

Unit 1

Teaching ideas

Background knowledge

Plants absorb water through their roots. This is transported through the stem to the leaves, where it is used to make food for the plant. The water is combined with carbon dioxide, which is taken in through tiny holes in the leaf, to make starch. (The starch is the food for the plant.) This process is photosynthesis. Photosynthesis needs light energy to work. Plants therefore need water and light to be able to make their own food. Without food, they cannot grow and will eventually die.

Too much water can kill a plant because the roots need to absorb small amounts of oxygen. They get this from the air in the soil. Too much water in the soil fills all the air spaces and the lack of oxygen kills the root. Some special plants, such as pond weed and rice, can grow underwater. Their leaves take in oxygen and they can transport it to the roots to keep them alive.

Like all other organisms, plants die if they get too hot or too cold.

Seeds do not have leaves to make food. They contain a food store instead. This allows them to germinate underground where it is dark, and grow a stem and their first leaves. Photosynthesis then takes over and the plant can continue to grow.

Unit overview

Topic	Number of lessons	Outline of lesson content	Resources in Learner's Book	Resources in Activity Book	Resources in Teacher's Resource
1.1 Plants and their parts	2	An observation of roots, stem, leaves and flowers. Making model plants.	Activity 1.1 Questions 1, 2.	Exercise 1.1	Worksheet 1.1a Worksheet 1.1b Resource sheet 1.1
1.2 Plants need light and water	2 Note: Plants will need to be grown in advance of the lesson.	Growing seeds. The effects of light and water on plant growth.	Activity 1.2a SE Activity 1.2b SE Questions 1, 2, 3. Ex	Exercise 1.2 SE	Worksheet 1.2a Worksheet 1.2b Worksheet 1.2c
1.3 Transporting water	1 Note: Seeds to be planted three weeks before the lesson.	An observation of roots and the transportation of water by the stem.	Activity 1.3 Questions 1, 2, 3.	Exercise 1.3	Worksheet 1.3

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1.4 Plant growth and temperature	1–2 Note: Plants will need to be prepared before the lesson.	Investigating plant growth at different temperatures.	Activity 1.4 SE Questions 1, 2, 3.	Exercise 1.4 SE	Worksheet 1.4a Worksheet 1.4b Worksheet 1.4c Su Worksheet 1.4d
Check your progress			Questions 1 L , 2, 3, 4. SE Ex	Language review L	Worksheet 1.5

Ex Extension **L** Language **SE** Scientific enquiry **Su** Support

Resources

- string
- straws
- coloured paper or card
- sticky tape
- glue
- young plants grown from seed (e.g. sunflowers, beans, alfalfa, radish, mung beans, cress)
- containers for planting seeds made from plastic cups or recycled materials such as plastic drinks bottles (you will need separate containers for each condition being investigated)
- compost or organic material to enrich the soil
- a watering can
- a box to cover three plants
- a white flower (e.g. carnation, lily, chrysanthemum, rose)
- some celery or stems of fennel, or white bean sprouts
- a container of water
- some blue food colouring
- a plastic knife
- a thermometer

Notes on practical activities for this unit

- Note that activities 1.2a and 1.2b both require young plants, which will need to be prepared in advance so that they are ready for the lesson (they will take a few weeks to grow from seed).

- Note that the lesson for topic 1.3 *Transporting water* requires a sunflower or bean seed to be planted about three weeks before the lesson.
- Activity 1.4 requires six similar bean plants for each group that will need to be prepared in advance of the lesson.
- For this unit, appropriate plants are beans and sunflowers. Alfalfa, radish, mung beans and cress also germinate quite quickly. Sunflower seeds sprout about 11 days after planting, but they will take longer to germinate in colder conditions.
- Depending on your situation, you may need to set up the activities as whole class activities (make sure all learners are involved in taking measurements over the period of the investigation).
- You can make containers for planting seeds using plastic cups or recycled materials such as plastic drinks bottles. You will need to cut the top off so that you have a cylindrical container. You will also need to punch or cut some drainage holes in the base. It is also a good idea to put some tape around the top of the container that you have made to smooth out any rough edges.
- For plants to grow well, they need nutrients in the soil in which they are planted. Compost is rich in nutrients. If this is not available, nutrients can be added to soil by adding organic matter and digging it in well. This is best done a couple of months in advance, if necessary, to give the nutrients time to enrich the soil.

