

**Macmillan**  
**Science**

**Teacher's book**



**2**

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**MACMILLAN**

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## Preface

The Macmillan Science series is a comprehensive science course for all students in primary schools. Building on practical experience and investigation, the books follow current best practice in science education. Through engaging content and carefully graded activities and exercises, students are guided to develop a sound framework of scientific knowledge, understanding and skills.

Discussing ideas with partners and then with the whole class is central to the approach used throughout. In this way, the children acquire and improve their spoken English, but are also active learners throughout each science lesson.

There are six full-colour Pupil's Books from the level 1 to the final year of primary school. The main strands of living things (plants, animals and humans), materials, and the physical world are repeated at each grade, reinforcing ideas learnt earlier and developing these to a higher level.

Science teaching, especially when it is 'hands-on', can be highly enjoyable and rewarding for teachers and students alike. We hope that Macmillan Science will contribute both to the effectiveness of your teaching and to the pleasure that you and your class gain from studying science.

David and Penny Glover

## Components

For each level there is a Pupil's Book, Workbook and CD-ROM, accompanied by a Teacher's Guide which gives clear instructions on how to plan lessons.

- The Pupil's Book contains clear illustrations and instructions for carrying out practical investigations, discussion activities and sections for the assessment of learning.
- The Workbook contains a range of different activities that enable children to review and consolidate their learning.
- The CD-rom packaged with each Pupil's Book, provides further reinforcement and assessment of skills and concepts developed in each unit through interactive activities.

The scope and sequence is displayed at the beginning of the Pupil's Book, together with the objectives for each unit. Each of the five main areas of science is colour-coded for easy reference from one book to another.

## Teacher's Guide structure

Each topic is divided into three sections: Lesson preparation, Lesson plan and After the lesson.

Lesson preparation: outlines the topic objectives, equipment needed, key words with definitions and teaching ideas and background information, linking theory with practice.

Lesson plan: detailed lesson plans including ideas for warm-up and extension activities.

After the lesson: Workbook and CD-ROM answers.

# Introduction

## Why teach science in the primary school?

Today, the case for teaching primary science hardly needs to be stated. Science, alongside numeracy and literacy, is a core component of the primary school curriculum in schools around the world.

The reasons for teaching science at the primary level may be summarised as follows:

- investigation-based science learning develops children's curiosity, problem-solving, practical and communication skills
- basic scientific knowledge of the human body, diet, living things, the environment, materials, forces and energy contributes to children's developing awareness of themselves and their relationship to their surroundings; this knowledge will help them to make healthy choices, to keep safe and to solve problems as they move through life
- scientific values and attitudes such as respect for evidence, questioning, flexible thinking and the willingness to share knowledge and ideas are relevant in all areas of children's learning, not just science
- through science, children become aware of environmental issues and the impact that they as individuals can have on their surroundings; they develop respect for living things and their environment and become aware of the harm that simple actions such as littering, wasting energy or contaminating water supplies can cause
- in the majority of countries, science is an examination subject at the end of the final year of primary school. Children may need to perform well in science to gain a place at the secondary school of their choice
- a good knowledge of science gained in the primary school prepares children to do well in their more formal science education at secondary school. Good results in secondary school science examinations open up a wide range of career opportunities.

## Successful teaching and learning with Macmillan Science

Effective science teaching should incorporate the following components:

- 1 Plan well-resourced lessons that engage all pupils, so each one is able to participate in the discussion and the practical tasks. Most of the equipment needed for the lessons is easy to obtain, but specific measuring equipment and an assortment of containers are essential for scientific investigations.
- 2 Allow children to reflect on their prior knowledge, articulating their views about scientific ideas. Sometimes these ideas may be quite different to accepted scientific ones but are often valid from a child's point of view. They provide a key to developing scientific concepts.
- 3 Encourage children to discuss their ideas with their partners and the rest of the class so that they learn to be active learners, articulating their own ideas and listening to those of others.
- 4 Introduce the key words shown in each unit, developing a shared understanding of these and encouraging children to use them when they express their ideas. Developing working definitions for new vocabulary and using the glossary can help children to clarify meanings of scientific terms.
- 5 Try to ask 'open questions' so that children are encouraged to think through their ideas in depth rather than just recalling information. Often, inserting 'do you think' into a question can elicit a more meaningful response.
- 6 Teach scientific recording, using charts and graphic organisers. These enable comparisons to be made and reduce the amount of writing required, leaving more time for discussion and practical work.

