Macmillan Science

Teacher's Book

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MACMILLAN

Contents

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 Book 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 Book 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.

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 an 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

- ✔ list some of the things a scientist studies
- ✔ describe some of the things a scientist does

EQUIPMENT

What do scientists study? Warm up

everyday objects that will encourage questions, eg a coconut, an ice balloon (a balloon filled with water and frozen overnight), a rock or a seed

What do scientists study? Extension

for each child: a magnifying glass, everyday objects

Activity 2

paper, coloured pencils

BACKGROUND INFORMATION

Science is about exploring the world by asking questions and carrying out investigations. It is important for children to understand this for themselves by exploring their world at first-hand. Using science skills such as observing, measuring, recording and investigating should form an important part of science lessons. Whenever possible, children should explore materials, plants and animals, carrying out investigations and raising their own questions. Not all questions can be easily answered, but it is helpful to convey the idea that there are many things we do not know, so scientists try to find answers and explanations.

It would be useful for children to start this science course by looking at one or two objects and raising their own questions, and then thinking how they could find out some of the answers. For example, you could bring in a coconut in its shell, or make an ice balloon. Tell the children that they are going to be scientists, doing the same sort of things that real scientists do. They can think of their own questions about the objects and then suggest some possible investigations.

Language support

Key word	Elicitation ideas	Quick concept check
experiment (v)	Show a picture of children doing a simple experiment.	Are the children seeing what happens? (Yes)
measure (v)	Show pictures of a measuring jug, scales or a ruler.	Is it a way of seeing 'how much'? (Yes)
observe (v)	Show a picture of children looking at an experiment.	Are they looking carefully? (Yes) Are they looking quickly? (No)
record (v)	Show a picture of a simple chart or table.	Does it show what happened? (Yes)
world (v)	Show a picture of Earth.	Is it where we live? (Yes)

Lesson plan

What do scientists study? p4

Warm up

Ask *What is science? What is a scientist?* Tell the children to talk in pairs about the answers. Then discuss the answers as a class. Ask *Can you draw a picture of a scientist?* Display the pictures and discuss how the children have represented scientists. Explain to the class that a scientist can be female or male, young or old, and that during these science lessons they are all going to become scientists.
Ask *What do scientists study?* Tell the children to look at page 4. Discuss the list of things that scientists study. Show an object, eg a coconut, rock, seed or ice balloon. Ask *Can you think of some questions about this?* (Where does it come from? What is it made of? Why is it that shape?) Ask *Can you think of anything we could do to find out more about this object? What will happen if we put it in water? Will it sink/float?* Explain that this is the way scientists work – asking questions and then carrying out experiments.

Activity 1 p4

Tell the children to look at the pictures on page 4. Ask *What are the scientists studying?*

Answers
a She is using a magnifying glass to examine a leaf. b She is measuring a liquid using a measuring jug.

Extension

Give each child a magnifying glass and some everyday objects. Ask them to look closely at each object, choose one, and make a close observational drawing.

What do scientists do? p5

Warm up

Tell the children to look at the picture on page 5. Ask *What do scientists do?* Tell the children to look at the list of skills on page 5. Ask them to think of some suggestions for each one.

Activity 2 p5

Tell the children to draw and colour a picture of themselves being a scientist. Ask *What are you doing?* Display the pictures the children have drawn next to those they drew of their ideas of what a scientist looks like. Discuss some of the similarities and differences between them.

Extension

Ask the children to think of questions that scientists might explore. Give them a few examples, such as *Why is the sky blue? Why do we need to sleep?* There is no need to answer the questions.

Check your progress p5

Answers
1 world, experiment
2 Children find pictures of scientists at work and say what they are doing.

Lesson preparation

OBJECTIVES

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

EQUIPMENT

no equipment needed

BACKGROUND INFORMATION

Science is essentially a practical subject with children carrying out practical investigations and moving around the classroom. It may involve hot water, heating substances, cutting things and weighing things. It is essential to keep any risk to the minimum. This topic outlines dangers in science and ways that children can keep safe during science lessons.

There are simple rules here that children need to follow and may need reminding of from time to time. It is helpful to look around the classroom before the start of the lesson, ensuring that clothing and bags are removed to one side of the room. If the children are to collect equipment, make sure that this is distributed around the room so that there is not a scramble in one area. Avoid using glass containers, choosing plastic wherever possible.