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- For these activities it is easiest to manage the observations required if the plants are in containers in the classroom. You do not need separate containers for each plant, but you will need separate containers for each condition being investigated (for example, if investigating the temperature, then you will need a separate container for each temperature that you are looking at).

Topic 1.1 Plants and their parts

This unit recaps on the names of the main parts of flowering plants but also asks learners to think about the wide range of different types and sizes of plants that can exist. There are opportunities for learners to develop their observation and comparison skills.

Learning objectives

- Know that plants have roots, leaves, stems and flowers.
- Know that plants need healthy roots, leaves and stems to grow well.
- Observe and compare objects, living things and events.

Curriculum links

- There are many children's stories that could lead to discussions about the parts of plants; for example, *The Enormous Turnip* by Alexei Tolstoy, *Jack and the Beanstalk* (traditional) and *The Tiny Seed* by Eric Carle.
- There are opportunities for links with Art, such as making leaf rubbings and observational drawings of the parts of plants.

Ideas for the lesson

- It would be useful to start by finding out what the learners already know about plants. You could give large sheets of paper to each group and ask them to work together to draw a diagram of a plant. Give learners sticky notes and ask them to write labels saying what each part of the plant does.
- Take learners into the school grounds to look for plants. Remember to look for plants of different sizes, including trees. Ask them to draw some that they

find, labelling the leaves, stem and any flowers. Warn learners to take care of any thorny or stinging plants. Learners can make rubbings of leaves by putting a leaf underneath some paper and rubbing over the top with a crayon. Some learners could take photographs. Help learners to dig up a plant or weed carefully to observe the roots. Learners could use Worksheet 1.1a to record their observations.

- Ask learners to try to find examples of plants that look unhealthy and discuss why this might be. They may be growing in thin soil, making the roots unhealthy, or they may have been damaged by too much sun or by insects.
- Ask learners to collect some samples of leaves and flowers. When you get back in class, these can be left for several days pressed between sheets of paper underneath heavy objects, such as a pile of books. Once pressed, the samples could be stuck onto paper and labelled.
- Activity 1.1 asks learners to make a model plant using coloured paper or card, string and straws.
- Learners could work in groups to lie on the floor to make a model plant using their bodies; one learner can be the roots and others can make up the stem, leaves and flowers. Other learners could hold large labels to show the parts of the plant. The website <http://www.crickweb.co.uk/ks1science.html> has an activity called 'Plant labels', which will reinforce this part of the lesson. Here, the learners are asked to drag labels to the different parts of a plant.
- Exercise 1.1 in the Activity Book asks learners to label a plant with its main parts.
- Show learners examples, or pictures, of wind-pollinated flowers – see *Internet and ICT* for relevant internet links. Wind-pollinated flowers are not brightly coloured and learners may not have noticed them. Some cacti only produce flowers very rarely when the conditions are just right.
- You may also wish to tell learners that there are small plants and big plants. The biggest plant is a sequoia tree. These trees can grow to 100 m tall. Sequoia trees are very big but they grow from tiny seeds which are 4–5 mm long.

- Worksheet 1.1b can be used to check the learners' understanding of the parts of a plant.

Notes on practical activities

Activity 1.1

Each pair or group will need:

- string
- straws
- coloured paper or card
- sticky tape
- glue.

The Learner's Book shows how the model plant might be constructed.

Encourage learners to make clear labels and attach these appropriately. Resource sheet 1.1 provides printed plant labels that can be given to learners that would benefit from them. Alternatively, the labels could be used to reinforce the vocabulary used in the lesson. The finished plants can be made into a classroom display or hung up on a string washing line across the classroom.