- 7 Use the school grounds and the neighbourhood as an extension of the classroom, encouraging children to observe things that they may otherwise walk past each day.
- 8 Science is a way of thinking, not just a body of knowledge, so encourage the children to think of themselves as scientists so that they develop a wonder of the natural world and an excitement for exploring the world around them.

## Teaching a lesson

- 1 Look through the learning objectives and key words to decide how the children can be supported during the topic. The language boxes give additional ideas for how children's language needs can be addressed.
- 2 Check the resources list and ensure that there is enough equipment for all the children to participate in the practical work. Resources can be put out on each table or placed nearby so that it does not cause a distraction during the introduction to the lesson. Ideally, children should work in pairs or small groups so that each person can play an active part.
- 3 Arrange the classroom to ensure easy movement, making sure that bags and clothing are not trailing from chairs.
- 4 If an interactive white board is available, look for visual materials and video sequences that will help to reinforce vocabulary and aid concentration.
- 5 Let the children decide on their own working definitions for new vocabulary and try to develop these during the lesson, refer to the glossary for more precise meanings. Write new vocabulary and summarise children's ideas on the board to reinforce learning, especially for visual learners.
- 7 Encourage children to be active listeners, responding to the ideas of others, saying if they agree or disagree and giving reasons why. Try to develop a sense that the children are talking to each other. Get children to give reasons for their thinking rather than giving short answers to questions.
- 8 At the end of the lesson, encourage the children to reflect on their learning, saying what they found particularly interesting or perhaps difficult. Look at the objectives again and ask the class to assess whether they managed to achieve these. Invite questions about any difficulties or puzzles they may still have. Close the lesson with Check your progress.
- 9 Set the children the Workbook and CD-ROM activities as homework to consolidate their learning.

## Developing children's scientific vocabulary

To become scientifically literate, children must acquire the vocabulary they need to describe their observations and ideas. To aid with this aspect of their learning, new key words are identified in every lesson. Simple definitions for all the key words are given in the glossary at the back of the Pupil's Book, and the Teacher's Guide offers suggestions for helping children to learn these new words.

During the lesson, you could write the key words on the board as they are introduced. Children could copy the key words into their notebooks. If you print the key words on individual cards, they can be used as flashcards for reading practice. Key word cards can also be used to label displays and to play word games.

# Introduction

## General safety rules for students

Hazardous laboratory chemicals such as strong acids and alkalis should not be used in the primary school, but common household chemicals such as cleaners and paints are often introduced for various activities. These must be treated as potentially hazardous, and any safety instructions on the container followed. In general, anything which is irritating, toxic or corrosive (bleach, for example) should be handled only by the teacher.

Particular care should be taken with matches, candles and other naked flames and heat sources. In lower primary, children should not use heat sources themselves; these should only be demonstrated by the teacher. We advise against the use of spirit burners by pupils in the primary school because of the fire risk posed by fuel spills.

## Safety equipment

There is some basic safety equipment that you should have when you do an experiment. Make sure you have the following nearby:

- First Aid box. Keep your First Aid box complete at all times – if you use something up, replace it. The most important things to have in your First Aid box are First Aid instructions, plasters, small bandages, large bandages and safety pins.
- Bucket of water (with cup). Burns or chemical poisoning (either swallowed, on the skin, or in the eyes) need water. Near the water, keep a cup with which to pour the water more effectively.
- Fire blanket. A blanket should be kept for smothering fires. If someone's clothes catch fire, quickly lay the person on the floor and smother the flames with the blanket.
- Fire bucket. Fill a metal bucket with clean, dry sand and keep a long-handled scoop or ladle in it. Sand is very good for putting out fires. NEVER put out a spirit or kerosene fire with water – ALWAYS use sand.

## Field work and visits

Nothing is as effective as first-hand experience in promoting curiosity and developing understanding of the natural world. As with any learning experience, preparation is the key to a successful field trip.

