Science@School | Book 3B

Helping plants grow well

Teacher's Guide

Support material for the pupil book
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Teacher's sheet: comprehension

See **pages 4 and 5** of *Helping plants grow well*

Answers

1. **A = flower, B = leaf, C = stem, D = root.**
2. **Air, sunlight.**
3. **The leaf.**
4. **New plants.**
5. **It goes into the root and into the stem.**

Complementary work

(a) Let the children examine a range of houseplants and draw their leaves. They should put the name of each plant next to its leaf. The pictures can then be used by others to identify the plants.

(b) You may wish to construct a simple leaf key to identify four plants from the pictures drawn in (a).

Teaching notes

The children should have covered some work on plants earlier in their school career. In this unit it will be useful to review this work to find out what knowledge has been retained.

Plants have the same characteristics of life as animals, but some of them are expressed differently. The seven characteristics of life are feeding, moving, growing, reproducing, respiring (using oxygen to release energy from food), excreting and sensing the surroundings. Plants differ from animals in that they make their own food, they move as they grow and may excrete wastes into their leaves, which are lost when the leaf dies. While plants are sensitive to changes around them, they respond much more slowly than animals. The process of respiration also occurs in plants, but the oxygen is taken in through holes in the leaves and through the surface of the roots.

There are two main methods of reproduction in the Plant Kingdom. Plants can reproduce using seeds, as in flowering plants and conifers, or they can reproduce by spores, as in ferns and mosses. Spores are much smaller than seeds and contain a small part of living plant tissue which grows into a new plant when the spore lands in favourable conditions. A seed contains an embryonic plant and a food store.

Teacher's sheet: activity

Based on **pages 4 and 5** of *Helping plants grow well*

Introducing the activity

(a) Ask the children about the purpose of the leaves. When they reply that the leaves make food, ask them how they could test the effect of leaves on a plant, and look for an answer about removing the leaves and seeing how the plant grows.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it (see note (iv)).

(f) Go through task 5, then let the children try it (see note (v)).

(g) Go through task 6, then let the children make regular observations and measurements over the next few weeks.

Completing the activity

(h) Let the children look at their table of results, then perform tasks 7 and 8.

(i) Let the children compare their results.

(j) You may use the children's data in an ICT exercise and make a display for the classroom wall.

Conclusion

When a plant has its leaves removed, it grows less well than a plant that has kept all its leaves.

Teaching notes

(i) Children often have difficulty in making comparisons and sometimes struggle with the concepts of similar and different. In this activity, the children begin by looking at similarities and end by looking at differences. Some children may need help when making both kinds of comparisons.

(ii) The children should simply nip off the leaves without tearing the stem or, if appropriate to their ability, they could use scissors.

(iii) The children may need some prompting to think about the height of the plant or how leaves may grow.

(iv) The test is made fair by keeping the two plants in the same conditions and giving them the same amount of water.

(v) The table should have a column for the date and a column for the feature being observed. If height is being observed make sure the measurement (mm) appears in the column heading.

2 Teacher's sheet: comprehension

See **pages 6 and 7** of *Helping plants grow well*

Answers

1. **(i) Plant 2 has not got enough water; (ii) Wilting; (iii) The plant should be watered.**
2. **Sap.**
3. **The leaf.**
4. **Cactus.**
5. **Rice.**
6. **(i) It is a soil full of water; (ii) There is no air in the soil for the plants to use.**

Complementary work

(a) The children could grow some water plants. Each group could be given three different plants from an aquarist shop and allowed to set up each one in a separate plastic jar or bottle. The floor of the container should be covered in gravel, and the plant roots may need to be pushed into position with a stick. The plants should be set up in a sunny window and the children could draw pictures of them every few days to illustrate how they grow.

Teaching notes

Huge numbers of plants are killed in the home every year due to over-watering. A soil or compost is made up of lumps which have spaces between them. When the soil is dry, the spaces contain air. The lumps contain a substance called humus which is made from the decomposition of dead plants and, to a much smaller extent, the decomposition of dead animals. The humus acts as a sponge and soaks up some of the water as it passes through the soil. The plant roots take in the water from the humus. They do not need all the spaces to be full of water in order to draw in the water they need.

Plants draw in water through their roots without using energy. This works because there are more dissolved substances in the plant's sap than in the soil water. This difference in the concentration of dissolved substances, and the way they are separated from each other by the skin of the root, causes water to flow into the plant root naturally by a process called osmosis. The children do not need to know this.