Internet and ICT

- There is an online slide show of *The Enormous Turnip* story here: <http://www.slideshare.net/marcliffprimary/the-enormous-turnip-story-book-5645523>.
- There are pictures of wind-pollinated plants on the following websites: http://www.ehow.com/list_5916512_examples-wind-pollinated-flowers.html#page=0, <http://www.buzzaboutbees.net/wind-pollination.html>.

Assessment

- Ask learners to name or label the four main parts of a plant. Are they able to describe the function of each part?
- Ask learners to discuss their model plants. What are they happy with? What could they have done better?

Differentiation

- Support lower achieving learners by making a display of new words and encourage them to repeat the words out loud. Cut pictures of plants into roots, stem, leaves and flowers.

Lower achieving learners can then rebuild the plant picture and add printed labels. Resource sheet 1.1 gives labels which you can give to the learners. The 'Plant labels' activity may also be particularly useful for this group.

- Cater for higher achieving learners by discussing with them the functions of the different parts in greater detail. Challenge them to discuss the 'Talk about it!' question.

Talk about it!

Ask learners if they have seen a dying flower. Usually flowers only last for a short period of time. They will either grow into seed heads or fruit containing seeds if pollinated, or just die back. Ask learners if they can name some fruits that contain seeds. Some plants, like *Euphorbia* and *Plumeria* (Frangipani), do flower all year but most plants only flower in warmer months when they are more likely to be pollinated by insects.

Common misunderstandings and misconceptions

- Many learners will use the word 'flower' to describe a whole plant that has flowers. Discuss this with learners and encourage them to use the word flower only when they mean the flower part of the plant.

Homework ideas

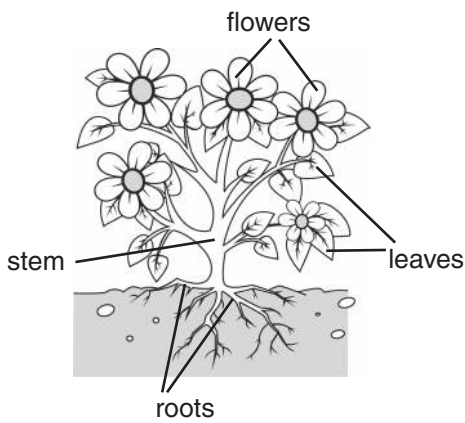
- Learners could be given seeds to take home and grow at home.
- Exercise 1.1 in the Activity book.

Answers to Learner's Book questions

- 1 roots, stem, leaves, flower
- 2 Learners could talk about differences in how healthy different plants are, where plants live, plant sizes or different types of plants.

Unit 1 Teaching ideas

Answer to Activity Book exercise



Topic 1.2 Plants need light and water

This topic asks learners to plant seeds and then find out how to look after them by investigating the growth of young plants. The investigations provide an opportunity for learners to practise their measuring skills, how to record results in tables and how to draw conclusions about the things that plants need for good growth.

Learning objectives

- Explain the observations that plants need light and water to grow.
- Measure using simple equipment and record observations in a variety of ways.
- Present results in drawings, bar charts and tables.
- Draw conclusions from results and begin to use scientific knowledge to suggest explanations.

Ideas for the lesson

- Learners could start this topic by planting some seeds such as sunflowers or beans. They will need to be encouraged to look after their seeds and they should be reminded to water them but not water them too much. Learners could be chosen to take responsibility for this job.
- The new scientific enquiry words ‘predict’ and ‘fair test’ are introduced in this topic. Explain to learners that a prediction is like a guess, but you have to think carefully about what you already know before making it. Make sure learners understand that a fair

test is about controlling variables – changing one variable while keeping the others the same. Explain that the test must be fair for the seeds (or plants). Some learners may think that fair test means making it fair for the learners, for example, so they all get a turn to do the measuring. An effective way to help learners understand this is by doing things unfairly and asking learners to say what you are doing wrong and why. For example, you could pretend to water only the plants with light and not those in the dark, and ask learners to say why that is not fair for the plants.

