Curriculum Visions

Plant Teacher's Guide

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Section 1: Planning

Introducing the Students' Book

The Plant Book is a full colour paperback book. It is arranged in double page spreads. The spreads are arranged in a sequence which can be used as a basis for teaching the topic, but each spread can also be taught on its own, so that it can be easily fitted into your existing scheme of work. This makes the material exceptionally flexible to your needs. For example, you may wish to dip into it in various years to study topics such as flowers, leaves or germination, or you may wish to take a term-long study ending by considering plants in their habitats which brings all the topics together.

Each spread follows the same format, to help the pupils develop their reading and information finding skills. The reader-friendly text styles are supported by clear, colourful diagrams and photographs to promote interest and thorough understanding. Every spread begins with a short introductory paragraph in bold type. This paragraph describes the main content of the spread and helps the reader settle down to the page. The content is then developed in the main text. Each section also has clear headings for easy reference. The content of the main text is developed further in the extended captions, for students with more advanced reading skills. This allows the content of the spread to be read and understood by children with a wide range of abilities across **Key Stages 2 and 3**. Key or difficult words are featured in bold type to signify that they are explained in the glossary on pages 46 and 47.

The *Students' Book* is designed to be used primarily in class and to be bought as class sets. You will find that sets are priced accordingly. There is also a hardback edition for library use.

Introducing the Teacher's Guide

This guide has the following features:

- Information to help you match the *Curriculum Visions* materials with the curriculum.
- Photocopiable masters of worksheets which test comprehension of one of the diagrams and the text on each of the spreads. These worksheets can be used in a portfolio assessment scheme.
- Answers to the comprehension worksheets, suggestions for introducing the spread and background information. These are in the teacher's sheet on the back of each of the worksheets.
- Practical activities to support most of the spreads. These may provide opportunities to develop individual investigative skills, or allow the planning and carrying out of whole investigations.
- Extension materials, to provide an opportunity for building differentiation into your work. Some items may also be used for whole class revision, and all items can be used in a portfolio assessment scheme.

Planning to use the Students' Book and Teacher's Guide

Examine a spread in the *Students' Book* and look in the worksheet section of this guide to find the comprehension worksheet photocopiable master for the spread. Each comprehension worksheet has a page reference to the *Students' Book* top centre, a number top left and a pencil top right. Most comprehension worksheets are followed by one or more practical worksheets.

Look at the teacher's sheet on the back of the comprehension worksheet to read how the teaching of the spread may be introduced. If the spread is supported by practical work, the worksheets will be listed here. Advice is given on how to integrate practical work into reading and comprehension work. Page references for the extension worksheets are given and where appropriate there will be a small section suggesting how you could link the spread with other spreads in the *Students' Book*.

If the spread is supported by practical work, look at the practical worksheets. They will have the same number as the

comprehension worksheet top left and a letter top right where there is more than one practical. Look on the back of these for the teacher's sheet which lists the equipment and facilities you will need. These are also featured on pages 6 and 7 of this guide, together with the whole list of practicals. In this list, practicals which are suitable for whole investigations are marked with an *. There are also suggested outcomes to the practical work, which you may like to use, or change to suit your purposes.

There may also be background information on the backs of both comprehension worksheets and practical worksheets.

There are opportunities for extending the work on the teacher's sheets of many of the practicals. Where equipment is required for these, details are given on the sheet and are also shown by a '*' in the list on page 6.

Finally, look at the extension worksheets, Section 5 beginning on page 109, where details of any facilities or materials for the worksheets are stated. Each extension worksheet bears the same number as the comprehension worksheet, but in a square instead of a circle.

Each extension worksheet begins with an exercise, using the cloze technique, which may be used directly with the spread or as revision at the end of the work on the spread, perhaps to review practical work. The second question may involve further practical or survey work. Supporting material for this is in the teacher's sheet on the back of the corresponding comprehension worksheet. The answers for the cloze exercises are on pages 131 and 132. In the last ***Go further*** section of the extension work, there is an opportunity for the students to use a range of secondary sources to consolidate their work. The students are set one or more assignments for which they will need resources such as books, CD-ROMs and web sites, including:

www.CurriculumVisions.com/plant

Support for the Science Co-ordinator

A major consideration in adopting a book for a course is the provision of materials and facilities for practical work. In the next section the requirements for core practicals (i.e. those that have a worksheet to themselves and follow the comprehension worksheets) are set out. This will help you take stock of your resources and help you plan your budget spending. The practicals have been designed to use the minimum of materials so that they can be made easily accessible to most children. The exception is the use of the microscope in the study of cells. This is a topic that you may chose not to use, but if you do have access to microscopes, instructions on set up and use are provided on the back of the appropriate sheet.

Also in the next section is a list of practicals that give the students an opportunity to plan and carry out whole investigations.

Section 2: Practical work

Safety first!

Before any kind of class or field work, please make sure you have thought through the appropriate safety precautions, especially safety with any sharp objects.

There are 27 practical activities. Most involve the minimum of specialist equipment, and all can be carried out in a classroom without the need for laboratory facilities. This makes the book a suitable course for both upper primary, and lower secondary schools where there is insufficient laboratory provision.

Before you begin, consult your school's policies on practical work with materials and the participation of children in experiments. Also consider the abilities and attitudes of the students in your class and select activities for which you are confident to take responsibility.

The following is a list of equipment needed for each of the practicals, set out by experiment. An asterisk indicates additional material required for the extended activity on the teacher's sheet.

1. A collection of house plants with care labels.

2A. Two-week-old bean seedlings, turf, newspapers, gloves, forceps.

2B. Dish of sand, beaker, mustard seeds, magnifying glass.

2C. Small onion, small-neck clear plastic bottle, ruler.

2D. Soaked beans, clear jar, blotting paper, paperclip, sand.

3A. Celery stalks, food dye, beaker, magnifying glass.

*Elder twig in leaf, two willow twigs in leaf, ink, three jars of water.

3B. Collection of twigs from broad-leaved trees.

4A. Collection of leaves from broad-leaved trees.

4B. Collection of plants in the classroom.

5A. Microscope, slide, potting compost or dry soil, desk lamp.

5B. Microscope, slide, dropper, cover slip, mounted needle or pencil, forceps, moss leaf.

*Jar of water, an onion, a scalpel or sharp knife, an old glazed white tile, a lettuce (or lettuce leaf), a potato.

5C. Two plant shoots, two beakers, measuring cylinder, top pan balance, felt tip pen, ruler.

6. Soaked peas or beans, pots, compost, black cardboard, tissue paper, sticky tape, scissors.

*A bunch of Canadian pondweed, a deep jar, a funnel, a test tube.

7. Wallflower, selection of plants with large flowers, flowers from wasteland.

*Dandelion heads, carnation flowers, food dye, beaker.

8. Insect pollinated flowers, microscope, slide, forceps, desk lamp.

9. Pine cones, plastic bags, damp sand, mushrooms, microscope slide, desk lamp.

*Moss plants, horsetails (in the spring), fronds from ferns with spore cases, collection of fern house plants, collection of cones.

10. Dandelion seeds and fruits.

11. Cress or mustard seeds, dishes of damp sand, places at different temperatures, measuring cylinders.

*Dry peas, jars, spring balance or suitable weighing machine, tissue paper.

12. Spider plant, a 'good luck' plant, clump of chives, garlic bulb, geranium, pots and compost.

*Potatos, pins, thread, branch of a beech.

13. Plants with greenfly, magnifying glasses.

*Colony of stick insects, privet shoots.

14. Packets of seeds for garden annuals, compost, pots, access to flower bed.

15. String with marks at 10cm intervals, two pegs, ruler or straight stick, access to hedge, identification books and keys.

16. Large hoop or metre rule, grassy area, identification books and keys.

17. Large white sheet, collecting jars, magnifying glasses, access to a wood, identification books and keys.

18. Plastic jar, cold water plants from an aquarist, magnifying glasses, microscope, dropper, slide, cover slip, desk lamp.
20. Mustard seed, large glass jar, two small pots, compost.
21. Two pieces of cloth (same size), safety pins, paper clips or bull dog clips, weighing machine, measuring cylinder, clock.

Note: please read the introductions to the spreads and practicals as they may contain suggestions for using various additional pieces of equipment and materials to help set the scene for the work.

Developing investigative skills

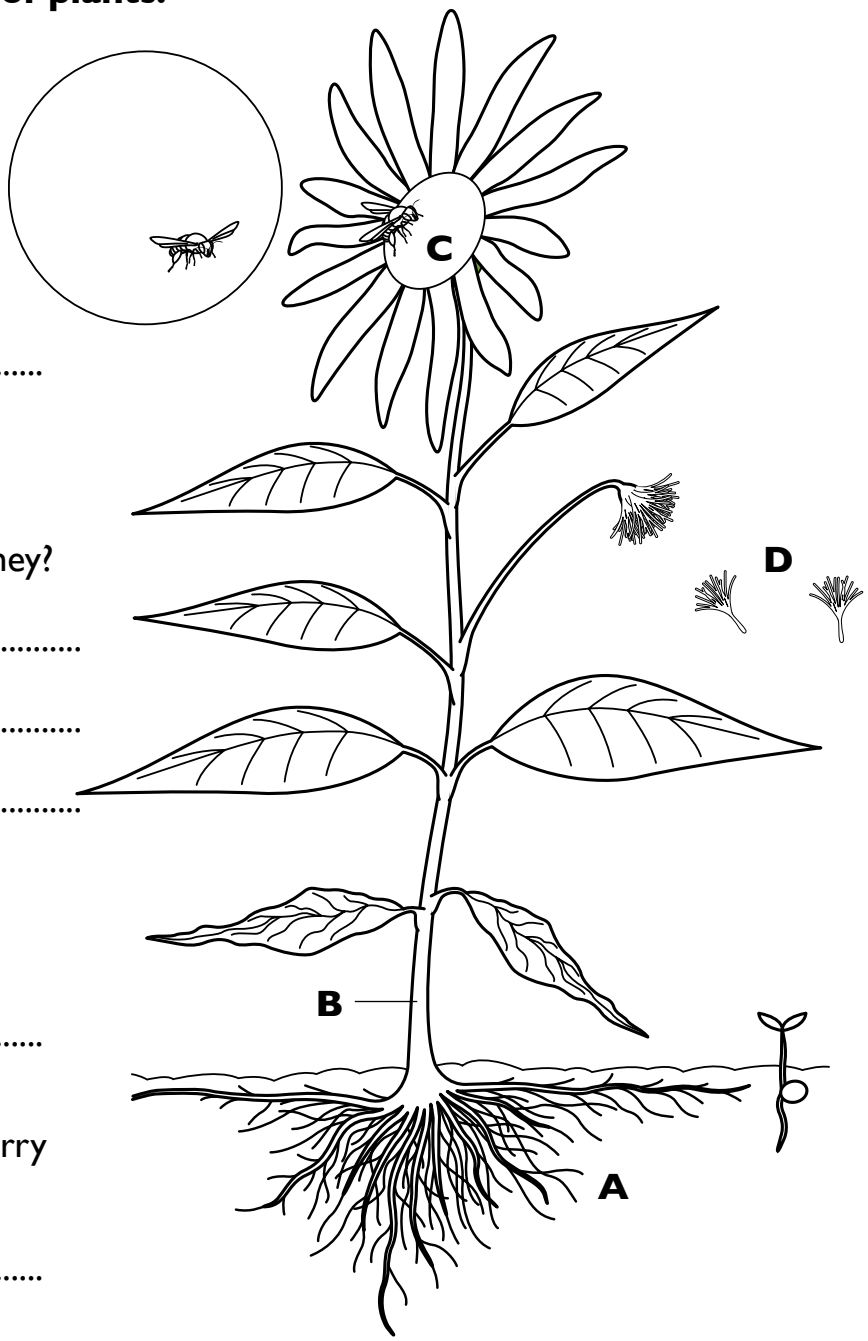
Whilst all the practical activities provide opportunities for observations, some also provide opportunities for completing tables, drawing graphs and scientific modelling. Those practicals marked with an asterisk in the list below provide an opportunity for the students to demonstrate their full range of investigative skills.

1: My plant
2A: Investigating roots
2B: Looking at root hairs
2C: The growth of onion roots*
2D: Roots and gravity*
3A: Investigating celery*
3B: Twigs
4A: Leaf key
4B: Using leaves to tell about seeds
5A: Using a microscope
5B: Looking at cells
5C: Losing water through the shoot*
6: Do plants need light?*
7: Different kinds of flowers
8: Looking at pollen grains
9: Plants without flowers
10: Testing the flight of seeds*
11: The needs of seeds*
12: New plants from old
13: What is living on the leaves?
14: How fast do they germinate?*
15: Making a transect
16: What grows in the grass?
17: What is living on the branches?
18: The pond in a jar
20: How does heat affect growth?*
21: How do cacti conserve water?*

Name: ..... Form: .....

Plants

Plants grow nearly everywhere in the world, both on land and in the sea. The place where a plant lives and grows is called its habitat. Because conditions vary so widely over the world, there are many habitats and many kinds of plants.



Q1. What is the part of the plant labelled A?

✎ .....

Q2. The part of the plant labelled B is the shoot. It has three main parts. What are they?

1 ✎ .....

2 ✎ .....

3 ✎ .....

Q3. What does the part labelled C produce?

✎ .....

Q4. What does the insect carry from plant to plant?

✎ .....

Q5. What is happening at the place labelled D?

✎ .....

.....

Teacher's sheet: Practical

Introduction

You may wish to begin by making the children aware that the surroundings, and even the planet, belongs more to plants than it does to animals. You could do this by saying that if you look out of almost any window you will see at least one kind of plant and maybe more. Ask the children to look out of the window (if appropriate) and tell you the plants that they see. You could follow this by asking them to make a note of the plants they pass on their way home from school or from their own windows at home.

Most of the food we eat comes from plants. You could build on this fact by asking the children to write down a list of plants that they eat. When the list is complete ask them about other foods which may contain food from plants but do not look like plants, such as different types of pasta. Develop this to include bread and pie crusts. You could also ask the pupils to consider what the animals that provide the meat in the diet eat, so that indirectly plants are involved with everything that is on the plate apart from the salt. You could complete this session by presenting the children with a range of everyday fruits and vegetables mixed with some exotic examples and ask the children to identify them.

Read through the spread with the children and relate the numbered paragraphs on page 4 to the diagram on page 5. You may let the children follow up the page references to see how their course on plants will develop. Depending on the age and ability of your class you may wish to stop on reaching paragraph 12, and leave page 5 for later in the work. Alternatively, you may like to go through the whole of the summary now.

At the end of your work you can return to this spread and go through it again with the class to check the knowledge and understanding they have acquired.

Practical work

1: My plant

Each child or group should be given a house plant to care for during their study of plants.

Integrating the practical work

When you have finished reading through the spread tell the children that they are to be responsible for the life of a plant for a few weeks and it is hoped that during that time the plant will thrive and grow.

Extension worksheet

Pages 109 and 110.

Links

This spread links to all the other pages in the book. You may wish to start with the sequence on plant structure beginning on page 6, or life cycles page 16 or habitats page 34.

Background

The first people gathered plants to eat from their environment and moved on when they had harvested all the roots or berries they could find. When people became farmers they grew crops but still supplemented their diet with local wild plants. In time, as civilisations built up in different parts of the world and traded with each other, crop plants were transferred to areas of the Earth in which they had not first developed. For example, the cultivation of citrus fruits began in China but passed to the Mediterranean countries as the trade in silk developed between these two areas. In 1550 citrus fruits were taken to South America from the Mediterranean region and later citrus fruits were taken from China to Australia and South Africa.

The early civilisations also cultivated plants for their beauty. The Egyptians cultivated water lilies and the Babylonians cultivated trees in parkland. Gardens were set up in China and Japan. When the European voyages of discovery began in the sixteenth century, the explorers brought back plants to be studied at the universities. As exploration continued, botanists were sent to collect seeds and plants from different regions of the world and in time these plants were introduced into the gardens of everyone from cottager to aristocrat.

The exploration by botanists continues today, especially in the rainforests, which are being destroyed rapidly. All plants are being examined for ways in which they may be used to improve crop yields and provide medicines.

Using the questions

You may like to use the questions in this worksheet to judge the knowledge and understanding of the children and plan your work accordingly.

Answers

Q1. The root.

Q2. The stem, leaves and flowers.

Q3. It produces seeds.

Q4. It carries pollen.

Q5. The seeds are being dispersed by the wind.

Name: ..... **Form:** .....

My plant

(1) Make a labelled drawing of your plant in this space.

(2) Record the height of the shoot.

✎ .....

(3) Describe any parts which are not green, or are green and have other colours mixed with them.

✎ .....

.....

.....

(4) Where is the plant kept while it is in your care?

✎ .....

(5) Over the time that you care for the plant measure its height regularly and perhaps take photographs of it.

Teacher's sheet: Practical

See **pages 4 and 5** of *The Plant Book*

Resources

A collection of house plants which have care labels. Try to feature plants which produce daughter plants such as the Strawberry Geranium, Spider Plant, Piggyback plant and Good Luck plant. Geraniums with lemon or mint-scented leaves add another dimension to the collection. Living stones are unusual plants (modified leaves) which contrast with other types of plant.

Introducing the work

Give each child or pair of children a plant to care for. This should be over a period of weeks. The children should read the care label and work out a strategy to keep the plant healthy.

They should then complete the early parts of the sheet. They may have to revise their work as the plant grows and comes into flower or develops variegated leaves. The emphasis is on close observation of a plant over a period of time to find that it does change and may be sensitive to the conditions around it.

The children may like to prepare a book about their plant using ICT, and featuring photographs and a line graph of the shoot growth.

Outcomes

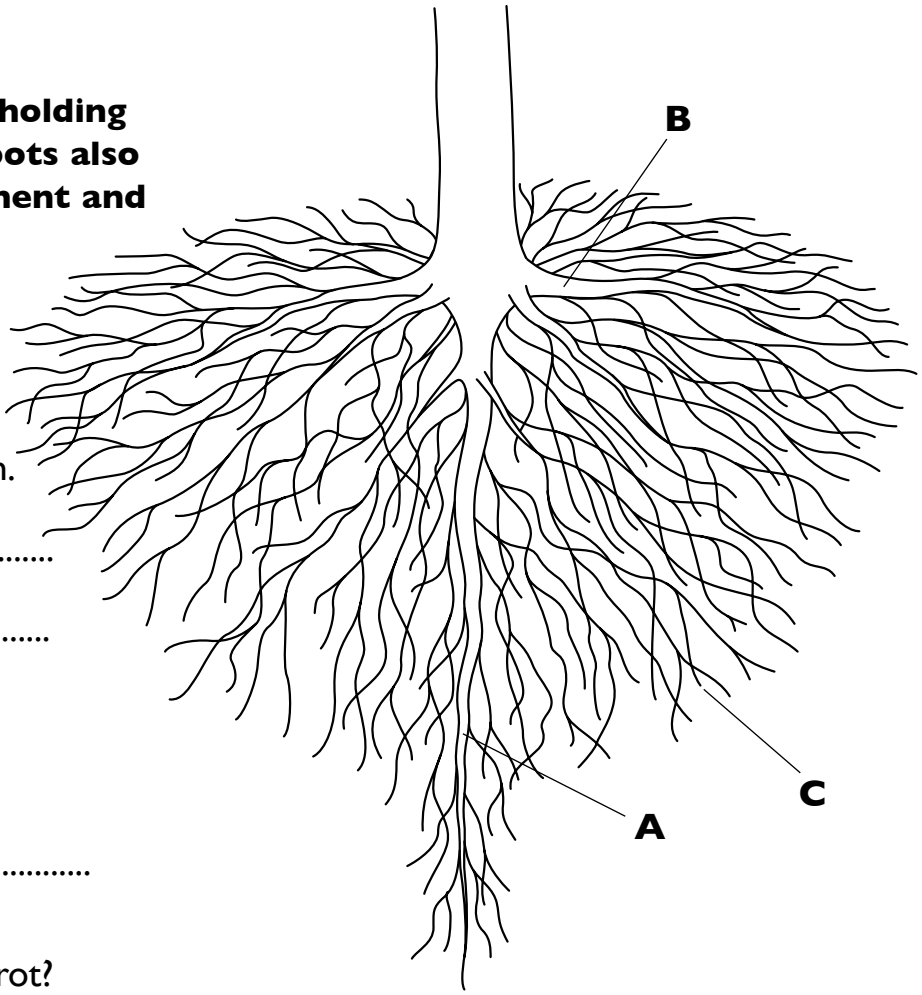
The children:

- Can care for plants by being aware of their needs.
- Can make observations and record them.
- Can take responsibility for the care of a living thing over a long period of time.

Name: ..... **Form:** .....

Roots

The root is like an anchor, holding the plant in the ground. Roots also take in water and nourishment and may also store food.



Q1. (a) Name the parts labelled A and B on the diagram.

A ✎ .....

B ✎ .....

(b) What is found at C near the root tip?

✎ .....

Q2. What kind of root is a carrot?

✎ .....

Q3. What kind of roots does a hydrangea have?

✎ .....

Q4. What happens to minerals in the soil when they meet water.

✎ .....

Q5. How do minerals enter the root?

✎ .....

Q6. Why do the root tips have tough skin on their ends?

✎ .....

Teacher's sheet: Practical

See **pages 6 and 7** of The Plant Book

Introduction

Although plant roots are seldom seen, they are vital to the organism's survival. You may like to show the children a plant that is pot-bound and demonstrate how it can be helped by setting it in a larger pot. Some children may wonder if the plant they are caring for is pot-bound and you may like to let them check. They will need to cover their tables with old newspaper to collect the soil that may fall away.

Practical work

2A: Investigating roots

2B: Looking at root hairs

2C: The growth of onion roots

2D: Roots and gravity

Integrating the practical work

You may like the children to try Practical 2A after reading the first paragraph on page 6.

Practical 2B may be tried after the children have studied diagrams 1, 2 and 3.

Practicals 2C and 2D may be set up at the end of the study of the spread. The children will need time in the following weeks to carry out observations and measurements, and a final session on presenting the results.

Extension worksheet

Pages 109 and 111.

Links

Stems, pages 8–9; **How seeds sprout**, pages 24–25; and the **Habitat** section beginning on page 34.

Background

Roots and anchorage

By growing a large number of roots downwards and outwards through the soil the plant becomes firmly anchored in the ground. There are fibres at the centre of the root which stretch along its length and are resistant to the tugging forces generated by wind and animals on the plant shoot. The positions of these fibres can be easily seen in the cross section and longitudinal section of a carrot.

Tap roots and fibrous roots

Not all plants have a tap root system. A second common system is the fibrous root system. This is best seen in grass, where many small roots grow out from the base of the stem. The roots branch but grow more horizontally than a tap root and in dry weather plants with fibrous root systems are at greater risk of dying from lack of water. Plants with tap roots can find water that is deeper in the soil. Fibrous roots in grass plants form a strong mat which can withstand the trampling of grazing animals and keeps the soil from being blown away.

Adventitious roots

Roots may grow directly out of the side of a stem, as in ivy, or from the base of the stem, as in the onion or the grass plant. Roots which grow this way are called adventitious roots. They perform the same function as the roots in the tap root system.

Answers

Q1. (a) A Tap root, B Side root.

(b) Root hairs.

Q2. Tap root.

Q3. Fibrous roots.

Q4. The minerals dissolve in the water.

Q5. Through the root hairs.

Q6. They protect the root as it burrows through the soil.

Name: ..... Form: .....

Investigating roots

(1) Take a bean seedling that has been growing in a pot and gently empty it out onto newspaper. Carefully remove the soil from the roots and draw them here. Label the tap root and the side roots.

(2) Take a small piece of turf and separate the grass plants in it.

Describe how the grass plants grew together and how it felt when you tried to separate them.

Teacher's sheet: Practical

See **pages 6 and 7** of The Plant Book

Resources

Each group will need a pot which has a small, broad bean plant growing in it. The root system should show a clear tap root and side roots.

The seeds should be germinated about two weeks before the lesson and the plants grown in warm surroundings.

You will also need newspapers to cover the table and collect the soil; a piece of turf from clean waste land (i.e. uncontaminated by dog faeces and litter); and plastic gloves and tweezers (forceps) so the pupils can pull the small piece of turf apart.

Introducing the work

Read through the first paragraph on page 6 and look at diagrams 1, 2 and 4 with the children. Introduce the bean plants, saying that in most plants the roots cannot be seen and we must carefully remove the soil to find out how the roots are arranged. Roots may be studied by examining the tap root system of the broad bean, the fibrous root system of grass and the root hairs of mustard and cress seedlings (see Practical 2B).

Outcomes

Most children can:

- Make an accurate drawing of the root system of the bean and label tap and side roots.
- Describe the way the grass plants are tangled together and are difficult to pull apart.

Background

The fibrous roots of the grass form a strong mat that helps the plants withstand the effect of trampling by grazing animals and prevents soil from being blown away.

Name: ..... Form: .....

Looking at root hairs

(1) Put some sand in a dish and pour some water on it to make it damp.

(2) Put some mustard seeds on the sand and look at them every day to check on the growth of the root.

(3) Make sure that the sand is kept damp as the seeds germinate and the seedling grows.

(4) As the root grows, look at it with a magnifying glass. How many days after germinating do the root hairs appear?

(5) Make a drawing of the seedling with its root hairs.

(6) Look at the root hairs through a magnifying glass and make a drawing of a few root hairs.

Teacher's sheet: Practical

See **pages 6 and 7** of The Plant Book

Resources

Each group will need a dish of sand, a beaker of water, a few mustard seeds. When the seedlings are growing, a magnifying glass will be needed.

Alternatively, you could sow cress seeds on damp blotting paper about four or five days before the lesson and present them to the class for instant study.

Introducing the work

When you have studied diagram 3 on page 6 with the children you could ask them to find out when a root starts to grow hairs by watching a root develop from a seed. You should read through the worksheet with the children and help them plan their investigation. They will need to construct a table in which to record their observations. Each day they make their observations they may need to be reminded to date their work.

Outcomes

Most children:

- Can keep the seedlings damp enough to grow well.
- Can keep a record of their observations and use it to tell when root hairs started to form.
- Can use a magnifying glass to see the root hairs more clearly.
- Can make a drawing of what they see without a magnifying glass (the entire seedling), and with a magnifying glass (a few root hairs).

Background

Each root hair is made from one cell. If you plan to study plant cells you may wish to return to this later and perhaps put some root hairs under a microscope.

Name: ..... **Form:** .....

The growth of onion roots

(1) Fill a bottle with water. Make sure it almost reaches the brim.

(2) Place a small onion on top of the bottle so that its base dips into the water.

(3) Examine the onion and bottle regularly and make sure the water is always touching the base of the onion.

(4) When the onion roots start to appear measure one of them and keep measuring at regular intervals.

(5) Make a table of your measurements here.

(6) Use your data to make a chart or graph.

(7) Plan a way to see how temperature affects the growth of onion roots.
Record your plan here.

✎ .....

.....

.....

Teacher's sheet: Practical

See **pages 6 and 7** of The Plant Book

Resources

Each group will need a small-neck clear plastic bottle, small onion and ruler.

Introducing the work

You may wish the children to try this investigation when you have finished the spread on roots. You may introduce the onion as a plant which has an unusual stem. It is the small disc at the base of the onion bulb. When the stem is brought into contact with water for some time it sprouts roots.

Let the children perform all the tasks except the last one. When they have completed the other tasks ask them to try the last one. You may use this just as an exercise in investigation planning or you may let the children try their plan.