The soil water contains minerals, or nourishment, much smaller amounts of minerals and nutrients than are in the plant sap. This means that the plant has to use energy to draw in more minerals. The root takes in oxygen from the air in the soil. Oxygen helps the plant release energy from its food so it can take in the minerals that are needed. When the soil is waterlogged, the roots cannot get the oxygen, the minerals are not taken up and the plant suffers and may eventually die.

Teacher's sheet: activity

Based on **pages 6 and 7** of *Helping plants grow well*

Introducing the activity

(a) Tell the children that many people think they can keep their plants healthy by giving them plenty of water. This idea can be tested by an investigation which the children can try.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form, then let the children try task 1 (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it.

(f) Go through task 5, then let the children try it (see note (iv)).

(g) Go through task 6, then let the children try it (see note (v)).

Completing the activity

(h) Let the children compare their results and their suggestions.

(i) Pool the children's results to produce a table for the class. (This could be an ICT exercise.) Emphasise the need for a large number of results to test an idea, and if a pattern or trend is shown in the class data, make sure that the children are aware of it.

Conclusion

If a bean seedling does not receive water it stops growing and dies. If a bean seedling receives too much water it may also stop growing and die. Bean seedlings only need a certain amount of water to grow healthily.

Teaching notes

(i) It is essential that the bean seeds are sowed some time before the lesson and that they are about two centimetres tall when the lesson begins. You may like the children to collect yoghurt pots and sow the seeds themselves.

(ii) You may wish to use other quantities than those described here. The purpose of using specific amounts of water is to provide an investigation which can be extended, for example trying other quantities of water later or using more seedlings.

(iii) Make sure the children always write in the date each time they make their measurements. You may wish to measure in centimetres or millimetres, depending on the ability of the children. Make sure they record the units they are using in the table.

(iv) Some children may need help in interpreting the data shown in the table.

(v) The children may need to be encouraged to make suggestions.

Teacher's sheet: comprehension

See **pages 8 and 9** of *Helping plants grow well*

Answers

1. **(i) The arrows should go up through the root, stalk and into the leaf; (ii) Water-carrying pipes.**
2. **Rotting dead plants.**
3. **Fertiliser.**
4. **Because compost smells.**
5. **It grows slowly and poorly.**
6. **Its flowers will be small and its leaves may be a funny colour.**

Complementary work

(a) You may like to try the experiment with the celery as shown in the pupil book. You could link this activity with the work on wilting in the previous unit. Present the children with a bendy piece of leafy celery from near the celery heart. Ask the children what they think will happen when the celery is put in coloured water. They should answer that it will become less bendy and the pipes in the stalk will become red.

Teaching notes

Although plants make their own food from air, sunlight and water, they also need other substances from the soil. These substances can be called nourishment at this level. Later in their school course the children can learn that this nourishment is due to chemicals that are sometimes called nutrients or minerals.

The major mineral in this nourishment is nitrogen (in the form of nitrates) which helps make substances called proteins that all living things – both plants and animals – need for growth and repair of their bodies. Phosphorus and sulphur are also important in protein formation. Potassium is another mineral that is needed to help the plant form protein, and to help form the green substance in leaves and stems. The chemicals are mentioned here in case you wish to show the children empty packets of fertiliser which may list some of these minerals.

The leaves of trees, and the shoots of herbaceous plants which die back in winter, are broken down by small animals such as woodlice, fungi such as moulds and microbes called bacteria. These bacteria do not cause disease, and receive the nourishment and energy they need by breaking up the dead remains of plants and animals. There are not as many dead animals in the humus because there are much fewer of them compared to plants. Animal waste, called manure, is also used to make humus.

Teacher's sheet: activity

Based on **pages 8 and 9** of *Helping plants grow well*

Introducing the activity

(a) You may begin by asking the children what happens to autumn leaves when they fall into puddles. Look for an answer that mentions floating and say that when the leaves rot to become nourishment for plants, the nourishment, called humus, floats too.

Ask the children how they could test a soil sample to see if it has any humus, and look for an answer which mentions mixing soil and water then looking for floating humus.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (i)).

(c) Go through tasks 2 and 3, then let the children try them.

(d) Let the children try task 4 and help them identify the humus.

(e) Let the children try task 5 (see note (ii)).

(f) Go through task 6, then let the children try it (see note (iii)).

(g) Go through tasks 7, then let the children try it (see note (iv)).

(h) Let the children try task 8 (see note (v)).

(i) Let the children try task 9 (see note (vi)).

(j) Let the children try task 10 (see note (vii)).

Completing the activity

(k) Let the children compare their results.

(l) If there are dog-free areas around the school, let the children collect soil samples and assess how much nourishment there is for the plants growing in the school grounds.

