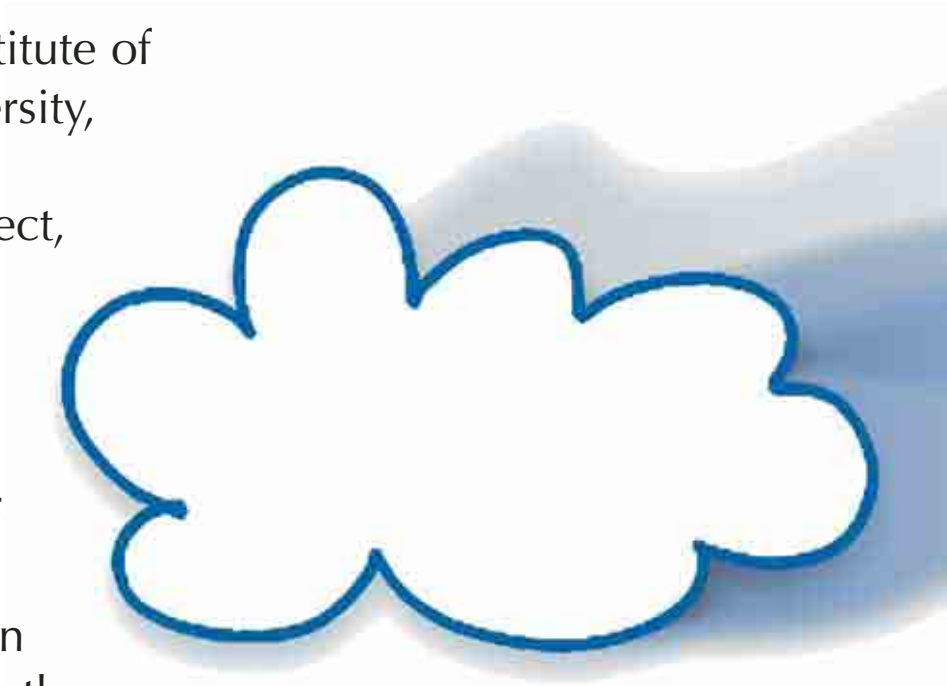
Planting ideas: climate-change activities for primary school

Sue Johnson from the Institute of Education, London University, UK, introduces the Plant Scientists Investigate project, and presents three plant-related activities for primary-school children. Compare the carbon dioxide concentrations of inhaled and exhaled air, visualise your own oxygen consumption or weigh up the importance of plant conservation versus economic development.



Plant Scientists Investigate: at school and in the botanic garden

The Plant Scientists Investigate project promoted collaboration between botanic gardens and local primary schools between 2005 and 2007. From Austria, Bulgaria, Italy and the UK, primary-school teachers, head teachers, representatives of national school boards (county advisors in the UK) as well as botanic garden educators have worked together to develop an enquiry-centred teaching resource.