Outcomes

The children:

- Can use simple apparatus safely and carefully when filling the bottle and maintaining the water level.
- Can treat the onion with care as they remove it from the bottle for measuring the root and then carefully return it to the bottle (this will become increasingly difficult as the roots grow.
- Can construct a table and fill it in.
- Can use their data to make a chart or graph.
- Can plan a fair test.
- Can consider risks and hazards in planning their investigation.

Background

The roots which grow from the stem are called adventitious roots.

2

Name: ..... **Form:** .....

Roots and gravity

(1) Look at a broad bean and find the V shape mark made by the position of the root. Use this mark to help you set up the four beans between the wall of the jar and the blotting paper.

Diagram 1

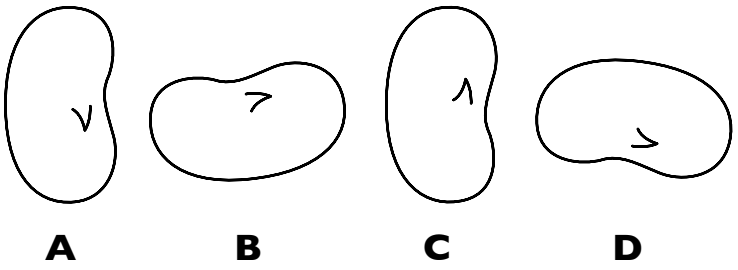
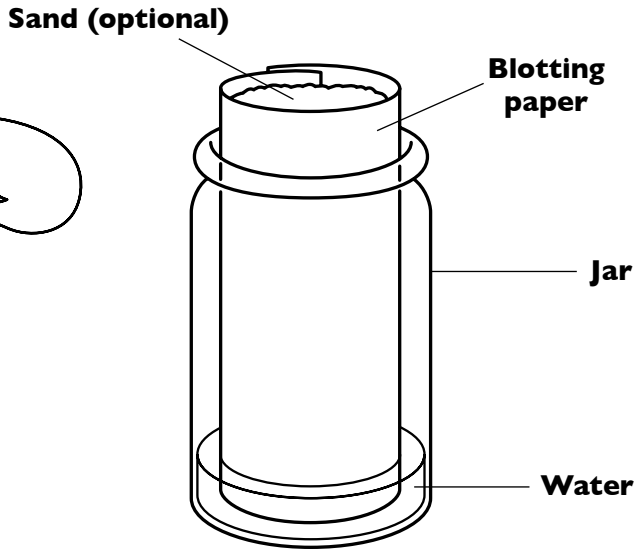


Diagram 2



(2) Put the blotting paper in the jar as Diagram 2 shows. (You may pour sand inside the roll to give it extra strength.)

(3) Place each bean between the wall of the jar and the blotting paper. Put one in each of the positions shown in Diagram 1. The beans should be about half way up the jar and arranged in a circle around the inside of the jar.

(4) Carefully pour some water into the jar. It will rise up the blotting paper so the beans can take it in.

(5) On the back of this sheet, make drawings of each root as it grows out of each bean.

(6) Write down here what happened to each root as it grew.

A ✎.....

B ✎.....

C ✎.....

D ✎.....

Teacher's sheet: Practical

See **pages 6 and 7** of The Plant Book

Resources

Each group will need soaked broad beans, transparent plastic or glass containers, blotting paper, paper clip, sand.

You may like to set up the sand filled tube of blotting paper in the container for the children. You may prefer just to set up the tube of blotting paper without the sand.

Introducing the work

The children should be familiar with gravity from their work on forces and Earth and space. Use this to challenge them to think what might happen if a seed was planted in different positions – would its root always grow down?

Help the children to decide how to use the materials and techniques in this activity and let them plan how they will record their results.

The children may wish to record the root growth with a camera instead of drawings. These must also be dated and used to prepare the written report on the sheet.

Outcomes

The children:

- Can set up simple equipment to perform an experiment.
- Can record results over a period of a few weeks.
- Can provide a written report based on their observations.

Background

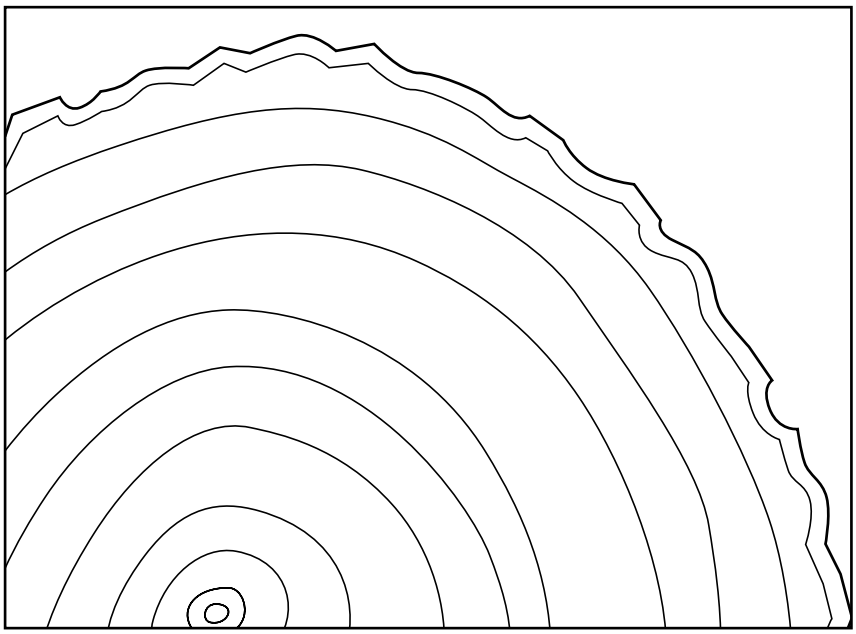
The roots will always eventually grow downwards no matter what the position of the seed. The tip of the root produces chemicals which control growth (hormones). If the root is on its side, for example, the chemicals collect at the lower side and slow down growth. On the upper side where the chemicals are in short supply the growth continues. The effect of having high growth on the upper surface and low growth on the lower surface is to make the tip of the root point downwards. In this position all sides of the root receive the same amount of chemical and grow at the same rate – downwards.

The bean seedlings may be potted and grown to produce leaves and flowers which can be used in activities on growth, flower, structure or life cycles.

Name: ..... Form: .....

Stems

The stem rises from the roots. It carries water from the roots to the leaves and flowers, and food to all parts of the shoot.



Q1. What are the two kinds of stem?

1 ✎ ..... 2 ✎ .....

Q2. In the diagram, find the part which protects the stem and colour it red.

What is the name of this part ✎ .....

Q3. In the diagram, find the part which makes new growth and colour it blue.

Q4. Shade in the part of the stem where the wood is dead.

Q5. Why are there rings in the wood?

✎ .....

.....

.....

Q6. There are two sets of tubes in a stem. What does each set carry?

1 ✎ ..... 2 ✎ .....

Teacher's sheet: Practical

See **pages 8 and 9** of *The Plant Book*

Introduction

You may like to introduce this topic by showing the children a range of stems. You may do this by making a collection of houseplants with different kinds of stems. The following collection could be used here and also in the next topic to show the arrangement of leaves on a stem. Plants with climbing stems – ivy, kangaroo vine; trailing stems – tradescantia, creeping peperomia; plants with upright stems – rubber plant, bay tree, blue gum. Alternatively, the pupils may examine garden plants or wild plants on a field trip.

Practical work

3A: Investigating celery

3B: Twigs

Integrating the practical work

You may wish to introduce the work on the celery stalk after the children have studied diagram 4 on page 9.

Woody shoots have features which help in identification of the plant. You may use this fact to introduce work on keys in a habitat study in winter.

Extension worksheet

Pages 109 and 112.

Links

Leaves, pages 10–11; **Stems that produce new plants**, pages 26–27; **How plants defend themselves**, pages 28–30.

Background

The tubes in the stem

There are two kinds of tubes in a stem. One carries water and minerals from the roots and the other carries food that has been made in the leaves. The tubes carrying water and minerals are made from a tissue called xylem, and the tubes carrying food are made from a tissue called phloem. You may wish to use these terms with older pupils. In the xylem tissue, columns of cells die, their upper and lower cell walls break down and a tube is formed. In the phloem tissue the cells remain alive and are connected to each other by holes in their upper and lower cell walls. These cell walls are called sieve plates.

The water is moved through the xylem vessels (the tubes made by xylem tissue) by:

(1) Root pressure pushing the water upwards.

(2) The suction of water by the leaves due to transpiration. The water moves upwards to replace that lost from the leaves by evaporation.

Woody and non-woody stems

The bark on a woody stem provides an insulating layer which protects the delicate tissues beneath from harsh winter conditions. This allows the stem to remain above the ground throughout the year and not die back like some non-woody plants.

The fibres which provide the supporting strength for the trunk and branches are used in paper making. The wood is made into a pulp and the fibres are made to settle across each other to form a sheet of paper.

Plants with non-woody stems are called herbaceous plants and you may like to use this term with older pupils. They have fibres which provide strength associated with the tubes that carry water and minerals.

Unusual stems

Some plants have stems which climb. The honeysuckle winds in a clockwise direction around branches of other plants. The bramble has prickles on its stem which help it hold onto other plants as it grows over them.

The potato is a stem tuber. The stem grows underground from the base of the shoot. Most of the shoot grows into the air. The iris stem remains underground and sends leaves and flowers into the air. This types of underground stem is called a rhizome.

The stems of grass plants contain silica, which is a mineral. This helps support the stem.

Answers

Q1. Stalks and trunks.

Q2. The outer layer is coloured red. It is the bark.

Q3. The layer below the bark should be coloured blue.

Q4. The centre of the stem should be shaded.

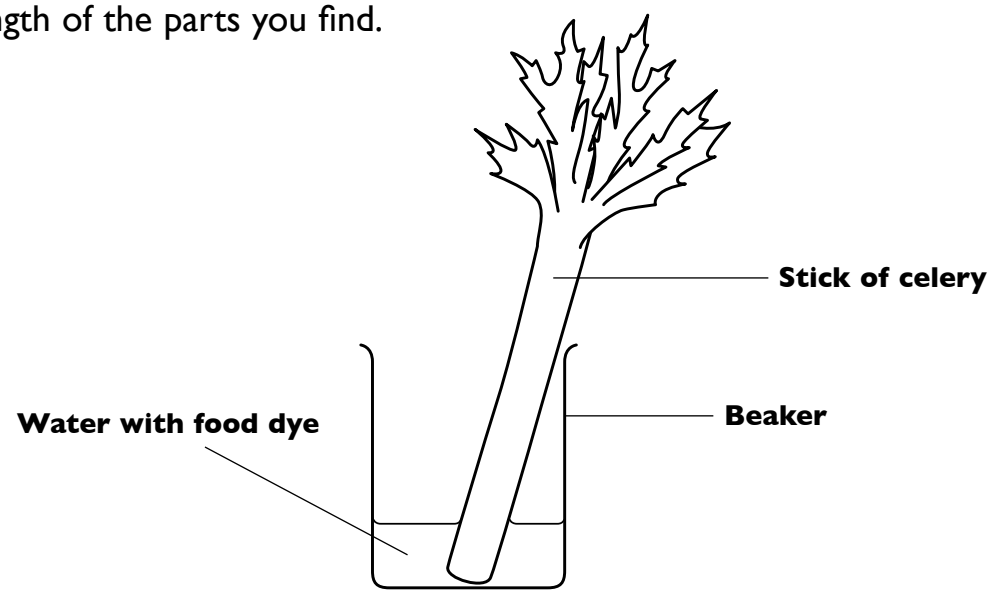
Q5. The wood grows at different rates throughout the year. In spring it grows faster and makes lighter wood. In summer it grows slower and makes darker wood.

Q6. One set carries water up the stem. The other set carries food up to the flowers and down to the roots.

Name: ..... **Form:** .....

Investigating celery

(1) Pull a piece of celery to pieces with your fingers. Describe the shape and strength of the parts you find.



(2) Set up a stick of celery as shown in the diagram above.

Leave it for a few hours, then break it open and look inside.

(3) Describe the inside of the celery stalk or make labelled drawings of what you can see.

(4) What may affect the result of your experiment? Work out plans to test your ideas.

✎ .....

.....

.....

Teacher's sheet: Practical

See **pages 8 and 9** of The Plant Book

Resources

Celery stalks, food dye, beaker, water, magnifying glasses.

Introducing the work

Read through the text on page 8 and make sure that the children are aware that stalks have fibres in them which give strength to the softer material around them. Look at the celery in picture 4 on page 9 and use this information to introduce this activity.

When the children pull a piece of celery to bits they should note that it has stringy bits that give strength and squashed, weaker bits that do not.

The children may say that the amount of leaf on the stalk affects the amount of water that passes through the stalk. They may also say that the temperature or the light may affect it. They can construct plans which feature a fair test to investigate the ideas. If time and resources permit you could let them test their ideas.

Outcomes

The children:

- Can report on observations made.
- Can plan a fair test.

Background

The celery stalk is really a long, leaf stalk. The stem is the disc at the base, as in the onion. However, it is often described as a stem at this level (and above) for the ease of illustrating how water passes through a stem.

Extending the work

You will need an elder twig in leaf, two willow twigs in leaf, ink, and three jars of water.

Show the pupils the cut end of an elder twig and ask them to predict what will happen if the end of the twig is dipped in inky water and the twig is left in a sunny place for two hours. When the twig is examined later, the central woody part will be found to be coloured due to the ink taken up with the water. The softer tissues and the bark around the central woody core will not be coloured, as they do not contain the tubes that conduct water. This shows that water passes up a woody stem.

Then take one willow twig in leaf and carefully cut a ring of bark about three centimetres from the end. Make the ring about one centimetre wide. This will also remove the tubes which carry food from the leaves.

Set up two twigs in separate jars of water. Make sure that the part of the twig with the ring of bark removed is also under water. Tell the pupils that willow twigs grow roots from their cut ends when placed in water but they need food from the leaves to do this. Ask the pupils to predict what will happen in the two twigs.

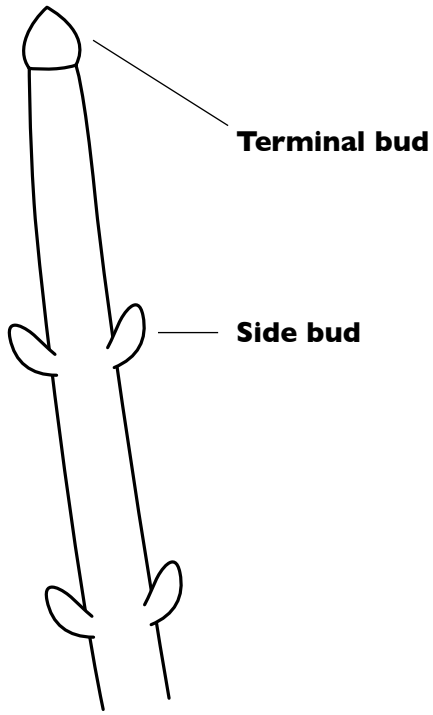
The twigs may take a few weeks to grow roots. The unringed twig will grow roots at its end. The ringed twig will grow roots above the ring and possibly a few short roots at the end. The difference is due to the food in the ringed twig not being able to reach the end of the twig.

This shows that if the food supply is reduced by damage to a plant, growth is adversely affected.

Name: ..... **Form:** .....

Twigs

(1) The diagram below shows the main features of a twig. Look at the twig you have been given. Make a drawing of it in the box and label the parts.



(2) Look at a second twig.

(a) Write down how it is similar to the first twig.

✎ .....

.....

(b) Write down how it is different from the first twig.

✎ .....

.....

(3) Look at a collection of six different twigs and try and construct a key to identify them. Write your key on the back of this sheet.

(4) Ask a friend to try your key and write about how successful they were at using it.

Teacher's sheet: Practical

See **pages 8 and 9** of The Plant Book

Resources

In the autumn or winter make a collection of twigs from broad-leaved trees. The twigs should be long enough to show the arrangement of the buds along the twig. Examples to collect could include oak, ash, beech, maple or sycamore, willow and horse chestnut.

Introducing the work

If you have tried the extension practicals in the previous activity, the children will already be aware of twigs and you can build on this here. If the children have not done the extension practicals, introduce the twig as the tip of a branch. It has many features of a wood stem but does not have the furrowed bark of some tree species.

Present each pupil with a twig. A horse chestnut is large and shows the features clearly, but a sycamore or maple may also be used. Point out the buds and ask the pupils to suggest their function. At the end of the discussion make sure the pupils can differentiate between a terminal bud and a side bud. Point out the relationship between the bud and the leaf scar. Ask the pupils to look for the places where the food and water pipes were connected to the leaf stalks (see below).

Outcomes

The children:

- Can record their observations in the form of a labelled diagram.
- Can construct a key.
- Can use a key.

Background

Stems and buds

A bud develops between a leaf stalk and the stem. This is called the side or lateral bud. At the tip of the stem is a larger bud called the terminal bud. Both types of bud are covered in scales to protect the delicate tissues inside. When a side bud opens, a new branch with leaves and flowers forms. When the terminal bud opens, the end of the stem lengthens and produces new leaves and flowers.

A twig is a part of a branch and not the main stem but it still shows all the features of the main stem. It also has scars which mark the positions of the past terminal buds and leaf stalks.

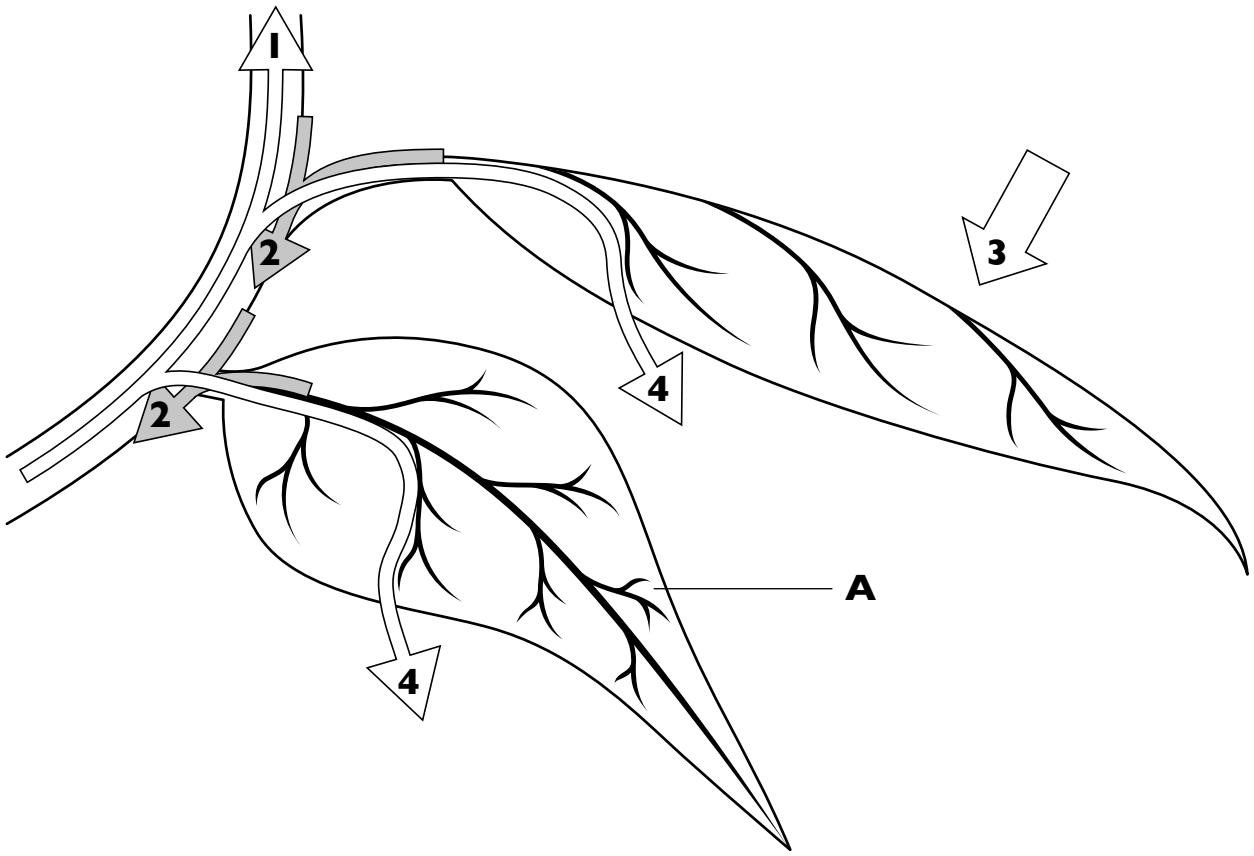
The scar of the terminal bud shows the position of the bud's scales. The scar of the leaf stalks show the position of the food and water pipes.

The colour, shape, size and position of the buds on a twig can be used in the identification of a tree or shrub.

Name: ..... **Form:** .....

Leaves

Leaves are thin blades which soak up sunlight and make food for the plant.



Q1. What is travelling in the direction shown by arrow 1?

✎ .....

Q2. What is travelling in the direction shown by arrow 2? ✎ .....

Q3. What is travelling in the direction of arrow 3? ✎ .....

Q4. What is travelling in the direction of arrow 4? ✎ .....

Q5. What is A? State two of the things that it does. ✎ .....

1 ✎ .....

2 ✎ .....

Q6. How do conifer leaves differ from those shown in the diagram?

✎ .....

.....

Teacher's sheet: Practical

See **pages 10 and 11** of *The Plant Book*

Introduction

Ask the children to look at the plants in their care and describe the leaves. Look for descriptions such as flat, thin, long stalks, short stalks, veins, and the colour of different parts. Ask the children what they think the leaves do. Some may already be certain that they make food. Go through the spread with everyone to check their ideas and help them make discoveries such as water vapour escapes from a leaf, or that leaves have a definite arrangement on a stem.

Practical work

4A: Leaf key

4B: Using leaves to tell about seeds

Integrating the practical work

Use the leaf key opposite to identify trees in the school grounds or nearby park.

Say that plants have one or two leaves in their seeds. They are called cotyledons. Plants that have two seed leaves are called dicotyledons, and use them to store food (you could show the children the cotyledons of a soaked bean). Plants which have one seed leaf, like maize (you could show them the white patch in tinned sweet corn), use the leaf to transport stored food to the plant inside the seed. They are called monocotyledons. However, you can tell the number of cotyledons in the seeds of a plant simply by looking at the plant's leaves, as they have a vein pattern which gives away their secret (see the teacher's sheet on page 38 of this *Teacher's Guide*).

Extension worksheet

Pages 109 and 113.

Links

Inside a leaf, pages 12–13; **How plants defend themselves**, pages 28–29; **Deserts**, pages 44–45.

Background

Monocotyledons and dicotyledons

These are the two groups into which flowering plants are divided. The seed of a flowering plant has either one or two seed leaves called cotyledons. If the plant seed has only one cotyledon it belongs to the monocotyledon group. If the plant has a seed with two cotyledons, it belongs to the dicotyledon group. The possession of parallel veins, or veins in a network, is related to the number of cotyledons in the seed.

Answers

Q1. Water and minerals.

Q2. Food.

Q3. Sunlight.

Q4. Water.

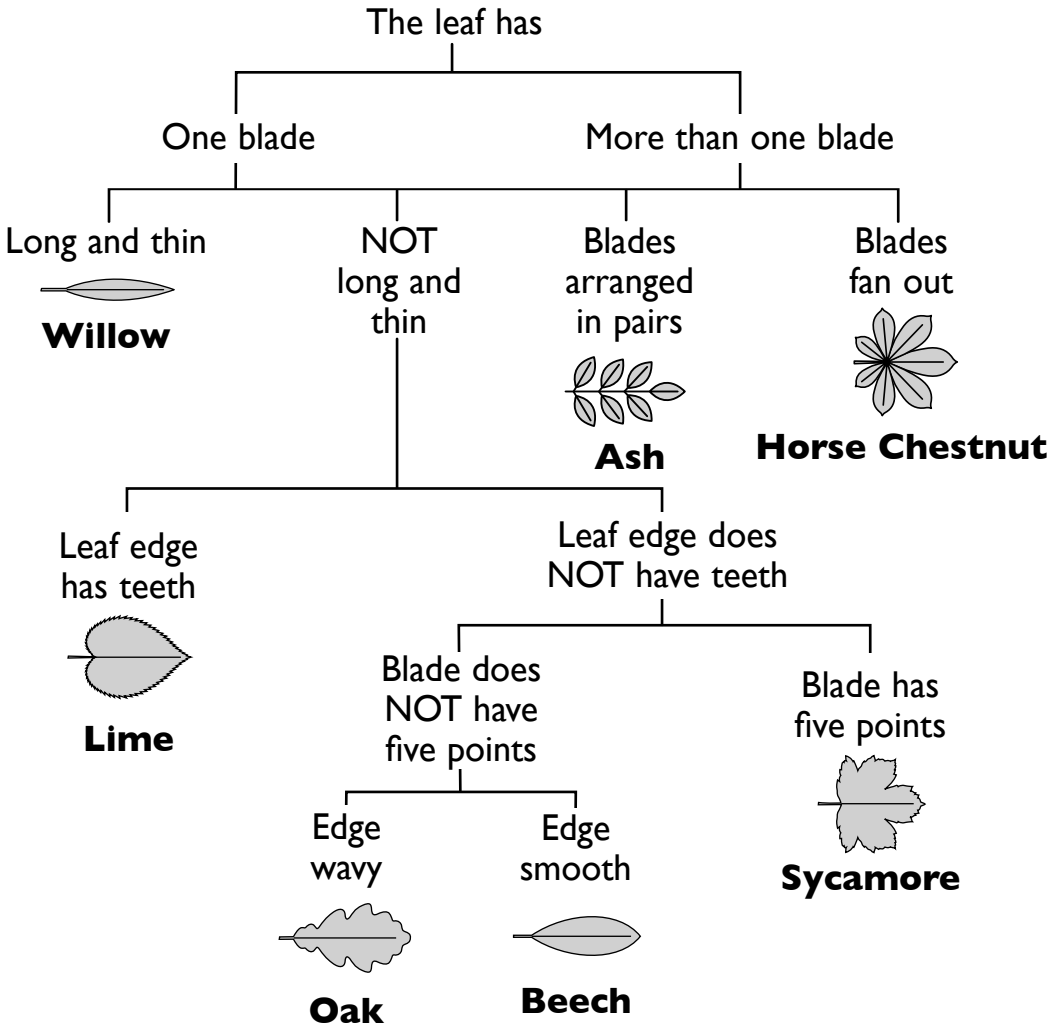
Q5. Vein, supports the leaf blade and carries food and water.

Q6. They have needle-shaped leaves.

Name: ..... Form: .....

Leaf key

(1) Use this leaf key to identify a collection of leaves.



(2) Make a table to record the letter of the leaf and its name.

Teacher's sheet: Practical

See **pages 10 and 11** of *The Plant Book*

Resources

A selection of leaves to be identified by the key. Each kind labelled with a letter of the alphabet.

Introducing the work

Tell the children that the leaves can be used to identify many species of plant, then let them try to identify the leaves in the collection. When they have done this the children could be taken to some trees and asked to identify them using the key.

Outcomes

The children:

- Can use a key to identify leaves in a collection.
- Can use a key to identify trees in a habitat.

Background

Deciduous and evergreen trees

The leaves of broad-leaved trees lose huge amounts of water in transpiration. The water is used for making food and to keep the leaves cool in hot weather. This water loss cannot be sustained in the winter when frozen ground reduces the amount of water that is available to the roots. In response to this the trees lose their leaves in the autumn and grow new ones in the spring when the weather improves. The holly has a thick, waxy surface which reduces water loss and allows the plant to keep its leaves through the winter.

Conifers

The leaves of conifers are mentioned on the spread. Conifers live in regions where snow is common. They have waxy leaves which make it easy for the snow to fall from them and not block out the light for photosynthesis. They are needle-shaped to present a small surface area for the evaporation of water as ground water is in very short supply in freezing winter weather.