Conclusion

The amount of nourishment in the soil can be assessed by looking at the amount of humus which floats when the soil is mixed with water.

Different samples of soil may have different amounts of nourishment for plants.

Teaching notes

(i) You should have three kinds of soil ready for this activity, all of them collected from areas which have not been fouled by dogs. The soil for the first sample should contain a moderate amount of humus, which will form a layer over the water perhaps a few millimetres thick. The second sample should have very little humus in it and the third sample should have plenty of observable leaf mould in it to help with the prediction.

(ii) Make sure that this soil has less humus than the first. Also make sure that there is the same amount of soil in the second sample as in the first.

(iii) Some children may need help in making a comparison.

(iv) The children should look at the soil before adding the water.

(v) Some children may need help in supporting their prediction with a reason.

(vi) Make sure the same amount of soil is used as in the other two samples.

(vii) Some children may need help in making the comparison.

Teacher's sheet: comprehension

See **pages 10 and 11** of *Helping plants grow well*

Answers

1. **(i) A; (ii) C; (iii) B.**
2. **Leaves and stems.**
3. **Air, water, nourishment and sunlight.**
4. **To catch the sunlight.**
5. **A fern.**
6. **The leaves turn to face the Sun so they can catch as much light as possible.**

Complementary work

(a) Put a pot plant, such as a geranium or a fuchsia, in a sunny window. Mark the side of the pot facing the window so the pot can always be put back in the correct position if it is removed for watering. Ask the children to look at the stems every few days, and perhaps draw them. They should find that the stems bend towards the light.

(b) Ask the children what they think would happen if the pot plant was turned round. Let the children investigate and discover that the stems then bend in the new direction of the light.

Teaching notes

The green substance in plants is called chlorophyll. The children do not need to know this, but some children may be curious. Light is a form of energy, and the chlorophyll absorbs some of this light energy from the Sun and stores it. This energy is then used to make food. The raw materials for making food are air, water and the minerals from the soil.

The trapped energy is first used to change carbon dioxide in the air, and water from the soil, into sugars and oxygen. The plant releases the oxygen it does not need for this process (respiration) into the air, and the sugar may be converted into starch and stored in the plant. Secondly, the energy is used to join minerals, such as nitrogen, to the sugars to make proteins. Thirdly, energy is used to change some sugars into oils. You may like to simplify this information and use it when the children are studying *3A Food, teeth and eating* in this series.

The process of making food (sugar) from light energy is known as photosynthesis.

The way that carbon dioxide gets into a leaf, and oxygen gets out, is through tiny holes on the underside of leaves. In leaves that stand vertically, the holes are on both sides.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Helping plants grow well*

Introducing the activity

(a) You may like to use this activity after introducing the unit, but before studying the pupil book. Alternatively, you may like to use it after studying the work in the pupil book to extend the experiment that is shown there.

Tell the children that they are going to find out what happens to seedlings when light shines on them from just one direction.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form. Go through task 1, then let the children try it (see note (i)).

(c) Go through task 2, then let the children try it (see note (ii)).

(d) Go through task 3, then let the children try it (see note (iii)).

(e) Go through task 4, then let the children try it.

(f) Go through task 5, then let the children try it (see note (iv)).

(g) Go through task 6, then let the children try it (see note (v)).

(h) Go through task 7, then let the children try it (see note (vi)).

(i) Go through tasks 8 and 9, then let the children try them (see note (vii)).

Completing the activity

(j) Let the children compare their results and the accuracies of their predictions.

(k) Ask the children to draw a conclusion from the activity.

Conclusion

When light only shines from one side onto seedlings, they grow towards the light.

Teaching notes

(i) If the children have the ability, you may like them to bring in a box from home and cut a hole in it. The box should be large enough to hold a small dish or a tin lid. It should be about ten centimetres high and the hole should be about two centimetres square. Alternatively, you could collect the boxes and make the holes in them before the lesson.

(ii) The cotton wool should be damp, but not too soggy or waterlogged.

(iii) About twenty seeds could be spread evenly over the cotton wool.

(iv) The purpose of this task is to let the children see how cress seeds grow so they can draw their shapes accurately in task 6. You should prepare the cress seeds about a week in advance.

(v) In this task, the children illustrate their prediction by making a drawing. You may like to point this out to the children.

(vi) The cotton wool will need checking every day at first, as the rate of drying will depend on the surrounding temperature. Later it may only need checking every two days. The children may like to work out a rota for this work.

(vii) Task 8 is the recording of the result. It is compared with the prediction in task 6.