- Activities 1.2a and 1.2b in the Learner’s Book ask learners to investigate whether plants need light and water to grow. You could start by asking learners in groups to make a list of things they think that plants need to grow. Worksheets 1.2a and 1.2b provide frames in which learners can record their results.
- Worksheet 1.2c asks learners to draw what will happen to young plants kept in different conditions. Learners could use the worksheet to make predictions for the above investigations, or to show what they have learned after the investigations are completed. Ask learners to explain the observations that plants need light and water to grow (link back to the previous topic on roots, stems, leaves, etc. and what plants need to stay healthy).
- Discuss with learners the types of plants that grow in very dry or very wet conditions. Show pictures of cacti and water lilies and other water plants. Explain that these plants have special adaptations that allow them to cope with extreme conditions. For example, cacti store water in the stem, water plants have leaves that float and the stem transports air from the surface down to the roots.
- Show learners photographs of underground caves with no plants. Ask learners why they think there are no plants in the caves. Plants cannot survive without light.
- Do plants need soil to grow? (See *Common misunderstandings and misconceptions*.) Help learners to grow cress, alfalfa or other fast germinating small seeds in trays lined with cotton material. Learners can sprinkle the seeds in the shape of their initials and keep them damp with a plant spray to see them grow without soil.

- Ask learners to draw bar charts from the results given in Exercise 1.2 of the Activity Book. Later, they can make bar charts of the results of their own investigations.

Notes on practical activities

Activities 1.2a and 1.2b

Each pair or group will need:

- small seedlings (15 max.)
- watering can
- box
- calendar showing days of the week.

For activity 1.2a, three given light and three given no light (kept in a box).

For activity 1.2b, three given water every day, three every week and three given no water.



Take care to keep water away from electricity when watering.

However, the results are more convincing if a greater number of plants are used in each situation. Therefore, to involve learners, you could put them into groups and make the test fair by keeping other factors the same, for example, light/water, types of plant. This investigation may begin to show results after a week but the differences will be easier to see after two or three weeks. Ask learners to measure the plants every few days and to draw the plants at the start and end of the investigation. Learners could use Worksheets 1.2a and 1.2b to record the results. **Note:** some plants kept in the dark will grow taller because they are trying to grow upwards to find light.

Planting seeds

Each pair or group will need:

- three seeds
- container with drainage holes
- soil or compost
- a sticky label.

Show learners how to plant the seeds by half filling the container with soil or compost, placing the three seeds on top then adding more soil to cover the seeds. Allow learners to add a sticky label with their name on as they will be more engaged with the activity if they know which seeds belong to them.

Internet and ICT

- Learners can see the effects of a lack of light and water using this simulation: http://www.bbc.co.uk/schools/scienceclips/ages/5_6/growing_plants.shtml.

Assessment

- Ask learners to explain how to look after their planted seeds.
- Ask learners to decide whether they can explain that the young plants will need light and water to grow. They could use a traffic-light system where green means very confident, amber (yellow) means less confident and red means not confident at all. Make sure you give those who show amber or red some extra support so that they feel more confident with the explanation.
- Once the seeds have germinated, learners could write instructions for others on how to look after young plants. They could look at another learner's instructions and say two things that they like about the instructions (clear, well-ordered) and one thing that could be improved (numbering them).

Differentiation

- Lower achieving learners may need to practise using rulers before measuring the height of plants.
- Higher achieving learners could investigate how the amount of water effects the growth of plants.
- In Activities 1.2a and 1.2b of the Learner's Book, higher achieving learners could plan their own investigations. Lower achieving learners can be supported by following the picture instructions in the Learner's Book.

Talk about it!

Ask learners to describe what the surface of the Moon looks like. Are there any plants? Is there any water? Water has been found on the Moon but it is in tiny amounts and trapped inside rocks so it could not be easily used by plants. There is light from the Sun on the Moon but the temperature varies from less than $-200\text{ }^{\circ}\text{C}$ at night to over $100\text{ }^{\circ}\text{C}$ in the day. Plants could not grow on the Moon unless kept at the right temperature and given water.