Ferns

The huge leaves of ferns are called fronds. They are different in structure from the leaves of conifers and flowering plants because they also produce spores which are an essential feature of fern reproduction (see page 21 of the Students' Book).

Mosses

Mosses have many tiny leaves. They are much simpler in structure than the leaves of conifers and flowering plants. They can take up water from the air.

Liverworts

Some liverworts have simple leaves similar to mosses, other liverworts have a strap-like structure called a thallus.

Algae

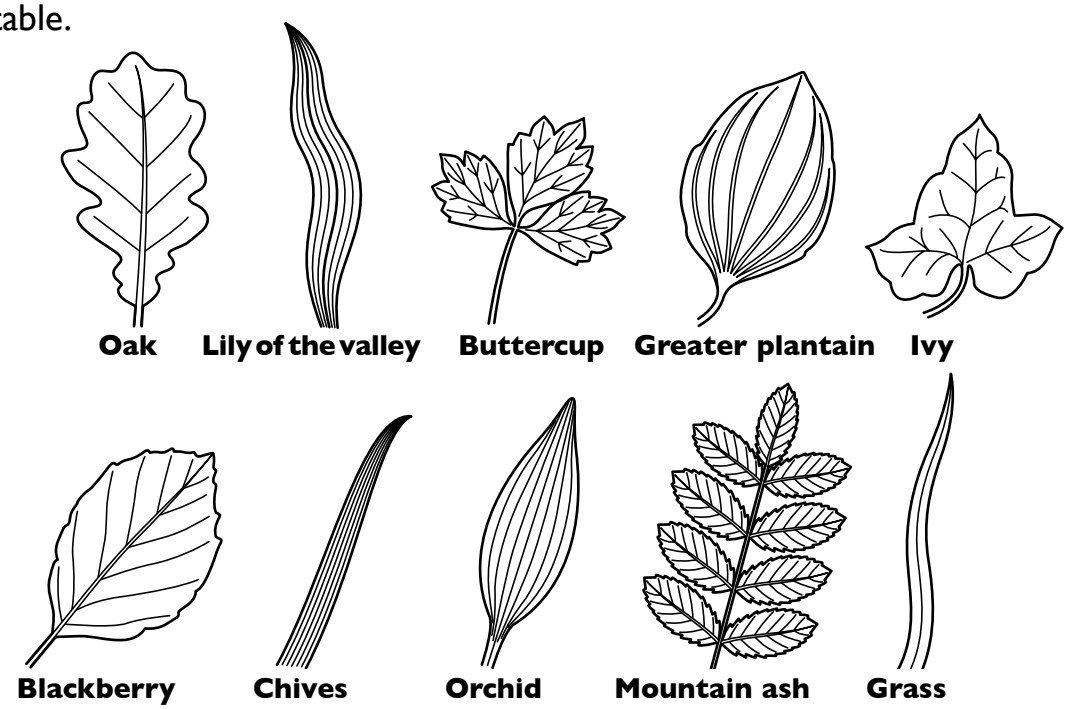
None of the algae (including seaweeds) have leaves.

Name: ..... Form: .....

Using leaves to tell about seeds

(1) A plant with parallel veins in its leaves has one seed leaf in its seed. It is called a monocotyledon. A plant with branching veins has two seed leaves in its seeds. It is called a dicotyledon.

Use this information to sort out the leaves of the plants in the diagram and fill in the table.



	Monocotyledon	Dicotyledon
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

(2) Look at the leaves of the plants in the classroom. Try to sort them into monocotyledon and dicotyledons.

Teacher's sheet: Practical

See **pages 10 and 11** of *The Plant Book*

Resources

The collection of plants in the classroom.

Introducing the work

Tell the children that leaves are a main feature of many plants and are even found inside the seeds of all flowering plants. Some plants have just one leaf inside their seed and use it to transport the food from its store to the developing plant when the seed germinates. Many plants have two seed leaves, which actually swell up with stored food. We eat the food in these leaves when we eat peas and beans. Plants can tell you about the seed leaves with a message in their veins. If the veins are parallel, there is just one seed leaf, but if the veins are branched, there are two seed leaves.

Outcomes

Children can:

- Observe the vein pattern on leaves and make deductions about seed structure.
- Sort flowering plants into their two major groups.

Background

Although the number of cotyledons in the seed is the only definite way to identify a monocotyledon or a dicotyledon, other characteristics can usually be used for identification

Monocotyledons generally have fibrous roots, leaves which grow vertically, parallel veins in the leaves, vascular bundles (the groups of water conducting tubes and strengthening fibres) scattered inside their stem and not arranged in a ring, petals and other flower parts arranged in threes or in multiples of three.

Dicotyledons generally have tap roots, leaves arranged horizontally with a network of veins, vascular bundles arranged in a ring in the stem, petals and other flower parts arranged in fours or fives or multiples of five.

Extending the work

When an onion seed germinates, the cotyledon arches out of the soil and the shoot grows out of it. When a marrow germinates it grows a peg at the top of its root which helps it push off the seed coat. The two cotyledons form green leaves above the soil which help the plant make food. You may wish to sow both these seeds to show the cotyledons in action.

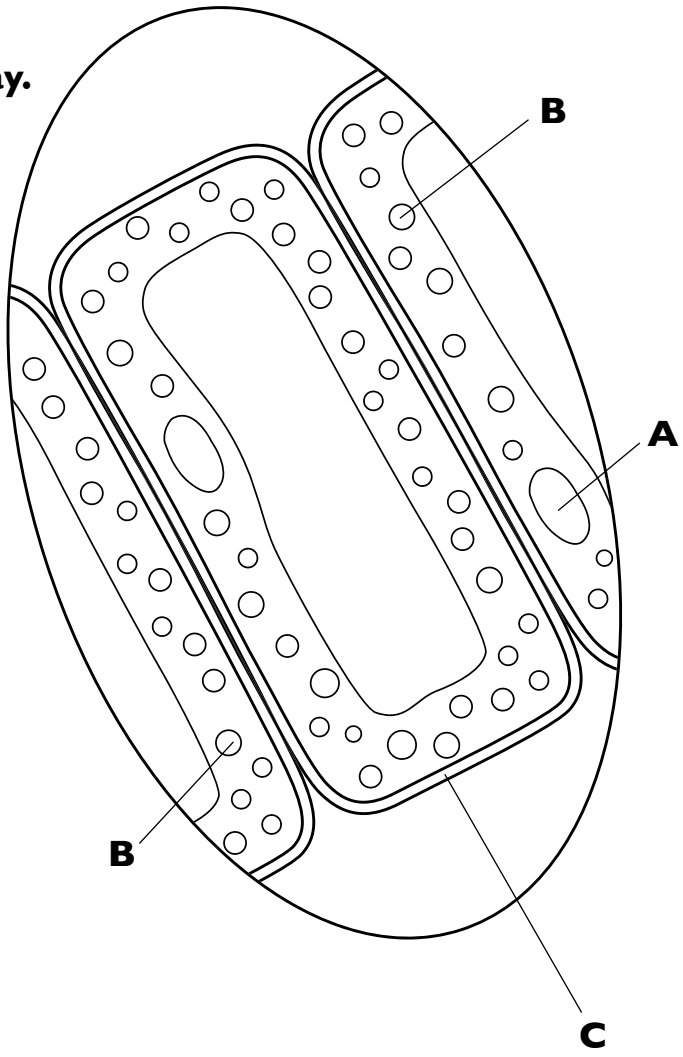
You could also let the children examine a garden or park for monocotyledon and dicotyledon plants.

5

Name: ..... **Form:** .....

Inside a leaf

Leaves are made of several layers.
Each layer has a special part to play.



Q1. (a) What is the structure shown in the diagram?

✎ .....

Q2. What is the name of the part labelled A?

✎ .....

Q3. What is found in the parts labelled B?

✎ .....

Q4. What is the part labelled C made from?

✎ .....

Q5. What are the holes in a leaf called and where are they found?

✎ .....

.....

Q6. What passes through these holes?

✎ .....

Teacher's sheet: Practical

See **pages 12 and 13** of *The Plant Book*

Introduction

You may wish to use this with older or more able children. The children may have heard about cells in connection with the human body. It is important that they realise that plants are also made of cells and this spread provides them with an opportunity to look at cells in connection with food production and the passage of water through a leaf.

Practical work

5A: Using a microscope

5B: Looking at cells

5C: Losing water through the shoot

Integrating the practical work

If the children have not used a microscope before, demonstrate its use and let the children use it to investigate the 'world of roots' – the soil.
When the children have mastered the basics of using the microscope show them how to mount a specimen using a drop of water and cover slip and look for cells.

Extension worksheet

Pages 109 and 114.

Links

Leaves, pages 10–11; **How flowers share pollen**, pages 18–19.

Background

Cells

You may wish to introduce the topic of the cell and the microscope at the same time. The microscope is thought to have been invented by Zacharias Janssen (Holland) between 1590 and 1609. By the middle of the seventeenth century it was widely known among scientists, and in 1665 Robert Hooke (England) used it to examine a thin piece of cork. He found the cork to be made of tiny compartments which reminded him of the rooms called cells in a monastery where the monks worked. He named the compartments cells. The cork cells appeared to be empty. Later, other scientists began finding components inside the cell. In 1831 Robert Brown (Scotland) named the dark spot inside the cell. He called it the nucleus which means 'little nut'.

The cells in a moss leaf

Although the moss is not a flowering plant, it has the same cell structure and its leaves are very thin, so that the cells can be clearly seen under the microscope.

Single celled plants

You may like to take a step further back in time to when algae were the only plants on the Earth. The bodies of many algae are made from only one cell. They occur in huge numbers, colour pond water green and give a bright-green colouring to bark. These organisms are no longer classified as plants but as Protista, a group of single celled organisms which includes amoeba.

Plant and animal cells

Plant cells are different from animal cells in the following ways: they have cell walls made from cellulose; a central vacuole containing water; and dissolved substances such as sugar and minerals.

The organisation in cells

The nucleus contains DNA, which contains the genetic code. All the instructions for the development of the cell are written into the genetic code. There are chemicals called Ribonucleic Acids (RNA) which make copies of the code inside the nucleus, then take them out into the cytoplasm where they are 'read' by tiny structures in the cells called ribosomes. As they read a strand of the code, the ribosomes join molecules together in the cytoplasm to make proteins which are either used to make other cell structures or to make chemicals called enzymes which speed up chemical reactions inside the cell. There are thousands of chemical reactions taking place inside the cell. Photosynthesis and respiration are just two examples.

Answers

Q1. Cell.

Q2. Nucleus.

Q3. Chlorophyll.

Q4. Cellulose.

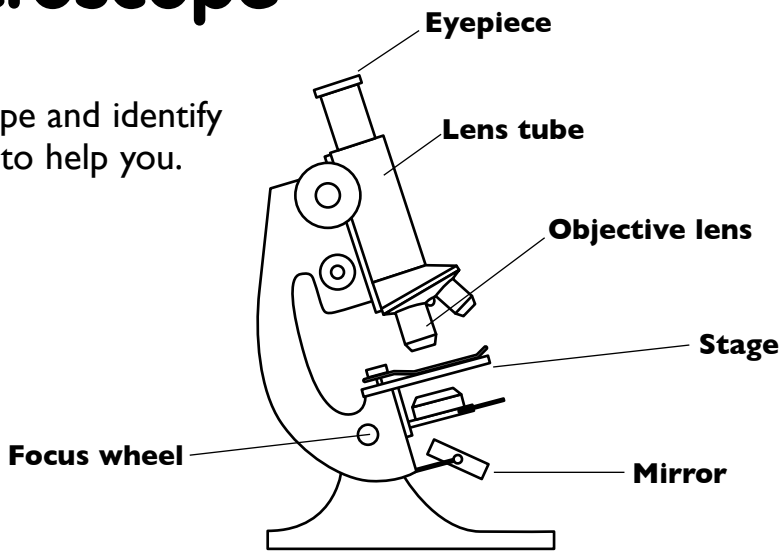
Q5. Pores, the underside of the leaf.

Q6. Air and water vapour.

Name: ..... Form: .....

Using a microscope

(1) Look at your microscope and identify its parts. Use this diagram to help you.



(2) Set up the microscope so that light shines from a lamp onto the mirror and up the lens tube. Check this by looking down the microscope and moving the mirror. When you can see a full circle of light, move on to (3).

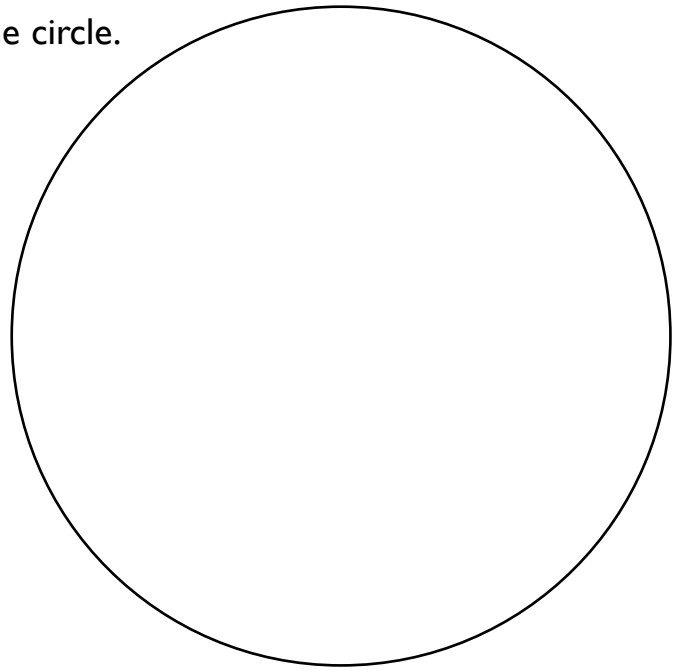
(3) Put a pinch of dry soil on a microscope slide.

(4) Put the slide on the microscope stage.

(5) Turn the focus wheel so the objective lens moves close to the slide.

(6) Look down the microscope and turn the focus wheel slowly, so the objective lens moves away from the slide, until you can see the soil particles come into view.

(7) Draw some of the soil particles in the circle.



Teacher's sheet: Practical

See **pages 12 and 13** of The Plant Book

Resources

You will need a microscope, a slide, a sample of potting compost or a sample of dry soil (from an area where dogs are not allowed to defecate) and a desk lamp.

Introducing the work

Let the children look at the compost or soil and describe what they see. Give the children a magnifying glass and let them look at the compost or soil again and again describe what they see. Tell the children that when two small lenses are put at a certain distance apart they each act as magnifying glasses and make things look even larger.

Show the children a microscope and demonstrate its use.

Let the children use the microscope and describe the 'world of the roots'. They should see particles of different sizes and colours. They may see fibres and even a small insect, mite or worm. This will most probably be a round worm, which is a common soil inhabitant.

Outcomes

The children can:

- Set up a microscope and use it safely.
- Make observations with a microscope.
- Make drawings of what they see down a microscope.

Background

The children should be familiar with using a magnifying glass. You may introduce the microscope as an instrument which has two magnifying glasses or lenses. One lens is in the eyepiece and one is in the lens mounting near the object to be viewed. The lens near the object to be viewed is called the objective lens, or simply the objective.

If the microscope has more than one objective lens make sure the lowest power lens is in position under the lens tube. This will give the widest field of view so you can observe more of the object. Select regions to look at more closely with the higher powered lenses.

Check to see if your microscope is brought into focus by moving the stage up and down, or by moving the mounting which carries the lenses. Some microscopes can be tilted, and children like to do this, but it is not useful for examining loose objects on slides, such as dry soil, as the objects simply fall off. Keep the stage flat.

By moving the mirror while they look down the microscope, they will see how the light from the lamp changes and will learn how to brighten a dim field of view. NEVER USE THE SUN AS A SOURCE OF LIGHT AND KEEP ALL MICROSCOPES AWAY FROM SUNNY WINDOWS. The bright light from the Sun shining on a mirror can seriously damage the eyes.

Let the children put their own soil on the slide and place it on the stage. They will see that the soil particles have to be over the hole in the stage if they are to be seen in the microscope.

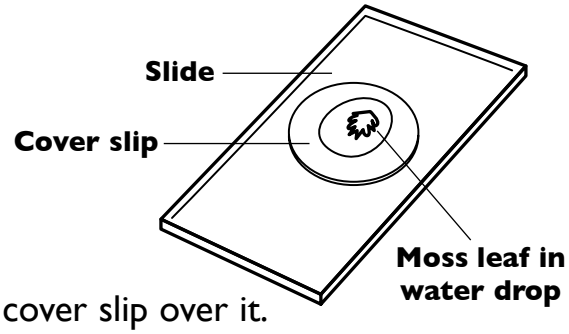
The children should be impressed by the range of colours and shapes in the soil particles. You may like them to look at other types of soil, too.

The children may find that when they push the slide to the left, it appears to move to the right when viewed down the microscope. All movements will appear to take place in the opposite direction due to the arrangement of the lenses in the microscope.

You may like to extend the activity by allowing them to view professionally prepared slides obtainable from secondary school science suppliers.

Name: ..... Form: .....

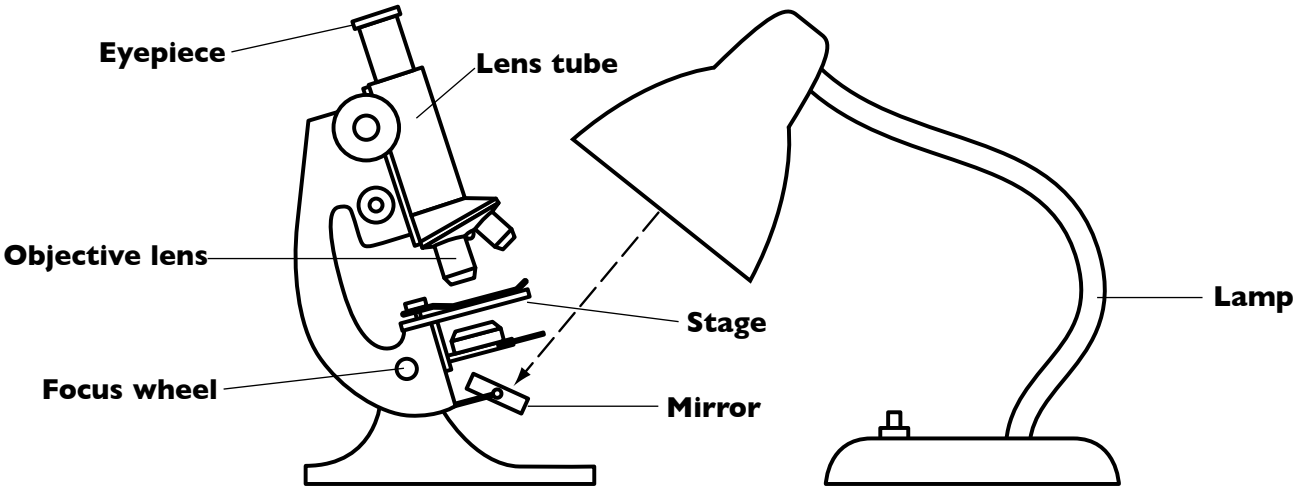
Looking at cells



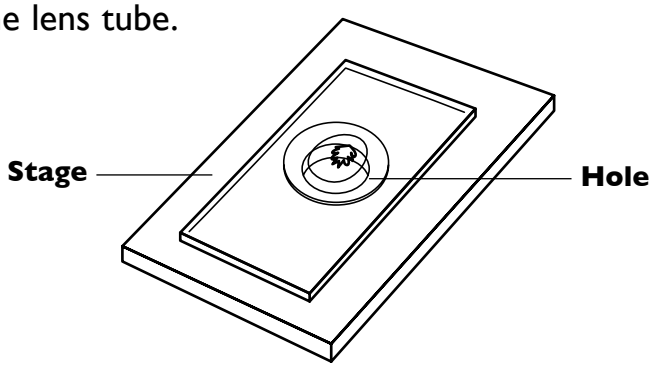
(1) Pull a leaf off a moss plant.

(2) Put it in the centre of a microscope slide.

(3) Put a drop of water on the leaf and place a cover slip over it.



(4) Set up the microscope so that light shines from a lamp onto the mirror and up the lens tube.

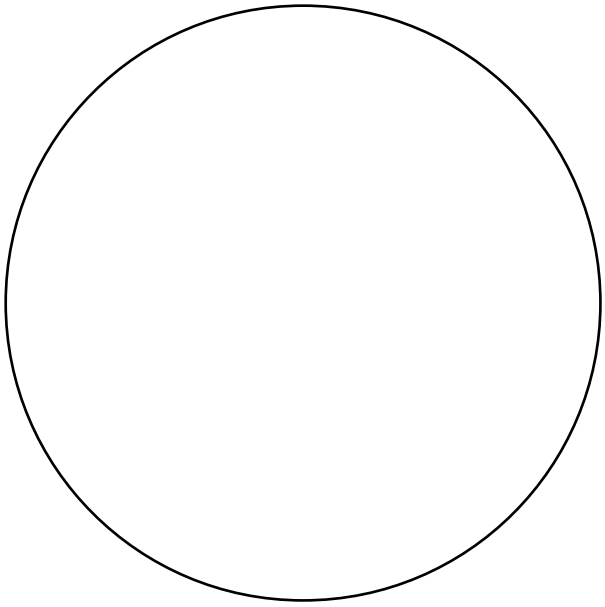


(5) Put the slide on the stage with the leaf over the hole in the stage.

(6) Turn the focus wheel so the objective lens moves close to the leaf.

(7) Look down the microscope and turn the focus wheel slowly, so the objective lens moves away from the leaf, until you see the cells come into view.

(8) Draw some of the cells in the circle.



Teacher's sheet: Practical

See **pages 12 and 13** of The Plant Book

Resources

A microscope, a glass slide, a dropper or pipette, a cover slip, a jar of water, a moss leaf, a pair of forceps, a mounted needle or a pencil. Do not use the large moss called Polytrichum found in woods. Other mosses found on walls are suitable.

Introducing the work

Tell the children that cells are so small that a microscope which has two strong lenses is needed to see them. Also, the cells need to be well lit and the light needs to shine through them. The material in which the cells are found needs to be very thin so that the light can shine through it. Although flowering plant leaves are very thin, they still stop light passing through them, so even thinner leaves are needed to look at the cells. The moss leaf is thin enough to let light shine through it and for the cells to be seen. The leaf will have to be removed using a pair of forceps. If this is proving difficult, a few leaves from the tip of the stalk may be removed and examined.

There is a special technique for examining cells in living things. It is called a wet mount. The specimen is placed in the centre of a slide and a drop of water is placed on it from a dropper. A cover slip is then carefully lowered onto the drop so that no air bubbles are trapped. This is best done by placing one edge of the cover slip on the slide and lowering the cover slip down over the water drop with a mounted needle or a pencil.

Under the microscope, the cells walls, the nucleus and the structures which contain the chlorophyll (the chloroplasts) can be seen.

Outcomes

The children:

- Can prepare a specimen for examination under the microscope.
- Can use a microscope safely to examine a specimen.
- Can make a drawing from their observations using a microscope.

Extending the work

Onion cells

You will need a microscope, a glass slide, a dropper or pipette, a cover slip, a jar of water, a pair of forceps, a mounted needle or a pencil, an onion, a scalpel or sharp knife, an old glazed white tile.

Preparation of the slide

You may wish to demonstrate the following procedure and let the children look at the slide you have made. Afterwards you may let the more able children try the technique under your close supervision.

Cut open an onion and pull off one of the outer leaf bases. On the inner wall of the leaf base is a silvery skin which you can pull off with a pair of forceps. The skin forms a translucent membrane. Place the skin on the tile and cut out a small square about one centimetre and place the square on a microscope slide. This may need some practice as the skin tends to fold upon itself very easily. When the square is in position in the centre of the slide, place a drop of water over the top. Place the slide on the microscope and examine first with low power. The cell walls will be clearly seen, and a grey patch in each cell marks the position of the nucleus.

Guard cells in lettuce

Soak a lettuce for a few hours before the demonstration so that it is crisp. Select a stiff lettuce leaf and bend it back to break open the skin or epidermis. Pull off a strip of the skin and mount it in water on a slide, then cover it with a cover slip. Examine it under the microscope and look for stomata, which will have guard cells in a 'banana' shape. If you wish to demonstrate the guard cells when the stomata are closed, take another piece of skin and mount it on the slide using a drop of salt water.

Starch grains

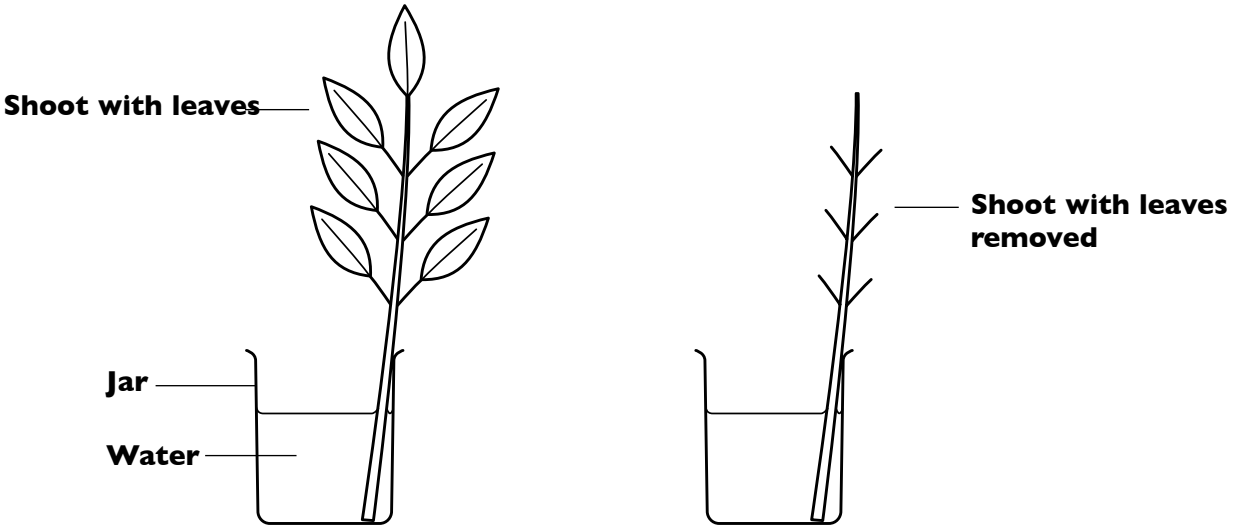
You may like to extend the idea that cells contain structures that help them perform particular tasks. For example, the children will have seen that a moss leaf has structures containing chlorophyll, which helps make food. The parts of some plants have cells which contain starch grains. They are stores of food.

Cut a block of potato about 1.5 cm by 0.5 cm by 0.5 cm and cut a very thin slice from one end. The slice should be as translucent as possible. Put the slice on the centre of a slide and focus on the thinnest edge. You should be able to see the cells containing starch grains.

Name: ..... Form: .....

Losing water through the shoot

(1) Does a shoot lose more water through its leaves or its stem? Set up two shoots like those in the diagram below and find out which loses the most water.



(2) Make a table for your results and fill it in as you carry out the investigation.

(3) What features of a habitat may affect the way a shoot loses water? Write them down.

✎ .....

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(4) Take one feature and plan an investigation to test it.

✎ .....

.....

Teacher's sheet: Practical

See **pages 12 and 13** of The Plant Book

Resources

Two shoots of similar size from the same kind of plant. Remove the leaves from one shoot. Two jars or beakers, a measuring cylinder or top pan balance, felt tip pen, ruler.