Teacher's sheet: comprehension

See **pages 12 and 13** of *Helping plants grow well*

Answers

1. **A = spring; B = summer; C = autumn; D = winter.**
2. **It turns to ice and swells.**
3. **They burst apart.**
4. **Autumn (you could also accept winter and spring).**
5. **Put them in a greenhouse.**
6. **Wheat grows in cool parts of the world. Pineapples need warm conditions all year.**

Complementary work

(a) The children could set up two dishes of seeds in damp sand or soil, and put each one in a box. One box could be put in a warm place and the other in a cold place. Predictions about which ones will grow better could be made and compared with the results.

(b) Two trays of seedlings could be set up, one in a cool place and one in a warm place. Both places should have the same amount of illumination. This experiment could be set as a challenge to the children to devise a fair test.

Teaching notes

All the processes of life that take place inside a plant involve chemical changes. The speed at which these changes take place depends on their temperature. This means that if a plant is in warm conditions, the speed of the changes will be faster than if the plant was in a cold place.

As plants contain large amounts of water, if the temperature drops to 0°C the water inside the plant can freeze, expand and kill it. Plants have various strategies to avoid this. Trees and bushes have bark to insulate their stems and branches. Herbaceous plants have shoots which simply die at the end of the growing season, and the plant remains alive as a bulb or tuber in the ground where it is insulated from the cold. Seeds survive very cold conditions because they have an insulating seed coat, and also because they contain very little water. This both keeps down their weight when they are being dispersed, and keeps moulds away while they rest in the soil waiting for warm conditions to develop.

The heat builds up in a greenhouse in the following way. Some of the energy released from the Sun is in the form of heat waves, or rays. These have enough energy to pass through glass. When rays of heat strike surfaces inside the greenhouse, they lose some of their energy, and when they are reflected they have less power. This means they do not have the power to pass out through the glass again and so remain in the air and warm it up.

Teacher's sheet: activity

Based on **pages 12 and 13** of *Helping plants grow well*

Introducing the work

(a) The sheet for this activity is designed so that you may use it in different ways (see note (i)). Use the activity after studying the work in the pupil book and show the children some seeds. Ask the children how they could make a model greenhouse to see if its warmth affected the way the seeds sprouted and the seedlings grew.

Using the sheet

(b) Give out the sheet, let the children fill in their names and form. Go through tasks 1 and 2, then let the children try them (see note (ii)).

(c) Go through task 3, then let the children try it (see note (iii)).

(d) Let the children try task 4 (see note (iv).

(e) Go through task 5, then let the children try it.

Completing the activity

(f) Ask the children to compare their predictions with their results.

(g) Let the children compare their work (see note (v)).

Conclusion

The seeds in pot B sprout earlier than those in pot A. The seedlings in pot B grow faster than those in pot A. The length of the seedlings in pot B is greater than the length of the seedlings in pot A.

Teaching notes

(i) The first three tasks set out the structure of the investigation, which may help the weaker pupils and will help more able ones to set out their work in an orderly way. Task 4 may simply be to carry out the plan as outlined in the answers to task 2, or it may be extended to allow the children to construct tables and record observations, or even to measure the lengths of the seedlings and compare their growth quantitatively. If this is done, the data may be used in an ICT exercise.

(ii) The answers to the questions should be: (i) In the soil in both pots; (ii) Five or ten seeds, depending on the size of the seeds; (iii) In a sunny window; (iv) Check daily that the soil has not dried out and water, if necessary, to keep it damp; (v) Every day.

(iii) An example may be: The seeds in pot A will sprout later and the seedlings grow well. The seeds in pot B will sprout earlier and the seedlings grow larger.

(iv) The complexity of the investigation may depend upon the ability of the children as outlined in note (i).

(v) If the children have made tables of data these could be displayed.

6 Teacher's sheet: comprehension

See **pages 14 and 15** of *Helping plants grow well*

Answers

1. **(i) A has more leaves; (ii) A has a shorter stem; (iii) A has more roots.**
2. **B.**
3. **So it can make food.**
4. **(i) Pot bound; (ii) Re-pot it.**
5. **To keep the trees small.**
6. **(i) So the trunks will grow tall, straight and with few branches; (ii) They would have shorter trunks with more branches and larger leaves.**

Complementary work

(a) The pea seedlings from the activity in this unit could be planted in small pots. When they become pot bound, one could be re-potted and its growth compared with the growth of the plant that remained in the small pot.

(b) The children could examine a selection of houseplants (perhaps those already growing in places in school, such as near the entrance) to see if they are pot bound. Any pot bound plants could then be re-potted in larger pots.

