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Light and shadows

Teacher's Resources Interactive PDF

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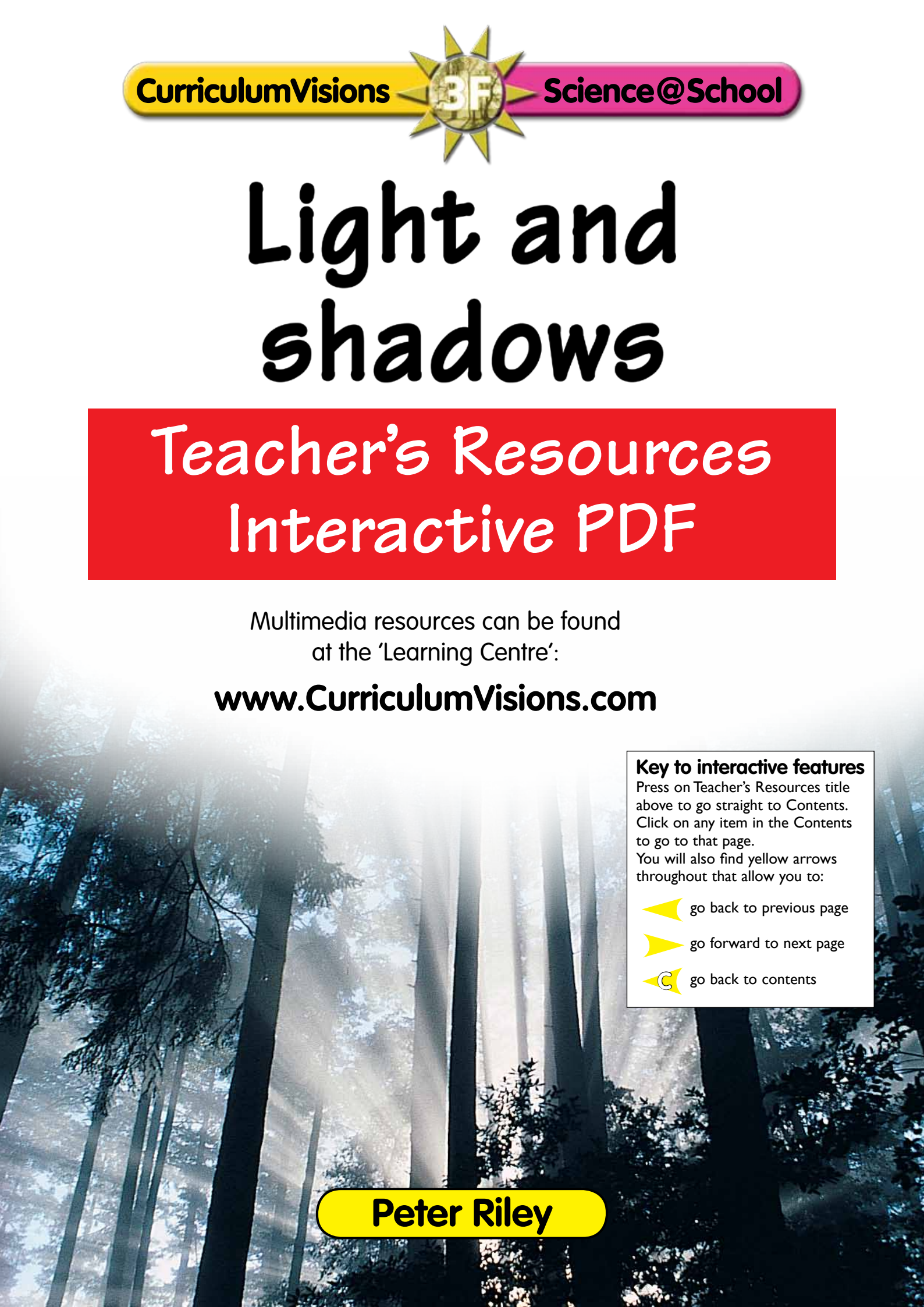