Introducing the work

Remind the children that leaves have small pores through which they lose water. Remind them that the stem is also covered with a skin that may let water pass through it. The purpose of the exercise is to compare water loss from the two parts of the shoot.

Let the children decide how they are going to measure the water loss. This could be by marking the water levels at the beginning of the test and measuring the fall of the water level or measuring the volume of water that has to be added to return to the original water level. It could also be measured by measuring the loss in weight of the shoot and container of water.

The children (with your help) should identify the effect of warmth and wind on water loss. A third factor is the humidity of the air, but this can be left until later in the children's school career.

Outcomes

The children:

- Can perform an investigation from the basis of an idea suggested to them.
- Can identify factors which affect the water loss of a shoot.
- Can plan an investigation to test an idea.
- Can carry out an investigation to test an idea.

Background

The layers of the leaf are: the epidermis which is covered in wax, the palisade tissue made from block shaped cells stood on their ends, the spongy mesophylll layer made from round cells with air spaces, and a lower epidermis with pores.
Plants secrete a layer of wax on the surface of their leaves. It prevents water entering the leaf but also prevents water escaping in an uncontrolled way. The waxy surface in conifers prevents large amounts of snow sticking to them and blocking out the sunlight, thus preventing photosynthesis.
The cells in the epidermis are transparent and do not have chloroplasts. Their purpose is to form a protective layer. Light passes through these cells to the cells inside the leaf.

Most plants hold out their leaves horizontally so the chloroplasts are concentrated in their upper surface nearest the light. The shape of the palisade cells allows them to pack closely together and, as they contain large numbers of chloroplasts, a huge layer for trapping sunlight is formed. In plants which hold their leaves vertically, the palisade tissue develops on both sides.

The spongy mesophyll cells play an important part in drawing water up into the plant. If they had shapes which allowed them to be tightly packed, there would not be any air spaces for evaporation from their surfaces.

The guard cells can control the amount of water vapour leaving the leaf, but the stoma also need to be open for the exchange of gases in photosynthesis and the need to photosynthesise may be greater than the need to conserve water, so the stomata stay open and the plant wilts.

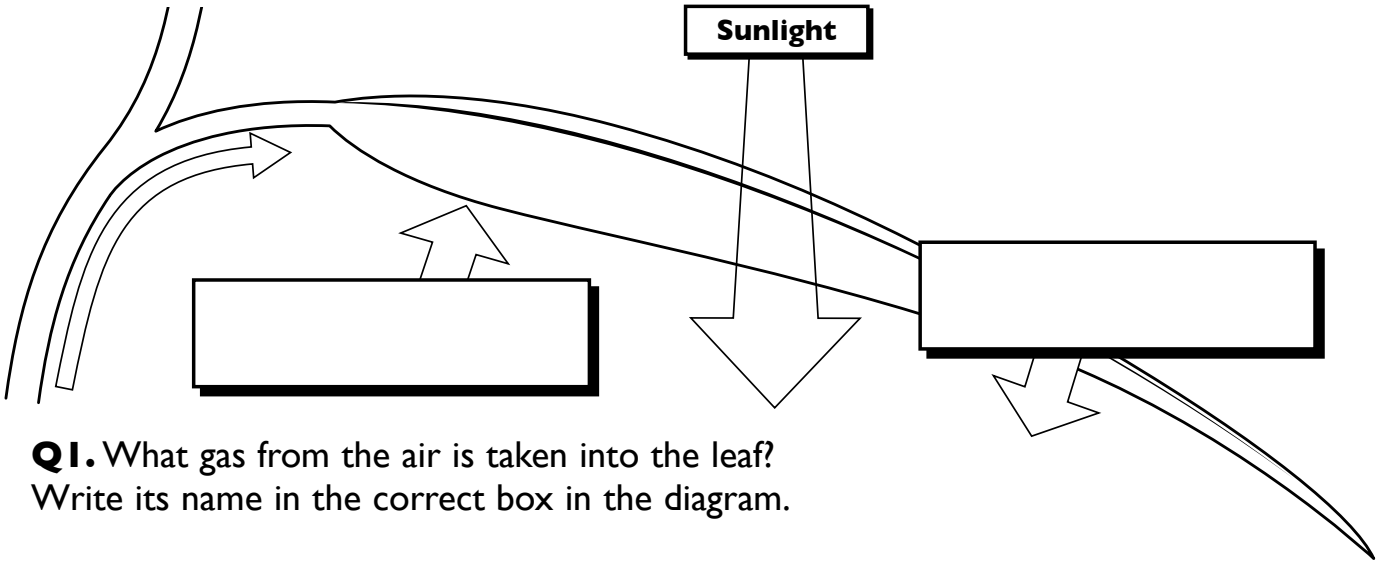
The mechanism by which the guard cells change shape is not completely understood, but the cells have a thicker wall towards the opening of the stomata. When they take in water and swell up, the thicker wall makes the whole cell bend into a banana shape. When the cells lose water they become straight. When salt water is used in the demonstration it removes the water from the guard cells by osmosis.

Food is stored in plants in the form of starch. This substance is insoluble and therefore does not form a concentrated solution like sugar, which can affect the water passing in and out of the cell by osmosis. Sugars are made in the leaves by photosynthesis and converted to starch in the leaves during the day. At night the starch is broken down into sugar and transported by the phloem tissue to more permanent storage organs – if the plant possesses them. In the potato plant, the sugar is transported from the leaves to the tubers, where it is converted back to starch and stored as grains in cells. Later, when the tuber forms a new plant on its own, the starch is turned back to sugar and used in respiration to release energy for plant growth.

Name: ..... Form: .....

How leaves make new tissue

Each part of a part – leaves, stems, roots and flowers – is made from tissues. The cells that make the tissues are produced from sunlight, air, water and dissolved minerals.



Q1. What gas from the air is taken into the leaf?
Write its name in the correct box in the diagram.

Q2. What gas does the leaf produce? Write its name in the correct box in the diagram.

Q3. What does the plant use in sunlight to make food?

✎ .....

Q4. What colour is chlorophyll and how does it help the plant make food?

✎ .....

Q5. What is the name of the food that plants store in their roots.

✎ .....

Q6. How important is the food-making process in plants? Explain your answer.

✎ .....

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Teacher's sheet: Practical

See **pages 14 and 15** of *The Plant Book*

Introduction

This spread brings together aspects of previous work and introduces the gas exchange that takes place when food is produced. You may wish to begin by reminding the children of the role of roots in taking up water and minerals, and that leaves have pores which open and let out water vapour to draw water up the stem. Water vapour is a gas and, just as it can move freely through the pores, so can other gases. During the day plants take in large amounts of carbon dioxide and produce large amounts of oxygen. Using radioactive materials, scientists have discovered that the carbon in the carbon dioxide plants take in is used to make food and new tissues in the plant. They have also found that water (which is made from two chemicals, hydrogen and oxygen) is broken up inside the leaf and that one part of it (hydrogen) is used to make food and new tissues, and the oxygen escapes from the leaf as a gas.

Practical work

6: Do plants need light?

Integrating the practical work

When the children have studied the spread they should be able to predict what may happen if light is not present. They should also be able to give a reason based on their scientific knowledge and understanding.

Extension worksheet

Pages 109 and 115.

Links

Leaves, pages 10–11; **Inside a leaf**, pages 12–13; **Stems that produce new plants**, pages 26—27.

Background

Photosynthesis provides food for plants and oxygen for animals and plants. Animals use the oxygen during respiration, which is a process in which energy is released from food. The energy is used to power the life processes which keep an animal's body alive. It is important to realise that the process of respiration also occurs in plants. It occurs at the same time as photosynthesis, and also throughout the hours of darkness. Plants respire all the time, just like animals. In the daytime, photosynthesis produces far more oxygen than the plant can use, so it is released. Photosynthesis requires far more carbon dioxide than the plant produces during respiration, and so the plant takes in the extra carbon dioxide it needs from the air.

Answers

Q1. Carbon dioxide.

Q2. Oxygen.

Q3. Energy.

Q4. Green, traps energy.

Q5. Starch.

Q6. Very important. Without it there would be no food or oxygen for plants and animals.

Name: ..... Form: .....

Do plants need light?

(1) How do you think the amount of light may affect plant growth?

✎ .....

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(2) What kind of plants would you use to investigate question (1)?

✎ .....

(3) How would you set up the plants to test your idea?

✎ .....

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(4) How would you compare the plants to check for differences?

✎ .....

.....

(5) When would you make your comparisons?

✎ .....

(6) How will you record your results?

✎ .....

.....

(7) How long would the investigation take?

✎ .....

Check you ideas with your teacher, and if your teacher approves, try your investigation.

Teacher's sheet: Practical

See **pages 14 and 15** of The Plant Book

Resources

Soaked seeds such as peas or beans which are about to germinate, pots and compost, or seedlings already in pots. A selection of pieces of cardboard (preferably black), tissue paper, sticky tape and scissors.

Introducing the work

The children may have done some work on the effect of light earlier in their school career so spend some time checking their experiences, and their ability to link what happened to their knowledge and understanding. This worksheet provides some structure to the planning of an investigation and may be used as an example of how the children should think about a problem and turn it into an investigation.

In their answers to the questions on the sheet look for:

(1) Plant growth is stopped when light is not present. This may be followed by an explanation involving the process of photosynthesis, although it does not need to be mentioned by name.
(2) Small plants that are ready to grow.
(3) Cardboard boxes (or a cupboard), some plants in light for fair test, some may suggest a box with layers of tissue paper to provide intermediate amounts of illumination.
(4) Measurements and observations of colours and shapes.
(5) Every few days.
(6) Measurements recorded in tables, descriptions, dated paragraphs.
(7) A few weeks.

Outcomes

Children can:

- Make predictions based on scientific knowledge and understanding.
- Plan an investigation involving a fair test.
- Carry out a fair test.
- Evaluate the results against predictions made.

Extending the work

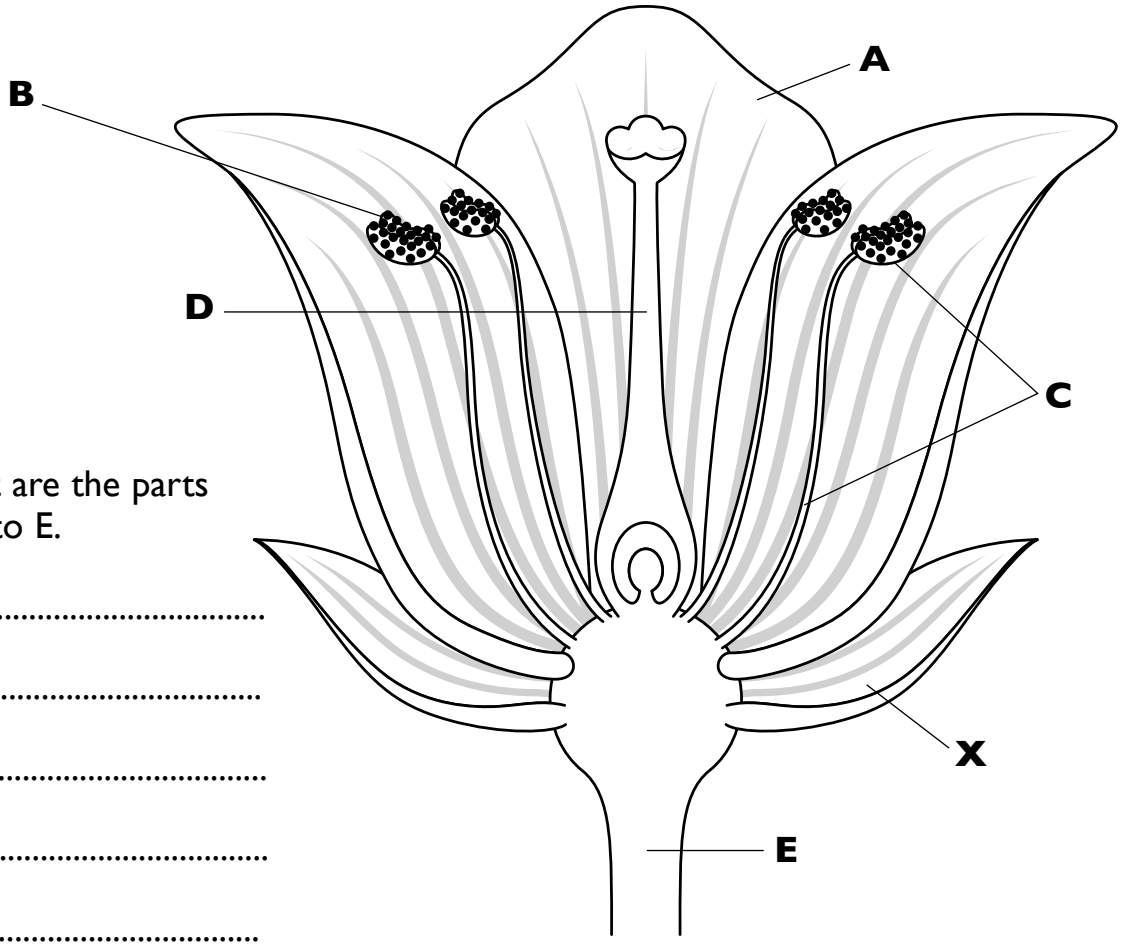
You will need a bunch of Canadian pondweed, a deep jar, a funnel, a test tube.

Put the pond weed in the bottom of the jar. Invert the funnel over it. Fill the jar so that the water completely covers the funnel. Fill a test tube with water. Put a cover over the end, invert the test tube and put the lower end under water. Remove the cover and put the test tube over the funnel. Leave the jar in a sunny place and bubbles of gas will soon collect inside the funnel, then move up into the test tube. In time the test tube will almost fill with gas. If you remove the test tube carefully, and plunge a glowing splint into it, the splint will relight, showing that oxygen is present. You may like to set up several of these in case you fail to remove the test tube without losing the oxygen the first time you try.

Name: ..... Form: .....

Flowers

Flowers develop from buds on the stem. They are designed to attract insects, birds and bats and so are often colourful or scented.



Q1. What are the parts labelled A to E.

A ✎ .....

B ✎ .....

C ✎ .....

D ✎ .....

E ✎ .....

Q2. Shade in the place where a seed will develop.

Q3. What does the leaf labelled X do?

✎ .....

Q4. Where are the parts labelled B made?

✎ .....

Q5. Which part of the flower only lasts a short time?

✎ .....

Teacher's sheet: Practical

See **pages 16 and 17** of The Plant Book

Introduction

The children may need reminding that not every plant produces a flower. Moss on a wall, or ferns growing in the shade, never produce flowers. The plants that do, belong to the flowering plant group. Each flowering plant has a time when it comes into flower. At other times it may be producing fruit, resting or growing new flowers in its buds. Introduce the flower as the part of the plant concerned with reproduction. In this process pollen has to move from one flower to another of the same type. Many plants produce flowers which are attractive to animals so the animals can help transfer the pollen.

Practical work

7: Different kinds of flowers

Integrating the practical work

After the children have studied the spread introduce them to the practical work.

Extension worksheet

Pages 109 and 116.

Links

How flowers share pollen, pages 18–19; **Seeds and spores from non-flowering plants**, pages 20–21.

Background

The parts of a flower

The flower can be thought of as a compressed stem. Each part, from the sepal (the part that protects the flower in bud) to the ovary (where the seeds grow) is formed from highly modified leaves.

Sepal

The tissues from which the flower forms in the bud are very delicate, and the sepals offer a tough protective coat, especially from winter conditions, but also from insects and fungi. The sepals may fall away when the flower opens, or persist right through to food formation, as in the tomato. The spidery stalk of the tomato is made by the sepals.

Petal

Petals may release scents from their surfaces. They may also have dark or coloured lines called honey guides which lead insects towards the nectaries.

Nectary

The nectaries may be at or near the base of the petal. They produce nectar, which is a solution containing sugar. It provides the insects with a high energy drink which can help them to fly. The solution does not contain protein, so the insects cannot use it for the repair of their tissues. Bees get their protein from pollen and may live for many days once in adult form. Butterflies and moths feed only on nectar and usually only live a few days as adults (unless hibernating) before their bodies wear out.

Stamens

It is usual to introduce the male component of the flower as the stamen, then to differentiate its parts – the anther, which produces the pollen, and the filament that supports the anther. In insect pollinated flowers, the filaments are sturdy structures which can withstand the insects clambering about in the flower after the nectar. In wind pollinated flowers, the filaments are long and slender and allow the anther to hang outside the flower and rock on the air currents to release its pollen.

The female part of the flower

This is at the centre of the flower. It may be made up of a number of carpels, as in the buttercup, which give the centre of the flower a knobbly appearance. Carpels join together to form a larger, bottle-shaped structure. This has the same parts as a smaller individual carpel – stigma, style and ovary. This is the structure that is usually used first in flower studies as the components are easier to see.

Answers

Q1. A Petal, B Pollen, C Male part, D Female part, E Stalk.

Q2. The oval in the female part should be shaded.

Q3. Protects the flower by covering it when it is in the bud.

Q4. In C, the male part.

Q5. A, the petals.

Name: ..... Form: .....

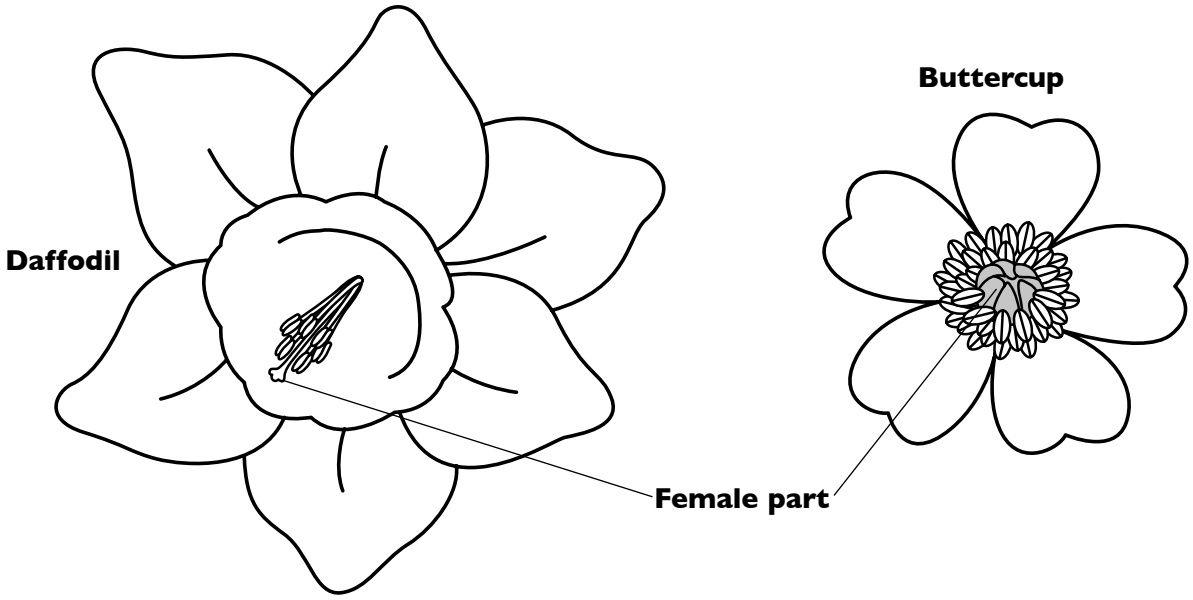
Different kinds of flowers

(1) Look at a flower and see if it has any small leaves below the petals which cover the bud. These small leaves are called sepals.

(2) Count the number of petals. See if the petals have any lines on them which guide the insect into the flower. These lines are called honey guides.

(3) Count the number of stalks which form the male part of the plant. These parts are called the stamens.

(4) Look in the centre of the plant for the female part. It may be just one thick stalk which is larger than a stamen, as in the daffodil, or it may be a spiky lump, as in the buttercup.



(5) Write down a description of the flower from your observations.

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(6) Look at the flowers of some different plants.

Make notes about the flowers that you think might help someone identify them.

Teacher's sheet: Practical

See **pages 16 and 17** of The Plant Book

Resources

A wallflower or similar plant. A selection of plants with large flowers. Flowers from wasteland, as an example of flowers found in a particular habitat.

Introducing the work

Let the children look at a flower and examine it with a magnifying glass. Show them the parts and then let them find the parts on their flowers. Discuss the arrangement of the parts with them and get them used to using words such as stamen and sepal. Provide the children with a selection of flowers and let them make their descriptions.

Outcomes

The children:

- Can make observations on flower structure.
- Can make written descriptions of their observations.

Background

The wallflower has four sepals, four petals, six stamens and a central carpel or female part.

Some flowers are not just one flower, but a large collection of smaller flowers. The dandelion and daisy are examples of this type. The collection of small flowers is called a flower head. Each small flower is called a floret. In the dandelion, each floret has both male and female parts. In the daisy, the outer flowers have a white petal and female reproductive organs, while the inner, yellow flowers have both male and female parts.

Some plants produce flowers on single stalks, as in the daffodil, other have a column of flowers on one stalk, as in the lupin, while yet others have flowers in clusters, such as the parsley.

Extending the work

Florets

The children could pull a dandelion head to pieces and discover how many florets are present. Each floret has one strap-like petal. Ask the children to compare the size of the florets with their position on the flower head. They will discover that the larger florets are at the rim of the flower head.

Modified leaves

You will need carnation flowers, a beaker, water and food dye.

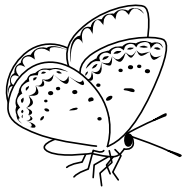
All parts of the flower form from modified leaves. You can remind the children of this fact by showing how petals can draw up water, just like leaves. This can be done by placing the stem of one white carnation flower in a solution of water and water-based ink or food colouring and letting the water rise. As the water rises, the colour of the flower changes.

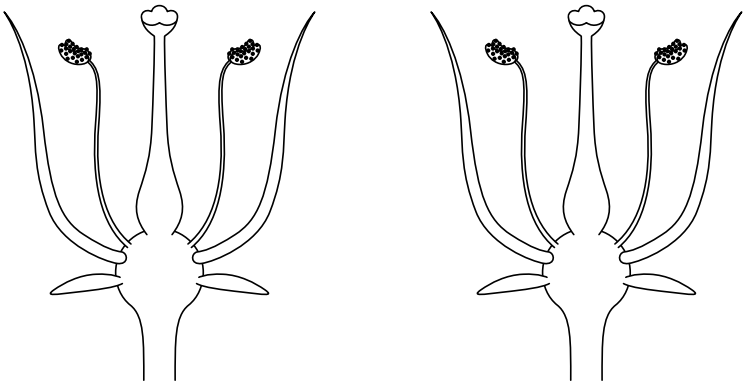
You could challenge the children to predict what would happen if the stalk was split lengthways and one half was dipped in water of one colour while the other half of the stalk was dipped in water of a different colour. (Answer: a two-colour flower is produced, as the water-conducting tubes on one side of the stalk serve the petals on the same side of the flower.)

Name: ..... Form: .....

How flowers share pollen

Plants make pollen so that they can produce new offspring. Before the offspring can be formed, the pollen must move from one plant to another in a process called pollination.





Q1. Draw arrows on the diagram to show the path of pollen between the two flowers.

Q2. Name three things that could attract the butterfly to the flowers.

1 ✎ .....

2 ✎ ..... 3 ✎ .....

Q3. How are the flowers of wind pollinated plants different from the flowers of insect pollinated plants?

✎ .....

.....

Q4. Name a plant which is pollinated by the wind. ✎ .....

Q5. What process occurs after pollination?

✎ .....

Q6. Where does this process take place and what are produced?

✎ .....

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Teacher's sheet: Practical

See **pages 18 and 19** of *The Plant Book*

Introduction

While the children have been examining flower structure they may have found quite large amounts of yellow pollen on the stamens. Remind them of this fact as they work through the spread. If you are teaching this spread in early spring, bring in some hazel catkins for the children to examine, or if there are some in a nearby habitat, take the children to see them and to find the small female flowers. Later in the year you may use summer willows and oak catkins (see background) or the flowers of plantains and grasses.

Practical work

8: Looking at pollen grains

Integrating the practical work

Show the children some insect pollinated flowers which are releasing pollen. Ask them how they could look at the pollen more closely. They may suggest a magnifying glass which will not reveal much greater detail or they may mention a microscope which will reveal much greater detail.

Extension worksheet

Pages 109 and 117.

Links

Flowers, pages 16–17; **How seeds are scattered**, pages 22–23.

Background

Cross pollination

Cross pollination is the transfer of pollen from the anther of one flower to the stigma of another flower of the same species. Most plants are cross pollinated. The DNA is rearranged in the gametes and then combined in fertilisation with the DNA from another plant. This produces variation between the offspring and parents, and between the various offspring themselves. This is sexual reproduction, DNA from two plants is combined to produce offspring.

Self pollination

This is the transfer of pollen from the anther of one flower to the stigma of the same flower, or the stigma of another flower on the same plant. In the formation of gametes, there is some rearrangement of the DNA. When the gametes fuse, the new offspring has re-arranged DNA from just one parent. This produces some variation, but not as much as in cross pollination (see above).

Many plants do not self pollinate, although they have both male and female reproductive structures, because the anthers release their pollen at a time when the stigma is not receptive to pollen grains. They become receptive later and are pollinated by other plants which have just come into flower and are releasing their pollen.

Catkins are formed from an inflorescence (a group) of male flowers and female flowers. In the hazel, the male catkins are large and conspicuous while the female catkins are small, red and emerge from a bud. A hazel tree has both male and female catkins, which may be seen on the same twig.

'Spring willows', such as goat willow and grey willow, produce their catkins before they come into leaf. 'Summer willows', such as the crack willow and the white willow, produce catkins as they come into leaf or after they have come into leaf. A willow tree will have either male or female catkins but not both.

Although catkins are often associated with plant activity in early spring, the oak also produces male flowers and female flowers in catkins in late spring.

The alder is a tree which grows by the side of lakes and rivers. It produces male and female catkins. The female catkins develop a structure which looks like a conifer cone. It contains the seeds. They have a webbing which traps air and helps the seeds to float and to disperse by water after they have left the catkin.

Plantains are found on waste ground and near footpaths, because their tough leaves can stand up to trampling. They produce a column of small, brown flowers which put out their white stamens in late spring and early summer. Grass plants also have many small, green flowers grouped together on the tip of a stalk. They put out their stamens in the summer.

Examine wind pollinated plants in season (see introduction) to identify the stamens. If a microscope is available, brush the anthers on a microscope slide and examine under low and high power and make drawings. These could be used later when pollination is being considered in more detail and the pollen of insect pollinated flowers can be examined microscopically.

Answers

Q1. Two arrows from the male parts of the first flower to the butterfly then one arrow from the butterfly to the female part of second flower.

Q2. Colour, scent and nectar.

Q3. No colour (green), scent or nectar.

Q4. Hazel, grass, willow, oak.

Q5. Fertilisation.

Q6. Female part, seeds.

Name: ..... Form: .....

Looking at pollen grains

(1) Use a pair of forceps to remove a stamen from an insect pollinated flower.

(2) Dab the tip of the stamen onto a microscope slide and look for yellow powder falling on the glass.

(3) Place the slide on the microscope and look at the pollen grains.

(4) Draw what you see.

(5) Repeat steps (1) to (4) with other insect pollinated flowers.

(6) Try to collect pollen from wind pollinated plants and draw them under the microscope.

7. Can you tell pollen moved by insects from pollen moved by the wind?

Explain your answer.

✎ .....

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Teacher's sheet: Practical

See **pages 18 and 19** of The Plant Book

Resources

A collection of insect pollinated flowers with large stamens for ease of manipulation. Forceps, microscope and slides, desk lamp. A place to set up the microscope which is out of direct sunlight.