Unit 1 Teaching ideas

Common misunderstandings and misconceptions

- Some learners will think that plants need light from the Sun to grow. Indoor plants are usually placed near windows and learners might not have seen plants grown indoors under artificial light. They could set up an investigation with a plant growing inside a dark box but with artificial light.
- Many learners will think that plants need soil to grow. Learners often think that soil is food for the plant. Soil provides extra nutrients to keep a plant healthy, but plants can grow without it. Learners could grow cress, bean or alfalfa seeds on trays lined with paper or cotton wool to hold water.

Homework ideas

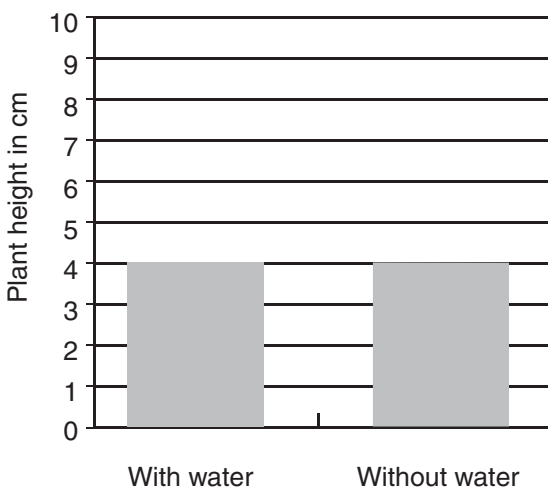
- Exercise 1.2 in the Activity Book.

Answers to Learner's Book questions

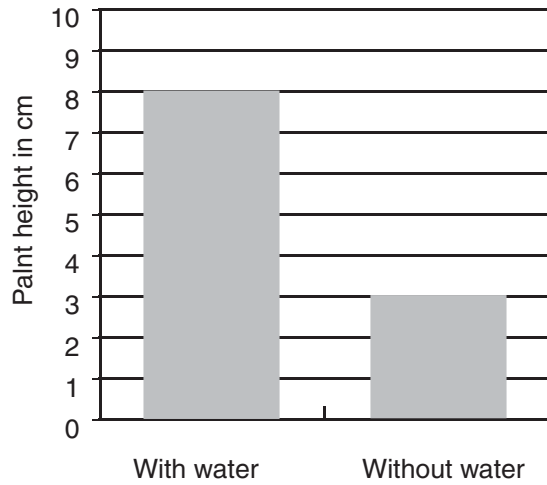
- 1 light, water (and warmth)
- 2 A plant in a dark place will not grow well. It may die.
- 3 Learners will plan their own investigation.

Answers to Activity Book exercise

Results on Day 1



Results on Day 10



The plant with water grew the best.

Answers to Worksheets

Worksheet 1.2c: Plants need light and water

- 1 Drawing of dead plant.
- 2 Drawing of dead plant
or
Drawing of taller yellow plant growing up to find light.
- 3 Drawing of a healthy plant.

Topic 1.3 Transporting water

Here learners will explore the function of the roots and stem by investigating how celery and flower stems transport coloured water. This topic encourages learners to make predictions and careful observations.

Learning objectives

- Know that water is taken in through the roots and transported through the stem.
- Suggest ideas, make predictions, and communicate these.
- Observe and compare objects, living things and events.

Ideas for the lesson

- Three weeks before this lesson, plant a sunflower or bean seed in a small plastic cup. Once this seed has germinated and grown to approximately 20 cm tall, it will need to be re-potted into a larger container. Remove the pot to show learners the roots and discuss how the roots need to absorb water for the plant (as shown in the Learner's Book on page 10). If many of the roots are touching each other rather than touching the soil, then they cannot absorb the water they need. Ask the learners to help you to gently separate some of the roots and re-plant in a larger pot using more soil or compost. Ask learners to look carefully at the roots. Most roots have tiny hairs that help them to absorb water; you could look at these using a magnifying glass or use a visualiser or computer microscope if these are available.
- You could explain that the trunk of a tree is like a busy main road. The roots are like smaller roads bringing traffic onto the main road and the branches and the twigs are like other smaller roads taking the traffic away from the main road.
- You could tell learners that the Baobab tree grows where it is very dry for most of the year. The trunk grows very large for storing water when there is rain.
- Activity 1.3 in the Learner's Book shows learners how to investigate the effect of coloured water on a white flower and a stick of celery.
- This is a demonstration that could be used as a follow up to Activity 1.3 in the Learner's Book, or as an alternative. Show learners a white carnation flower (any white flower with large fleshy petals will work such as lilies, chrysanthemums or roses). Split the base of the stem in half, putting one half into water coloured red and the other half into water coloured blue – food colouring can be used to colour the water. Ask the learners to make predictions. The predictions could be recorded on the board along with the number of learners who agree with that prediction. Discuss with learners whether their predictions were correct and ask them to explain how this shows that one job of the plant stem is to transport water around the plant.