Key to interactive features

Press on Teacher's Resources title above to go straight to Contents.
Click on any item in the Contents to go to that page.
You will also find yellow arrows throughout that allow you to:

- go back to previous page
- go forward to next page
- C go back to contents

Peter Riley

Curriculum Visions

A CVP Teacher's Resources
Interactive PDF

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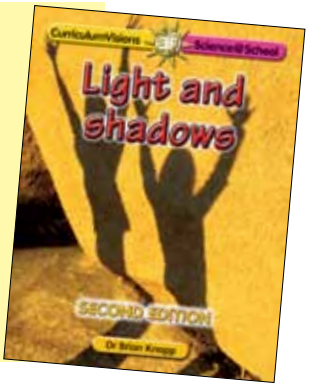
Contents

Section 1: Resources

Welcome to the Teacher's Resources for *Light and shadows*. The resources we provide are in a number of media:

1 The Light and shadows pupil book is the full-colour paperback book that provides a comprehensive study of light sources, light behaviour and shadow production which affects our daily lives – all in simple, easy-to-follow units which make it accessible to a very wide range of abilities.



3 You can buy various Science @School sets, for example Year 3 set, KS2 class book set, KS2 TG set or the complete Book Box set.

2 Our Learning Centre at

www.curriculumvisions.com

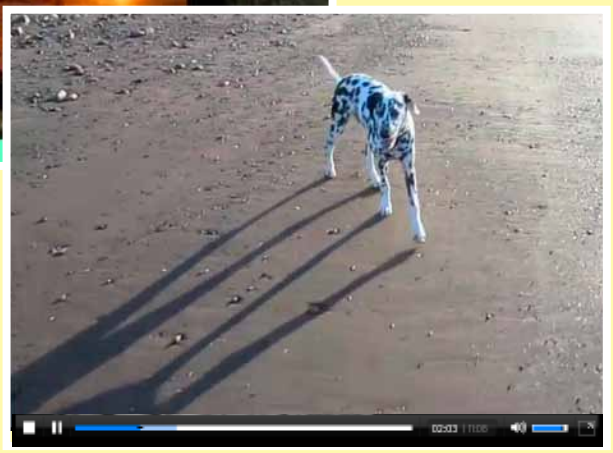
has almost everything you need to teach your primary curriculum in one convenient Virtual Learning Environment.

You can use support videos, e-books, picture and video galleries, plus additional Creative Topic books, graphic books called Storyboards, and workbooks. Together they cover all major curriculum areas.

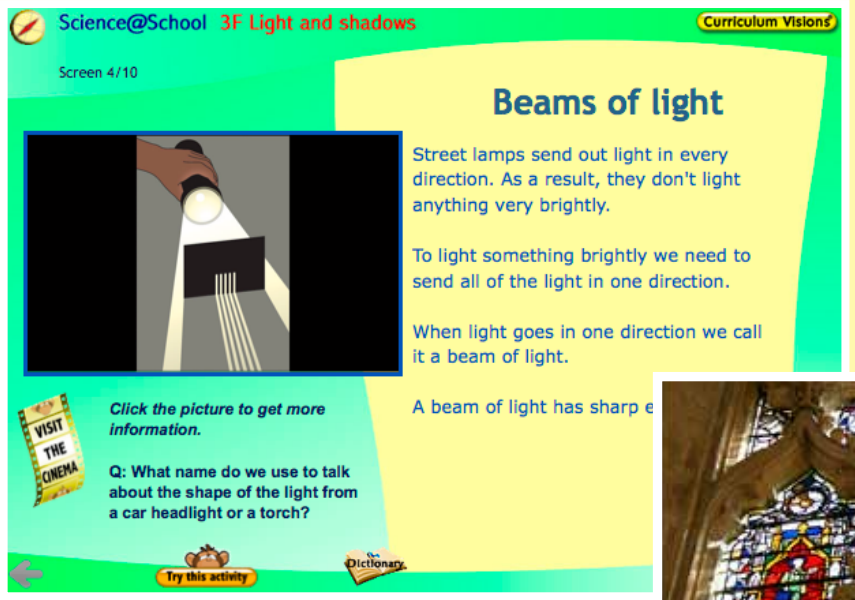
All topics are easily accessible, and there is a built-in context search across all media.