Language support

Key word	Elicitation ideas	Quick concept check
heavy (adj)	Show a picture or mime a heavy object.	Is it light? (No) Could you pick it up? (No)
hot (adj)	Show a picture of the 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

Ask *What kind of things do scientists do? Do you think that any of these are dangerous? Do you think you will be doing anything dangerous in science lessons?* Discuss responses with partner.

Activity 1 p6

Tell the children to look at the pictures on page 6. Ask them to decide how each of these things could be dangerous. Make sure your discussion includes the danger of things that are hot, heavy, sharp and poisonous.

How to stay safe in science p7

Ask the children to think of some simple rules for keeping safe in science, and have a class discussion about their ideas.
Tell the children to look at page 7 and read the rules. Discuss each in turn and explain that these must be followed every science lesson.

Extension

Ask the children to work in pairs on creating a short role play about one of the dangers they have discussed. Look at the list of rules for ideas. Get the class to act out the dramas and discuss some of the main points.
Ask the children to design a poster warning about one potential danger. Make sure that the message is clear and that the illustration reinforces the message.

Check your progress p7

Answers

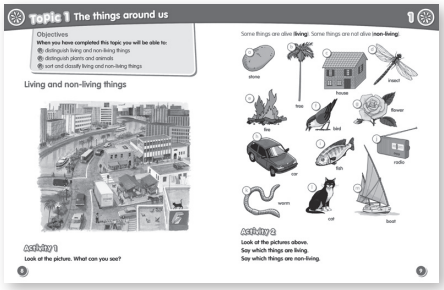
1 sharp, hot, poisonous

2 Children say some things they must do to stay safe in science. Suggestions should include the main ideas on page 7.

Plants

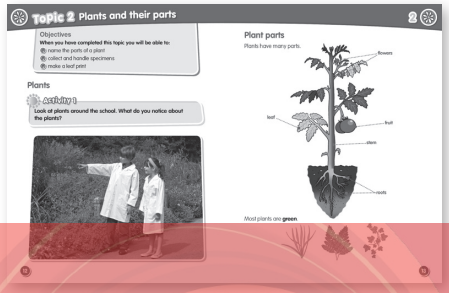
Topic 1 The things around us PB p8–11

- Distinguish living and non-living things
- Distinguish plants and animals
- Sort and classify living and non-living things



Topic 2 Plants and their parts PB p12–15

- Name the parts of a plant
- Collect and handle specimens
- Make a leaf print

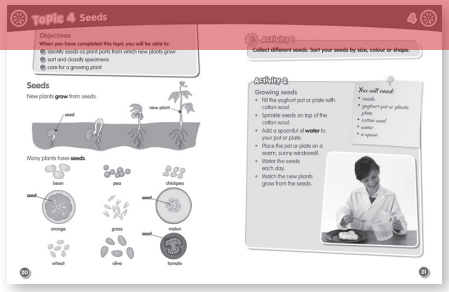


Topic 3 The importance of plants PB p16–19

- Identify how some plants and plant parts are used
- Use good hygiene to handle and prepare food
- Identify different fruits

Topic 4 Seeds PB p20–23

- Identify seeds as plant parts from which new plants grow
- Sort and classify specimens
- Care for a growing plant



Review questions PB p24–25

Level 2

Topic 1 Plant life
Topic 2 Plants we eat
Topic 3 Making things from plants
Topic 4 How do plants grow?

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

- distinguish living and non-living things
- distinguish plants and animals
- sort and classify living and non-living things

EQUIPMENT

Activity 3

a collection of pictures and/or objects that the children can sort into living/non-living things, eg plants, animals, common household objects; labels for 'living' and 'non-living'.

Living and non-living things Extension

a camera

BACKGROUND INFORMATION

Distinguishing between living and non-living can be difficult for young children. Although they may correctly label things as 'living' or 'non-living', their reasons for choosing these categories are often not scientific ones. Many psychologists, including Piaget, have carried out research into children's ideas about 'living' things. They found that children are likely to identify things that move as living, but may decide that a clock or a toy car is living because it shows some movement. Children may also choose incorrect reasons such as 'it is living if it is not broken' or 'it is not living if you can buy it in a shop'.

The biological criteria for living are things that feed, move, grow, reproduce, breathe, excrete and respond to stimuli. At this stage it is appropriate for children to understand that living things feed, grow and move. Take children out into the local environment and give them lots of opportunities for sorting and classifying objects. This will help them to understand the idea of classifying things according to given criteria. It is also helpful for children to devise their own criteria for deciding whether objects are living or non-living. For example, if they say a plant is living, encourage them to think of reasons for their choice. Some things are very difficult to classify because they show some of the characteristics of living things, eg fire and a car.