Introducing the work

Ask the children about pollen, and when they describe it as yellow dust, challenge them to justify their claim. The following discussion should bring in the use of the microscope and the collection of a small amount of dust (perhaps off the top of a cupboard). Remind the children about how to use the microscope and never to point the mirror at the Sun, then let two groups demonstrate to the rest of the class. The first group can present a slide with a little dust on it. The second can present a slide with some pollen on it. The whole class should see that the pollen is different from the dust and is in the form of grains. Let the children work through the sheet. They can do their drawings on the sheet, but should name the plant they have taken the pollen from.

Wind pollinated pollen may be collected by brushing a catkin or group of grass flowers on the slide.

Neither type of pollen needs to be placed in a drop of water or covered with a cover slip.

Outcomes

The children:

- Can make a slide of pollen grains.
- Can examine the pollen grains with a microscope.
- Can draw pollen grains they have seen with a microscope.

Background

The pollen from insect pollinated plants is large and spiky. The spikes help the pollen stick to the hairs on the insect's body. This pollen is produced in small quantities because the insect increases the chance of the pollen passing from one flower to the next. The pollen from wind pollinated plants is small and smooth. It is produced in large quantities because the chance of a single grain reaching its destination is small.

Extending the work

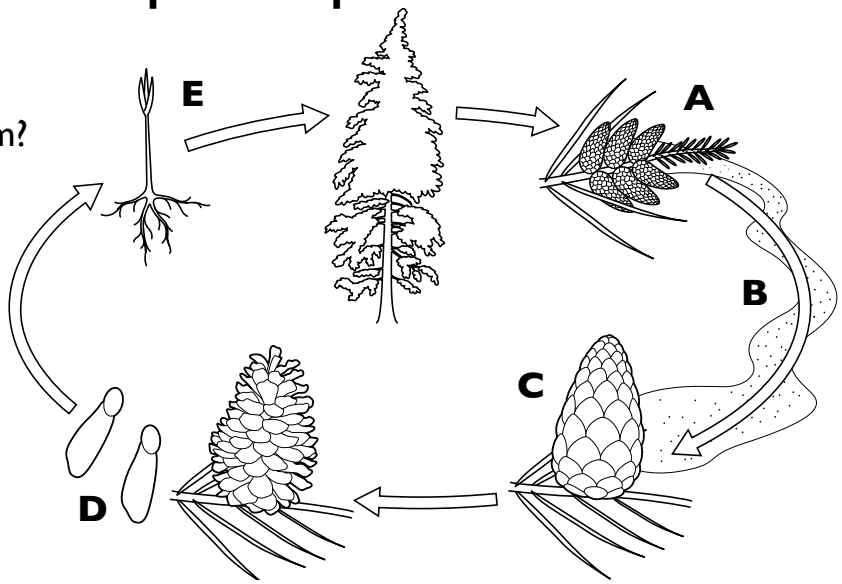
If you are going straight onto the next spread in the *Students' Book* you may like to show the children a male cone from a pine and let them collect its pollen. They will see that each pollen grain has two air bags which help it float in the air.

Name: ..... Form: .....

Seeds and spores from non-flowering plants

Not all seed-making plants have flowers. Some plants produce seeds on cones and still others produce spores.

Q1. What are the structures labelled A to E on the diagram?



A ✎ .....

B ✎ .....

C ✎ .....

D ✎ .....

E ✎ .....

Q2. Which of the structures are transported by the wind?

✎ .....

Q3. What is the name of the group of plants that reproduce in this way? ✎ .....

Q4. What does a spore contain?

✎ .....

Q5. How can you tell when a moss plant is ready to release spores?

✎ .....

.....

Q6. Where are the spores made on a fern plant?

✎ .....

Teacher's sheet: Practical

See **pages 20 and 21** of *The Plant Book*

Introduction

You may like to begin by showing the children a pine cone and ask them what it is. (Do not be surprised if someone thinks it is an acorn!) Ask the children about the kind of tree it comes from and look for words like evergreen (although the larch is deciduous) and needle-shaped leaves. Study page 20 with the children, then stop and show them some moss which has spore-producing stems, like the moss in picture 3 on page 21. Look at all three pictures on the page and ask the children where they may find each type of plant, then work through the rest of the spread.

Practical work

9: Plants without flowers

Integrating the practical work

When the children have studied the spread, ask if they have heard about using plants for weather forecasting. You can then ask them to test pine cones in both dry and damp conditions. After this the children can ponder how to collect spores from a mushroom when it opens its cap.

Extension worksheet

Pages 109 and 118.

Links

Flowers, pages 16–17, **Woodland through the seasons**, pages 36–37.

Background

The larch is a deciduous conifer. The alder produces a cone-like structure but is a broad-leaved tree.

People have used their environment to tell them about weather changes for thousands of years. In addition to pine cones, seaweed is also used. If a piece of seaweed is hung up on a wall, it will swell up and feel damp as wet weather approaches, and shrink and feel dry in fine weather. The scarlet pimpernel, a small red flower, opens in sunny weather but remains closed when the weather is rainy.

Answers

Q1. A Male cone, B Pollen, C Female cone, D Seeds, E Seedling.

Q2. B Pollen and D Seeds.

Q3. Conifers.

Q4. A piece of the parent plant.

Q5. It produces a stem with a swelling on the end.

Q6. Underside of a leaf.

Name: ..... **Form:** .....

Plants without flowers

(1) Pine cones have been used in weather forecasting. It is said they close when wet weather comes and open when the weather is turning dry. How could you test these ideas?

Write your plan here. If your teacher agrees, try out your investigation.

✎ .....

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(2) When a mushroom opens, spores gently drop from its gills. How could you use this piece of information to examine the spores under a microscope?

Write your plan here. If your teacher agrees, try out your investigation.

✎ .....

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Make a drawing of some spores here.

Teacher's sheet: Practical

See **pages 20 and 21** of *The Plant Book*

Resources

Pine cones, plastic bags, damp sand, access to a warm dry place. Mushrooms, bought from a shop, which have opened, microscope slides, microscope, desk lamp, place to use microscope out of direct sunlight.

Introducing the work.

Explain that people in the past have used pine cones in weather forecasting and that the children have to see if there is any scientific evidence which can support the use of pine cones in this way. (They should set up one cone in a damp atmosphere and one in a dry atmosphere and see which cone stays shut and which opens.)

When they have set up the first investigation they can try and work out how to get spores from a mushroom, and examine them microscopically. (They should lay the mushroom cap across a slide and leave it overnight. The spores will settle on the glass and can then be examined.)

Outcomes

The children:

- Can devise an investigation and provide scientific evidence to answer a question.
- Can use previous scientific knowledge in a new situation.

Extending the work

Moss spore cases

Moss plants grow on walls in urban areas. Collect some plants which have their spore cases raised above their leafy stems. Do not collect too many plants from one place. Let the children examine the moss plants with magnifying glasses. The spore case may be seen to be covered by a hood which falls away when the spores are ready to be released.

Horsetail cones

In the spring, collect horsetails which have a cone on the top of their stems. Collect some horsetail stems without cones for comparison. Horsetails grow in waste ground. Do not collect too many from one place. Show the children horsetail stems which have cones, and stems which do not have cones. If a microscope is available, tap a cone onto a microscope slide to release some spores. If they are examined under the microscope they will be seen to have strands which help them float in the air and slow down their sinking speed.

Fern spores

Search among woodland ferns for fronds which have spore cases on their underside. Select just one frond to show the children back in the classroom. Allow the children to examine the spore cases under a fern frond with a magnifying glass. Ask them to compare the structure with the spore case of a moss and the cone of a horsetail.

Fern collection

Make a collection of fern house plants. Note that some plants called ferns are really flowering plants. Look for the unfurling of the fern frond where the underground stem reaches the soil surface.

Cone collection

Make a collection of pine cones and cones from other conifers, if possible. Allow the children to compare the cones and work out a way to use them for identification.

When the pine cones are open, seeds may fall out of them. Seeds may be removed from an open cone by inserting forceps between the scales and pulling out the seeds. The seeds can be examined and kept for work on seed dispersal.

Name: ..... Form: .....

How seeds are scattered

Plants have many ways of spreading their seeds. They may use the wind, animals or even water.

A	B

Q1. In box A draw a seed that is carried by the wind. Label the seed S and the part that catches the wind W.

Q2. In box B draw a seed that is carried by an animal. Write down here how the animal carries the seed.

✎ .....

Q3. Why must seeds be scattered?

✎ .....

.....

Q4. Name two plants which use the wind to scatter their seeds.

1 ✎ ..... 2 ✎ .....

Q5. What does the coconut plant use to scatter its seeds? ✎ .....

Q6. How far can a coconut seed travel? Explain your answer.

✎ .....

.....

Teacher's sheet: Practical

See **pages 22 and 23** of *The Plant Book*

Introduction

Remind the children how the seed formed following the processes of pollination and fertilisation. Tell them that the seeds form in the female part of the plant, called the ovary. After fertilisation, as the seed forms, the ovary also changes. It becomes a fruit. The purpose of the fruit is to help the seed move away from the parent plant and also to let the seeds spread out away from each other.

Practical work

10: Testing the flight of seeds

Integrating the practical work

When the children have read the section 'Carried by the wind', ask them what might happen if a parachute was damaged. Challenge them to test their ideas with the practical.

Extension worksheet

Pages 109 and 119.

Links

How flowers share pollen, pages 18–19; **How seeds sprout**, pages 24–25.

Background

The female part of the plant comprises the stigma, style and ovary. The stigma receives the pollen. The pollen tube grows through the style to the ovary. The ovary contains the ovules. Inside each ovule is a female sex cell. Each pollen grain contains a male sex cell. It travels down the pollen tube and enters the ovule. It joins with the female sex cell in the process called fertilisation. After this the ovule develops into the seed and the ovary develops into the fruit. The structure of the ovary varies but the fruits that are produced can be classified as succulent fruits, which are brightly coloured and have soft material called flesh for animals to eat, and dry fruits.

One type of succulent fruit are drupes, which have a seed enclosed in a woody case called the stone. Plums and cherries are examples of drupes. The second group of succulent fruits are berries. These have many seeds without stones. Oranges and tomatoes are examples of these fruits.

The dry fruits can be divided into those that split open when ripe to release their seeds, like the pea pod, lupin or chestnut; and those which do not open, like the nuts, grains and those that carry wind-dispersed seeds.

Answers

Q1. In A there should be a parachute fruit with the seed labelled S and the parachute labelled W, or a winged fruit with the seed labelled S and the wing labelled W.

Q2. In B either (a) a succulent fruit or (b) a burr should be drawn. The written answer should be either (a) inside its body (digestive system) or (b) outside the body (on the fur or feathers).

Q3. Otherwise they would compete with each other for water, minerals and light.

Q4. Dandelion, sycamore.

Q5. Water.

Q6. Thousands of kilometres because they float and travel on the ocean currents.

Name: ..... Form: .....

Testing the flight of seeds

(1) Drop a seed with a parachute and blow on it. How far does it move?

✎ .....

Try this a few times to see if it moves a different distance each time.

(2) How do you think the seed would move if its parachute was (a) slightly damaged, (b) badly damaged?

Work out a plan and write it down here.

✎ .....

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(3) If your teacher approves, try your plan and make a report of your findings.

✎ .....

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Teacher's sheet: Practical

See **pages 22 and 23** of The Plant Book

Resources

Dandelion seeds and fruits.

Introducing the work

If a seed was blown away by a gust of wind, how far would it go? Ask the children to remember a time when they blew on a dandelion to estimate an answer. Introduce the sheet and let the children work out a fair test for dropping the seed in front of their face and blowing. Make sure that the children do not blow too hard or too frequently.

Outcomes

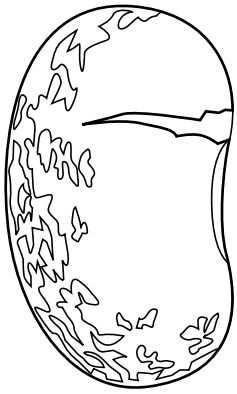
The children:

- Can devise a fair test.
- Can repeat a test and collect a range of measurements.
- Can make a prediction and devise an investigation to test it.
- Can present the results of a test and draw conclusions.

Name: ..... Form: .....

How seeds sprout

A seed contains both a tiny plant and a store of food. When conditions are favourable, the seed bursts open and the plant grows out.



Q1. Draw in the position of the root and shoot on this sprouting seed. Label both parts.

Q2. Which part grows out of the seed first?

✎ .....

Q3. When the seed leaves its parent it remains inactive for some time. What is the word that is used to describe an inactive seed? ✎ .....

Q4. The early stage of growth when a seed sprouts is described by one word. What is this word?

✎ .....

Q5. The inside of the seed is almost dry. There are two reasons for this. What are they?

1 ✎ .....

.....

2 ✎ .....

.....

Teacher's sheet: Practical

See **pages 24 and 25** of *The Plant Book*

Introduction

This spread follows logically from the previous spread but you can also use it to start the children's study of flowering plants. Children of all ages enjoy seeing if their seeds have germinated and some like to grow them on. Some of the seedlings can be grown into full plants and compared with other plants that are brought into class. If there is space, pea seeds may be kept through the summer until they flower and produce fruit pods and seeds for the next generation of plants.

If you are following on from the previous spread, tell the children that when the seeds land they may not be 'right side up'. If they have done Practical 2D earlier they can re-examine their results and find that a root will always grow down and a shoot will always grow upwards, due to the effect of gravity.

Practical work

11: The needs of seeds

Integrating the practical work

The text in the spread suggests that germinating in cold weather would not be an advantage, so the children may be steered into thinking that an increase in temperature may affect germination. The children will pick up from the text that water is needed and they may be encouraged to find out how much water. It is difficult to test for the presence of oxygen but it may be pointed out that water holds much less oxygen than air. Soil that is waterlogged is depleted of oxygen and the seeds will not get enough to germinate.

Extension worksheet

Pages 109 and 120.

Links

How seeds are scattered, pages 22–23; **How annuals compete**, pages 30–31.

Background

The tiny plant in the seed is called an embryo. In large seeds, such as peas and beans, it can be seen, shaped like a 'walking stick', between the two cotyledons. The root of the embryonic plant is called the radicle and the shoot is called the plumule. The embryonic plant is connected to each cotyledon by a cotyledon stalk. Food passes from the cotyledon to the embryo plant through this stalk.

The food stored in the seed is starch. In many seeds, such as the pea or the bean, the food is stored in the cotyledons. In grasses and cereals the starch is stored in a structure called the endosperm and the single cotyledon plays an important part in transferring the food from the endosperm to the embryonic plant. When wheat grains are ground up to make flour it is the starch in the endosperm that makes the white part of the flour.

When the seed begins to germinate it takes in water. This is used to make a solution in the cells in which the chemical reactions of life processes can take place. Oxygen is also needed for this process and this is taken from the air that enters the seed. The insoluble starch in the cotyledons is converted to sugar. The sugar is soluble in the water and is transported to the embryo plant where it is used in respiration to release energy for growth. When the seed coat splits, more oxygen can reach the plant to meet its demands as it grows.

The food store in the seed contains enough energy and materials for the plant to establish itself and start producing food for itself by photosynthesis. If the seed is planted too deeply, its food stores will not be large enough for the shoot to grow all the way through the soil and produce leaves and the seedling will die.

The sunflower 'seed' is really a single-seeded fruit but can be described as a seed at this level.

Answers

Q1. The root grows downwards and the shoot grows upwards. Both should be labelled, with the lines reaching each structure.

Q2. Root.

Q3. Dormant.

Q4. Germination.

Q5. 1. In cold weather, the water in the seed would freeze and expand and destroy the seed.

2. Fungi would grow in the damp conditions and eat the stored food in the seed.

11

Name: ..... **Form:** .....

The needs of seeds

(1) Think of something that a seed needs in order to germinate.
Write it down here.

✎ .....

(2) How could you show that seeds need this in order to germinate?
Write down your ideas.

✎ .....

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(3) Make a list of all the things you will need.

✎ .....

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(4) Draw a table in which to record your results.

(5) If your teacher agrees, try your investigation.

Teacher's sheet: Practical

See **pages 24 and 25** of The Plant Book

Resources

For testing the effect of temperature: Cress or mustard seeds, dishes of damp sand, space in places at different temperatures to leave the dishes.
For testing the effect of water: Cress seeds or mustard seeds, dishes of sand, measuring cylinders, warm place to leave the dishes.

Introducing the work

Tell the children that they are going to plan an investigation to find out about something that affects germination. You may wish to use the word factor to describe this 'something'. Ask the children to think carefully before they write down their plan and to set it out clearly.

The children may suggest sowing the seeds on dishes of moist sand and placing them in locations which differ in temperature. They may wish to leave some on a sunny windowsill and some in a cool cupboard. This should lead them to acknowledge that the test is not fair as the seeds on the windowsill are in the light while those in the cupboard are in the dark. The test can be made fair by putting the seeds on the windowsill in a box.

The children may wish to refine both investigations and set up seeds over a range of temperatures and in different amounts of water.

Outcomes

The children:

- Can plan a fair test.
- Can carry out a fair test.
- Can construct a table to record results.
- Can draw conclusions from the data they have collected.

Extending the work

You may like the children to find out how much water seeds take in and how the appearance of the seeds changes.

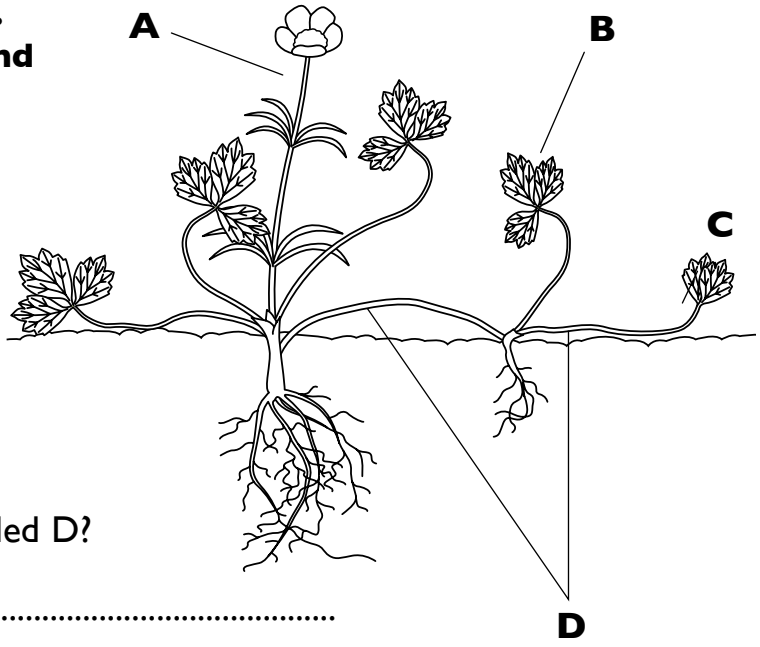
You will need dry peas, jars, spring balance or suitable weighing machine, and tissue paper.

Ask the pupils to find out how much water dry seeds take in. Ask them to weigh a few (about 10) dry peas, then place them in water and leave them overnight. The next day, ask the pupils to remove them from the water and dry them with a tissue, then weigh them again. The pupils may also be asked to observe how the appearance of the seeds changes as they take in water.

Name: ..... Form: .....

Stems that produce new plants

Not all plants use seeds or spores to produce new plants. As some plants grow, they send out shoots from their stems and new plants develop from these.



Q1. Which of the three plants is the (i) oldest, (ii) youngest?

(i) ✎ ..... (ii) ✎ .....

Q2. What are the structures labelled D?

✎ .....

Q3. How has plant B been produced?

✎ .....

Q4. Name a plant with an underground stem. What does this plant store there?

✎ .....

Q5. What is produced by the side buds in a bulb?

✎ .....

Q6. How is a bulb different from a corm?

✎ .....

.....

Q7. Name a plant that has a bulb and a plant that has a corm.

✎ ..... ✎ .....

Teacher's sheet: Practical

See **pages 26 and 27** of *The Plant Book*

Introduction

Ask the children if they can think of a plant they have seen that just grows baby plants. Show them a spider plant which has a number of runners with plantlets growing on them. Tell the children that the production of offspring without seeds is not uncommon and then introduce them to the spread.

Practical work

12: New plants from old

Integrating the practical work

When the children have completed the spread, challenge them to produce new plants from old ones.

Extension worksheet

Pages 109 and 121.

Links

How flowers share pollen, pages 18–19.

Background

The production of offspring without seeds is called asexual reproduction or vegetative propagation.

The advantages of this form of reproduction is that the parent produces offspring in an environment where it has successfully survived. By comparison, when seeds are dispersed, the offspring can easily land in an unfavourable environment and fail to thrive. This form of reproduction allows a slow, steady colonisation of an area as the cloned plants grow close to their parents and crowd out competitors.

One disadvantage of vegetative propagation is that, as the clones grow close to their parent and to each other, they compete with the other plants for water and minerals in the soil, and for light, which may lead to stunted growth. By comparison, in sexual reproduction seeds are scattered greater distances and there is less competition between seedlings and their parent plant.

A further disadvantage is that the plant can only colonise an area slowly, while in sexual reproduction seeds are more widely dispersed and can produce growing plants in several regions of an area at one.

A third disadvantage is that there is no variation in the offspring produced. This means that if the environmental conditions change, all the plants have the same features, all of which may not be suited to survival. In sexual reproduction (through pollination), the variation in the offspring means that some may have features which are particularly advantageous if the environmental conditions change, and these will survive while others perish. These survivors will be able to grow and reproduce and prevent the species becoming extinct.

To counteract the disadvantages of asexual reproduction, the plants which can reproduce in this way also reproduce sexually and produce flowers.

Advantage of food storage

Bulbs, corms, tubers and rhizomes are food storage organs. They provide the plant with an advantage over plants which over-winter as seeds. In the early spring they provide the leaves and roots with all the energy and materials they need in order to grow quickly. This enables the plants to grow faster than seedlings, or produce their leaves before deciduous trees. This reduces competition with other plants for water, minerals and light. It also allows the plants to grow in woodlands. Here they can complete the food gathering part of their life cycle before the tree leaves come out and create shade.

Asexual reproduction in animals

The sea anemone forms buds in its gut, which form miniature sea anemones that are washed out into the sea when the anemone collapses. The hydra is a freshwater relative of the sea anemone which forms a bud on the outside of the body.

The artificial cloning techniques which are used to propagate complex animals such as the sheep are much more complicated than this and involve taking the nucleus from a sheep cell and inserting it in a sheep egg from which the nucleus has been removed.

Answers

Q1. (i) A, (ii) C.

Q2. Runners.

Q3. A runner has grown out of the parent plant and a bud on the runner has grown into a new plant.

Q4. Iris, food.

Q5. Tiny bulbs.

Q6. A bulb is a short stem surrounded by leaves and a corm is a short thick stem swollen with food.

Q7. Bulb – daffodil, tulip, hyacinth. Corm – Crocus, gladioli.

Name: ..... Form: .....

New plants from old

(1) Look at the selection of plants you can use to make new plants. Pick two plants which produce new plants in different ways.

Here are the ways you can make new plants:

Spider plant

Cut off a plantlet and plant it in a pot of compost.

'Good luck' plant

Take a fully formed plant from the leaf and plant it in a pot of compost. Alternatively, take a plant which has recently fallen from the parent plant.

Chives

Separate the bulbs in a clump of chives. Plant each bulb in a separate pot.

Garlic

Separate the cloves of a garlic bulb and plant in a pot.

Geranium

Cut off the top eight centimetres of a side branch on a geranium plant. Pull off the lower leaves but leave those at the top. Make a hole in a pot of compost and put the lower end of the branch in it. Press down the compost around the branch so that it is held firm.

Keep a diary of the development of your plants. Record when you watered them, and record their growth and any other changes.

Teacher's sheet: Practical

See **pages 26 and 27** of *The Plant Book*

Resources

Spider plant

You will need a spider plant with plantlets, compost, plant pot, space to leave pots in light airy conditions.

'Good luck 'plant

You will need a 'good luck' plant (bryophyllum diagremontianum) with plantlets growing round the edge of its leaves, compost, plant pot, space to leave pots in light airy conditions.

Chives

You will need a clump of chives, small pots of compost.

Garlic

You will need a bulb of garlic, large pot of compost.

Geranium

You will need a geranium plant, sharp knife (to be used only with your supervision), pot of compost.

Introducing the work

Challenge the children to find out how easy or difficult it is to grow new plants from old ones. Alternatively, you can point out that when plants reproduce, the new plants grow close together. They could compare plants growing close together with plants that are grown singly or far apart.

Tell the children that some plants can be reproduced by simply taking a cutting of them and planting it in some compost. Make sure you closely supervise children who are taking cuttings.

Outcomes

Children can:

- Show that they can care for a living thing.
- Can record data over a long period of time.

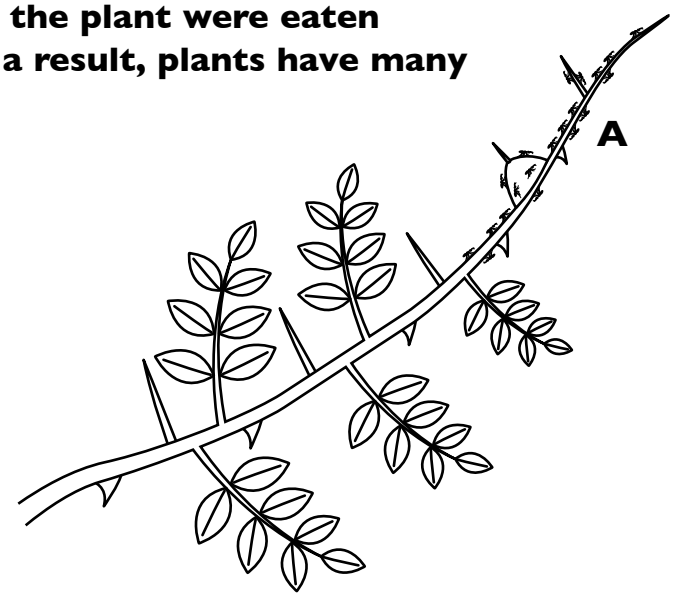
Extending the work

You can show that the potato is really a modified stem by making the following demonstration. You will need a potato, pins, thread and a branch of a beech. Begin by pointing out that the eyes of the potato are buds and ask the pupils to look at the arrangement of buds on a woody stem such as the beech and the potato. On a woody stem the buds may be seen to be alternate or in pairs. On a potato, you can demonstrate that the buds are in a spiral by sticking a pin in each eye then, starting at the eye furthest from the crown, wind a thread past the base of every pin up to the crown. This will show that the buds are arranged in a spiral.

Name: ..... Form: .....

How plants defend themselves

Plants are food for animals. But if the plant were eaten away completely, it would die. As a result, plants have many ways of defending themselves.



Q1. What are the animals on the plant at A and how do they help the plant?

✎ .....

Q2. Label a spine and a thorn on the diagram. How can you tell them apart?

✎ .....

.....

Q3. How does a grass plant defend itself against grazing animals?

✎ .....

Q4. How do deadly nightshade and bracken defend themselves from hungry animals?

✎ .....

Q5. How do nettles defend themselves?

✎ .....

.....

Q6. How can plants defend themselves against fire?

✎ .....

.....

Teacher's sheet: Practical

See **pages 28 and 29** of *The Plant Book*

Introduction

The children may already have done some work on food chains, so it would be useful to remind them of this now. Almost all food chains begin with green plants. Without plants there would not be the diversity of animal life that is found on the planet. However, a balance has to be struck between a plant giving all of its body to feed animals, and protecting itself completely from animal attack. Some animals are greatly discouraged by a plant's defences while other animals are adapted to get around the defences.

Practical work

13: What is living on the leaves?

