cells. A cell is the smallest structural and functional unit of an organism. Each cell of an organism performs certain functions such as nutrition, transport, excretion and reproduction. To perform these functions, the cell needs energy. Even when we are eating, sleeping or reading we require energy. But, where does this energy come from? Can you say why your parents insist that you should eat regularly? The food has stored energy, which is released during respiration. Therefore, all living organisms respire to get energy from food. During breathing, we breathe in air. You know that air contains oxygen. We breathe out air which is rich in carbon dioxide. The air we breathe in is transported to all parts of the body and ultimately to each cell. In the cells, oxygen in the air helps in the breakdown of food. The process of breakdown of food in the cell with the release of energy is called **cellular respiration**. Cellular respiration takes place in the **cells of all organisms**.

In the cell, the food (glucose) is broken down into carbon dioxide and water using oxygen. When breakdown of glucose occurs with the use of oxygen it is called **aerobic respiration**. Food can also be broken down, without using oxygen. This is called **anaerobic respiration**. Breakdown of food releases energy.

$$\text{Glucose} \xrightarrow[\text{of oxygen}]{\text{in the presence}} \text{carbon dioxide + water + energy}$$

You should know that there are some organisms such as yeast that can survive in the absence of air. They are called **anaerobes**. They get energy through anaerobic respiration. In the absence of oxygen, glucose breaks down into alcohol and carbon dioxide, as given below:

$$\text{Glucose} \xrightarrow[\text{of oxygen}]{\text{in the absence}} \text{alcohol + carbon dioxide + energy}$$

Yeasts are single-celled organisms. They respire anaerobically and during this process yield alcohol. They are, therefore, used to make wine and beer.

Our muscle cells can also respire anaerobically, but only for a short time, when there is a temporary deficiency of oxygen. During heavy exercise, fast running (Fig. 6.1), cycling, walking for many hours or heavy weight lifting, the demand for energy is high. But the supply of oxygen to produce the energy is limited. Then anaerobic respiration takes places in the muscle cells to fulfil the demand of energy:

$$\text{Glucose (in muscle)} \xrightarrow[\text{of oxygen}]{\text{in the absence}} \text{lactic acid + energy}$$

*Fig. 6.1 During exercise, some muscles may respire anaerobically*

Have you ever wondered why you get muscle cramps after heavy exercise? The cramps occur when muscle cells respire anaerobically. The partial breakdown of glucose produces lactic acid. The accumulation of lactic acid causes muscle cramps. We get relief from cramps after a hot water bath or a massage. Can you guess why it is so? Hot water bath or massage improves circulation of blood. As a result, the supply of oxygen to the muscle cells increases. The increase in the supply of oxygen results in the complete breakdown of lactic acid into carbon dioxide and water.

## 6.2 Breathing

### Activity 6.1

**CAUTION**

Do this activity under the supervision of your teacher.

Close your nostrils and mouth tightly and look at a watch. What did you feel after some time? How long were you able to keep both of them closed? Note down the time for which you could hold your breath (Fig. 6.2).

So, now you know that you cannot survive for long without breathing.

Breathing means taking in air rich in oxygen and giving out air rich in carbon dioxide with the help of respiratory organs. The taking in of air rich in oxygen into the body is called **inhalation** and giving out of air rich in carbon dioxide is known as **exhalation**. It is a continuous process which goes



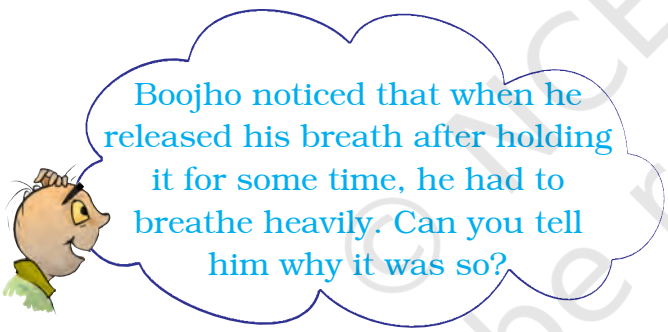


Reprint 2024-25

on all the time and throughout the life of an organism.