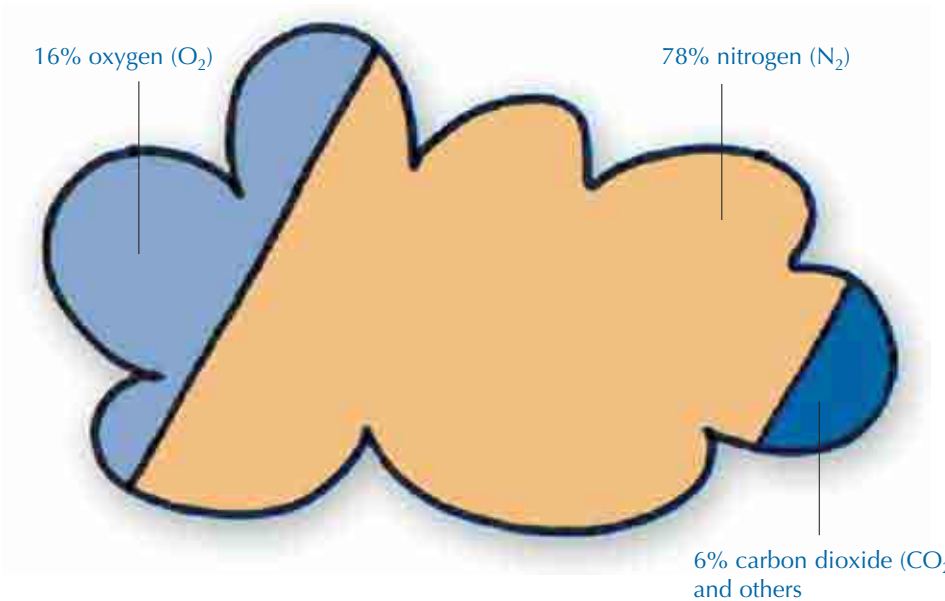
Key features of the teaching materials are that they engage children in working like scientists, encourage them to use reasoning skills and scientific thinking, maximise group discussion, and generate their own questions and ideas. By making observations and creating experiments or models, pupils derived a deeper understanding of plants and were able to explain their ideas and make more effective arguments when presenting their work.

The Plant Scientists Investigate website[w1] is divided into four topics: conservation, art, food, and experiments about plant growth. Ready-to-use teaching materials on these topics have been designed to overcome gaps in knowledge of teachers surveyed at the outset of the project. Each activity can be taught independently or in combination, and the content is easily adapted to a wide range of ages. All materials can be downloaded from the website.

Carbon dioxide in exhaled air

Overview

Children should already know that the air they exhale contains less oxy-



Constituents of exhaled air

gen than fresh air does. With this experiment, they can test if there is more carbon dioxide in exhaled air than inhaled air using a colour-change indicator.

Aim

To understand that the air people exhale contains more carbon dioxide (and less oxygen) than the air they inhale.

Timing

1 h 20 min

Materials per group

- 2 glass containers
- 2 straws
- 1 bike pump
- Tube with dissolved potash lye (10% KOH)
- Tube with colour indicator (phenolphthalein solution)
- Pipette
- Photocopies of Activity Sheets 1 and 2 (see pages 58, 59)
- Film on the Plant Scientists Investigate website[w2] (optional)

Skills

- Precise working with a pipette and chemicals
- Observing

Keywords

- Exhaled air
- Carbon dioxide
- Oxygen
- Inhaled air

Cross-curricular links

Mathematics

Teaching sequence

1. Divide the children into groups and distribute Activity Sheet 1. To review the composition of air, children should colour in the different components of fresh air on the activity sheet (see teachers' notes on page 57). Exhaled air is missing 5% of the oxygen that makes up inhaled air. Ask children to consider what may replace this missing oxygen. Ask them to consider how they could test their ideas. Scientists can use highly specialised machines in a laboratory to test, but we can still investigate air using basic equipment.
2. Tell the children that the next experiment can test whether there is more carbon dioxide in exhaled air. A colour-change indicator will show if the carbon dioxide concentration in the liquid is increasing.
3. Distribute the necessary materials (except for the chemicals and air pumps).
4. If this is the first time that children have used a pipette, show them how to use it properly by practising pipetting water and releasing it drop by drop.
5. Go through appropriate health and safety measures with the children. As they will be working with chemicals, it is very important for them to work carefully and precisely. If there is some liquid left in the pipette, it should be dripped back into the small jar (tubes). Only then should the tubes with chemicals be distributed.
6. Ask the children to follow the instructions on the activity sheet

on how to use the colour-change indicator.