Teaching notes

Most children are familiar with the spinning winged fruits of the sycamore. At the end of the wing is a single seed. The purpose of the wing is to disperse the seed and move it away from others of its kind. Most plants have modified fruits to help them disperse their seeds. Even oaks, which drop acorns around their roots, rely on squirrels and jays to carry some seeds away. These animals bury the seeds to eat throughout the winter, but then forget about some of the stored seeds. These seeds can then produce seedlings without overcrowding.

Different kinds of plants can live in the same place because they do not compete directly for light, water and nutrients. In a woodland, the plants grow roots at different levels in the soil, so they take water and nutrients from different places. The shoots grow to different heights so the leaves do not overlap. Even where one plant shades another, the plant in the shade may be adapted to cope with less light.

Problems of overcrowding occur when seeds are sown by humans. This is why there are instructions on seed packets to prevent seeds being planted too close together. On farms, seeds are planted by seed drills which automatically release a certain number of seeds as the drill is moved across the field. This allows the crop plants plenty of space to get all the light, water and nourishment that they need before harvesting.

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *Helping plants grow well*

Introducing the activity

(a) Tell the children that the growth of a plant shoot is easy to see, but the growth of a root is more difficult because it is hidden in the ground. One way to watch a root grow is to grow a seed against a transparent wall. Tell the children that they are going to watch carefully how the root of a plant grows during the first weeks of a plant's life.

Using the sheet

(b) Give the children the sheet, let them write their names and form on it, then go through task 1 and let the children examine the jar (see note (i)).

(c) Let the children carry out task 2 (see note (ii)).

(d) Go through task 3 with the children, then let them try it (see note (iii)).

(e) Let the children try task 4 (see note (iv)).

Completing the activity

(f) Let the children compare their results.

Conclusion

The root of a seedling can be investigated by growing the seedling against a transparent wall. By observing the root at regular intervals over two weeks the pattern of its growth can be worked out. Different pea seedlings produce the same growth pattern.

Teaching notes

(i) The jar could be glass or plastic. The pea seeds should be soaked for a day before use. It is tricky to get them into place so you may like to set them up before the lesson. The blotting paper should be placed in the jar so that it presses against the jar's side. Water can be carefully poured into the bottom of the jar and this will spread through the blotting paper and moisten it. The peas may then be carefully slipped between the paper and jar until they are about half-way down the jar. You may put four seeds in a jar so that they can be examined by different children at the same time. Add a small amount of water to the bottom of the jar over the two weeks to keep the blotting paper moist.

(ii) You may like the children to divide their paper up into six or eight pictures before they start their work on the pea. You may also like to take photographs of the pea and store them on the computer.

(iii) It is important to move the jars as little as possible to prevent the peas falling out of place.

(iv) The answers may be (a) day 2; (b) day 4; (c) day 8 depending on temperature; (d) Near the top of the root; (e) This will depend on the temperature which affects the rate of growth; (f) tiny white hairs.

7 Teacher's sheet: comprehension

See **pages 16 and 17** of *Helping plants grow well*

Answers

1. **(i) Fungus; (ii) Caterpillars; (iii) Grub; (iv) Wireworm; (v) Roots.**
2. **Pests.**
3. **(i) Natural defences; (ii) Plants that are not growing well.**
4. **Mildew and rust.**
5. **By spraying with chemicals called insecticides.**
6. **Because they are grown close together in large numbers and the disease can spread easily between the plants.**

Complementary work

You may wish to show the children some moulds. You could grow them using the following method. Moisten a slice of bread and put it in a clear plastic bag. Make a few tiny holes in the bag with a pin. Show the children the bread daily and point out any mould that begins to grow. Tell the children that moulds also grow on many plants if they get too damp, or on seedlings which are over-watered. Dispose of the mould in accordance with your school policies.

Teaching notes

Microbe is a term used to describe bacteria, viruses and some fungi, such as moulds. Fungi are included because they produce spores which are microscopic in size and are carried on air currents in a similar way to bacteria and viruses. The moulds are unusual for microbes in that they are large enough to be easily seen without a microscope.

Not all bacteria cause disease. Some cause materials in the soil to break down and make humus.

Not all insects cause disease. In fact, ladybirds feed on greenfly and can be introduced into a greenhouse to kill this pest. This is an example of biological control. In addition to greenfly, plants can also be infested with blackfly, which have the same structure but a different colour.

Whiteflies look like tiny moths. Scale insects have waxy shells and look like tiny tortoises. Mealy bugs look like tiny white splodges of matter on a leaf, and have a covering of cotton-like fibres. They feed on sap. The red spider mite bites at its leafy food. It belongs to the spider (arachnid) group.