You can also use our printed student books online as part of your subscription to the Learning Centre. There page-turning versions of every printed Curriculum Visions book for use on your whiteboard.

▼ The Light and shadows home screen



▲ 'Classroom cinema' video

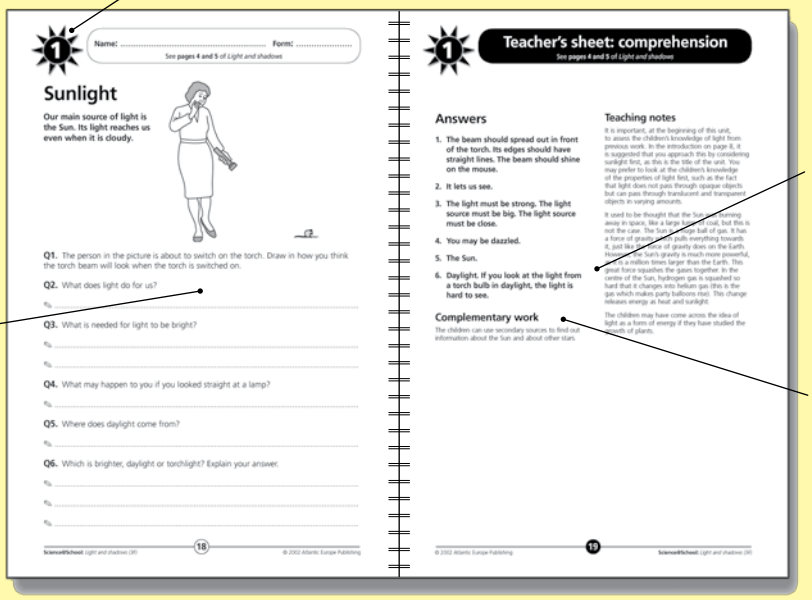


▲ Web site page

▶ Web site caption

▼ ***Each unit has one comprehension worksheet and one activity worksheet, each with a teacher's sheet.***

▶ ***The photocopiable comprehension worksheet and supporting teacher's sheet.***

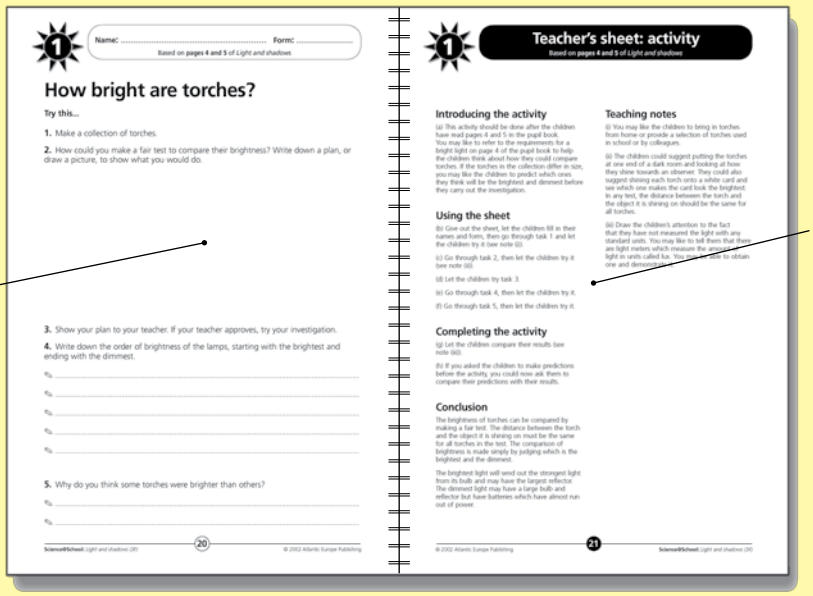


Left hand page is to photocopy and hand out to pupils.