- Visit the site yourself in advance to explore what it has to offer
- If there is a warden or an education officer, discuss what he or she will show the children on the day of the visit. Brief them about the topics the children have been studying in recent lessons
- It is often helpful to prepare worksheets for the trip. These should prompt the children to find and answer questions about the important specimens/features you want them to see and understand
- Make a safety assessment before committing yourself to the trip. How many adults will you need to accompany the class? Are there any particular hazards at the site?
- Follow up the trip with a lesson in which children talk and write about their experiences.

## Lesson preparation

### OBJECTIVES

- ✓ explain how scientists make and record observations
- ✓ name some of the instruments scientists use

### EQUIPMENT

#### Warm up

a variety of natural and man-made objects, such as a pine cone, spices, stones, shells, a recorder, measuring instruments such as weighing scales, rulers, timers, thermometers, fabric bags for feelie bags

#### Activity 1

a timer

### BACKGROUND INFORMATION

The children started to learn about being a scientist in level 1. In this topic the children learn the importance of using their senses to explore the world. They also learn to take measurements using appropriate equipment. Children need to be taught the scientific skills needed to carry out investigations.

We take measurements in science in order to make accurate comparisons. Spend some time with the children looking carefully at the measuring instruments available. Make sure the children are able to read the measurements accurately and that they understand the scales being used. Children may have learnt to measure in mathematics but it is just as well not to assume that they are able to do this in a different context. Young children will need guidance when choosing appropriate ways of measuring, but as they gain more experience with carrying out scientific investigations, they should also learn to choose their own ways of measuring.

Results in science are normally recorded in tables. They are a great way to organise information and involve very little writing. Looking at rows of results enables comparisons to be made easily.

Children should be encouraged to use their senses to explore – touching, smelling, observing, hearing and sometimes tasting, although you should discuss with the children why they must not taste unknown substances.

### Language support

Key word	Elicitation ideas	Quick concept check
data (n)	Show a picture of a table of results or a chart.	Does this tell us what happened? (Yes)
instruments (n)	Show pictures of scales, a spatula, a glass beaker.	Do scientists use these? (Yes)
measure (v)	Show pictures of a ruler, a measuring jug or scales.	Is this a way of telling 'How much?' (Yes)
record (v)	Show a picture of a simple chart or table.	Does it show what happened? (Yes)
senses (n)	Show pictures of the five senses.	Do we have four senses? (No)

## Lesson plan

### How do scientists make observations? p4

#### Warm up

Give each group a natural or man-made object and ask them to use the senses of touch, sight, hearing and smell. First of all, put an object for each group in a feelie bag and ask one member of the group to feel the object and to describe it to the rest of the group. Ask Can you tell what the object is? Then ask the children to explore the object with their other senses, recording their results. Circulate the objects around the class. Discuss the findings, saying which senses were most useful in each case, for example, it is easy to distinguish spices by smell.

#### Activity 1 p5

**Sit quietly and listen, as a scientist, to the sounds in your classroom. When you hear a new sound note it down in your notebook. Name the sound and describe it. Was it loud or soft, distant or nearby? How many sounds do you hear in five minutes? Think of a question about the sounds that you could investigate with further observations.**

Tell the children to look at page 5. Ask them to read through the instructions for Activity 1. Discuss what we mean by 'loud' and 'soft' sounds, and by 'distant' and 'nearby'. Explain that it is easiest to record the information in a table. Ask the children to have a go at devising an appropriate table, and then discuss their ideas. Write the best ideas on the board for children to use. Demonstrate how to fill in a table.

Ask *How will we know when five minutes is up?* Talk to the children about using a timer, show them how it works and set it for five minutes.

Ask the children to listen and write down all the sounds they hear in five minutes. Have a class discussion about the sounds the children heard, making sure they understand which were loud, soft, distant or nearby.

#### Extension

Record a sound quiz for the children to guess the sounds. Possible sounds to record are a running tap, a door slamming, a person walking up some steps or a toy that makes a noise.

Take the children outside on a sound walk. Ask the children to make a simple map to show where they heard different sounds.