You may wish to present organically grown food as an alternative to food raised by treating with sprays. Organically grown food is raised without chemical fertilisers, using manure; weeds are removed by hand without the use of weed killers; and insects are kept away by planting insect repellent plants next to food crops, instead of using insecticides.

7 Teacher's sheet: activity

Based on **pages 16 and 17** of *Helping plants grow well*

Introducing the activity

(a) Remind the children of how a doctor treats them when they are ill. The doctor asks questions to find out the cause of the illness. Tell the children that they can be plant doctors by trying to find out if a plant is healthy or ill (see note (i)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (ii)).

(c) Go through task 2, then let the children try it (see note (iii)).

(d) Go through task 3, then let the children try it (see note (iv)).

(e) Go through task 4, then let the children try it.

(f) Go through tasks 5 and 6, then let the children try them.

Completing the activity

(g) Let the children compare their results.

(h) You may extend the activity by pooling the results from each group so that you collate information about all the type 1 plants, type 2 plants, and so on (see note (v)).

Conclusion

In this activity, four ways of recognising causes of plant ill health were identified. Depending on the plants used, some plants may have been completely healthy while others may have had more than one sign of ill health. Certain types of plants may all show the same signs of ill health, while other types of plants may show different signs of ill health.

Teaching notes

(i) There are many causes of plant ill health and the purpose of this activity is to help the children realise that observation can give a clue to plant healthiness. The observations are not intended to be used in plant treatment. For example, brownness may be caused by draughts, sun scorch, over-watering, over-feeding and rot.

(ii) Brownness may be caused by a variety of things (see note (i)), the edges are eaten by caterpillars, the dark marks may be caused by fungus, white marks might be mealy bug, the tiny animals may be greenfly, whitefly, scale insects, mealy bugs or red spider mites.

(iii) Let the children select a healthy leaf. Each group of children could have the same five kinds of plants numbered in the same way. This could help you extend the activity as described in 'Completing the activity'.

(iv) You may make a copy of the table on the board and fill in a line about a fictitious plant so the children can see how their data will look.

(v) This information could be used in an ICT exercise.

Teacher's sheet: comprehension

See **pages 18 and 19** of *Helping plants grow well*

Answers

1. **(i) A = Natural forest; B = farmland; (ii) B or farmland.**
2. **Crops.**
3. **Wheat, barley, rice, maize (corn).**
4. **Rice.**
5. **In the roots (tubers), stem or leaves.**

Complementary work

(a) If you can provide suitable facilities, the children could grow salad crops such as radishes and lettuce.

(b) The children could use secondary sources to find out about the life of a farmer.

(c) The children could use secondary sources to find out the countries which export fruit, vegetables and cereals.

(d) The children could use secondary sources to find out how plant produce is transported from farms to shops.

Teaching notes

For most of human history, people have been hunter-gatherers. They moved through their environment feeding on the plants and animals that they found. The men hunted large animals while women and children gathered fruits, nuts, roots and edible fungi.

About ten thousand years ago people began to practise agriculture. They may have started to do this because other foods were in short supply, or the human population increased and could not be sustained by hunting and gathering. Some people still live a hunter-gatherer lifestyle today (for example, in rainforests and deserts). They live in places where food is easy to gather, or where crops do not grow well (too wet or too dry).

Over time, farmers have bred plants and animals to provide more food. In plants, this has involved the production of larger fruits, seeds, leaves and roots. Along the way, other changes have taken place. For example, the plant from which the carrot was developed had yellow or purple roots.

Farming was first practised in the Middle East, the Americas and Asia. It arose independently in these places. Farming practice spread from the Middle East to Europe. Farm crops such as the onion, cabbage, carrot and lettuce originated in the Mediterranean; the potato, tomato and maize came from South America while Asia has provided foods such as rice, soy beans and bamboo shoots. The mung bean grows naturally in tropical Asia and has been cultivated for thousands of years in India and China.

8 Teacher's sheet: activity

Based on **pages 18 and 19** of *Helping plants grow well*

Introducing the activity

(a) Tell the children that in this activity they are going to be mung bean farmers. They are also going to make a record of how their mung bean crop grows (see note (i)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1.

(c) Let the children try task 1.

(d) Go through tasks 2 and 3, then let the children try them.

(e) Go through task 4, then let the children try it (see note (ii)).

(f) Let the children try task 5 (see note (iii)).

(g) Go through task 6, then let the children try it (see note (iv)).

(h) Let the children try task 7 (see note (v)).