The number of times a person breathes in a minute is termed as the **breathing rate**. During breathing inhalation and exhalation take place alternately. A breath means one inhalation plus one exhalation. Would you like to find out your breathing rate? Do you want to know whether it is constant or it changes according to the requirement of oxygen by the body? Let us find out by doing the following activity.

*Fig. 6.2 Holding breath*




## Activity 6.2

Generally we are not aware that we are breathing. However, if you try you can count your rate of breathing. Breathe in and out normally. Find out how many times you breathe in and breathe out in a minute? Did you inhale the same number of times as you exhaled? Now count your breathing rate (number of breaths/minute) after brisk walk and after running. Record your breathing rate as soon as you finish and also after complete rest. Tabulate your findings and compare your breathing rates under different conditions with those of your classmates.

From the above activity, you must have realised that whenever a person needs extra energy, he/she breathes faster. As a result more oxygen is

**Table 6.1 Changes in breathing rate under different conditions**

| Name of the classmate | Breathing rate | | | |
|---|---|---|---|---|
| | Normal | After a brisk walk for 10 minutes | After running fast 100 m | At rest |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Self | | | | |

On an average, an adult human being at rest breathes in and out 15–18 times in a minute. During heavy exercise, the breathing rate can increase upto 25 times per minute. While we exercise, not only do we breathe fast, we also take deep breaths and thus inhale more oxygen.

supplied to our cells. It speeds up the breakdown of food and more energy is released. Does this explain why do we feel hungry after a physical activity?

When you feel drowsy, does your breathing rate slow down? Does your body receive sufficient oxygen?

## Activity 6.3

Figure 6.3 shows the various activities carried out by a person during a normal

*Fig. 6.3* *Variation in the breathing rate during different activities*


day. Can you say in which activity, the rate of breathing will be the slowest and in which it will be the fastest? Assign numbers to the pictures in the order of increasing rate of breathing according to your experience.

## 6.3 How do We Breathe?

Let us now learn about the mechanism of breathing. 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** (Fig. 6.4). This cavity is surrounded by ribs on the sides. A large, muscular sheet called **diaphragm** forms the floor of the chest cavity (Fig. 6.4). Breathing involves the movement of the diaphragm and the rib cage.

During inhalation, ribs move up and outwards and diaphragm moves down. This movement increases space in our chest cavity and air rushes into the lungs. The lungs get filled with air. During exhalation, ribs move down and inwards, while diaphragm moves up to its former position. This reduces the size of the chest cavity and air is pushed out of the lungs (Fig. 6.5). These movements in our body can be felt easily. Take a





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deep breath. Keep your palm on the abdomen, feel the movement of abdomen. What do you find?

After having learnt that during breathing there are changes in the size of the chest cavity, children got involved in the chest expansion competition. Everyone was boasting that she/he could expand it the maximum. How about doing this activity in the class with your classmates?

Smoking damages lungs. Smoking is also linked to cancer. It must be avoided.