## After the lesson

### Check your progress

#### Answers

- 1 Scientists observe the world with their senses. Scientists use clocks, rulers and other instruments to make measurements. Scientists must record all their observations.
- 2 Children's own answers.



## Lesson preparation

### OBJECTIVES

- ✓ identify dangers when doing science
- ✓ explain how to do science safely

### EQUIPMENT

If possible, have real examples of the things shown on page 6: a kettle, a weight, a knife or scalpel and a kitchen or bathroom cleaning product.

### BACKGROUND INFORMATION

The children started to learn about science safety in level 1. In this topic they continue to learn about science safety.

As science involves children moving around the room and using equipment, there will always be a few risks involved. Occasionally the risks are greater, such as when a source of heat is used, heavy weights are needed or when sharp objects are needed to cut materials.

Always check that bags and clothing are stored well away from the practical area, to avoid any trip hazards. Encourage the children to check around their working area at the start of the lesson.

Make sure that long hair is tied back and clothing is neat. For some experiments, protective clothing and goggles may also be advisable. Explain to the children that real scientists have to take care in the same way. It is advisable not to use glass containers so whenever possible use plastic instead. Do not allow children to walk around the room carrying glass containers in case they fall and cut themselves.

Safety rules could be written and displayed on the science room wall to reinforce them.

### Language support

Key word	Elicitation ideas	Quick concept check
heavy (adj)	Show a picture or mime with a heavy object.	Is it light? (No) Could you pick it up? (No)
hot (adj)	Show a picture of a hot sun.	Is it cold? (No)
poisonous (adj)	Show a picture of a snake.	Does it bite? (Yes) Will it make you ill? (Yes)
sharp (adj)	Show a picture of a sharp knife.	Will it cut? (Yes) Is it sharp? (Yes)

## Lesson plan

### Dangers of science p6

#### Warm up

Elicit children's ideas about possible dangers in science. Ask *Do you think science is dangerous? What kind of dangers can you think of?* Ask the children to talk in pairs and discuss some of their ideas as a class.

#### Activity 1 p6

**Talk about the dangers in these pictures. Name other dangers in science.**

Tell the children to look at page 6. Ask them to look at each picture in turn and to say what possible dangers there are. Have a discussion about how to keep safe when these things are used in science.

#### Answers

Possible dangers: hot things, heavy things, sharp things, poisonous things

#### Extension

Ask the children to make up and act out a short role play about a danger in science.

### How to stay safe in science p7

#### Warm up

Ask *How can we make sure that everyone keeps safe in our science lessons?* Discuss ideas as a class. Ask *What are rules for?* Discuss the need for rules at school in general, at home and in science lessons.

#### Activity 2 p7

**Read these laboratory rules. Can you think of any more?**

Ask the children to read the rules, and have a class discussion about them. Ask the children to think of one or two more rules of their own. Discuss the type of language used to write rules. We use instructions, and keep them short and clear. Put up a copy of the science rules in your classroom and make sure the children understand and follow them.

#### Extension

Ask the children to practice saying some of the rules in a loud and clear voice. Discuss how the children know that these are instructions, both from the tone of voice and the way they are written or said.

## After the lesson

### Check your progress

#### Answers

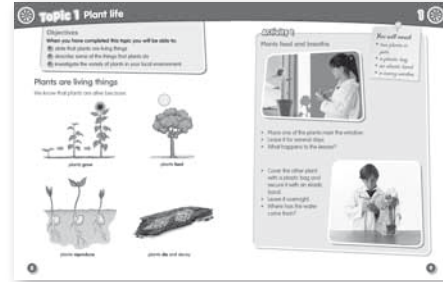
- 1 A sharp tool might cut you. Hot water can burn you. When you do science you must not put things in your mouth. They could be poisonous.
- 2 Children say some things they must do to stay safe in science.