Completing the activity

(i) Let the children compare their results.

(j) The investigation could be extended by repeating it, but storing the beans in cool conditions.

Conclusion

Soaked bean sprouts can be ready for eating in three to four days, depending on the temperature of the surroundings.

Teaching notes

(i) The purpose of this activity is to help the children realise that there is a daily routine in farming which must be followed if the crop is to be raised successfully. You may like to set up bean farms of your own, but tend to them irregularly, and perhaps neglect one altogether to show how poorly your crops grew compared to the rest of the class. You will need to begin this activity on a Monday so it can be completed by Friday, or you may like to extend it over a weekend to provide extra data.

It is important to stress at the outset that, as strict hygienic conditions will not be met (due to the children having to take out sprouting seeds and returning them), the food crop cannot be eaten. You may, however, wish the children to take the sheet home and ignore the drawing exercise so they can rear their own bean sprouts and eat them.

(ii) If the children pour the water off too quickly it can pull off the muslin cover and the beans will escape too.

(iii) The children may need help at first in realising that this is a two-stage process.

(iv) The children may need help in setting up this routine. You may like to extend the investigation over the weekend and use the extra spaces provided in the table.

(v) You may like to have some commercially prepared bean sprouts for comparison.

Teacher's sheet: comprehension

See **pages 20 and 21** of *Helping plants grow well*

Answers

1. **(i) C; (ii) A; (iii) D; (iv) any of the three pine trees between regions A and B.**
2. **Cold, freezing, snowy.**
3. **Warm and rain falls all year round.**
4. **Alpines.**
5. **Cactus.**
6. **(i) The bromeliad would die;**
   (ii) The conditions are different from the rainforest. It cannot survive because the desert is too dry.

Complementary work

(a) The children could make a survey of houseplants. They could find out how many plants are in their homes, how many of these plants have flowers, how many are cacti, and so on. They could find out in which rooms people keep plants, such as hall, living room, kitchen.

Teaching notes

The purpose of this unit is to introduce the children to a wide variety of plant forms and to make accurate observations about them. In the introduction, the point of the 'play' was to show that plants are living things and subject to the same environmental conditions as animals. While animals can sometimes move away to avoid the most extreme conditions in their environment, a plant must adapt its body to cope with all the conditions in its surroundings.

The concept of adaptation need not be developed at this stage, as it is dealt with thoroughly in *6A Adapting and surviving*. However children may ask some "Why?" questions about the plants they are observing, so the following information might be useful.

Alpine and Arctic plants need to keep out of the wind as it will rip them and dry out their leaves. They are small and grow close to the ground, to shelter from the wind, and have small leaves which lose little water. These plants are also in danger of being frozen, so some have woolly fibres to provide insulation.

Heathers grow on mountain sides and are subject to strong winds, so they are small and grow close to the ground and have small leaves. The stems form a bush which provides some insulation to the middle of the plant.

Cacti store water to stop it from leaving the plant. They have tiny leaves which are very difficult to see, and so cacti are often described as leafless. This also helps conserve water. They have a stem with a waxy coat which prevents water escaping, and they have spines which prevent animals from biting into them to get at the water.

If plants become too wet, mould may grow on them and kill them. In a rainforest, water pours down for a part of most days, so it is important that the plants do not have any standing water on their leaves. They have wax that makes the water move quickly across the leaf, and drip tips which direct the water quickly off the leaf. Bromeliads are unusual in that they have a circle of leaves which have bases that can stand up to the water and make a pool which the plant can use.

9 Teacher's sheet: activity

Based on **pages 20 and 21** of *Helping plants grow well*

Introducing the activity

(a) You may like to introduce this activity by telling the children about the great journeys of discovery that were made on sailing ships in the past. Tell them that many of these ships had a scientist who studied plants, and the scientist would examine and draw the plants in the new lands that were discovered. In this activity the children are going to make notes, just as the plant-studying scientists did. You may tell the children that plant-studying scientists today still make notes in a similar way (see note (i)).

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1 (see note (ii)).

(c) Let the children try task 1.

(d) Let the children try task 2.

(e) Let the children try task 3 (see note (iii)).

(f) Let the children try task 4 (see note (iv)).

Completing the activity

(g) Let the children compare their observations.

(h) Present the children with some unusual plants, such as 'living stones', Venus flytrap and pitcher plants. Ask for volunteers to examine the plants under your supervision and make observations for the rest of the class.

Conclusion

Plants from different parts of the world differ in a wide variety of ways (see note (v)).