7. Before carrying out the experiment, the children should discuss what they want to find out, i.e. to investigate if the carbon dioxide content of exhaled air is different from fresh air. The pink solution (phenolphthalein) changes colour when it comes into contact with carbon dioxide.
8. The children should carry out the first part of the experiment. Discuss what happened and why it happened.
9. Ask the children to think about how to get fresh air into the second jar. Let them work in pairs to come up with ideas and then come together as a class to decide what to do. Distribute Activity Sheet 2 and the air pumps. The children should pump fresh air into the second jar. Note: the colour is not going to change (or should change only slightly).
10. Discuss with the children what the experiment is designed to find out. It can show that there is more carbon dioxide in exhaled air than in fresh air.
11. Complete the drawing with the fresh air.
12. Ask the children to summarise two things which they discovered during the experiment.

The change in colour of the indicator

Image courtesy of PSI

Teachers' notes

A film demonstrating how to run this activity is available on the Plantscafe website in the media gallery[w2].

Fresh air consists of 78% nitrogen, 21% oxygen and 1% of other gases (including carbon dioxide and others). Oxygen is necessary for every burning process, whether burning a candle or burning food at a cellular level.

Health and Safety

Because 10% KOH is corrosive, it should not come into contact with skin or the eyes. Children should use gloves, or this specific part of the activity should be carried out only by the teacher. Regulations on the control of substances hazardous to health (COSHH) will apply. After the experiment, the solutions in the jars can be disposed of down the drain.

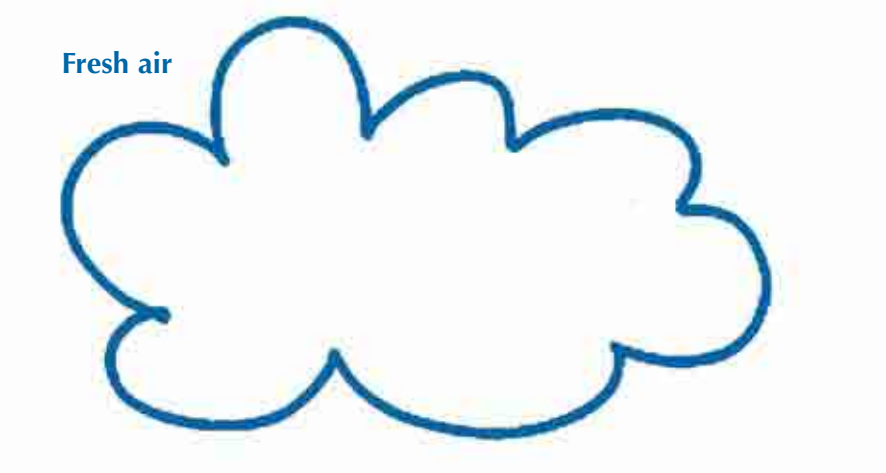
For preparation and experiment methodology, see Activity Sheets 1 and 2.

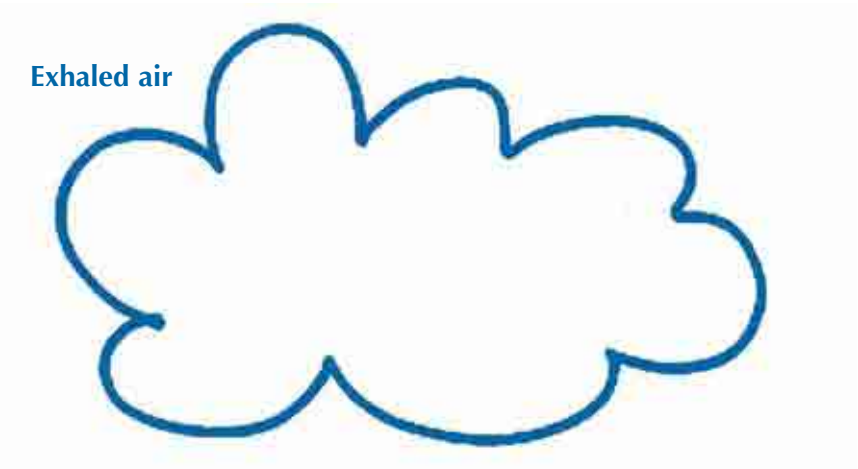
Explanation

KOH produces a slightly alkaline solution, which is coloured pink by an indicator. Exhaled carbon dioxide produces carbonic acid in the water, so the alkaline solution turns acidic (changing the pH value). The pink solution becomes colourless when exhaled air is added to the solution.

