11 RESPIRATION IN ORGANISMS

We know that people may survive without food for several days. They go on a fast or hunger strike but during time that they drink some water or other liquids a least once a day. But what about air? Don't we feel suffocated if we don't get air even for a short while!

The process by which air goes in and out of our body is called breathing. In this lesson we will study about what happens when we as well as other organisms breathe? How does this process help in respiration?

Let us do - 1: Respiration in Human Beings

Let's first find out how long a person can hold her/his breath. Use a watch with a seconds' needle to time your breathing. If you don't have a watch, then practice counting at a uniform rate. You can measure the time by counting. Close your mouth and close your nose with your fingers so that air cannot pass through it.

Fig.1

- How long could you keep your mouth and nose closed?
- What did you feel after keeping your mouth and nose closed for so long?

Let us do-2: How many Breaths in a Minute?

Hold a finger under the nose of one of your friends. The side with the fingernail should face the nostrils. Ask your friend to breathe in and out normally.

Fig. 2

- What did you feel on your finger when your friend exhaled?
- Use this method to find out how many times your friend inhales and exhales in a minute.
- Did your friend inhale as many times as (s)he exhaled in a minute?

The process of breathing in air is called inspiration and that of breathing out air is called expiration. The number of times we breathe in and breathe out air in a minute is called the respiration rate.

Exercise and breathing:

You may have seen that we begin to pant after running or exercising. So do exercise and running affect the rate at which we breathe in and out?

- In your opinion does the expiration rate increase or decrease after exercising?

The air we breathe in fills our lungs that are located in our chest. In the following experiment we shall see what happens to our chest when we inhale or exhale air.

Let us do - 3: Expansion of chest with each breath

Take a length of twine or a measuring tape. Wrap the tape around the chest of one of your friends and measure the width of her/his chest. Hold the tape lightly and ask your friend to breathe in and out deeply a few seconds.

Fig. 3

- Do you find any difference between measurements?
- How does the width of the chest change when air is inspired or exhaled?

Let us do - 4: How much air in your breath?

Make a measuring cylinder with a two-litre plastic bottle and 100 ml injection bottle. To do this, pour 100 ml of water at a time in the bottle and mark the water level after each addition.

Now fill the bottle to the brim and invert it in a bucket or a large container of water. But remember, no air bubbles should remain in the bottle after you invert it. Insert one end of a rubber tube into the mouth of the bottle under water. Hold the other end of the tube in your hand. Inhale as much air as you can and blow the air into the measuring cylinder through the rubber tube. Don't breathe in while blowing the air out. Blow out as much air as you can in a single breath. This air will collect in the measuring cylinder. As a result, the water level in the cylinder will fall. The reduction in water level is equal to the air you breath.

Fig. 4

- How much air were you able to exhale in a single breath?
- Find the amount of air the others in your group breathe out in a single breath and compare these amounts.
- Was the amount of air the same for all your friends?

Let us do - 5: Difference between inhaled and exhaled air

Exhale air from your nose on the back of your index finger.

- Is this air warm?

Now use a syringe to pump some air on your finger.

- Is the air from the syringe also warm?

Let us day - 6: Moisture in our breath

On cold winter mornings you may have noticed that the air you breathe out is misty.

- Why does this happen?
- We shall do an experiment to find out.

Take a mirror. Wipe it clean with a cloth. Blow air from your mouth on the surface of the mirror.

- Look at the surface of the mirror carefully. What did you see?
- Clean the mirror again and blow air on it with a syringe.
- Did you see the same effect on the mirror this time?
- On the basis of this experiment would it be correct to say that exhaled air is more moist than air from a syringe?

Discovery of Carbon dioxide

The first step towards trying to find out what air contained was carried out by Von Helmont. He conducted an experiment of burning charcoal which leads to the formation of ash. He found the weight of ash to be much less as compared to charcoal. On the basis of this, he concluded that the decrease in mass was due to formation of an invisible substance which he named "gas".