Integrating the practical work

Most children think of large animals feeding on plants, while millions of tiny animals also feed on them. Some of the most common are greenflies and blackflies, which are found on the underside of leaves and may even be seen waiting round buds in twigs as they come into leaf. Challenge the children to look for these small animals in a local habitat.

Extension worksheet

Pages 109 and 122.

Links

How leaves make new tissue, pages 14–15; **How annuals compete**, pages 30–31; **How shrubs and trees compete**, pages 32–33.

Background

Up until 1977 it was generally thought that plants were always the beginning of food chains. In that year, life was discovered around hydrothermal vents on the ocean floor. The origin of these food chains were bacteria which fed on the chemicals in the water and stored energy for other organisms to use.

Greenflies and blackflies are insects that belong to the bug group, not the fly group, despite their common name. They feed on the sap in leaves.

When the children are looking for them they may find lines which wiggle across the surface of the leaf. These are made by tiny wasps called leaf miners which burrow through the layers of cells inside the leaf.

Answers

Q1. Ants, they defend the plant from larger animals.

Q2. Any spine or thorn should be labelled clearly with a label line. A spine is long and thin, a thorn is shorter and more cone shaped.

Q3. It forms new leaves from a place underground where a grazer's teeth cannot reach.

Q4. They have poisons in their leaves.

Q5. They have poisonous spines which break open when touched, and the poison reaches the skin where it causes a stinging sensation.

Q6. By having tough stems, bark, seeds and deep roots.

Name: ..... **Form:** .....

What is living on the leaves?

(1) Look at a leaf which has greenfly on it. Examine them with a magnifying glass. They have a mouth like a needle which they stick in the leaf to drink its sap.

(2) Look for greenfly among a collection of indoor plants. Make a table to record whether the plants had none, a few or a large number of insects on them.

(3) Examine the plants in a local habitat and record your results.

(4) Write down your conclusions from the two sets of data you have collected.

✎ .....

.....

Teacher's sheet: Practical

See **pages 28 and 29** of The Plant Book

Resources

A plant which has greenfly on its leaves. Magnifying glass. A local habitat.

Introducing the work

Not all animals are large. Some are small and hide away under leaves. The greenfly is a very common example of this type of plant-feeder. When the children are looking at the plants, challenge them to design a table to record their results. For the indoor plants, the columns could be labelled 'Plant' (and the child could name it), 'No greenfly', 'A few' (less then 20 say) and 'A large number' (more than 20).

When the children are recording in the habitat, they may simply record the plant (preferably a tree or shrub) and the presence or absence of greenfly.

Outcomes

The children:

- Can make observations.
- Can construct tables.
- Can collect data and evaluate it.

Extending the work

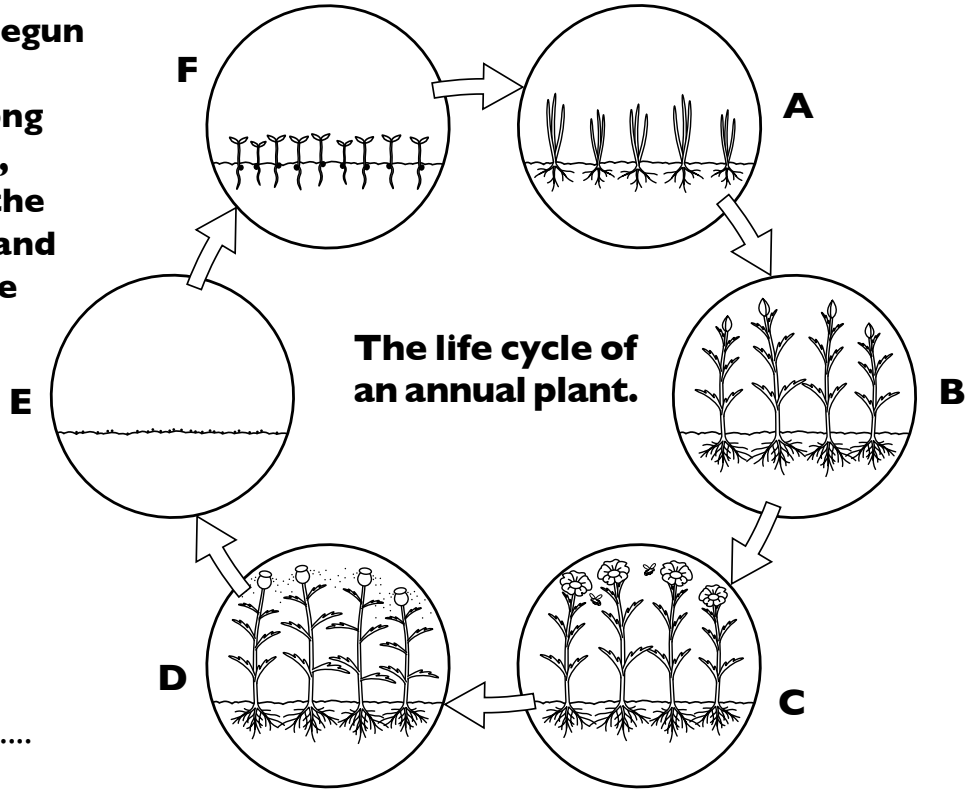
You will need a colony of stick insects.

If you keep stick insects you might let the children weigh the privet shoots before and after they have been fed to the insects. This will give them some idea of the quantity of plant material the colony eat over a few days. From this they could calculate the time it would take the insects to eat a section of a hedge.

Name: ..... Form: .....

How annuals compete

Once a plant has begun to sprout, it finds itself growing among many other plants, all competing for the same light, water and nourishment. Some plants, called annuals, grow quickly in order to out-compete their neighbours.



The life cycle of an annual plant.

Q1. Which circle shows winter? ✎ .....

Q2. What is happening at time C? ✎ .....

Q3. Which circle shows autumn and what is happening to the plants then? ✎ .....

✎ .....

Q4. What is happening in circle F and what time of year is it?

✎ .....

.....

Q5. What is the special feature of an annual plant?

✎ .....

Q6. Name an annual plant which may be found growing in a field of wheat. ✎ .....

Teacher's sheet: Practical

See **pages 30 and 31** of *The Plant Book*

Introduction

You may like to begin with the general idea of life cycles in living organisms and that there are stages in the life cycle. The first stage in animals is birth. This is followed by a period of growth to maturity. Maturity is a period when the animal is capable of breeding. Finally there is a period in which the animal is too old to breed, and it gradually deteriorates and dies. The plant life cycle starts with the seed and follows the general pattern shown in Diagram 1 on page 30 of the *Students' Book*. The diagram shows the life cycle of an annual plant. These are the plants which are quick to stake a claim on any bare ground and begin the process of colonisation of an area.

Practical work

14: How fast do they germinate?

Integrating the practical work

When you have studied the spread with the children tell them that there are a large number of annual plants. Ask them how fast they think they will germinate, and would they expect them all to germinate in the same short time. Challenge them to test these ideas in the practical.

Extension worksheet

Pages 109 and 123.

Links

How plants defend themselves, pages 28–29; **How shrubs and trees compete**, pages 32–33; **Deserts**, pages 44–45.

Background

Emphasise that a plant must go through all the stages in the diagram to complete its life cycle, and that many plants may not reach a stage where they reproduce, due to competition from other plants or because they are eaten by an animal. These plants do not complete their life cycle.

There are plants with other kinds of life cycles. Biennials such as the carrot take two years to complete a full life cycle. At the end of the first year, the biennial stores its food in an organ such as a root and grows from this in the following year. Some plants live for many years, they are called perennials.

Herbaceous perennials add to their perennating organs each year. A new corm replaces an old corm and rhizomes (underground stems) of plants such as the iris produce side branches. In woody perennials, the stem adds a layer of wood each year. This can be used not only to tell the age of the piece of wood but also to compare the weather in each growing season. In a warm summer, a wide ring of wood will be formed. In a cold summer, the ring will be narrow.

Herbaceous perennials such as the iris can begin the reproductive stage several years after germinating from a seed. A woody perennial may take much longer. For example, an oak tree may be about 60 years old before it produces flowers and acorns. However, trees can be very long lived. Many reach an age of over 200 years. It has been estimated that the bristle cone pine has a life span of 5,500 years and that the large Californian sequoia (sequoia giganteum) can live for up to 6,000 years.

It is important to draw the pupils attention to how the life cycle of one organism may affect another. Bees, for example, help plants to reproduce by pollination. However, if the bee population is reduced due to the use of insecticides, the population of plants which depend on them for pollination also decline.

Answers

Q1. E.

Q2. Plants flower and set seed. (Pollination, then fertilisation.)

Q3. D, their leaves die back and the seed heads lose seeds in the wind.

Q4. Last year's seeds germinate. It is spring.

Q5. It completes its life cycle in a year.

Q6. Poppy.

Name: ..... **Form:** .....

How fast do they germinate?

(1) Work out a plan to compare how fast seeds germinate. As you plan, think about how many seeds of each kind you are going to use and how you will know that the seed has germinated. Also think about how often you are going to check the seeds.

(2) Write down your plan here and draw a table for your results.

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(3) If your teacher agrees, try out your investigation. Sow the seeds as directed by your teacher.

Teacher's sheet: Practical

See **pages 30 and 31** of *The Plant Book*

Resources

Packets of seeds of annual plants such as cornflower, annual sunflower, candy tuft, sweet pea, dwarf nasturtium and night-scented stock, compost, pots, space to leave the seeds to grow or access to a flower bed.

Introducing the work

There are many kinds of annual plants. Some are used in the garden for their colour and scent. The germination of the seeds can be studied, then the plants can be grown and planted outside at school or at the children's homes.

Outcomes

The children:

- Can plan an investigation.
- Can appreciate the need for having a large number of samples.
- Can construct a table and fill it in.
- Can draw conclusions from their data.

Background

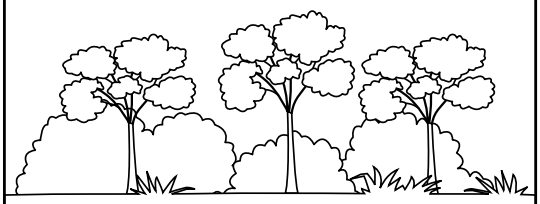
Let the children sow the seeds in accordance with the instructions on the packets. The night-scented stock opens at night and is pollinated by moths. Pupils who grow this at home may use the plant to extend their experience of pollination.

Name: ..... Form: .....

How shrubs and trees compete

In general, the bigger the plant will become, the more slowly it grows. All shrubs and trees grow slowly, but eventually they shade out the faster-growing flowers and take over.

A



B

Q1. In box B below draw how you think the plants in box A would look in a few years time.

Q2. Explain why the changes you have drawn have taken place.

✎ .....

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Q3. What is the name given to a plant that lives for many years?

✎ .....

Q4. When a piece of ground is cleared, what kind of plants are the first to grow there?

✎ .....

Q5. How do these plants help trees?

✎ .....

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Q6. How can you tell if a woodland is still developing?

✎ .....

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Teacher's sheet: Practical

See **pages 32 and 33** of *The Plant Book*

Introduction

You may like to begin by showing the children some photographs of the local countryside where a replanting scheme has been set up. The photographs should show the saplings and the trees as they are now. You should also tell the children how long the trees have been growing. Tell the children that, as trees and bushes take a long time to grow, it is hard to see the changes that they make on their surroundings. It is only by looking back at old photographs that changes can really be seen. Study the spread with the children and conclude that in most of the United Kingdom, if a piece of land is left alone, eventually a woodland will develop on it.

Practical work

15: Making a transect

Integrating the practical work

One way of seeing how trees and bushes alter the plants around them is to make a transect into a hedge. You may also make it under a tree such as a conifer. This will show the plants that grow in the habitat when they are not affected by the hedge, and will show the plants that can survive under the branches of the hedge trees and bushes.

Extension worksheet

Pages 109 and 124.

Links

Woodland through the seasons, pages 36–37;
Adapting in the tropical rainforest, pages 42–43.

Background

The trees and shrubs in a hedge will shade the ground so that only plants which can survive in low light will grow there. The trees and bushes will also provide a habitat for scrambling plants like brambles, and climbers like ivy. Under conifers, not only is there a lack of light, but also a carpet of slowly rotting leaves which prevent plants growing.

Answers

Q1. The trees are larger, bushes are fewer, annuals are fewer or absent.

Q2. The trees have grown and shaded the other plants. Only plants adapted to shade will survive.

Q3. Perennial.

Q4. Annuals.

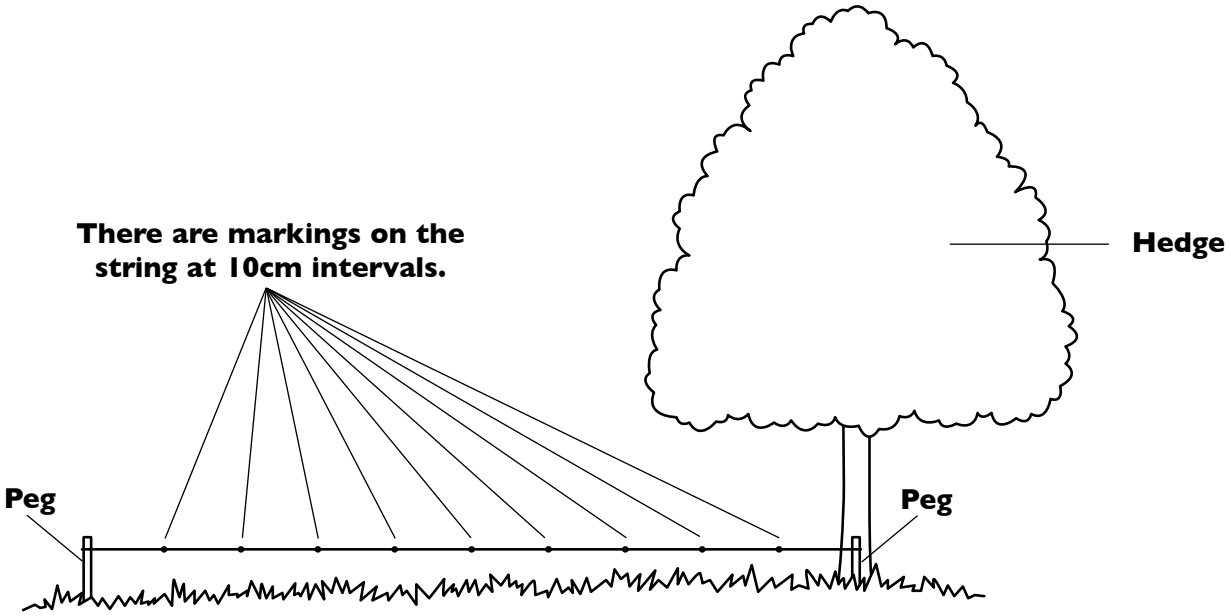
Q5. Shade the soil and keep it moist so tree seeds can germinate in it.

Q6. The trees have not completely shaded the ground.

Name: ..... Form: .....

Making a transect

The diagram shows you how to set up a transect into a hedge.



(1) Set up a transect in a hedge.

(2) Start at the marking on the string that is furthest from the middle of the hedge. Lower a ruler or stick vertically downwards and note the plant it touches.

(3) Repeat the procedure in step (2) at each of the markings until you reach the middle of the hedge. (You may have to use a shorter ruler or stick when you are working inside the hedge.)

(4) Make transects at four more places along the hedge.

(5) Make a table for all your results and fill it in.

(6) Write down what your results show.

Offer an explanation for your observations.

Teacher's sheet: Practical

See **pages 32 and 33** of *The Plant Book*

Resources

You will need a piece of string about a metre long and marked or knotted at 10cm intervals, two pegs, a ruler or straight stick, access to a hedge with at least 2m of plant life on one side. The hedge should be in a situation where the children (under supervision) can make their transects safely. Plant identification books or keys. The string may be pegged into the ground in the centre of the hedge, then gently pulled until it is straight and at right angles to the hedge. The end away from the hedge may also be pegged down.

Introducing the work

Tell the children that before the hedge was set up the ground was probably covered by grass and meadow plants. The effect of the hedge can be seen by taking an ordered set of samples from the ground. This is done by touching the ground at 10cm intervals up to the centre of the hedge and noting the plants that are touched by the ruler or stick. If the stick does not touch a plant, then a word such as soil or rock is used to describe what is touched.

Outcomes

The children:

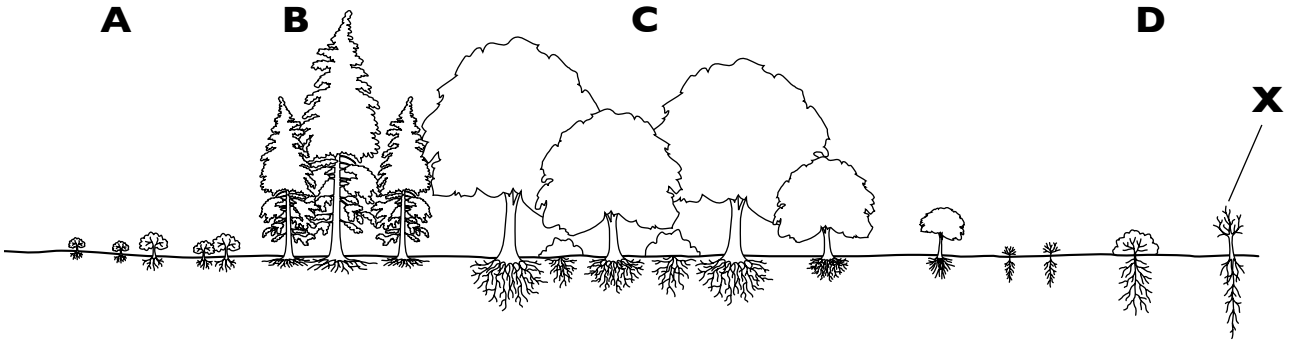
- Can safely make an investigation in a habitat.
- Can make a table and record data in it.
- Can draw conclusions from the data they have collected.
- Can suggest ways of improving the value of their data.

Name: ..... Form: .....

Habitats

Plants grow almost everywhere in the world. To survive they have to be adapted in many ways.

This diagram shows the plants in four different habitats



Q1. What is habitat A and why don't trees grow there? ✎ .....

✎ .....

Q2. What is habitat D and why don't trees grow there? ✎ .....

✎ .....

Q3. What are the trees growing in habitat B and habitat C?

B ✎ ..... C ✎ .....

Q4. Where would you find habitat A? ✎ .....

Q5. State one way that plant X is adapted to its habitat.

✎ .....

Q6. As you moved from habitat A to C, how do you think the temperature would change? Explain your answer.

✎ .....

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Teacher's sheet: Practical

See **pages 34 and 35** of The Plant Book

Introduction

The children may need to be reminded of the meaning of the term habitat. It is the place where a particular plant or animal lives. If the children have studied Earth and space they may know about how the Sun's rays strike directly down on the equator but strike more obliquely further north or south. This results in a lowering of environmental temperatures as you move from the equator to the poles, and is reflected in the plants that grow in different regions. Each group of plants is adapted to living in the particular conditions found in its habitat. Relate the habitats described on the page to their positions on the globe and to the amount of sunlight they receive.

Practical work

16: What grows in the grass?

Integrating the practical work

Two grassland habitats are described on the spread. The children learned in an earlier spread that if an area of land is left to itself a woodland habitat will develop on it, but grassland habitats are also common and are maintained by grazing or mowing. People tend to think a grassland is just full of grass, but are there any other plants that can share this habitat? Challenge the children to find out.

Extension worksheet

Pages 109 and 125.

Links

All the other spreads in this section, pages 36–45.

Answers

Q1. Tundra, too cold.

Q2. Prairies, too dry.

Q3. B Conifers, C Broad-leaved trees.

Q4. Near the poles of the planet.

Q5. Long roots to search for water in dry soil.

Q6. It would rise. Habitat A is nearest the pole, habitat B is further away from the pole and habitat C is furthest away from the pole. The answer could also include consequences of this, such as short, cool summers and longer, warm summers.

Name: ..... **Form:** .....

What grows in the grass?

(1) Throw the hoop over your back and let it settle on the grass.

(2) Look at the plants inside the hoop and identify any that are not grass plants.

Count how many of each kind of plant you found inside the hoop.

(3) Repeat steps (1) and (2) four more times in different parts of the grassy area.

(4) Record the data from your five investigations in a table below.

(5) Describe the plants that you found. For example, are some plants more common than others and are some found in larger numbers in one part of the grassy area than in another?

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(6) Find a well-worn path across the grass and look for plants near the worn edges of the path. Record what you find.

✎ .....

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Teacher's sheet: Practical

See **pages 34 and 35** of The Plant Book

Resources

A large hoop, Alternatively, a metre square can be measured out. Access to a safe grassy area which is free from dog excrement. Books or keys for plant identification. The children must be supervised at all times.

Introducing the work

An area of grass seems to contain only grass plants, but if you look closer you can sometimes find that it is also a habitat for other plants such as daisies, dandelions and plantains. The scientific way of examining a habitat such as grassland is to examine the plants in a certain area chosen at random. This can be done by throwing a hoop over your back or by setting up a metre square. Both these methods give you a way of measuring the frequency of plants. For example, one plant may be found in four out of five samples while another is found only once. The number growing in an area can be simply found by counting the plants growing inside the hoop or square. If there is a large number of plants, you could estimate how much of the area inside the hoop or square they cover.

Outcomes

The children:

- Can safely make an investigation in a habitat.
- Can use the data they collect to make charts.
- Can draw conclusions from the data they have collected.
- Can suggest ways of improving the value of their data.

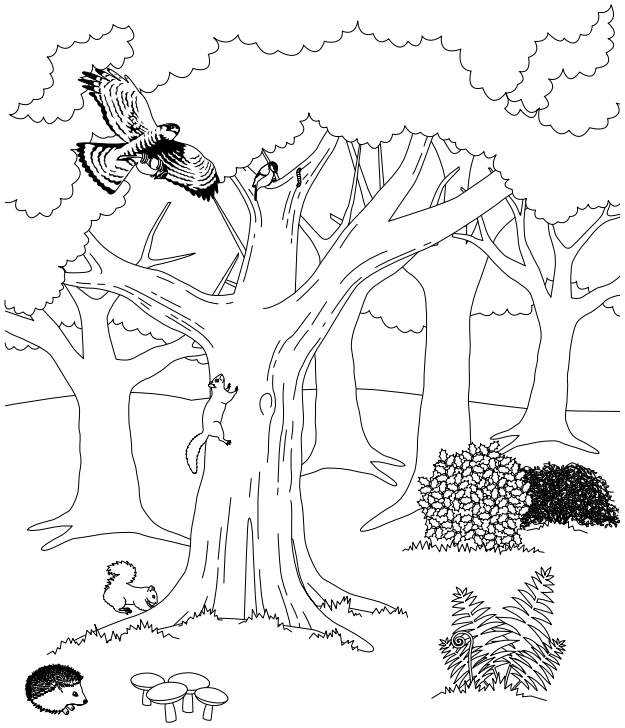
Background

Plantains are plants which form a rosette of tough leaves. They may be found in large numbers along the sides of paths or in the goal-mouth areas on playing fields.

Name: ..... Form: .....

Woodland through the seasons

A woodland changes dramatically through the seasons. The lives of both plants and animals are adapted to the changes.



Q1. What season is it in the wood in the picture and how can you tell?

✎ .....

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Q2. What will be the next season and how will the woodland change then?

✎ .....

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Q3. The branches of the trees grow together to make a covering of leaves. What is this part of the wood called? ✎ .....

Q4. The trees in the wood are deciduous. What does this mean?

✎ .....

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Q5. Some plants on the woodland floor come into leaf and flower early in the year. Why is this?

✎ .....

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Teacher's sheet: Practical

See **pages 36 and 37** of *The Plant Book*

Introduction

If the children have been studying Earth and space then they can relate their work on seasons to the changing conditions in the wood shown on the spread. If they have yet to study the seasons in the context of Earth and space, this spread can provide an introduction to it. You may like to begin by relating to the wood in the current season you are in, and then move round the text and pictures until a full year is completed. Alternatively, you may prefer to follow the text and the sequence of pictures as they occur on the spread.

Practical work

17: What is living on the branches?

Integrating the practical work

The children will spend some time looking at the animals in the pictures. You may build on this by saying that the large plants (the trees) create a habitat in which the animals can live. For example, they provide shade and shelter and also food and places to build nests. As trees provide habitats for large animals, do they also provide places where smaller animals can live?

Extension worksheet

Pages 109 and 126.

Links

How shrubs and trees compete, pages 32–33.

Background

The branches provide a resting place for flying insects and a place for spiders to set up webs to catch insects. Beetles burrow in the bark and their young feed on the wood. Some insects feed on the leaves and even snails and slugs sometimes ascend into trees to shelter. The practical work may reveal a wide range of animals which the children can identify and research to find out more about their ways of life.

Answers

Q1. Summer, the trees are in full leaf and no leaves are falling.

Q2. Autumn, trees lose leaves, bushes produce berries, jays and squirrels store nuts, trees take in food that was stored in the leaves.

Q3. Canopy.

Q4. They shed their leaves in autumn and grow new ones the following spring.

Q5. They use the sunlight which reaches the ground before the trees grow leaves and shades them.

Name: ..... Form: .....

What is living on the branches?

(1) Spread out a white sheet under a branch.

(2) Hit the branch a few times with a stick or shake the branch over the sheet.

(3) Look for any animals that fall onto the sheet.

(4) Look at the different types of animals and quickly count the number of each different type.

(5) Collect one of each type to identify.

(6) Make a record of your results below.

(7) Use this method to find out an answer to one of these questions:

(a) Are different animals found on different sides of the same bush or tree?

(b) Are different animals found on different kinds of trees and bushes?

(c) Are different animals found on trees or bushes of the same kind in different parts of the wood?

Teacher's sheet: Practical

See **pages 36 and 37** of *The Plant Book*

Resources

You will need a large white sheet, a stick, collecting jars, magnifying glasses, pooters (optional), books for invertebrate identification or keys, access to a wood. The children must be supervised at all times.

Introducing the work

A squirrel or a bird may be easily seen living on a tree but what about smaller forms of life? If you look on a branch you may not see anything, as many small animals are camouflaged. A way to see them is to dislodge them from the branch and let them fall onto a white sheet which will make them easy to see.