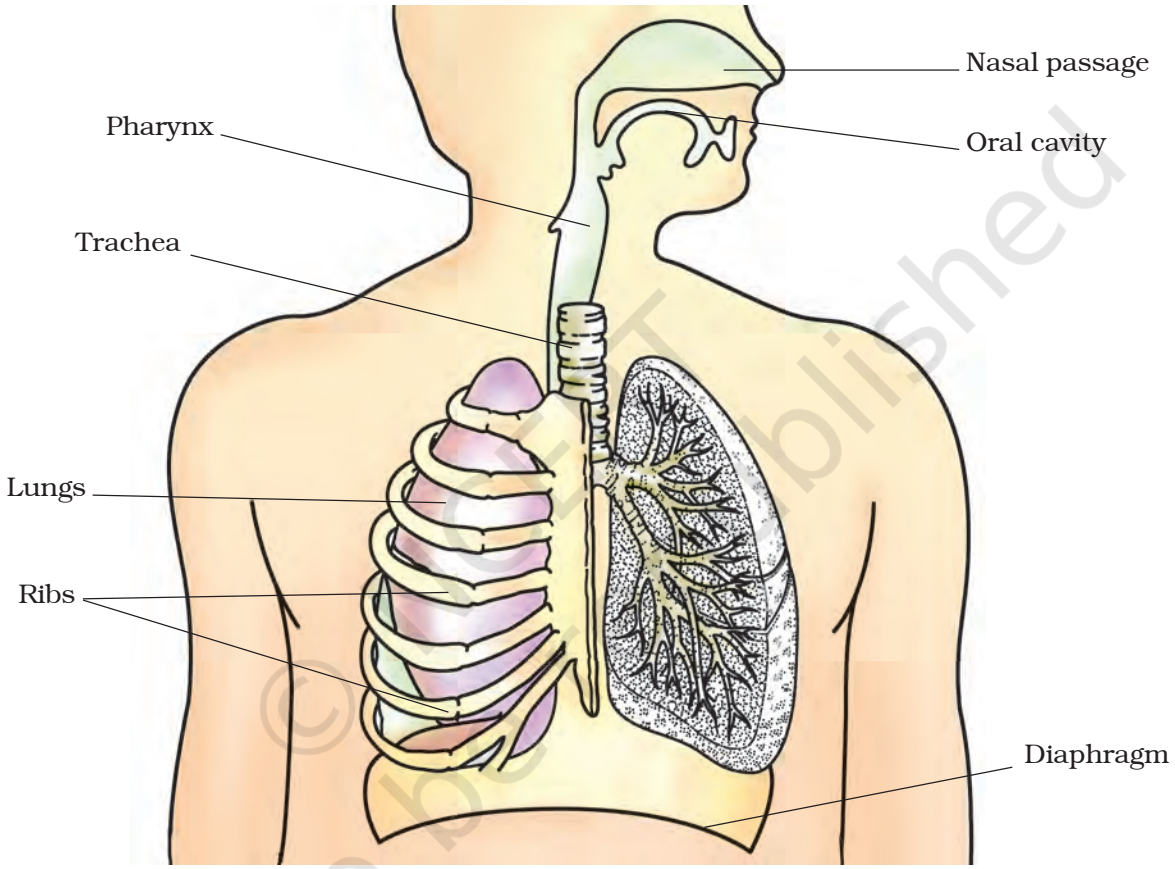


***Fig 6.4*** *Human respiratory system*

The air around us has various types of unwanted particles, such as smoke, dust, pollens, etc. When we inhale, the particles get trapped in the hair present in our nasal cavity. However, sometimes these particles may get past the hair in the nasal cavity. This may irritate the lining of the cavity, as a result of which we sneeze. Sneezing expels these foreign particles from the inhaled air and a dust-free, clean air enters our body.

**TAKE CARE:** When you sneeze, you should cover your nose so that the foreign particles you expel are not inhaled by other persons.

## Activity 6.4

Take a deep breath. Measure the size of the chest with a measuring tape (Fig. 6.6) and record your observations in Table 6.2. Measure the size of the chest again when expanded and indicate which classmate shows the maximum expansion of the chest.

We can understand the mechanism of breathing by a simple model.

## Activity 6.5

Take a wide plastic bottle. Remove the bottom. Get a Y-shaped glass or plastic tube. Make a hole in the lid so that the tube may pass through it. To the forked end of the tube fix two deflated balloons. Introduce the tube into the bottle as shown in Fig. 6.7. Now cap the bottle. Seal it to make it airtight. To the open base of the bottle tie a thin rubber or plastic sheet using a large rubber band.