Teaching notes

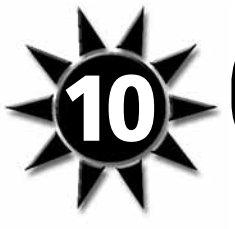
(i) In the previous activities, the children have followed specific instructions to build up their knowledge. In this activity they can use their observational and presentation skills more freely, just as botanists do. Although botanists now use cameras, they still make drawings to help them focus on the detail of the plant's structure.

(ii) Suggest that the children may take some measurements such as height, size of leaf and flower. They may draw a leaf or flower to show its structure, and describe the colours and markings they see. Tell them that they should make and record similar observations with the other plants in this activity.

(iii) Remind the children not to touch the spines. If possible, have some cacti which are in flower.

(iv) Select a plant with waxy leaves which helps water run off it and has a point on its leaf (a drip tip) which helps water leave the leaf. If you select a bromeliad (urn plant) try to have one in flower.

(v) Later in the course the children will look at how these differences are adaptations to their habitat. At this stage it is important to make the children aware that great differences exist.



Teacher's sheet: comprehension

See **pages 22 and 23** of *Helping plants grow well*

Answers

1. **(i) Rainforest; (ii) Around the base of the tree.**
2. **The leaves get brown tips.**
3. **The stem will rot.**
4. **Cactus or spider plant.**
5. **Near the equator.**
6. **There is more light. The air is moister.**

Complementary work

The children could examine the strawberry geranium, piggyback plant and the succulent called the good luck plant to see how they produce plantlets. They could try and rear some plantlets in a similar way to the rearing of the plantlet of the spider plant in this unit's activity.

Teaching notes

Some plants can reproduce by making copies of themselves. In the case of the spider plant and the strawberry geranium, the small copies, or plantlets, grow out on stalks. They grow from the leaves of the piggyback plant and the good luck plant. In the good luck plant, the plantlets grow around the edges of the leaves, and when they are large enough, they fall into the soil around the parent plant. This can provide an example of overcrowding and can be used in Unit 6.

The children can carefully remove the plantlets, separate them and grow them up in separate plant pots. This form of reproduction, in which a plant makes a copy of itself, is called vegetative propagation and occurs naturally. The plants that are produced are clones of their parent. This type of reproduction allows a plant that is successfully growing in a habitat to colonise the habitat steadily without having to produce flowers and seeds. The disadvantage of this method of reproduction is that there is no variation in the offspring which could allow them to survive in slightly different environments and give rise to new species. This is the reason why it is not very widespread.

The taking of cuttings is called artificial propagation. It is used where copies are needed of a particularly attractive or useful plant. Many plants can be copied by taking cuttings of their stems and leaves.

Teacher's sheet: activity

Based on **pages 22 and 23** of *Helping plants grow well*

Introducing the activity

(a) Tell the children that some plants make small copies of themselves which grow out on stalks. Show them a spider plant with stalks carrying plantlets, and tell the children that their task is to try and rear the baby plants. Show the children a large geranium plant and tell them that they might also be able to raise baby plants from this larger plant, although it does not have any plantlets on stalks.

Using the sheet

(b) Give out the sheet and let the children fill in their names and form, then go through task 1.

(c) Let the children try task 1 (see note (i)).

(d) Go through tasks 2 and 3, then let the children try them (see note (ii)).

(e) Go through tasks 4 to 6, then let the children try them (see note (iii)).

(f) Go through tasks 7 and 8, then let the children try them (see note (iv)).

(g) Go through task 9, then let the children try it (see note (v)).

(h) Go through tasks 10 and 11, then let the children try them (see note (vi)).

Completing the activity

(i) Let the children compare the growth and health of their spider plants. Let them compare the root growth of their cuttings.

(j) Let the children plant their geranium cuttings in another plant pot. The children now have two plants to start their houseplant collection.

Conclusion

A spider plant can be reared from a plantlet. A new geranium plant can be reared from a cutting.

Teaching notes

(i) Some children tend to only half-fill their plant pots. Make sure that they have a well-filled pot ready for the plantlet.

(ii) You may like to remove the plantlets for the children, or if they are able they can remove them by nipping off the stalk or by using scissors.

(iii) Check that the children do not plant the spider plant too deeply, or place it too close to the surface.

(iv) The soil should be watered with the equivalent of about three or four teaspoons of water. Make sure the children do not waterlog the plant.

(v) The children could choose to measure the length of one leaf every few days over the coming weeks.

(vi) You should use a knife to take the cutting. It should be about 5 centimetres long. You should remove the lower leaves and keep just two or three at the top to let the cutting make food. Small roots should sprout from the stem over the course of the next few weeks.