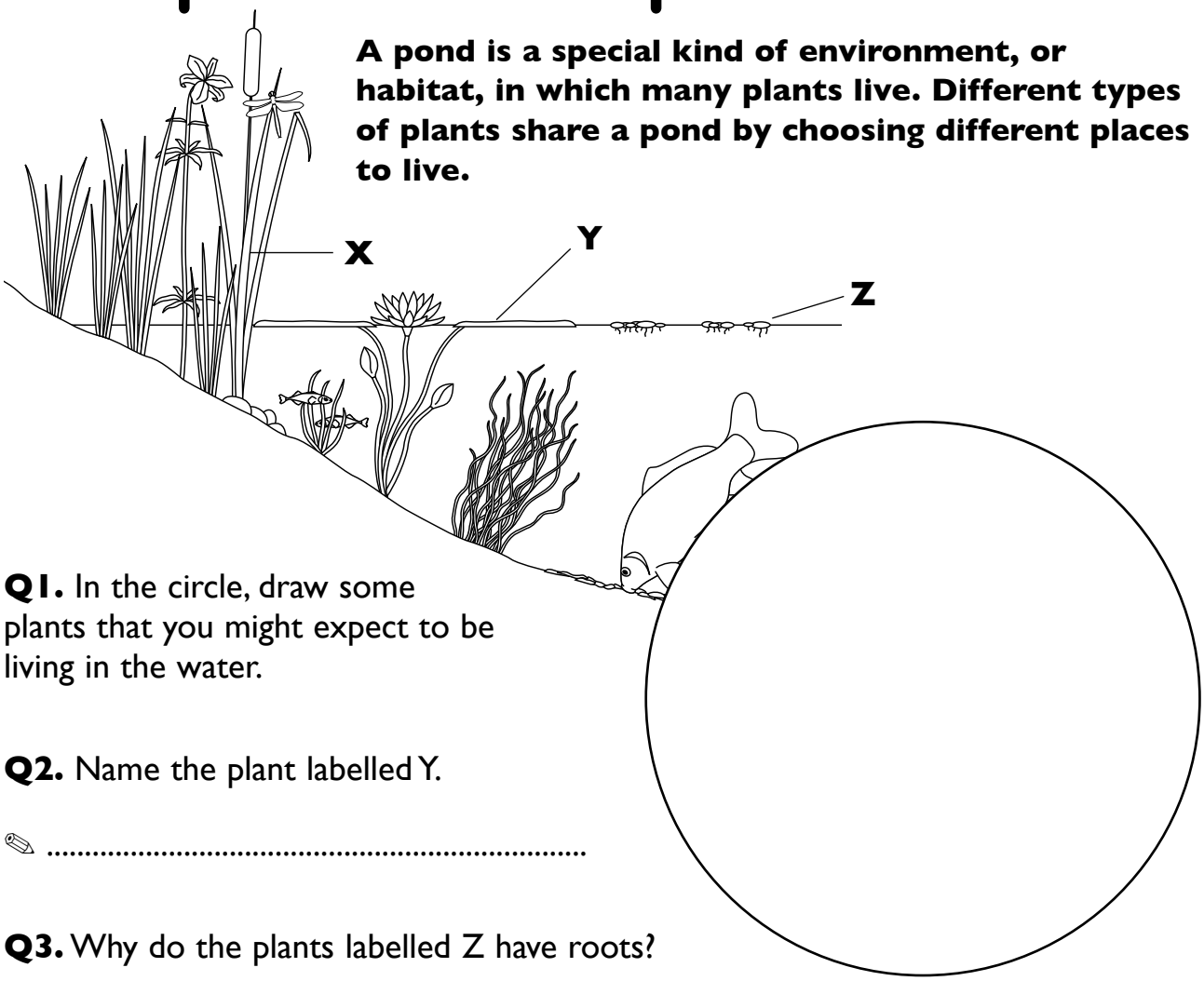
Outcomes

The children:

- Can safely make an investigation in a habitat.
- Can use the data they collect to make charts.
- Can draw conclusions from the data they have collected.
- Can suggest ways of improving the value of their data.

Name: ..... Form: .....

How plants are adapted to water



A pond is a special kind of environment, or habitat, in which many plants live. Different types of plants share a pond by choosing different places to live.

Q1. In the circle, draw some plants that you might expect to be living in the water.

Q2. Name the plant labelled Y.

✎ .....

Q3. Why do the plants labelled Z have roots?

✎ .....

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Q4. In warm, sunny weather bubbles are produced on the leaves of plants under water. Why is this?

✎ .....

.....

Q5. Why does plant X have long roots?

✎ .....

.....

Teacher's sheet: Practical

See **pages 38 and 39** of The Plant Book

Introduction

You may like to use an evolutionary context to introduce water plants. You could begin by saying that life first developed in water and some of the simplest plant forms can still be found in water or damp surroundings today. You could point out the bright green coating of algae on trees. They are found on the sides which receive the most rain. Algae are found on walls which are damp or have water rushing over them in wet weather. You could follow this by saying that plants developed ways of living on land but some, such as mosses and liverworts, still need damp surroundings at some stages in their lives if they are to survive. Flowering plants can be found in all kinds of habitats and some still live in freshwater ponds, lakes and rivers. At this point you may wish to introduce and study the spread.

Practical work

18: The pond in a jar

Integrating the practical work

When the children have studied the spread, take them to a pond and show them the water plants growing round the side. If possible, collect some duckweed and Canadian pondweed. There may also be some filamentous algae, such as Spirogyra, which could also be collected.

If it is not possible for the children to visit a pond, buy some Canadian pondweed and any other cold water aquarium plants from an aquarist.

Extension worksheet

Pages 109 and 127.

Links

How leaves make new tissue, pages 14–15.

Answers

Q1. The children should draw algae as in the circle on page 38 of the *Students' Book*.

Q2. Water lily.

Q3. To help them balance.

Q4. The bubbles contain oxygen. This is produced when the plants make food in the sunlight.

Q5. To collect water from deeper in the soil when the water level falls in summer and the pond edge dries out.

Name: ..... Form: .....

The pond in a jar

(1) Set up a pond in a jar. Do this by half-filling the jar with rain water and putting some water plants in it. Put some duckweed on the surface.

(2) Keep the jar in a well-lit place which does not become hot.

(3) Keep a record of the number of duckweed in the jar and look for signs that they are reproducing.

(4) Examine a drop of water under the microscope to look for small algae plants.

(5) Look for signs of growth in any of the plants.

(6) Look for small animals swimming between the plants.

(7) Repeat steps (3) to (6) every few days for a month and write a report here or on a separate piece of paper.

Teacher's sheet: Practical

See **pages 38 and 39** of The Plant Book

Resources

You will need access to a pond which shows a diversity of plant life, large plastic jars, Canadian pondweed, filamentous algae, duckweed, magnifying glass, microscope, slides and cover slips, dropper, place to set up microscope out of direct sunlight, desk lamp.

Introducing the work

When people visit a pond they are usually more interested in looking for animal life, as the animals move about. The lives of water plants can be studied in more detail by setting them up in a jar and observing them regularly over a period of time. If the children have studied animals on the branches of a tree, they may be interested to find out if any animals live on pondweed. They may be seen swimming in the water in the jar. If the water turns green, it can be examined with a microscope to see what is causing the colour. (It will be found to be caused by large numbers of algae.)

Outcomes

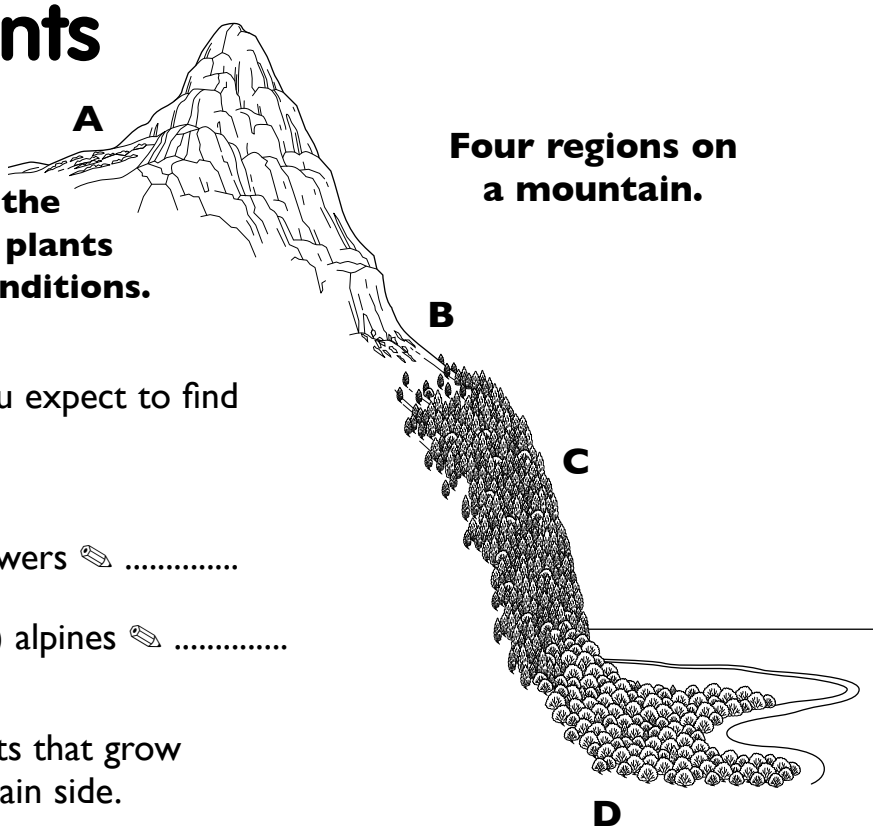
The children:

- Can make a series of observations over a long period of time.
- Can write a report of their observations.
- Can use a microscope and its associated equipment in a safe manner.

Name: ..... **Form:** .....

Mountain plants

Many mountain plants have to survive through cold, wind and snow. Only the hardiest and best adapted plants can survive these harsh conditions.



Four regions on a mountain.

Q1. In which region would you expect to find

(a) oak trees ✎ .....

(b) grass growing with wild flowers ✎ .....

(c) pine trees ✎ ..... (d) alpines ✎ .....

Q2. Name two flowering plants that grow with the grasses on the mountain side.

✎ ..... ✎ .....

Q3. Why are trees not found at the top of the mountain?

✎ .....

Q4. Why does the ground dry out quickly near a mountain top and how are plants adapted for this?

✎ .....

.....

Q5. Why are many mountain plants dark in colour?

✎ .....

Q6. Why are most plants near the top of the mountain perennials and not annuals?

✎ .....

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Teacher's sheet: Practical

See **pages 40 and 41** of *The Plant Book*

Introduction

You may like to begin by showing the children a map of the world which shows the major mountain chains. You can tell them that if they were to go to any of the mountains they would walk through the same kind of vegetation zones no matter where they are on the planet. Introduce the spread and take them on an imaginary climb to the summit.

Extension worksheet

Pages 109 and 128.

Links

Deserts, pages 44–45.

Practical extension

You could take the children to look at an old stone wall and see the plants that are trying to live on its surface. You may find lichens and mosses. You may also find other plants growing in crevices. You would not find these on mountains, but their presence illustrates the point that plants will try and colonise a rocky habitat if they can get a root-hold.

You may also like to show the children some alpine plants that can be purchased from a garden centre.

Answers

Q1. (a) D, (b) B, (c) C, (d) A.

Q2. Lupins and buttercups.

Q3. The weather conditions are too harsh for them to grow.

Q4. The winds dry it up. The plants have long roots to find water deeper in the ground.

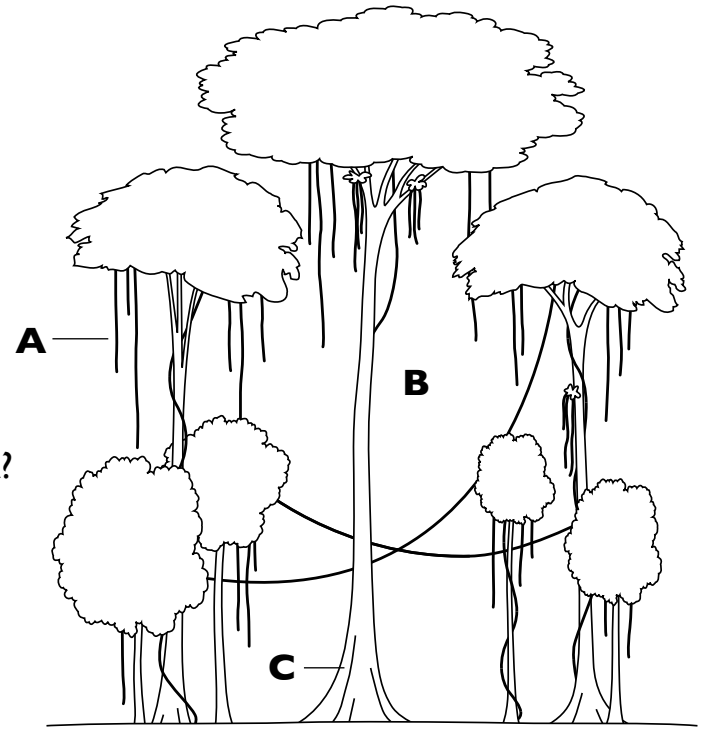
Q5. To soak up heat.

Q6. The conditions only allow slow plant growth, so annuals could not grow enough to flower and complete their life cycle in one year.

Name: ..... Form: .....

Adapting in the tropical rainforest

The year-round heat, strong sunlight and high amount of moisture found in many places close to the equator means that these places are filled with plants. This causes intense competition.



Q1. What are the structures labelled A?

✎ .....

Q2. Why doesn't the tall tree have any leaves at B?

✎ .....

Q3. What are C and how may they help the tree?

✎ .....

.....

Q4. Most rainforest trees are evergreens. What does this mean?

✎ .....

Q5. Why are most rainforest trees evergreen?

✎ .....

Q6. Why are the roots of rainforest trees just below the surface of the soil?

✎ .....

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Teacher's sheet: Practical

See **pages 42 and 43** of *The Plant Book*

Introduction

You could create a 'rainforest corner' for a short time, by asking staff and parents to donate large foliage houseplants such as the Swiss cheese plant, rubber plant, philodendrons, bromeliads and climbing vines. Point out the drip tips on some of the leaves and show how the waxy surface directs water off the leaves. Move from the display to the material on the spread, then let the children model the rainforest in miniature with the practical work.

Practical work

20: How does heat affect growth?

Integrating the practical work

If the children have studied germination they will have already come across heat as a factor that affects growth. This practical gives them an opportunity to remember that work and to use it in explaining any predictions they may make. The heat and humidity of a rainforest cannot easily be created on a large scale unless for display purposes at a botanical garden. A move towards those conditions can be made by enclosing the plants in a glass jar with some moisture and setting them up in a sunny window.

Extension worksheet

Pages 109 and 129.

Links

How shrubs and tress compete, pages 32–33;
Woodland through the seasons, pages 36–37.

Answers

Q1. Climbing plants known as lianas.

Q2. Because it is too shady due to the leaves above.

Q3. Buttress roots. They may help prevent the tree falling over.

Q4. They stay in leaf all year round.

Q5. Because there are no seasons.

Q6. So that they may collect any nutrients that are washed into the soil from rotting plants. There is little nourishment in the soil as most of it has been washed away by the rain.

Name: ..... Form: .....

How does heat affect growth?

(1) Sow some seeds in two small pots of compost.

(2) Water the compost.

(3) Set up one pot under a clear glass jar on a sunny windowsill. Set up the other pot next to the first one, but do not cover it with a jar.

(4) Set out a plan to find out if heat affects the way seedlings sprout and grow.

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(5) Set out tables of data on a separate sheet.

(6) Write your conclusion here.

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Teacher's sheet: Practical

See **pages 42 and 43** of The Plant Book

Resources

You will need mustard seeds, a large glass jar, two small plant pots, compost, data logger for temperature (optional).

Introducing the work

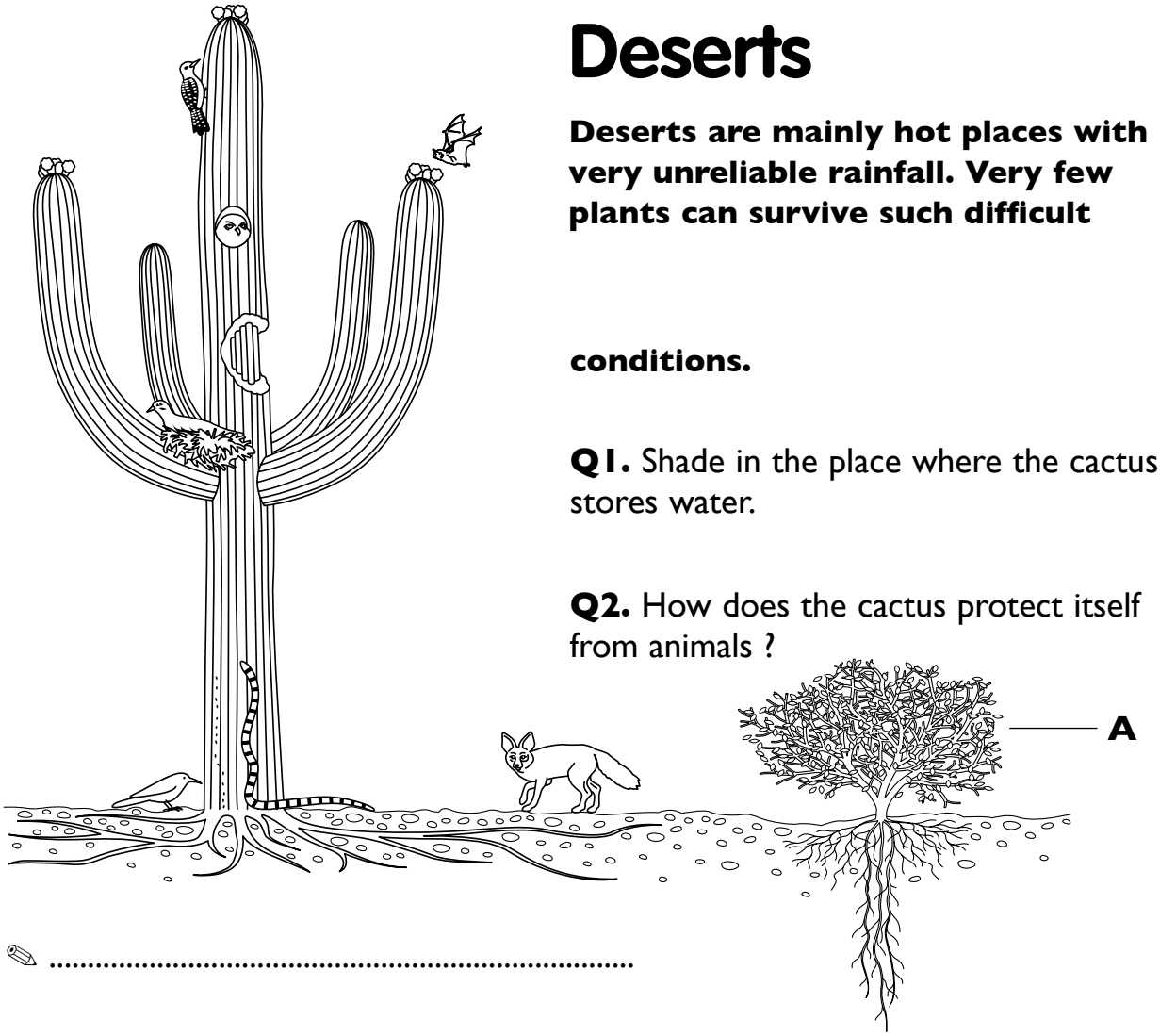
It is difficult to think what conditions may be like in a rainforest, but a miniature version may be set up in a jar on a sunny windowsill. The glass traps the Sun's heat and warms the air inside. This in turn warms the compost and the seeds. As the children have probably learned that warmth is needed for germination and growth, they may predict that germination and growth may be faster in the pot in the jar than the one outside the jar. Let them test their predictions.

Outcomes

The children:

- Can make a series of observations over a long period of time.
- Can write a report of their observations.

Name: ..... **Form:** .....



Deserts

Deserts are mainly hot places with very unreliable rainfall. Very few plants can survive such difficult conditions.

Q1. Shade in the place where the cactus stores water.

Q2. How does the cactus protect itself from animals ?

✎ .....

Q3. Which part of a cactus makes food?

✎ .....

Q4. What is the name of the plant labelled A and how is it adapted to survive in the desert?

✎ .....

.....

Q5. When can annual plants complete their life cycles in the desert?

✎ .....

Q6. How are the leaves of desert plants adapted to stop them losing water?

✎ .....

.....

Teacher's sheet: Practical

See **pages 44 and 45** of The Plant Book

Introduction

Ask the children if they own a cactus. Some children in a class may, but if not, ask them what they know about cacti and lead their answers and discussion towards a study of the spread.

Practical work

21: How do cacti conserve water?

Integrating the practical work

Give the children a leaf from a tree or a bush and ask them to find out how many squares of graph paper it covers. This will give them a measurement of the surface area. Now ask them to multiply that figure by two so that they find the surface area of the whole leaf. Follow this by asking them to multiply it by a few hundred, or even a thousand, to represent the surface area of the leaves of the tree or shrub.

Hold up a cloth and show them its surface area and show them how the surface area can be reduced by folding up the cloth. Now move onto the practical work and, at first, let the children try to come up with a plan without your help.

Extension worksheet

Pages 109 and 130.

Links

Mountain plants, pages 40–41. You may wish to contrast it with **How plants are adapted to water**, pages 38–39.

Answers

Q1. The cut away section, or the whole stem, should be shaded.

Q2. It has sharp spines.

Q3. The stem.

Q4. Creosote bush. It has a long tap root and leathery leaves.

Q5. After rain.

Q6. They are small, have a waxy coating and few pores.

Name: ..... Form: .....

How do cacti conserve water?

(1) Use two pieces of cloth to be models of plants. One piece of cloth can be hung from a coat hanger. This represents a plant with a large number of leaves. It has a large surface area for its weight. The other piece of cloth is rolled up and stood on one end. This represents a cactus. It has a small surface area for its weight.

(2) How could you use these two models to compare the way that water evaporates or escapes from the two 'plants'? Work out a plan here.

✎ .....

.....

.....

.....

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.....

(3) If your teacher agrees, try your investigation and present your results and conclusion to the rest of the class.

Teacher's sheet: Practical

See **pages 44 and 45** of The Plant Book

Resources

Two pieces of cloth which are the same size, a coat hanger and safety pins, paperclips or bulldog clips, depending on the age and ability of the children, a weighing machine, measuring cylinder, clock, access to warm area.

Introducing the work

You may like to show the children a collection of cacti temporarily donated by staff and parents. Make sure the children do not handle the plants at any stage. Ask the children what the plants have in common and look for a lack of leaves and dome-shaped or column-shaped bodies. Use their answers to talk about surface area, and if the children have already studied evaporation in other contexts, remind them of it here to help them support any predictions they make with their scientific knowledge.

The children may need a little help to realise that they can soak both cloths, weigh them, set one up as a plant with leaves, and the other as a cactus and some time later weigh them to find which one has lost the greater amount of water and so would be less likely to survive in a desert.

Outcomes

The children:

- Can devise an investigation.
- Can perform an investigation using scientific modelling.
- Can relate their results to observations of real plants in a habitat.

Section 5: Extension work for The Plant Book

Each page in this section supports one of the spreads in the *Students' Book*. The pages are linked to the comprehension worksheets and practical sheets by sharing the same number. The page reference to the *Students' Book* is also given.

The first question on every page in this section is a cloze exercise. The students can do them either while studying the page, after work on the practical or as a revision exercise. Answers to these questions are on pages 131 and 132. When the student has successfully completed this question it can be placed in the student's workbook for further revision purposes later in the year.

The second question may involve some simple practical activity, or may be work directly related to the page in the *Students' Book*. The sheets which need resources, together with a list of the resources, are featured below.

Some activities provide an opportunity to use ICT skills and these are simply marked (ICT) in the list below. The extent of the ICT work you wish to do, such as preparing spreadsheets, databases or making graphs, will depend on the time and facilities you have available and the ability of the students.

In the ***Go further*** section the children are challenged to use a range of secondary sources such as books, CD-ROMs and web sites to find information related to the topic and present it either to the class or to the teacher.

Extension worksheets which need resources and those which are suitable for ICT work:

2. Access to area where dandelions grow, trowel.
3. Brussel sprout.
4. Access to a wide range of plants.
6. Onion, compost, pot, ruler. (ICT.)
9. Access to school site to look for mosses. (ICT.)
10. Piece of paper.
11. Soaked broad bean seed.
12. Carrot tops, saucers, knife (used under supervision), ruler. (ICT.)
13. A piece of turf, pot, compost, ruler, scissors. (ICT.)
14. Seeds of annual plants, compost, seed tray, ruler. (ICT.)
15. Access to a weedy flower bed.
16. Atlas, globe, paper, sticky paper, torch.
18. Canadian pondweed, jar of water, clock or stop clock.
19. Access to local neighbourhood (under supervision).
19. Packets of ready-prepared meals.
20. Compost, salt, filter paper and funnel, dish for evaporation, beaker of water.
21. Sand, compost, funnels with cotton wool, plugs, beakers of water, measuring cylinder, stop clock.

Name: ..... Form: .....

Plants

Q1. Here is some information about plants but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

The part of the plant that is in the ground is called the _____. It has three main tasks. It _____ the plant in the _____ and takes in _____ and _____.

The part of the plant above the ground is called the _____. It is made of the _____ which supports the _____ and _____.

Many _____ attract insects to them. These animals carry _____ between the flowers. After the flowers are _____ they produce _____. As the plant grows it may defend itself with spines, thorns or _____. Some plants complete their life cycles in a year, they are called _____. Other plants live for many years, they are called _____.

Seeds sprout in a process called _____.

Word list: annuals, flowers, minerals, poisons, shoot, germination, seeds, supports, holds, pollen, root, ground, pollinated, stem, perennials, water, leaves.

Q2. Make a story in pictures or in words about how a plant sprouts from a seed, grows up and makes seeds of its own.

Go further

Find out about one plant which grows in North America, South America, Europe, Africa, Asia or Australia.

Name: ..... **Form:** .....

See **pages 6 and 7** of The Plant Book

Roots

Q1. Here is some information about roots but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Plants are held in the [ ] by their [ ] . Some plants, such as the carrot, have a thick central root called a [ ] root. It grows [ ] into the [ ] . Side roots grow [ ] from the [ ] root. Grass plants have a different kind of root system. They have thin roots which are all of a similar size. These roots are called [ ] roots.

The [ ] of the roots grow out through the [ ] . They are covered with tough skin which [ ] them from the sharp edges of the [ ] particles. Behind the root [ ] are root [ ] . They take up water and [ ] . The [ ] are [ ] in the water.

The ivy is a plant which has extra roots on its [ ] . They help the plant [ ] on to trees and walls.

Word list: tap, outwards, roots, stem, dissolved, soil, downwards, cling, minerals, protects, hairs, tips, fibrous.

Q2. Try and pull up a dandelion plant by its leaves. What happens? Make a drawing of how you think the dandelion root will look, then use a trowel to dig it up.

Go further

Find out about plant roots that we eat.

Name: ..... **Form:** .....

See **pages 8 and 9** of The Plant Book

Stems

Q1. Here is some information about stems but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

There are two kinds of stem. They are called _____ and _____. Soft stems which are light and _____ are called _____. They contain _____ which are very strong and do not _____ easily. _____ also helps to hold up a _____. If the soil dries out, less _____ goes into the _____ and it bends over or _____.

The second type of stem is made of _____. It is slightly _____ but does not _____ when the soil is _____. The surface of the _____ is covered by _____. Underneath the _____ is the _____ part of the stem.

There are two sets of _____ in a stem. One set carries food from the _____ to the _____ and _____. The other set carries water from the _____ to the _____ and _____.

Word list: **flexible, trunks, roots, break, leaves, dry, water, wood, stalks, wilts, tubes, living, fibres, bark, trunk, stalk, flowers, wilt.**

Q2. A brussel sprout is a large bud. Take one apart and find out what it is made of.

Go further

Find out what is meant by soft woods and hard woods.

Name: ..... **Form:** .....

See **pages 10 and 11** of *The Plant Book*

Leaves

Q1. Here is some information about leaves but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Each leaf has a [ ] . A network of [ ] branch out from the [ ] . Together the [ ] and [ ] make a [ ] material which supports the rest of the leaf. It makes the leaf strong enough to stand up to the [ ] and [ ] . The bulk of the leaf is made of softer [ ] . It forms a wide, [ ] part of the leaf called the [ ] .

A plant holds its leaves up to the sunlight. It uses the [ ] to make [ ] . The leaves are arranged on the [ ] to catch as much [ ] as possible. They may be arranged in [ ] or [ ] along a stem. In some plants the leaves are arranged in a star shape on the stem. This arrangement is called a [ ] . When the leaves have made [ ] they send it along the [ ] to the stem.