Activity sheet 1:
Carbon dioxide in exhaled air

Using different colours, show what makes up the air in these clouds.





Carry out the following experiment:

1. Take two glass containers and fill each with 200 ml water.
2. Add 20 drops of 10% potash lye to both containers.
3. Clean the pipette in the sink or a glass with fresh tap water.
4. Add 20 drops of indicator and stir it with a straw.

What are we trying to investigate with this experiment?

5. One person in the group should breathe through a straw, using strong breaths, into one of the containers.
6. Write down what happens and why.

Activity sheet 2: Carbon dioxide in inhaled air

In order to test if there is more carbon dioxide in the exhaled air than in the fresh air, we need to get fresh air into the second container.

How could you do this? Consider your ideas as a group and then discuss it with the class.

1. Pump fresh air into container 2.
2. Write down what happens and why.

Complete the composition of the exhaled air in Activity Sheet 1.

Today I learned:

Image courtesy of PSI

Children enclosing an area of the school grounds that will produce sufficient oxygen, by way of photosynthesis, for one person for one day

My own oxygen consumption

Overview

This activity will demonstrate to children how much green space is needed to produce enough oxygen for one person for one day.

Aims

- To work out the relationship between our daily oxygen requirements and the quantity of plants necessary to produce this volume of oxygen.
- To understand that all green plants produce oxygen.
- To understand the importance of the rainforests and seaweed for the maintenance of the gas balance in the atmosphere.

Timing

30 min

Material

- String
- Wooden sticks

Keywords

- Plants
- Humans
- Oxygen
- Carbon dioxide
- Rainforests
- Seaweed
- Atmosphere

Cross-curricular links

Mathematics

Teaching sequence

1. Walk with the children to a lawn or other green space outdoors. Ask children if they have any idea how much oxygen we consume every day.
2. Explain that studies have shown that a human needs, on average, 360 litres of oxygen per day.
3. Review what children have learned so far about how plants produce oxygen (what a plant needs for photosynthesis). Emphasise that all green plants produce oxygen.
4. Children should guess how large a piece of lawn needs to be to provide enough oxygen for one human to live for one day. Let the children mark out their estimated area using the string.
5. Explain that an area of grass of about 3 m² provides the daily oxygen needs of one human. Each group should then mark out this area of grass to visualise the area of plants that each one of them needs to produce his or her daily intake of oxygen.
6. How big must the area be so that the whole class or the whole school has enough oxygen?
7. Discuss the following points:
   - Humans and animals live in cities where there is little green space but they still need to breathe. How can this happen?
   - What happens in winter, when many trees shed their leaves?
   - How can we still breathe at night if light is needed to produce oxygen?
   - The rainforests and seaweeds (algae) in the sea produce and release enough oxygen to maintain the gas balance in the atmosphere. Rainforests and seaweeds are the lungs of Earth. What would happen if the rainforests or seaweeds died because of pollution?

A new ski run?

Overview

This activity puts children in a real-life situation where plant conservation and economic development clash. In an alpine setting, children play the part of citizens in a ski resort where new plans for ski slopes threaten an area rich in biodiversity. In this role play, children will develop abilities to discuss complex problems, examine pros and cons, and make decisions – and by doing so accept that one often has to compromise.

Aims

- To resolve complex problems, and help children to accept that compromise is often necessary.
- To understand that extinction is a problem linked with human action, but that humans can also help to conserve and protect threatened species.