Language support

Key word	Elicitation ideas	Quick concept check
animal (n)	Show pictures of a cat, a giraffe and a hippo.	Is it a person? (No)
living (adj)	Show pictures of people, animals, plants and trees.	Do they all need food? (Yes)
non-living (adj)	Show pictures of rocks and a wall.	Do they need food and water? (No)
plant (n)	Show a picture of a plant.	Is it a tree? (No) Is it alive? (Yes)

Lesson plan

Living and non-living things p8

Warm up

Take the children outside and ask them to name some of the things they see around them. Ask *Can you name two things that are the same in some way?* They may name two buildings. Ask the children to give reasons for their choices. Ask *Can you name two things that are different?* Again, ask the children to give reasons for their choices.
At this stage it is not necessary to discuss living and non-living things.

Activity 1 p8

Look at the picture. What can you see?
Tell the children to look at the picture on page 8. Ask *What can you see?* Ask the children to name some of the things in the picture. Ask the children to talk in pairs, taking it in turns to choose two things in the picture that have something the same. Ask *In what ways are the two things the same?* Ask the children to share some of their examples with the rest of the class.
Draw out the idea that some of the things are living things and others are man-made or non-living. Ask the children to tell you which things in the picture are living things and which are non-living things.

Activity 2 p9

Look at the pictures above. Say which things are living. Say which things are non-living.
Tell the children that some things are alive (living) and some things are not alive (non-living). Tell the children to look at the pictures on page 9. Ask *Which of these are living? Which of these are non-living?* Ask the children to talk in pairs and discuss each picture, giving reasons for their choices. Discuss the answers as a class. Talk about each object, asking children to say reasons for their choice. Encourage the children to listen carefully to each other, saying whether they agree or disagree with their classmates' ideas.

Answers
Living: tree, insect, bird, flower, fish, worm, cat
Non-living: stone, house, fire, car, radio, boat

Activity 3 p10

Make a set of living things. Make a set of things that are non-living.
Tell the children to look at the picture on page 10. Ask *Which are living things? Which are non-living things?* Ask the children to sort pictures and objects into sets of living and non-living things. Ask them to do this in pairs and discuss each item. Encourage the children to think of reasons for their choices.

Activity 4 p10

Look at the picture above. How are the things different?
Which things move? Which things grow? Which things stay the same?
Tell the children to look at the picture on page 10. Ask *How are these things different? Which things move? Which things grow? Which things stay the same?* Tell the children that living things move and grow, whereas some non-living things can move but do not grow. Plants can turn towards the light and twine around poles. Ask the children to follow the same procedure, in pairs, with the sets of living and non-living things they made in Activity 3. Discuss the responses as a class.

Answers
They are different because the boy, girl and plant are living and the other items are non-living.
Move: boy, girl; Grow: plant; Stay the same: glasses, book, toothbrush, feather, ball

Extension

Ask the children to photograph six living and six non-living things in the local area and present them as a slide show.
Ask the children to make a chart, with the headings 'feed', 'move' and 'grow'. Then ask them to write things in the chart, and say whether each thing is living or non-living.

Living things p11

Warm up

Ask *How do you decide if something is living? Can you see any living things?* Ask the children to look around the classroom and school grounds, and make a list of living things.

Activity 5 p11

Say which of these things are plants. Say which are animals.
Tell the children to look at the pictures on page 11. Ask *Which things are plants? Which things are animals?* Discuss the answers as a class.

Answers
Plants: c, e, f, i, j; Animals: a, b, d, g, h

Extension

Take the children to a nearby garden or park. Ask them to list the living and non-living things.
Play *20 questions* with objects such as a plant, an animal, a rock, a toy car and an apple.

Check your progress p11

Answers
1 living, non-living
2 Children draw a plant and an animal.

After the lesson

Workbook p4–7

Answers

1 Living things: b, d, e, g, h, i, k; Non-living things: a, c, f, j, l, m
2 Children draw a living thing and a non-living thing in the boxes.
3 Animals: a, b, d, g, h; Plants: c, e, f, i, j
4 Children draw their favourite animal and their favourite plant in the boxes.
5 a true, b false, c true, d true, e false
6 Children draw a bigger tree and a bigger cat in the boxes.
7 Children complete the arrows on the chart.
8 Children chant the sentences and add more themselves.