MODULE 3

Joseph Priestley’s experiment

Overview

In this module an historic experiment, which helped to show that plants produce oxygen, is discussed. Historical experiments show how science developed over time and children can learn how science influences people’s understanding of the world.

Aims

To understand how it was discovered that plants produced oxygen.
To understand how oxygen is necessary for animals and humans.

Teaching sequence

1. Review what children have learnt so far. Discuss why, if we breathe in air rich in oxygen and exhale air rich in carbon dioxide, why the air that surrounds us is not full of CO\textsubscript{2} (which would be fatal to humans)? Consider too why there is still oxygen in the air.
2. Give children a brief biography of Joseph Priestley’s life and explain that in Priestley’s time people had no understanding of oxygen and carbon dioxide as gases.
3. Divide the children into groups and distribute the sheets E6, E7 and E8. Read the first part of the letter from Priestley to his friend Benjamin Franklin, which explains the experiment. You could use jars, plants and the two toy mice to visualise it.
4. In groups, children should label the experiment and predict what will happen to the two mice, explaining their reasons. If they have different opinions, they should discuss their ideas and agree on a prediction. It is important that the children always justify their statements. Each group then presents its prediction.
5. As a class discuss the predictions.
6. Read the second part of Priestley’s letter and ask what he could have meant by ‘used up air’? What did he mean by ‘Plants give the air freshness back’?
7. Show the children a photograph of stomata in Media Gallery Experiments about plant growth M3 Stomata and tell them that carbon dioxide is absorbed through the stomata and oxygen is released.
9. Discuss how Priestley planned his experiment to prove that ‘plants give used up air its freshness back’? He made two almost identical experiments and compared the results; the only difference was the plant. (Refer to Module 1 for characteristics of a good experiment; only one parameter was changed.) In this way he proved that the plant was responsible for improving the quality of the air. Each of the experiments in Modules 1 and 2 changed only one variable; in Module 1, the air in the jars was fresh or exhaled.
10. Children summarise two things which they found out today

SKILLS

Argumentation

KEYWORDS

Plants
Oxygen
Carbon dioxide
Stomata
Carbon dioxide and oxygen cycles

CROSS CURRICULAR ACTIVITY

Literacy

MATERIAL

2 big jars with cap
2 models of mice
1 small plant that fits into the jar
Photos of stomata (see Media Gallery)
Photocopies of sheets E6, E7, E8
Teachers’ notes

See Module 1 for characteristics of a good experiment for reference.
Consider the sensitivity some children may have to the use of animals in scientific experiments.

Plants take carbon dioxide in through small openings on the leaf surface called stomata. Stomata are mostly found on the lower side of the leaf. Through the process of photosynthesis, the carbon dioxide reacts with water (which comes into the plant via the roots) and is transformed into sugars (stored as starch) and oxygen. The oxygen is a by product of the process and is released into the atmosphere through the stomata. It is now understood that Priestley’s experiment showed that plants take in carbon dioxide from exhaled air and release oxygen. Thus, the mouse was able to survive for a short amount of time in a container with a plant.

A brief biography of Joseph Priestley

Joseph Priestley was a preacher who was born in 1733 in Yorkshire, England. His enthusiasm for natural sciences began when he was 5 years old and he was well known for his work on gases. He lived next to a brewery, where he became interested in the role of gas in alcohol fermentation. He researched the properties of this gas (which is now known as carbon dioxide), and by adding it to water invented soda water. In addition, he also discovered a gas which would be named three years later, by the French scientist Lavoisier, as oxygen. Priestley also discovered that animals and humans ‘consume air’ and that plants’ can give the air back its freshness’. How this process – photosynthesis – works, was only discovered in 1862, almost 100 years after Priestley’s discovery.

Joseph Priestley’s letter to his friend Benjamin Franklin (1 July 1772)

Dear Mr. Franklin,

I am fully convinced that the air, which is made harmful by our breathing out, can be restored through plants. I have gathered up used air in a container and sealed this container hermetically. Seven days later, I placed a mouse into this container. In another container with the same used up air, I placed a plant. Seven days later I placed a mouse in the same container where the plant was.

Stop reading. Only read further when the children have come up with a prediction about what will happen to the mice!

Start again:

The mouse which was in the container without a plant died after 5 seconds. The mouse placed in the container with a plant, lived happily in the container for many minutes. Then I took the mouse out and placed it in the other container without any plants in. This poor mouse, which did so well in the container with the plant in, had to be taken out and resuscitated after spending as little as two seconds in the container without plants. This experiment shows us that plants can give the air its freshness back.

Extension activity

Write a letter that Benjamin Franklin could have written to Joseph Priestley.
Joseph Priestley’s experiment

Label Priestley’s experiment

What do you think happened to the mouse in experiment 1?

Why do you think that happened?

What do you think happened to the mouse in experiment 2?

Why do you think that happened?
Joseph Priestley’s experiment

Now that you have listened to what Priestly wrote to his friend, what do you think Priestley mean by ‘used up air’ and ‘plants give the air its freshness back’?

1 ‘Used up air’ means:

2 ‘Plants give the air’ its freshness back means:

Thinks about what plants give us. What do we produce that is used by plants and is necessary for photosynthesis? Complete the circle.

What are the small openings in the underside of a leaf called?

Today I learned
London, 1. July 1772

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I have gathered used up air in a container and sealed this container hermetically. Seven days later, I placed a mouse into this container. In another container with the same used up air, I placed a plant. Seven days later I placed a mouse in the same container where the plant was.

The mouse which was in the container without a plant died after 5 seconds. The mouse placed in the container with a plant, lived happily in the container for many minutes. Then I took the mouse out and placed it in the other container without any plants in. This poor mouse, which did so well in the container with the plant in, had to be taken out and resuscitated after spending as little as two seconds in the container without plants. This experiment shows us that plants can give the air its freshness back.

Kind regards

Joseph Priestley