Right hand page is the teacher's sheet and provides answers, suggestions for complementary work and teaching notes.

Resources needed to support the complementary work are shown in List 2 on page 15 of this Teacher's Guide.

▶ ***The photocopiable activity worksheet and supporting teacher's sheet.***



Left hand page is to photocopy and hand out to pupils. For some activities, pupils will also require additional sheets of paper.

Right hand page is the teacher's sheet and provides a detailed activity plan, conclusion and teaching notes. *Resources needed to support the activity worksheet are shown in List 3 on page 15 of this Teacher's Guide.*

Matching the curriculum

This book covers the light and shadows component of the curriculum in a way that is highly relevant to work in the lower junior classes of a primary school. It forms a firm foundation in the study of light and shadows which the children can apply to other contexts in their school work. A wide range of light sources – both natural and artificial are introduced and compared. This is followed by an examination of the key properties of light and shadows which will prepare students for further work.

While covering the subject matter of the curriculum, *Light and shadows* also facilitates the development of investigative skills, both in the pupil book and the *Teacher's Guide*.

The pack is fundamentally built around the idea that light travels in straight lines and that this plays a major role in how shadows form or change.

Section 2: The pupil book explained unit by unit

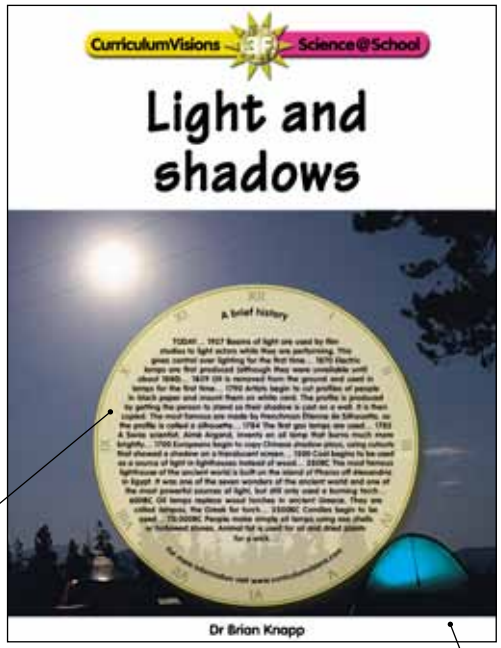
Although the pupil book – *Light and shadows* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *Light and shadows*.

It is possible to use *Light and shadows,* and the worksheets and activities, without reading this section, but we would strongly recommend that you take a short time to familiarise yourself with the construction of the pupil book.

The units are arranged in sequence, to help you with your lesson planning. In this section, a brief description of the content of each unit is given, together with hints on how to start or support it. List 1 (Starting a unit with a demonstration) on page 15 sets out the resources that you could use to do the demonstrations where suggested. The activity associated with each unit is also briefly described to help you see how the unit and activity work together.

Title page

The book begins on the title page (page 1). Here you will find information about science and technology in the form of a clock. You may want to use this to set the scene for the study of the book's contents. You may choose to focus on an event which ties in with your work in history, before moving onto the rest of the book. Alternatively, you may wish to skip over this page and return to it later. It is not a core part of the book, but helps the children see how the work they are doing now fits in with the work of scientists and engineers in the past. It may also be used to stimulate more able pupils to research the people and events that are described here.



A time clock giving additional historical information about the topic.