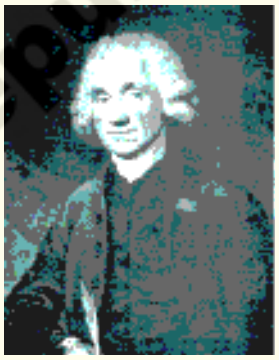
Von Helmont

Joseph Black

In the year 1756, Joseph Black studied this gas in more detail. He found that when limestone is heated or reacted with acids, it gives rise to a gas which he called "fixed air". He studied several properties of this gas. One of the properties was, lime water turned milky when this gas was passed through it. Now we know this gas as carbon dioxide.

Discovery of Oxygen

After nearly two decades of discovery of carbon dioxide, oxygen was discovered. Joseph Priestley, published his "Experiments and observations on different kinds of air" and was the first to prove the different qualities of the gases released by plants and the one's exhaled by animals (mice). He discovered that, although a candle burned out in a closed container, when he added a living sprig of mint to the container, the candle would continue to burn.



Joseph Priestley

Lavoiser

At the time, Priestley did not know of Oxygen, but he correctly concluded that the mint sprig "restored" the air that the burning candle (or mice which he used in a similar set of experiments) had spoiled.

Priestley shared his observations with Lavoiser. Lavoiser had also conducted several experiments on atmospheric air and knew that it contained many gases, and he identified Priestley's discovery as the active component of air for which he had been searching. He called it oxygen (Greek: acid former), in the belief that all acids contained it.

- Why did we use a syringe in Experiments 5 and 6?

You must have understood from these experiments that there are differences between the air we breathe out and the air from a syringe.

What does our breath contain?

We know that we inhale and exhale air. The exhaled air is warm and has moisture in it. What we do not know is about the gases our body takes from the inhaled air and throws out in exhaled air. For this we would have to know about the gases present in air. Also, how we came to know about them.

We know that air is a mixture of several gases not only Oxygen and Carbon dioxide, there are others as well. Air also contains several suspended particles.

Let's do some experiments to find more about gases present in inhaled and exhaled air. For this we shall refer to the discoveries of the gases mentioned in the previous section.

We would have to prepare some solutions to test the gases. These are phenolphthalein indicator solution and lime water. Prepare them in the same manner as you had done in the chapter on acids and bases.

Let us do - 7: Gases in our breath

Set up the apparatus shown in Figure 5 for this experiment. Be careful while inserting the glass tube in the cork. It could break. So take the help of your teacher to do this.

Fig. 5

Fill both boiling tubes one fourth with phenolphthalein solution. Mark them A and B.

Now repeatedly blow in and suck out air in this apparatus as shown in Figure 6.

Find the answers to the following questions while doing the experiment:

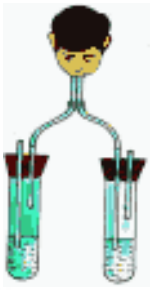


Fig. 6

- When you suck in air, through which boiling tube does the air flow into the apparatus? How can you find out?
- When you blow air out, through which boiling tube does the air flow out of the apparatus? Can you say why the air does not go out through the other boiling tube as well?
- In which boiling tube did the colour of the indicator solution change?
- Are the inspired air and expired air similar? If they are not, what are the differences between them?

Wash and clean the two boiling tubes and fill both of them with one fourth lime water.

Repeat the experiment of repeatedly blowing in and sucking out air.

Answer the following questions on the basis of this experiment:

- What was the colour of lime water in boiling tubes A and B before you began the experiment?
- In which boiling tube did the lime water turn milky after you blew in and sucked out air?
- What difference between inspired and expired air did you find out in this experiment?

You have studied the test of carbon dioxide

with lime water in the section of "discovery of carbon dioxide"

- On the basis of what you learned can you say which gas is present in exhaled air?
- Can you explain how and from where this gas came into the exhaled air?