# Plants

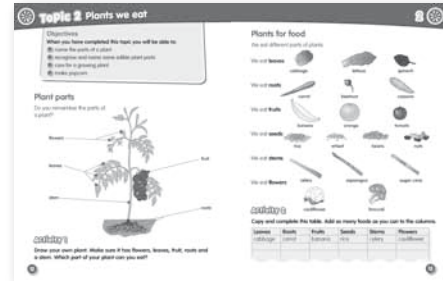
## Topic 1 Plant life PB p8-11

- State that plants are living things
- Describe some of the things that plants do
- Investigate the variety of plants in your local environment



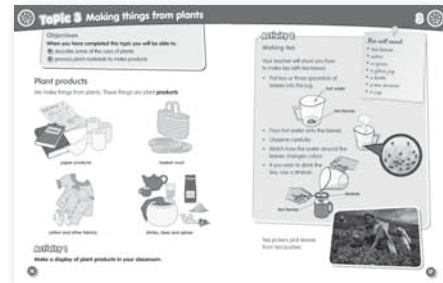
## Topic 2 Plants we eat PB p12-15

- Name the parts of a plant
- Recognise and name some edible plant parts
- Care for a growing plant
- Make popcorn



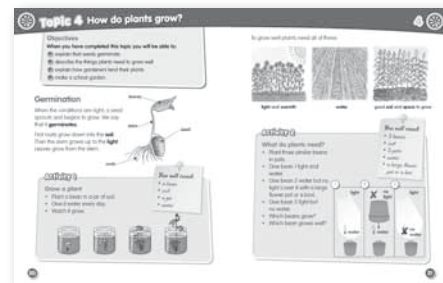
## Topic 3 Making things from plants PB p16-19

- Describe some of the uses of plants
- Process plant materials to make products



## Topic 4 How do plants grow? PB p20-23

- Explain that seeds germinate
- Describe the things plants need to grow well
- Explain how gardeners tend their plants
- Make a school garden



## Review questions PB p24-25

### Level 2

- Topic 1 The things around us
- Topic 2 Plants and their parts
- Topic 3 The importance of plants
- Topic 4 Seeds

### Level 3

- Topic 1 Plant parts: roots and stems
- Topic 2 Plant parts: branches and leaves
- Topic 3 Looking at flowers
- Topic 4 Germination and growth

## Lesson preparation

### OBJECTIVES

- ④ state that plants are living things
- ④ describe some of the things that plants do
- ④ investigate the variety of plants in the local environment

### EQUIPMENT

#### Activity 1

somewhere to look at plants outside

#### Plants are living things Extension

a camera

#### Activity 2

a camera

### BACKGROUND INFORMATION

The children started to learn about plants in level 1, so already have some basic knowledge of plants in the locality. In this topic, children are introduced to the idea that plants feed and breathe. Children will explore the variety of plants, helping them to develop the idea that there are many types of plants including trees, shrubs, garden flowers and crops.

There is a common misconception that plants take in food from the soil, but this is not true. Plants manufacture their food by using energy from the sun to convert carbon dioxide and water into sugars during a process called photosynthesis. We can show this by growing seeds on cotton wool or paper, without any soil.

Children tend to think that plants are not alive, because they don't show any obvious movement, and do not appear to feed. As children's thinking develops they may realise that plants grow and die, so they are living. Living things can move, feed, respire, excrete, show sensitivity to stimuli and grow. Children build up their understanding of this concept gradually.

## Language support

Key word	Elicitation ideas	Quick concept check
crops (n)	Show a picture of healthy common crops growing in a field.	Are they growing? (Yes) Can we eat them? (Yes)
die (v)	Show a picture of crops that have failed.	Are they growing? (No) Are they good to eat? (No)
feed (v)	Show a picture of a plant being watered on a sunny day.	Does the plant use the sun and water to make food? (Yes) Is the plant alive? (Yes)
grow (v)	Show two pictures of a plant, one as a seedling and one as a bigger plant.	Has the plant got bigger? (Yes)
reproduce (v)	Show a picture of a sunflower, and some sunflower seeds.	Is the plant alive? (Yes) Do new plants grow from the seeds? (Yes)
shrub	Show a picture of a shrub.	Is it a tree? (No) Is it a bush? (No)
tree (n)	Show a picture of a tree.	Is it a flower? (No) Is it a tree? (Yes)
vegetables (n)	Show pictures of vegetables.	Are they good to eat? (Yes) Are they fruit? (No)

## Lesson plan

### Plants are living things p8

#### Warm up

Ask questions to find out about the children's existing ideas. Firstly get the children to think of their own responses, and then ask them to talk to their partner about their ideas. Ask *How do you decide if something is a plant? Do you think a plant is living? What makes you say this?* Discuss the responses as a class. Encourage the children to respond to the ideas held by others, saying if they agree or disagree, and giving their reasons.