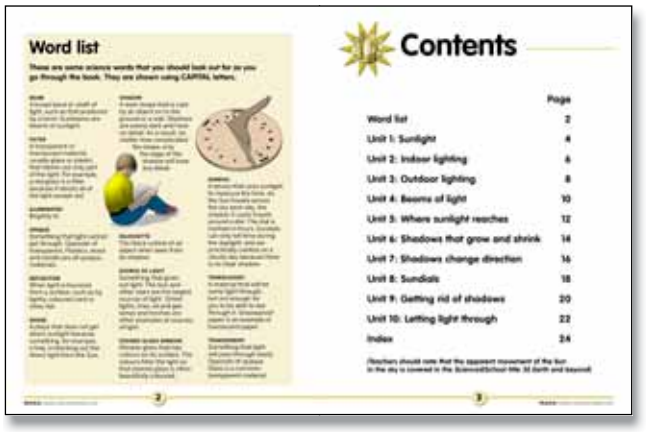
This picture shows a tent and campers lit by the Moon. The Moon can produce shadows when it is full. It is, of course, a reflector of light, not a source of light.

Word list and contents

The core content of the book begins with a word list on page 2. This is a glossary, brought to the front for the pupils' attention. Pupils could be encouraged to look at the list and see how many of the words they already recognise.

One of the important things about science is the precision with which words are used. However, many scientific words are also common words, often used in a slightly different way from how they would be used in science. The word list presents the opportunity for pupils to consider the words they already know, and the meanings they are familiar with.

When your teaching unit has been completed, you may want to invite pupils to revisit this list and see if their understanding of the words has been enhanced or changed in any way. A visual dictionary is also given on the CD.



The entire contents are shown on page 3. It shows that the book is organised into double page spreads. Each double page spread covers one unit.

The units

Heading and introduction

Each unit has a heading, below which is an introductory sentence that sets the scene and draws out the most important theme of the unit.

Body

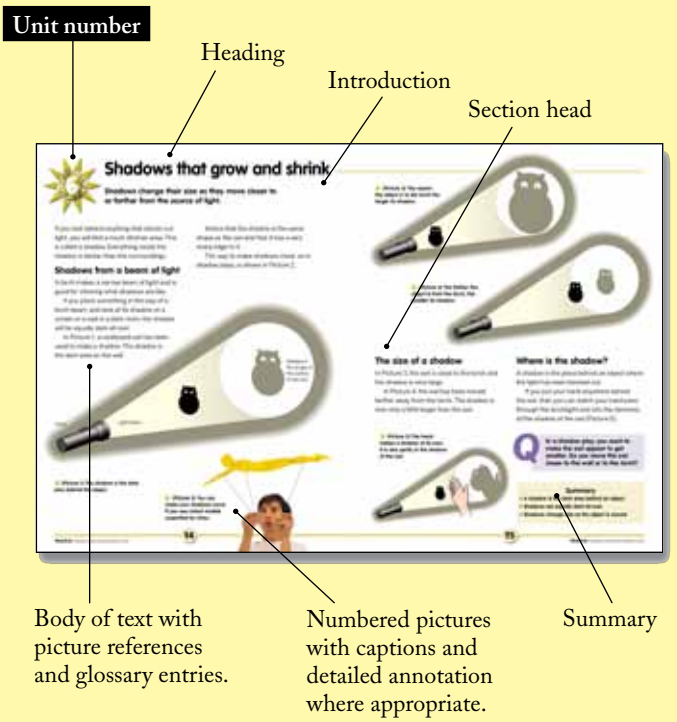
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

Words highlighted in bold capitals in the pupil book are defined in the word list on page 2. A visual dictionary is also given on the CD.

The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

Each unit concludes with a summary, highlighting and reinforcing the main teaching objectives of the unit.



1 Sunlight

You may like to begin by asking the children about day and night. Draw pictures of the Sun and the Earth on the board. Draw sunbeams spreading out in all directions, with some striking the Earth. Ask the children what happens when the sunbeams strike the Earth and look for an answer about bringing daylight. Colour in the part of the Earth which the children think is in daylight. If they think it should all be coloured in, point out that your drawing of the Earth is a side view. Let the children explain to you that it is dark on the side of the Earth away from the Sun, and it is night-time there. Explain to the children that day and night alternate because of the way the Earth turns on its axis.