- Help learners to set up an experiment using the tops of carrots. The carrot is the root of the plant and after a few days it will begin to grow new stems and leaves. Ask learners to record the changes observed over several days.
- In Exercise 1.3 of the Activity Book learners can demonstrate how to label a plant and show the path of the water from the soil to the leaves.

Notes on practical activities

Activity 1.3

Each pair or group will need:

- a white flower
- some celery
- a container of water
- blue food colouring
- a plastic knife.

This activity reveals the job of the stem by looking at the effects of coloured water. Set up the experiment as shown in the Learner's Book (page 11), then ask learners to predict what will happen. For the best results, leave overnight. The white flower will take on colour from the coloured water. This shows that the stem carries water around the plant. Use flowers with large fleshy petals for this experiment; carnations, lilies, chrysanthemums and roses all work well, but this demonstration only works if the flowers are white. If the celery has leaves, then these should take on the colour well but the colour will also show in the xylem that transports water through the stem. Show learners how to cut the celery stem carefully with a plastic knife. Learners should easily see the colour in these water carrying tubes. Stems of fennel are a good alternative to celery. White bean sprouts will also show a colour change in this experiment but the xylem tubes are too small to identify. Learners could use Worksheet 1.3 to record the results of this activity. Ask them to explain the results in terms of the stem being used to transport water around the plant.

Internet and ICT

- Learners can find out about the other parts of plants we eat by doing the quiz on this website: <http://www.naturegrid.org.uk/plant/foodparts.html>.

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- See some time-lapse photography of white flowers changing colour here: <http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/colour-your-own-flowers/>

Assessment

- Ask learners to work in pairs, taking turns to explain to each other the jobs of the root and the stem of the plant. Ask them to give each other feedback about whether they covered both the support and the water-related jobs of both the roots and the stem.

Differentiation

- Lower achieving learners will benefit from digging up different plants to look at the roots.
- You could allow higher achieving learners to carefully cut along the length of some stems and some larger roots. Use soft stems and roots, and plastic knives for safety. Ask them to use hand lenses to closely observe the tubes that transport the water. Celery works well for this activity.

Talk about it!

Talk with learners about how to make cut or picked flowers last longer. Ask them whether we just pick the flower or the stem too. Ask learners the stem can do to help keep the flower alive. It can transport water from a vase to the flower. If there are no leaves to make food for the plant, then the flower will die quite quickly. If there are some leaves, then the flower may last longer.

Common misunderstandings and misconceptions

- Some learners may think that the stem and the root are just there to support the plant.
- Many learners assume that the roots also absorb food for the plant from the soil. The food is actually made in the leaves, from carbon dioxide and water, in photosynthesis.
- Many learners will think that the leaves collect water for the plant. To test this you could set up an investigation into what happens to a plant if you remove the roots.

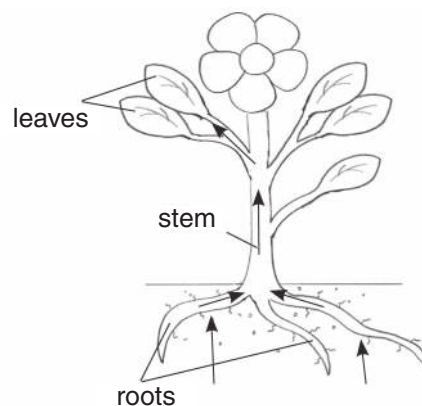
Homework ideas

- Exercise 1.3 in the Activity Book.
- If learners have taken seeds home to plant, you could ask them to check the roots as they grow and re-plant them if necessary.