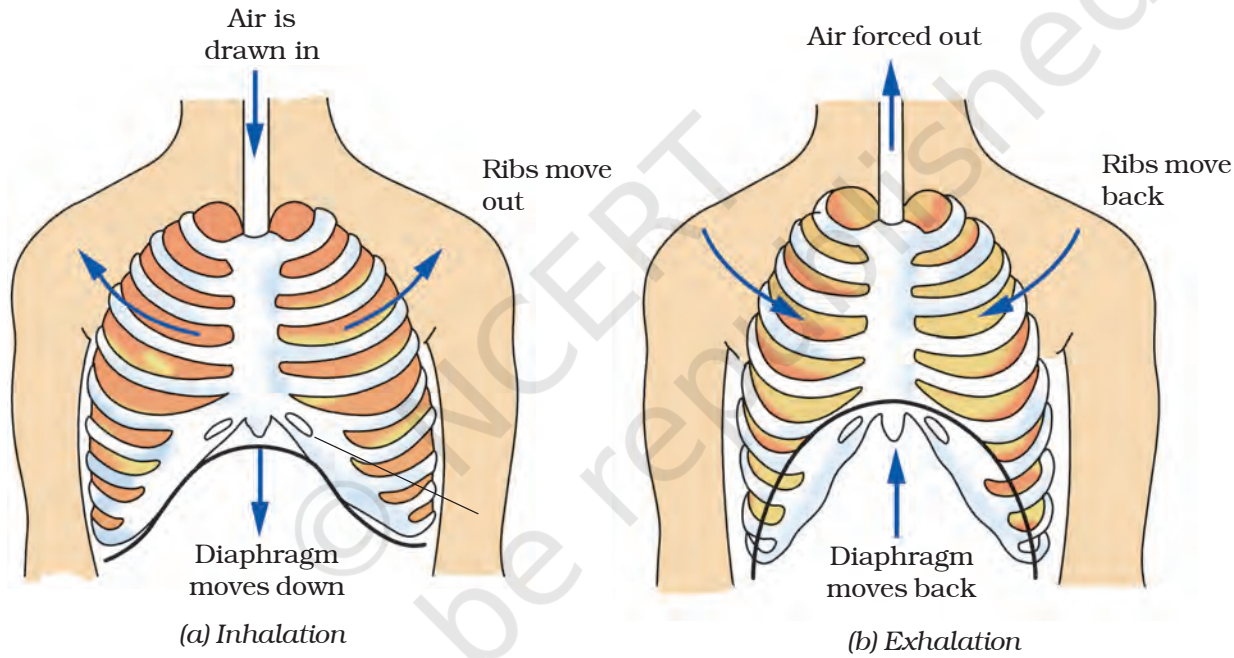


*Fig. 6.5 Mechanism of breathing in human beings*

**Table 6.2: Effect of breathing on the chest size of some classmates**

| Name of the classmate | Size of the chest (cm) | | |
|---|---|---|---|
| | During inhalation | During exhalation | Difference in size |
| | | | |
| | | | |
| | | | |
| | | | |





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*Fig. 6.6 Measuring chest size*

To understand the expansion of the lungs, pull the rubber sheet from the base downwards and watch the balloons. Next, push the rubber/plastic sheet up and observe the balloons. Did you see any changes in the balloons?

What do the balloons in this model represent? What does the rubber sheet represent?

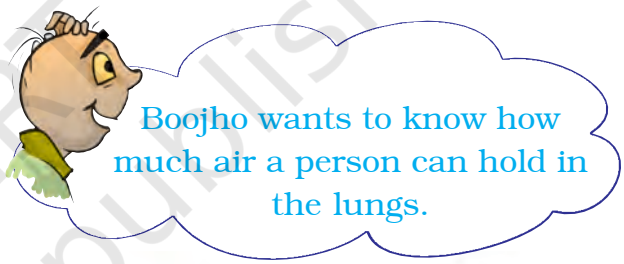
Now, you should be able to explain the mechanism of breathing.

## 6.4 What do We Breathe out?

### Activity 6.6

Take a slender, clean test tube or a glass/plastic bottle. Make a hole in its lid and fix it on the bottle. Pour some freshly prepared lime water in the test-tube. Insert a plastic straw through the hole in the lid in such a way that it dips in lime water. Now blow gently through the straw a few times (Fig. 6.8). Is there a change in the appearance of lime water? Can you explain this change on the basis of what you learnt in Chapter 5?

You are aware that air we inhale or exhale is a mixture of gases. What do we exhale? Do we exhale only carbon dioxide or a mixture of gases along with it? You must have also observed that if you exhale on a mirror, a film of moisture appears on its surface. From where do these droplets come?