S.No.	Gases	Inhaled Air (ml.)	Exhaled Air (ml.)
1	Oxygen	210	165
2	Carbon Dioxide	0.4	40
3	Nitrogen and Other Gases	790	795
4			
5			
6			
7			

The air we breathe in does not contain only oxygen. It is a mixture of many gases. Similarly, the air we breathe out is not only carbon dioxide, but a mixture of several gases. The quantity of gases in every 1,000 ml of inspired and expired air is as follows:

- Try to state the difference between inspired and expired air on the basis of Experiments 5, 6, 7 and the table given above?

This kind of change that we see through the experiments done so far and the table , we come to know of a process that occurs beyond breathing, known as respiration.

Think ...! Think ...!

What happens to air after it reaches our lungs? Try to find out about this from your school library or your teacher.

Breathing in other Animals:

Let us study some organisms and find out how they breathe.

Fish:

Observe fishes in an aquarium. Fishes continuously open and close their mouth in water. Why do the flaps on both sides of the head alternately open and close?

Fig. 7

If you look below the flaps, you will see red colored gills. These are the respiratory organs of the fish. The water that enters the mouth flows through both the gills as it comes out of the flaps. The gills absorb the oxygen that is dissolved in the water. This oxygen is carried to different parts of the body.

Frog:

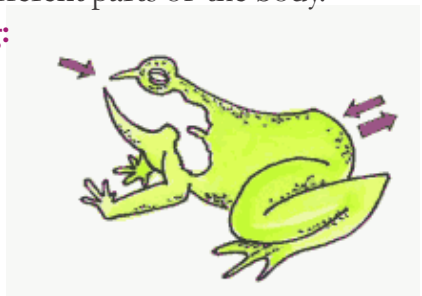


Fig. 8

In class 6 we have studied that frog is able to stay on land, in water and even underground.

How does it manage to do so? To breathe on land it has lungs while it goes deep underground and sleeps twice every year, its moist skin takes over the function of its lungs. In baby frogs or tadpoles there are special organs like that of fishes called gills. These gills help them to breathe in water by taking in the air dissolved in water.

Fig. 9

Tadpoles of the frog live only in water but the frog lives either on land or in water. Sometimes you may see frogs under the soil also.

Think! How does the frog respire under the soil?

Cockroach

A cockroach has small openings on the sides of its body. Other insects have similar openings. On the underside of the cockroach in each segment, there are small holes which are connected through respiratory tubes in a network. These help the cockroach to breathe. These holes are called spiracles. The network of respiratory tubes called trachea take air from these spiracles, circulate it throughout the body, collect it back and send it out through these spiracles.

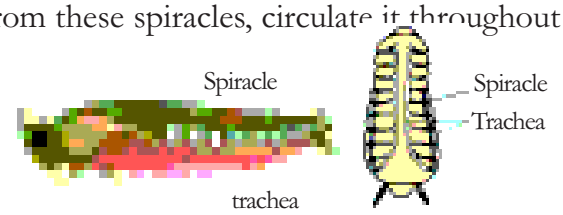


Fig. 10

To know more about this process you may observe a live cockroach by keeping it covered by a transparent bottle or glass. See the movements that occur in its body. What do you observe? Write your observation in a few lines.

Earthworm

Earthworms breathe through their skin. It is thin and moist with minute holes. Through the skin, air passes in and out. The earthworm thus breathes through its whole body surface. Name some other animals that breathe through their skin.

Fig. 11

Respiration in plants

Do plants respire in the way humans do? In human beings gaseous exchange with the surroundings takes place through nose and mouth. We have studied in class 6 about the parts in plants that help in gaseous exchange. They are stomata present on surface of leaves and lenticels present on the surface of stems.

Let's do an experiment to find out

Take a conical flask. Fit a two-holed rubber cork tightly into its mouth and insert glass tubes into the two holes. Fit a rubber tube on one of the glass tubes and a funnel on the other. If the funnel does not sit tightly on the glass tube, make a funnel with an ink dropper.

Fill a test tube about one fourth with lime water and dip the rubber tube into it.

Now add water to the funnel drop by drop. Keep adding water till the conical flask is filled one fourth with water. Observe the test tube carefully while you add water.

- Did the lime water change colour?