#### Activity 1 p9

##### Plants feed and breathe

Tell the children to look at page 8. Discuss the criteria for 'living' that are shown here: plants grow, plants feed, plants reproduce, and plants die and decay.

Compare the ideas here to the views expressed by the children in response to the warm-up questions. Ask *How do we know that plants grow? How do we know that plants feed? How do we know that plants reproduce? How do we know that plants die?* Discuss the responses to these questions, encouraging the children to think of reasons for their ideas.

Take the children outside to look at plants. Ask them to look for evidence of new plants growing from seeds, new growth on plants, and dead plants.

Explain that plants take in water through their roots. They make food in the green parts of the plant, using sunlight.



## Extension

Ask the children to photograph some examples of evidence showing that plants are living.

Ask the children to make some quick sketches, together with a few short notes, saying what they have found out about plants (they grow, feed, reproduce and die).

## Plants p10

Ask *What plants can you think of?* Make a list on the board of some of the suggestions.

Tell the children to look at the pictures of plants on page 10. Make sure the children are aware that plants come in all shapes and sizes.

## Plant types p11

### Warm up

Tell the children to look at the pictures of plant types on page 11. Discuss the terms shrub, tree, crop and vegetable. Ask *Can you think of more examples of each type of plant?*

### Activity 2 p11

**Write the names of some of the different plants that grow around your school or home. Are they shrubs, vegetables, crops or trees?**

Take the children on a 'plant walk' around the local area. Look at lots of different plants. Discuss what each plant is, and classify each plant under the headings: shrubs, vegetables, crops and trees. Ask the children to photograph or sketch some of the plants.

Make a display in the classroom and add labels to show which group they belong to.

### Extension

Visit a garden centre and ask the gardener to explain how they look after the plants, how they grow new plants, and what different types of plants they have there.

## Check your progress p11

### Answers

- 1 Plants are alive. They can reproduce by making seeds. A shrub is a large plant.
- 2 a vegetable: okra, cabbages, carrots, potatoes; a crop: cotton, coffee, maize, wheat; a tree: cashew, olive, orange, apple, palm, oak; a shrub: hibiscus; a garden flower: marigolds, roses



## After the lesson

### Workbook p4-7

#### Answers

- 1 Children trace over the lines.  
Stem: Stems sprout and new plants grow. Leaves: Leaves make food with light, air and water. Roots: Roots take water from soil.
- 2 feed, air, soil, die, decay, water, reproduce, light
- 3 palm, grapes, rose, wheat
- 4 a trees, b crops, c flowers, d vegetables
- 5 1c, 2 d, 3a, 4e, 5b
- 6 a Plants are living things. b New seeds grow from plants. c Leaves use sunlight to make food.
- 7 feed, breathe, die, take up water, reproduce
- 8 Children chant the rhyme and make up suitable actions to go with the words.

### CD-rom

Children complete topic 1 of the CD-rom.

#### Answers

- 1.1 **Click True or False for each sentence.**
  - 1 New plants grow from seeds. **T**
  - 2 Plants need food. **T**
  - 3 Plants do not die. **F**
  - 4 Plants grow towards light. **T**
- 1.2 **Type the letters in the correct order. Make words about plants.**
  - 1 wgro      **grow**
  - 2 efde      **feed**
  - 3 ucereprod      **reproduce**
  - 4 edi      **die**
- 1.3 **Drag the words to the correct gaps to make sentence.**
  - 1 Roots take water from soil.
  - 2 Plants need sunlight, air and water.
  - 3 Fruit and vegetables are good to eat.
  - 4 Farmers grow crops to sell.
- 1.4 **Drag each picture to the correct plant type.**
  - 1 vegetable (*picture of carrot*)
  - 2 tree (*picture of tree*)
  - 3 garden flower (*picture of sunflower*)
  - 4 crop plant (*picture of cotton plant*)