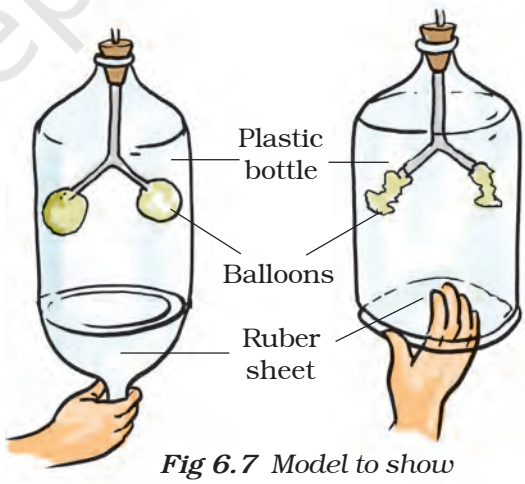




*Fig 6.7 Model to show mechanism of breathing*

**Breathe for Better Life**

Regular traditional breathing exercise (pranayama) can increase the capacity of lungs to take in more air. Thus more oxygen can be supplied to the body cells resulting in release of more energy.

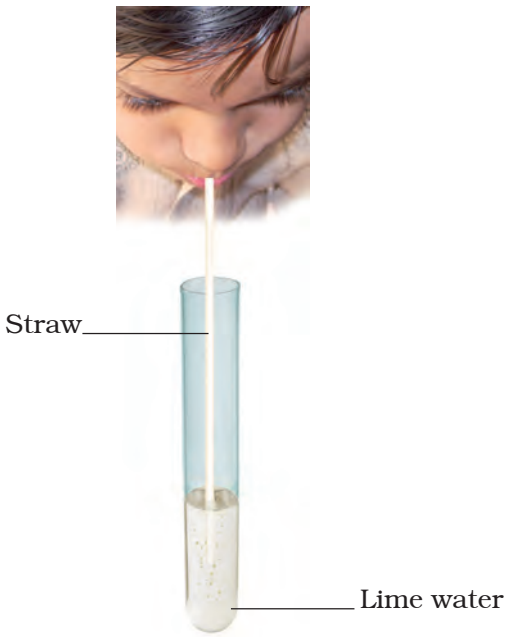



*Fig. 6.8 Effect of exhaled air on lime water*

The percentage of oxygen and carbon dioxide in inhaled and exhaled air.

| **Inhaled air** | **Exhaled air** |
|---|---|
| 21% oxygen | 16.4% oxygen |
| 0.04% carbon dioxide | 4.4% carbon dioxide |

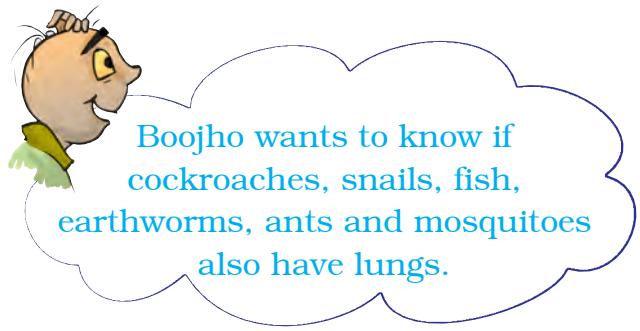
Lungs

## 6.5 Breathing in Other Animals

Animals such as elephants, lions, cows, goats, frogs, lizards, snakes, birds, have lungs in their chest cavities like the human beings.

How do other organisms breathe? Do they also have lungs like those of human beings? Let us find out.

***Cockroach:*** A cockroach has small openings on the sides of its body. Other insects also have similar openings.




These openings are called **spiracles** (Fig. 6.9). Insects have a network of air tubes called **tracheae** for gas exchange. Oxygen rich air rushes through spiracles into the tracheal tubes, diffuses into the body tissue, and reaches every cell of the body. Similarly, carbon dioxide from the cells goes into the tracheal tubes and moves out through spiracles. These air tubes or tracheae are found only in insects and not in any other group of animals.