Word list: rain, stalk, alternately, material, sunlight, stem, veins, thin, pairs, wind, tough, blade, food, whorl.

Q2. Look along the stems and branches of different plants. Are the leaves all the same size or do they vary?

Go further

Some plants have leaves which are adapted for catching insects. What can you find out about them?

Name: ..... **Form:** .....

See **pages 12 and 13** of *The Plant Book*

Inside a leaf

Q1. Here is some information about the inside of a leaf but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

The leaf makes [ ] for the plant. In order to make [ ] the plant must take in [ ] , [ ] and [ ] . Light passes in through the [ ] top surface of the leaf. Some of the [ ] is trapped by a [ ] substance in the leaf. This substance is called [ ] . There are holes called [ ] on the [ ] of the leaf. When they open [ ] is [ ] from inside the leaf. This causes the leaf to begin to [ ] out so it takes more [ ] from the [ ] . They take more [ ] from the stem, which in turn takes more [ ] from the roots, so the [ ] take in more [ ] from the soil. At night the [ ] on the leaf [ ] so less water is lost.

The leaf is made of cells. Each [ ] has a wall made of [ ] and a control centre or 'brain' called a [ ] . Cells near the top surface of the leaf are packed with [ ] to trap sunlight. Around the [ ] are [ ] cells which bend like [ ] to open the [ ] and go straight again to close them.

Word list: green, light, food, dry, veins, nucleus, underside, cellulose, roots, water, chlorophyll, lost, pores, transparent, minerals, cell, guard, bananas, close.

Q2. Imagine you are water vapour inside a leaf. Describe what it is like in there and how you can escape into the air.

Go further

Find out the names of the different layers of cell in a leaf.

Name: ..... **Form:** .....

See **pages 14 and 15** of *The Plant Book*

How leaves make new tissue

Q1. Here is some information about how leaves make new tissue but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Roots take up _____ and _____ from the soil. The _____ are dissolved in the _____. Tubes inside the plant take the _____ and _____ from the root through the _____ to the leaf _____ and the _____. A gas called _____ in the air passes through the open _____ on the _____ of the leaf. The water and _____ gas are changed into food inside the leaf. The food is called _____. It is _____ in the roots or the stem of the plant. The energy to make food comes from _____. This is trapped in a _____ substance called _____.

When a plant makes food it also makes a gas called _____. We take in this gas when we _____. Plants and _____ need this gas to stay _____. The process of making food using sunlight is called _____.

Word list: **alive, veins, water, photosynthesis, underside, breathe, stored, sunlight, oxygen, stem, minerals, starch, stalk, green, pores, chlorophyll, carbon dioxide, animals.**

Q2. Set up a small onion in a plant pot of compost. When its leaf starts to grow, measure it every day and work out how fast it is making new material for itself.

Go further

Find out which plants have leaves that provide us with food.

Name: ..... **Form:** .....

See **pages 16 and 17** of The Plant Book

Flowers

Q1. Here is some information about flowers but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

A flower forms inside a [ ] . It is [ ] by small green [ ] that cover the [ ] . When the [ ] is ready to grow out of the [ ] the [ ] fall away. Many plants produce flowers with large colourful [ ] . Many flowers have just four or five [ ] but some can have over [ ] . The bright colours of the [ ] help to attract [ ] to the flower. These animals help the plant [ ] .

Inside the [ ] are small stalks. They are the [ ] part of the flower and are called stamens. They produce a [ ] dust called [ ] . The [ ] is carried from flower to flower by [ ] .

At the centre of the flower is the [ ] part of the flower. It may form a long [ ] and the bottom part may be shaped like a bottle. Inside this is the place where [ ] are made.

Word list: protected, bud, twenty, female, insects, pollen, leaves, seeds, petals, stalk, yellow, reproduce, male, flower.

Q2. Watch a flower bud open. Check the changes every few hours for a few days and draw pictures to show the changes. Try watching the flowers of different plants.

Go further

Find out where the plants live that use birds and bats to pollinate their flowers.

Name: ..... **Form:** .....

See **pages 18 and 19** of *The Plant Book*

How flowers share pollen

Q1. Here is some information about how flowers share pollen but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Plants produce flowers when they are ready to _____ . Most flowers contain both _____ and _____ parts . The _____ parts produce pollen. This is made up of tiny _____ . They have to reach the _____ part of a flower for reproduction to take place. The process of transferring pollen from the _____ parts of a flower to the _____ parts is called _____ . Usually when the male parts of a flower produce _____ the _____ parts are not ready to receive it so the _____ has to be moved to other flowers where the _____ parts can receive it. Most plants use either the _____ or _____

_____ pollinated flowers have large bright _____ which may be scented. These features attract _____ . The flowers also produce a high energy drink for the _____ . This liquid is called _____ . Wind pollinated flowers do not have _____ , scent or _____ for this. They make large amounts of _____ to increase the chance of some being blown into flowers that are ready for them.

After pollination, a second process takes place called _____ . This results in _____ developing in the female part of the plant.

Word list: nectar, fertilisation, seeds, grains, female, pollination, petals reproduce, wind, pollen, insects, male, insect.

Q2. Describe how the contents of a pollen grain travel from the male part of a flower to the place where fertilisation occurs and a seed is made.

Go further

Find out about the life cycles of some wind pollinated plants.

Name: ..... **Form:** .....

See **pages 20 and 21** of *The Plant Book*

Seeds and spores from non-flowering plants

Q1. Here is some information about seeds and spores from non-flowering plants but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

One group of plants make seeds without making _____ . They make cones instead and are called the _____ . There are two kinds of cone, _____ cones and _____ cones. The male cones make _____ which is blown into the _____ . When some of the pollen reaches a female cone _____ is said to have taken place. After this, _____ takes place and the _____ cone produces seeds. These do not have _____ . The _____ cone simply opens in dry weather and releases the seeds into the _____ .

Some plants do not produce pollen or seeds. They produce _____ instead. A _____ is a tiny capsule which contains a piece of the _____ plant. It is so small that you need a _____ to see it clearly. The green plants that produce spores are _____ and _____ . Fungi, like the mushroom and _____ also produce spores.

Spores travel on _____ currents. When they land in warm, damp conditions they break open and the piece of the _____ plant grows out and forms a _____ plant.

Word list: pollination, spores, microscope, new, conifers, mosses, male, toadstool, pollen, spore, parent, flowers, fruits, female, air, fertilisation, ferns.

Q2. Make a survey of where moss grows around your school. Does it grow in sheltered places, or places exposed to the weather? Can you make any predictions about where you might find moss growing?

Go further

Find out how fungi help plants get the minerals from plants that have died.

Name: ..... Form: .....

How seeds are scattered

Q1. Here is some information about seeds but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

When a plant produces _____ it needs to scatter them. If the seeds simply dropped around the parent plant the _____ would not grow well. The _____ of the _____ would compete with each other for water and minerals. Many would not get enough water and minerals for _____ growth. The leaves would compete with each other for _____ and some would be put in the _____ and not make much _____ .

Plants avoid these _____ conditions by scattering their seeds. Many seeds are carried by the _____ . They may have hairs which act as a _____ , like the _____ seed, or they may have _____ like a sycamore. Some seeds are _____ by animals. The plants may attract the animals with brightly coloured, juicy _____ . When the animals _____ these _____ they also _____ the seeds, but the seeds pass through the animal's _____ unharmed. By the time the seeds leave the animal's _____ the animal may have travelled a long way from the _____ plant. A few plants produce _____ which have _____ for clinging to the _____ of passing animals. They may travel for many kilometres before they fall to the ground.

Plants that grow near water may use it to carry their seeds away. The _____ tree grows on _____ beaches and its seeds fall into the sea and may travel great distances before they are washed up on another _____ .

Word list:	**shade, fur, healthy, fruits, tropical, parent, dandelion, coconut, digestive system, seeds, overcrowded, wind, shore, roots, sunlight, parachute, seedlings, food, wings, carried, eat, hooks.**

Q2. Can you make a model of a winged seed from a piece of paper? You need to crumple up part of the paper into a tiny ball (this is the 'seed') and tear the other part of the paper into two wings like helicopter rotors. If you experiment with the size of the wings you should be able to make the seed spin when you drop it.

Go further

Find out about the plants we grow to provide us with fruits and seeds.

Name: ..... Form: .....

How seeds sprout

Q1. Here is some information about how seeds sprout but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Inside a seed there is a tiny [ ] and a store of [ ], protected by a seed [ ]. When the seed leaves the parent plant the [ ] of the seed is almost dry. This makes the seed light in [ ], easy to [ ] and it also stops [ ] attacking the food and making the seed [ ].

Seeds usually remain inactive for some [ ] after they have left the parent plant. They are said to be [ ] at this [ ]. [ ] protects the seed from [ ] in unfavourable weather conditions, as seeds are usually [ ] at the end of the growing season when the weather conditions may be [ ].

When the weather improves, two features of the habitat make the seeds sprout, or [ ]. These features are [ ] and [ ]. When a seed [ ] it takes in water, swells up and the [ ] bursts out. At first the tiny plant uses its store of [ ] but once it has grown [ ] it uses them to make [ ] instead.

Word list: time, coat, food, dormant, warmth, leaves, sprouting, transport, root, dormancy, scattered, plant, mouldy, inside, fungi, germinate, water, weight, harsh, germinates.

Q2. Break open a soaked broad bean seed and find how the tiny plant is attached to its food stores. Make a drawing of what you find.

Go further

How are bean sprouts produced for us to eat?

Name: ..... Form: .....

Stems that produce new plants

Q1. Here is some information about stems that produce new plants but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Some plants have a second way of _____ . As well as making _____ in their _____ they also make new plants from _____ of their body. The new plants grow close to the _____ plant. In time a large group, or _____ , of plants may form.

The _____ grows out a long, _____ side shoot. This is called a _____ . There are buds on the _____ and they can change into new plants. When a bud touches the soil it may sprout a root and _____ . The young plants may remain connected to the _____ plant for some time before the _____ withers away.

The _____ has a thick, _____ stem swollen with _____ . There are joints in this stem and new plants may form at the joints. The plants use some of the _____ stored in the stem to help them start growing, then make their own _____ when their _____ grow out through the soil.

The _____ has a bulb. This is a flat _____ with leaves swollen with food. Some of the buds on the _____ grow into small bulbs which eventually separate from the _____ plant. The _____ has a short thick underground stem called a corm. This has side _____ which make new _____ that grow round the side of the parent plant.

Word list: clump, flowers, parts, parent, reproducing, seeds, iris, thin, food, runner, crocus, buds, underground, shoot, daffodil, corms, leaves, stem, buttercup.

Q2. How much carrot top do you need to make it sprout a shoot? Work out an investigation plan and then try it.

Go further

Find out about how daffodils and tulips are reared for sale in a florist's shop.

Name: ..... Form: .....

How plants defend themselves

Q1. Here is some information about how plants defend themselves but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Plants make [ ] in their leaves and [ ] it in parts of their bodies such as the [ ] and the roots. Animals attack plants to [ ] on their stored food. Plants have a variety of ways of [ ] themselves.

When animals attack and eat the [ ] some plants grow [ ] ones or produce a second set of [ ] later in the growing season. The grass plant hides the bases of its leaves [ ] . The base of the leaf makes new leaf material. If the leaf is eaten by a [ ] animal, the leaf base survives and a [ ] leaf is grown. Some plants produce poisons in their leaves and the animals soon learn to [ ] them.

Larger animals do not just eat single [ ] , but can take in a group of them and part of the [ ] in one mouthful. Some plants can [ ] themselves against this kind of attack by having [ ] and [ ] which cut into the animal's mouth if it tries to feed. Some spines may break [ ] and release a poison which stings the animal's mouth.

A few plants rely on ants to help them. They provide the ants with [ ] in the form of sugary [ ] and the ants [ ] any animal that tries to feed on the plant.

Word list: store, stem, food, underground, attack, avoid, leaves, sap, thorns, defending, new, spines, open, grazing, defend, feed.

Q2. How fast does grass grow? Put a piece of turf in a pot. Cut off the leaves with scissors, water the turf and measure its growth every day. Does the amount of water you give the turf affect the way it grows?

Go further

Find out about holly and bramble plants.

Name: ..... Form: .....

How annuals compete

Q1. Here is some information about annuals but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

An annual plant is a plant that completes its life cycle in a _____. The life cycle starts in the _____ when the soil is moist and _____. These conditions cause the seeds to sprout, or _____. First the _____ grows out into the soil and then the _____ grows up into the air. The leaves of the seedling make _____ from air, _____ and _____ in the soil. The plant uses the _____ to grow _____ and produce flowers.

When the flowers open, they attract _____ to them to feed on the _____. The _____ carry away pollen from the _____ parts of the plant and leave it on the _____ parts of other flowers of the same kind. This transfer of the pollen is called _____. Later _____ takes place inside the _____ part of the flower and _____ are produced and scattered.

Annual plants move through all the stages of their life cycle _____ so they can _____ areas of bare ground before other, more slowly growing plants, reach them. Many annuals grow in gardens and among crops where they are not _____. These plants are called _____.

Word list: year, weeds, germinate, shoot, wanted, spring, water, warm, female, food, insects, quickly, sunlight, fertilisation, colonise, pollination, seeds, male, root, nectar.

Q2. Sow a mixture of annual plants in a seed tray and compare how they germinate, grow and compete with each other.

Go further

Find out about the life cycle of the poppy.

Name: ..... Form: .....

How shrubs and trees compete

Q1. Here is some information about shrubs and trees but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Plants that live for many years are called _____. Some plants have _____ that die back at the end of the growing season and the plant remains alive as a root, _____ or underground _____ in the soil. These plants are called herbaceous perennials. A second type of _____ plant makes wood in its _____. This does not die back at the end of the growing _____ but remains above _____ and grows _____ every year. These plants are called woody perennials and are _____ into two groups called trees and _____.

When an _____ of ground is cleared, annual plants are the first to _____ it. In time, herbaceous _____ may also begin to grow there. Both these kinds of plants die back in _____, but when _____ perennials begin to grow there they do not die back. They just keep getting _____ and every year their _____ shade more of the ground below them. In time, it is too _____ for many other plants to grow there and the _____ and shrubs have formed a wood.

Word list: perennials, autumn, trees, stems, ground, shrubs, area, shady, larger, season, bulb, stem, perennial, colonise, divided, leaves, woody.

Q2. Annuals are great colonisers. Look in a flower bed and find out how many different weeds you can find (plants that have not been deliberately planted there). These are the annuals that begin the first stage of turning bare soil into a wood.

Go further

Find out about the life cycle of the oak tree.

Name: ..... **Form:** .....

See **pages 34 and 35** of *The Plant Book*

Habitats

Q1. Here is some information about habitats but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

The place where a plant or an animal lives is called its _____. There are many different kinds of _____. Each one depends on the _____ it receives during the year. For example, some places have short, cool _____ and long, cold winters, while others have longer periods of warmer weather. No plant can _____ in all these different _____, so you find different plants growing in _____ habitats.

Near the poles of the planet the _____ is too harsh for trees to grow and the plants are adapted to the strong _____ by growing close to the _____. They are adapted to the cold weather by growing _____. Further away from the poles the weather is less severe and _____ trees grow in huge _____. These trees have waxy _____ which lets the snow fall from them easily. This stops the snow blocking out the _____ and preventing the leaf from making _____. Conifers keep their _____ all year round to get as much _____ as they can from the weak sunlight in their habitat.

In places with warmer _____, broad-leaved _____ grow in woodlands. They have large leaves to make as much _____ as they can from the summer sunlight, then _____ their leaves to _____ the winter gales and _____ new ones in the following year.

Word list: **conditions, habitat, food, shed, leaves, conifer, winds, grow, energy, weather, different, summers, trees, avoid, forests, slowly, live, ground, light.**

Q2. Use an atlas to find the tundra region, a large area covered by coniferous forest, a large area covered by a rainforest and a large area covered by a desert. Write their names on paper and stick them in the appropriate places on a globe. Shine a spot of light on the globe from a torch to make a model of the Earth and Sun. Keep the torch horizontal as you shine it on the different regions of the world and see how the spot changes size. Use this model to explain why the different regions have different weather.

Go further

Find out about the plants that grow in the prairies and on the savanna.

Name: ..... **Form:** .....

See **pages 36 and 37** of *The Plant Book*

Woodland through the seasons

Q1. Here is some information about woodland through the seasons but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Trees which lose their [ ] in winter are called [ ] trees. They grow together to form a [ ] habitat in places with cool climates and cold winters. The [ ] of the trees fit together to form a [ ] over the woodland [ ] .

In winter and early spring, when the branches are [ ] , sunlight can [ ] down to the woodland floor. In early spring, before the [ ] burst into leaf, some woodland [ ] sprout their leaves to catch the [ ] in the sunlight and make [ ] . They grow their flowers and then [ ] back when the [ ] come into leaf and the canopy [ ] the woodland floor. Some plants, such as [ ] and [ ] , are adapted for living in the shade of the trees. Fungi can grow in the shade too because they do not use energy from [ ] to survive. They [ ] on decaying leaves and branches which have fallen onto the woodland floor.

The woodland plants provide [ ] for many animals. Caterpillars feed on [ ] , squirrels feed on [ ] and birds like the thrush feed on [ ] . In winter, when the canopy is bare, the animals are not protected from the [ ] weather and may hide away in [ ] , like the squirrel, or hibernate like the [ ] and the [ ] .

Word list:	**bat, nests, food, die, leaves, reach, woodland, trees, berries, hedgehog, ferns, deciduous, branches, mosses, shades, sunlight, feed, plants, floor, energy, nuts, harsh, canopy, bare.**

Q2. Write an account of how a wood changes from one New Year's day to the next.

Go further

Find out how hedgerows have been lost in Britain and how this has affected wildlife.

Name: ..... **Form:** .....

See **pages 38 and 39** of *The Plant Book*

How plants are adapted to water

Q1. Here is some information about how plants are adapted to water but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

If a plant is to live in a [ ] it has to be adapted to the special conditions there. In ordinary soil the roots take [ ] from the air in the spaces between the soil particles. In a pond, the soil is soaked in [ ] to form [ ] and there is no [ ] for the roots. Pond plants are adapted for this by having a stem that has spaces in it so that air can carry [ ] down to the [ ] to keep them [ ] .

Water absorbs sunlight, so the deeper the water the [ ] it becomes. Plants that live below the [ ] are adapted to living in the [ ] conditions there. Some plants survive in deep water by growing long leaf [ ] to the water [ ] and having leaves which [ ] . These leaves collect as much [ ] as plants on land. A few water plants have dispensed with a root holding them to the [ ] and simply [ ] on the water surface. They use their roots to help them [ ] and stop them [ ] over and sinking.

The smallest water plants are the [ ] . They do not have roots, stems or leaves and their tiny, [ ] bodies can only be seen clearly by using a [ ] . Algae may float in the water or form a green [ ] on stones.

Word list: oxygen, shady, water, slime, mud, float, roots, microscope, darker, stalks, surface, green, balance, sunlight, algae, tipping, alive, pond.

Q2. Put some Canadian pondweed in a jar of water in a sunny window and time how long it takes for bubbles of oxygen to appear. You may leave the plants and return to them periodically to look for bubbles.

Go further

Find out about plants that grow in streams and rivers.

Name: ..... **Form:** .....

See **pages 40 and 41** of *The Plant Book*

Mountain plants

Q1. Here is some information about mountain plants but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

At the bottom of the _____, the weather conditions are mild enough for broad-leaved _____ to grow. _____ is an example of this kind of tree, and can form a _____. Above the _____ forest the _____ conditions become cooler and harsher. _____ trees are adapted for living in these conditions. They have dark green leaves for absorbing as much _____ from the _____ as possible so that they can continue to _____ slowly and _____ food in the cold weather. The _____ are evergreen, so the ground around them is always _____. Some plants, like the _____ and _____, are adapted to these conditions and thrive there.

As you climb a mountain, there comes a place where the weather is too harsh even for _____. Here grasses and flowers such as _____ and _____ form a meadow in summer. Above the _____ the weather is even colder and the surface of the mountain is covered with _____ and only a little soil. Some plants called _____ live here. They stay small so they are not _____ away by the strong _____ and may have long _____, which search through the thin soil for _____.

Word list: **mountain, water, conifers, alpines, coniferous, wind, oak, make, weather, forest, trees, shady, sunshine, heat, bilberry, lupins, meadow, roots, mosses, blown, grow, buttercups, rocks.**

Q2. Lichens form yellow, pale green or grey crusts on rocks. Look for them on walls in your neighbourhood or around the school. How many can you find?

Go further

Find out about how the different kinds of conifers can be identified.

Name: ..... **Form:** .....

See **pages 42 and 43** of *The Plant Book*

Adapting in the tropical rainforest

Q1. Here is some information about plants adapting in the tropical rainforest but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

In some of the lands around the [ ] it is so hot and wet that [ ] numbers of different [ ] grow rapidly together. These form tropical [ ] . Most of the trees grow very [ ] . Their [ ] do not have side branches until almost the [ ] of the tree. Here, the [ ] spread out and form a leafy crown. The crowns of the trees form a [ ] which blocks out much of the [ ] and makes the forest below very [ ] .

When a seed sprouts, or [ ] , on the forest floor, the seedling grows quickly to reach the [ ] . Some plants grow up the [ ] of trees and twist around them for [ ] .

Some plants live on the [ ] of the trees. They have small roots to [ ] them in place, and some have leaves shaped like cups to collect [ ] water. These cups of water become homes to small animals like [ ] .

As the rain has poured over the soil for a long time, most of the [ ] have been washed out of it. The trees rely on rotting leaves and fallen branches for their [ ] . They collect the minerals by spreading out their [ ] just under the [ ] surface to reach the minerals before they can be washed away.

Word list: soil, minerals, frogs, trunks, tall, rainforests, roots, rain, light, canopy, plants, branches, germinates, top, huge, shady, support, equator, hold.

Q2. See if you can demonstrate how minerals are lost from a soil by mixing some soil and salt. Put the mixture in a filter funnel and pour water onto it. Collect the water that has passed through the soil and let it evaporate. If the soil has lost its minerals, predict what you will see when the water has gone. Was your prediction correct?

Go further

Find out about the causes of rainforest destruction and what can be done to stop it.

Name: ..... **Form:** .....

See **pages 44 and 45** of *The Plant Book*

Deserts

Q1. Here is some information about deserts but there are gaps in the text. Fill in the gaps from the word list. You may use some words more than once.

Deserts are hot, [ ] places where very little [ ] falls. There may be many [ ] when no [ ] falls and plants have to be adapted to survive these long [ ] periods.

Annual plants survive as [ ] during dry weather. When it rains, the [ ] quickly soak up the water and [ ] . The seedlings grow rapidly and soon the plant is able to produce [ ] and set more seed as the ground [ ] out again.

[ ] plants have tough shoots and long [ ] to help them survive in the dry spells. A plant loses most of its water through its [ ] , so desert perennials like the [ ] bush have small, [ ] leaves to stop [ ] escaping. The cactus uses its green stem to trap [ ] for making [ ] , instead of using leaves.

The [ ] of the cactus lie just under the desert sand, so that when it [ ] they can draw in water as soon as it sinks into the [ ] . The cactus stores the water in its stem and defends itself with [ ] . They stop animals biting into the stem to get a [ ] .

Word list: drink, roots, leathery, flowers, dry, spines, food, creosote, perennial, germinate, rain, ground, sunlight, leaves, dries, seeds, months, rains, water, sunny.

Q2. Does sand lose water faster than potting compost? Work out a plan for an investigation and then try it. What do you find?

Go further

Find out about the plants which grow in an oasis.

Answers

1. root, holds, ground, water, minerals, shoot, stem, leaves, flowers, flowers, pollen, pollinated, seeds, poisons, annuals, perennials, germination.

2. soil, roots, tap, downwards, soil, outwards, tap, fibrous, tips, soil, protects, soil, tips, hairs, minerals, minerals, dissolved, stem, cling.

3. stalks, trunks, flexible, stalks, fibres, break, water, stalk, water, stalk, wilts, wood, flexible, wilt, dry, trunk, bark, bark, living, tubes, leaves, roots, flowers, roots, leaves, flowers.

4. stalk, veins, stalk, stalk, veins, tough, wind, rain, material, thin, blade, sunlight, food, stem, sunlight, pairs, alternately, whorl, food, stalk.

5. food, food, light, water, minerals, transparent, light, green, chlorophyll, pores, underside, water, lost, dry, water, veins, water, water, roots, water, pores, close, cell, cellulose, nucleus, chlorophyll, pores, guard, bananas, pores.

6. water, minerals, minerals, water, water, minerals, stem, stalk, veins, carbon dioxide, pores, underside, carbon dioxide, starch, stored, sunlight, green, chlorophyll, oxygen, breathe, animals, alive, photosynthesis.

7. bud, protected, leaves, bud, flower, bud, leaves, petals, petals, twenty, petals, insects, reproduce, flowers, male, yellow, pollen, pollen, insects, female, stalk, seeds.

8. reproduce, male, female, male, grains, female, male, female, pollination, pollen, female, pollen, female, wind, insects, insect, petals, insects, insects, nectar, petals, nectar, pollen, fertilisation, seeds.

9. flowers, conifers, male, female, pollen, air, pollination, fertilisation, female, fruits, female, air, spores, spore, parent, microscope, mosses, ferns, toadstool, air, parent, new.

10. seeds, seedlings, roots, seedlings, healthy, sunlight, shade, food, overcrowded, wind, parachute, dandelion, wings, carried, fruits, eat, fruits, eat, digestive system, digestive system, parent, fruits, hooks, fur, coconut, tropical, shore.

11. plant, food, coat, inside, weight, transport, fungi, mouldy, time, dormant, time, dormancy, sprouting, scattered, harsh, germinate, warmth, water, germinates, root, food, leaves, food.

12. reproducing, seeds, flowers, parts, parent, clump, buttercup, thin, runner, runner, shoot, parent, runner, iris, underground, food, food, food, leaves, daffodil, stem, stem, parent, crocus, buds, corms.

13. food, store, stem, feed, defending, leaves, new, leaves, underground, grazing, new, avoid, leaves, stem, defend, spines, thorns, open, food, sap, attack.

14. year, spring, warm, germinate, root, shoot, food, sunlight, water, food, quickly, insects, nectar, insects, male, female, pollination, fertilisation, female, seeds, quickly, colonise, wanted, weeds.

15. perennials, stems, bulb, stem, perennial, stem, season, ground, larger, divided, shrubs, area, colonise, perennials, autumn, woody, larger, leaves, shady, trees.

16. habitat, habitat, weather, summers, live, conditions, different, weather, winds, ground, slowly, conifer, forests, leaves, light, food, leaves, energy, weather, trees, food, shed, avoid, grow.

17. leaves, deciduous, woodland, branches, canopy, floor, bare, reach, trees, plants, energy, food, die, trees, shades, mosses, ferns, sunlight, feed, food, leaves, nuts, berries, harsh, nests, hedgehog, bat.

18. pond, oxygen, water, mud, oxygen, oxygen, roots, alive, darker, surface, shady, stalks, surface, float, sunlight, mud, float, balance, tipping, algae, green, microscope, slime.

19. mountain, trees, oak, forest, oak, weather, coniferous, heat, sunshine, grow, make, conifers, shady, bilberry, mosses, conifers, lupins, buttercups, meadow, rocks, alpines, blown, wind, roots, water.

20. equator, huge, plants, rainforests, tall, trunks, top, branches, canopy, light, shady, germinates, light, trunks, support, branches, hold, rain, frogs, minerals, minerals, roots, soil.

21. sunny, rain, months, rain, dry, seeds, seeds, germinate, flowers, dries, perennial, roots, leaves, creosote, leathery, water, sunlight, food, roots, rains, ground, spines, drink.