Timing

2 h

Skills

- Reasoning
- Problem solving
- Argumentation
- Communication skills

Material

- Role play material (downloadable online[w3])
- Character cards (downloadable online[w3])
- Sticky labels
- Coloured pens
- Photocopy of Activity Sheet 3 (see page 62)
- Paper (A2 size)

Keywords

- Biodiversity
- Impact of human activity
- Land management

Cross-curricular activity

- Personal, social and health education
- Citizenship
- Literacy, specialised language, slogans (genre writing)
- Art

Teaching sequence

A new ski run?

This game is a role play, based around characters in a society: the mayor, hotel managers, botanists, ski-run builder, foresters and wildlife rangers. The plot is about economic development in the countryside; building a new ski slope. The full story, character cards and instructions for running the game can be downloaded from the media gallery on the Plantscafe website[w2].

1. Give each child a card that describes their role at least one day before the activity so that they can begin to empathise with the character. Consider the ability level needed for each role and assign roles accordingly.
2. Each child writes their character name on a sticky label and wears it during the role play.
3. They sit in a semicircle to represent a real open public meeting.
4. The mayor convenes the meeting at which every role player sets out his or her case for or against the construction of a new ski slope. The mayor must guarantee order and must let all representatives speak.
5. Because of the complex issues discussed, the mayor declares a citizens' referendum in which every character has a vote.
6. Before any vote is made, each group has to develop marketing or promotional materials, e.g. posters, to persuade the citizens to vote for their cause. These posters/leaflets should be distributed and the representatives should have time to read them.
7. A secret ballot is taken.
8. The result of the vote is read out by the mayor. In the case of a split decision, the mayor has the deciding vote.
9. The outcome should be discussed by everyone.
10. Children should fill in Activity Sheet 3 to summarise their opinions.

Image courtesy of PSI

The role-play game, with children making posters to support their opinions about the ski-run development

Activity sheet 3:
Will the new ski run be built?

Name: _____

Date: _____

My character is: _____

I am / am not in favour of the new ski run (circle one option)

The final decision about the ski run proposal is:

_____

_____

_____

_____

_____

What in your opinion are the pros and cons of this decision?

_____

_____

_____

_____

_____

_____

_____

_____

Web references

w1 – All teaching materials from Plant Scientists Investigate can be downloaded here: www.plantscafe.net

w2 – The film depicting the 'Carbon dioxide in exhaled air' activity can be downloaded here: www.plantscafe.net/en/experiments/gallery.php?module=enex02

w3 – For the 'A new ski run?' activity, the full story, character cards and instructions for running the game can be downloaded here: www.plantscafe.net/en/conservation/gallery.php?module=enco10

Resources

Other *Science in School* articles related to climate change (mostly for secondary school) include:

Benestad R (2007) What do we know about climate? The evidence for climate change. *Science in School* **7**: 49-51. www.scienceinschool.org/2007/issue7/climate

Benestad R (2008) What do we know about climate? Investigating the effects of anthropogenic global warming. *Science in School* **8**: 48-51. www.scienceinschool.org/2008/issue8/climate

Grigorov I (2006) Bringing global climate change to the classroom. *Science in School* **3**: 56-59. www.scienceinschool.org/2006/issue3/euroceans

Sedwick C (2008) What killed the woolly mammoth? *Science in School* **9**: 18-21. www.scienceinschool.org/2008/issue9/woollymammoth

Shallcross D, Harrison T (2008) Climate change modelling in the classroom. *Science in School* **9**: 28-33. www.scienceinschool.org/2008/issue9/climate

Shallcross D, Harrison T (2008) Practical demonstrations to augment climate change lessons. *Science in School* **10**: 46-50. www.scienceinschool.org/2008/issue10/climate

For a full list of *Science in School* articles about climate change, see: www.scienceinschool.org/climatechange

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Image courtesy of PSI

Field work to increase children's knowledge and enthusiasm for conserving plants – plants that might otherwise be destroyed by human activity, such as the ski-run development