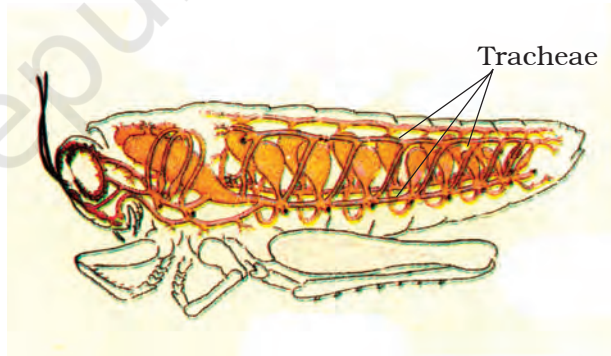



*Fig.6.9 Tracheal system*

***Earthworm:*** Recall from Chapter 6 of Class VI that earthworms breathe through their skins. The skin of an earthworm feels moist and slimy on touching. Gases can easily pass through them. Though frogs have a pair of lungs like human beings, they can also breathe through their skin, which is moist and slippery.

Boojho has seen in television programmes that whales and dolphins often come up to the water surface. They even release a fountain of water sometimes while moving upwards. Why do they do so?

## 6.6 Breathing under Water

Can we breathe and survive in water? There are many organisms which live in water. How do they breathe under water?

You have studied in Class VI that gills in fish help them to use oxygen dissolved in water. Gills are projections of the skin. You may wonder how gills help in breathing. Gills are well supplied with blood vessels (Fig. 6.10) for exchange of gases.

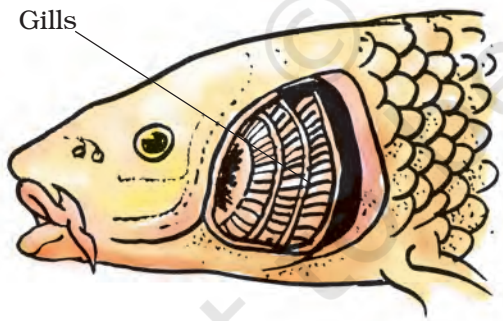



*Fig. 6.10 Breathing organs in fish*

## 6.7 Do Plants also Respire?

Like other living organisms, plants also respire for their survival as you have learnt in Class VI. They also take in oxygen from the air and give out carbon dioxide. In the cells oxygen is used to break down glucose into carbon dioxide and water as in other organisms. In plants each part can independently take in oxygen from the air and give out carbon dioxide. You have already learnt in Chapter 1 that the leaves of the plants have tiny pores called stomata for exchange of oxygen and carbon dioxide.

Paheli wants to know whether roots, which are underground also take in oxygen? If so, how?

Like all other living cells of the plants, the root cells also need oxygen to generate energy. Roots take up air from the air spaces present between the soil particles (Fig. 6.11).

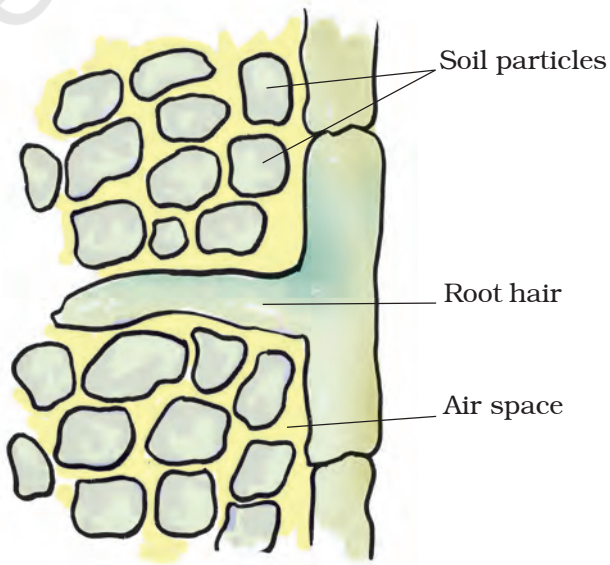



*Fig. 6.11 Roots absorb air from the soil*