The unit opens by stating that the Sun is our main source of light and that we need light in order to see. The features that allow a light source to shine brightly are clearly stated, and the relationships between them and the amount of light leaving the source is expressed. The children are invited to try a simple experiment to compare the light from a torch with sunlight. This allows the children to appreciate

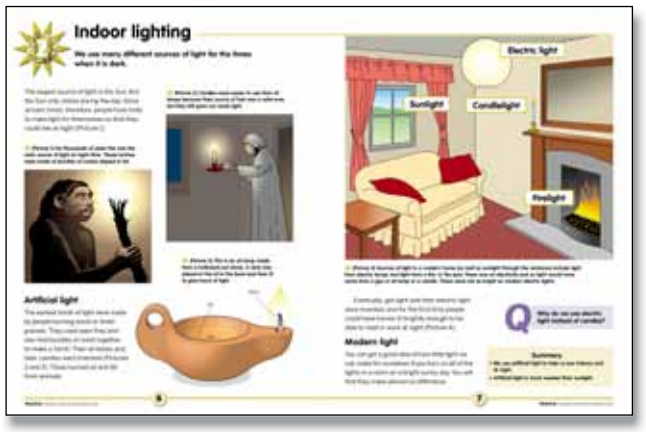
the power of sunlight over torchlight. The power of the Sun is emphasised by considering that sunlight is so strong that it can pass through thick cloud. The unit ends by making sure the children realise that daylight is sunlight.

In the complementary work, the children find out about the Sun and stars. In the activity, the children make a fair test to compare the brightness of torches.

2 Indoor lighting

You may like to begin by switching all the lights off and asking the children what people used before they had electric lights. Look for answers about fires and candles. Make the room as dark as possible and light a candle. Ask a child to read something by candlelight. Take a large, globular wine glass and fill it with water. Hold it in line with the candle flame so that a beam of bright light shines onto the child's text. Ask the child to read again and compare which condition is better for reading. Tell the children that when people used candles to light their homes, some of them also used large glass globes of water to concentrate the light so they could see better to read.

This unit builds on the previous one by considering the light we use inside from a historical point of view. The unit begins by showing how people made light in ancient times. Fires and torches are featured, followed by an oil lamp made from stone and candles made from the fat of animals. The brightness of gas and electric light is compared with older methods of illumination.



A large, colourful picture shows four light sources that may be found in the home. The unit ends by inviting the children to make a simple experiment to compare how the light from electricity is still weak compared to the power of sunlight.

In the complementary work, the children find out about indoor lighting in Tudor and Victorian times. In the activity, the children make a survey about light sources in the home.

3 Outdoor lighting

You may like to begin by asking the children about the kinds of lights that are found outside. Look for answers about street lights, outside lights and security lights. Take the children on a walk around the neighbourhood of the school and ask them to note down whenever they see an outside light. You could show the children how to estimate the height of a street lamp by standing a child of known height at the bottom of the lamp, standing back until an outstretched small object, like a pencil, covers the child then seeing how many 'pencil heights' there are to the top of the lamp.

This unit builds on the previous two units by considering what the world is like when the Sun is no longer in the sky, and by looking at the artificial light we use to illuminate outside at night.

In this unit, the Moon is introduced as a major source of natural light. Football stadiums are then given as an example of where the most powerful artificial lights are used. The expense of lighting is linked to the comparatively dimmer lighting used in streets, which in turn results in vehicles needing

headlamps. An intriguing picture of the world from space at night shows how the lights from the major cities make small parts of the planet shine. The unit closes by showing the huge number of lights that shine in a city at night.

In the complementary work, the children find out about what time lights are turned on. In the activity, the children look for a relationship between the height of a lamp and the size of the area it illuminates.