Answers to Learner's Book questions

- 1 Plants need to be moved to a bigger pot because the roots will grow too big. An alternative answer would be because the roots cannot absorb enough water.
- 2 The stem transports the water to the leaves.
- 3 A plant with no roots would die because it cannot absorb any water.

Answers to Activity Book exercise



Topic 1.4 Plant growth and temperature

Here learners find out that plants need to be kept warm in order to grow well. They will discover what happens to a plant that gets too cold or too warm. Learners can plan and carry out a full investigation, presenting their results as a bar chart and using them to make generalisations such as 'plants like a warm place to grow'.

Learning objectives

- Know that plant growth is affected by temperature.
- Collect evidence in a variety of contexts to answer questions or test ideas.

- With help, think about collecting evidence and planning fair tests.
- Present results in drawings, bar charts and tables.
- Make generalisations and begin to identify simple patterns in results.

Ideas for the lesson

- Activity 1.4 in the Learner's Book explains how to investigate plant growth at different temperatures. Learners can record their results on Worksheet 1.4a.
- Worksheet 1.4b asks learners to count the number of plants in habitats at four different temperatures and draw a bar chart of the results. The fourth habitat on this worksheet is your own environment. Learners will need to count the number of plants in a particular area and record the temperature. They should draw some plants that they found, and draw the temperature on the blank thermometer.
- Worksheet 1.4c asks learners to practise reading temperatures from a thermometer.
- Learners can practise their height measuring skills using Exercise 1.4 in the Activity Book.
- Ask learners to help set up an investigation into what happens when you freeze a plant by putting a pot plant in a large container and filling the container around and underneath the plant with ice cubes. Make sure that light can still get to the plant. You may need to leave the plant for several days and will need to add new ice cubes often.
- Discuss the concept of farming with learners. In which month or months do farmers sow their seeds? In which month do farmers harvest foods? Make a one year timeline and sketch in times for seed planting, plant growth and harvesting. You could link back here to the need for water for plants to grow, particularly if the temperature does not vary in your region as much as rainfall does.
- Talk with learners about the seasons and how plants grow more slowly in cooler seasons and more quickly in warmer seasons. Discuss how many plants lose their leaves, in countries with a temperate climate, and stop growing completely in winter and then grow new leaves in spring.

- Discuss the parts of the world where the conditions are not ideal for plant growth. Introduce learners to Death Valley, which is located in Eastern California, within the Mojave desert in the USA (see *Internet and ICT*).
- Worksheet 1.4d can be used to check the learners' understanding of how to look after growing plants.

Notes on practical activities

Activity 1.4

Each pair or group will need:

- two similar young bean plants or sunflowers in pots
- a thermometer.

You will need to discuss with learners which of the two investigations they will be doing. This will depend on the climate and the time of year. It is not necessary to recreate the conditions exactly as shown. However, in order to demonstrate that plants do not grow well in conditions that are too hot or too cold, any cold place used should be at a temperature of less than 10 °C. Similarly, any hot place used must be uncomfortably hot for the plant. So long as the air temperature outside is over 20 °C then using a clear plastic box as a mini greenhouse in strong sunshine should keep the temperature over 40 °C. The greater the temperature differences that you can achieve, the more obvious the differences between the plants will be. This investigation will show results after two to three weeks.

The learners should work in groups and each group should set up their own experiment. However, if resources are limited, the whole class could observe the same two plants.

Talk with learners about how to plan a fair test by keeping other factors the same, for example, the amount of water, time spent in light, and types of plant. Each group will put one plant in each of the two places chosen. Make sure learners know to let the thermometer reading stop moving before taking a measurement of the temperature in a certain place. Learners could use Worksheet 1.4a to record their results. This investigation can be simplified by omitting the temperature measurements. The temperature of each place can still be checked regularly but not recorded in the results table.