Now remove the water from the conical flask and put some flowers and buds in it. Fit a cork on the flask and let it stand for half an hour.

Now add water drop by drop to the conical flask through the funnel as you did in the previous experiment. Look carefully at the test tube while doing so.

- Did the lime water change colour this time?

After completion of your experiment try to draw a figure of your apparatus arrangement in your note book.

You can do the above experiment by taking a small rooted plant with moist soil at its root instead of flowers and buds. But you would have to keep the set up in a dark place.

Do you Know?

In day time plants respire as well as photosynthesize. At night only part of the process of photosynthesis takes place and carbon dioxide is not used up completely by this process. So at night it can be tested by the above experiment.

Let us do - 8: Respiration in Sprouted seeds

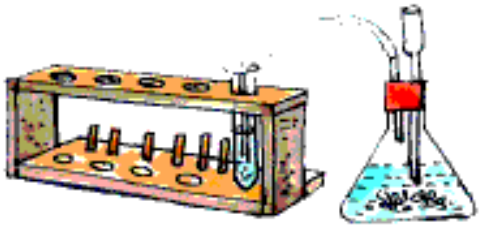


Fig. 12

Repeat Experiment 8, using sprouted seeds (moong, gram etc) instead of flowers and buds.

- What effect did the experiment with sprouted seeds have on the lime water?
- On the basis of your observations in these experiments can you say that flowers, buds and sprouted seeds respire? Give reasons for your answer.

Plants respire like us. But it is difficult to observe this through experiments. Both plants and animals use oxygen during respiration.

You may have heard of big hospitals keeping cylinders filled with oxygen. When a person has breathing problems he is given oxygen. An oxygen mask is fitted to the nose and mouth of the person and a rubber tube connects the mask to the oxygen cylinder. Sometimes a patient is given oxygen during an operation.

Key words

Spiracle, Gills, Carbon dioxide, Oxygen, Inhale, Exhale, Inspiration, Expiration, Trachea

What we have learnt

- Respiration occurs in all organisms. In this process, oxygen is taken in while carbon dioxide and water vapour are released.
- Skin, Gills, tracheae and lungs are respiratory organs.
- Stomata and lenticels helps in exchange of gases in plants.

Improve your learning

1. Fill in the blanks and give reasons.

(i)..... are the respiratory organs of fish.

(ii) In a cockroach, a network of …….. is found.

(iii) …….. are found on leaves for the exchange of gases.

2. Select correct answer and give reasons.

(i) The process which involves the exchange of gases is called ( )
a). Respiration b). Circulation c). Digestion d). Breathing

(ii) During inspiration air passes into lungs due to ( )
a. Increased volume of thoracic cavity
b. Fall in pressure inside the lungs
c. Increase in the volume of thoracic cavity and fall in lung pressure.
d. Muscular expansion of lungs

(iii) Roots respire through ( )
a). Spiracles b). Lenticels c). Stomata d). Air spaces

(vi) Which of the following animals breathe through their skin and lungs? ( )
a). Fish b). Frog c). Snake d). Earthworm

(v) What happens to lime water, when we exhale air into it? ( )
a). Remains same b). Turns blue c). Turns milky d). Becoms colourless

(vi) Plants respire through ( )
a). Cells b). Stomata c). Gills d). Cell membrane

(vii) The respiratory organs in cockroach are ( )
a. Lungs b. Gills c. Lenticels d. Spiracles

3. What is respiration? How is it different from breathing?

4. Frogs breathe through their skin as well as their lungs. Explain.

5. If you want to know about 'Actions of gases in lungs'. What questions you would like to ask?

6. If you did this experiment of respiration with fruits ard dry leaves, what would the result be? Explain.

7. It is very interesting to watch fishes in an acquarium. Make your own bottle acquarium.

8. Do you find any relation between plants and animals by their respiration and photosynthesis?

9. Asif wondered how plants and animals which live under water also respire. Do you know how?

10. Imagine the lungs and size of elephant. Is there any relation between body size and lung size? Collect information from School Library or Internet.