4 Beams of light

You may like to begin by switching on a table lamp or desk lamp, holding up a mirror, and asking the children how you could get a beam of light to shine around the walls of the room. Look for an answer about holding the mirror so that it catches some of the lamp's light and reflects it onto a wall. Follow the suggestion and make the beam of light dance on the wall. Tell the children that the lamp sends out light in all directions, and what you have done is collect some of them and focus them into a beam.

After the three previous units which establish the use of light sources, this unit moves on to consider the way light moves. The unit begins by stating that to get a bright light, the light has to be concentrated into a beam. However, it is pointed out that in normal circumstances the beam of light cannot be seen – only the source of the bright light, and the place where the beam falls, are clearly seen. However, there are certain circumstances, such as fog and mist, when a light beam can be seen. It is explained that the visibility of the beam in these circumstances is

due to the way light shines on water droplets. The unit ends by showing the children a sample experiment in which they can try to make small beams of light.

In the complementary work, the children find out about light beams in lighthouses and how light shines through milky water. In the activity, the children investigate how light shines through slits.

5 Where sunlight reaches

You may like to begin by establishing the relationship between light, an opaque object, shade and shadows. Take a large object, such as a ball, and place it on your desk. Shine a torch on the object and show the children the surfaces that the light is striking. Also show them areas where the light does not reach. Use the terms shade and shadow and differentiate between them. You could finish by shining the torch upwards from just in front of your chin and asking the children to say which parts of your face are lit up and which parts are in shadow.

This unit follows from the last one by considering what happens when a beam of light meets its destination. The term illumination is introduced to describe how a surface on which a beam of light falls is lit up by the light. The concept of blocking a light beam is introduced, and the absence of light is discussed by considering shade and shadows. The distinction between a shadow and a silhouette is made by a clear diagram, and the

unit ends with a busy city scene showing the places where shadows fall.

In the complementary work, the children can find out about the shady places around the school. In the activity, the children investigate how different shadows are made.

6 Shadows that grow and shrink

You may like to begin by setting up a slide projector and a screen, and making shadows of a rabbit, cat, spider and horse's head with your hands. You could show the children how to make these shapes and try them in front of the screen. Alternatively, you could set up a screen and a lamp and place objects on the far side of the screen so that they cast a shadow on it. The children must then guess what is making the shadow. You could start by putting the object close to the lamp, so that it casts a large shadow on the screen, and then reduce the size of the shadow by moving the object until the children guess the identity of the object.

The unit builds on the previous one by looking in more detail at some aspects of shadow production. The unit begins by showing how a shadow is cast when an object is placed in a beam of light, then goes on to explore how the distance between the light source and the object affect the size of the shadow. This account is accompanied by some large, clear diagrams which reinforce understanding. A photograph of a cutout used in a shadow play serves

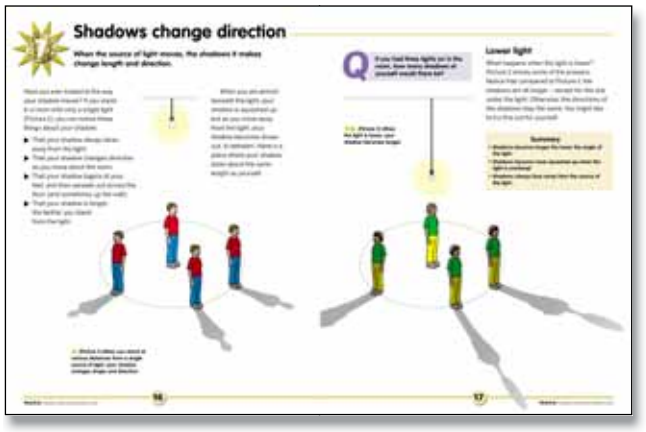
to show an application of shadows. The unit ends by emphasising that a shadow is created when light is blocked by an object.

In the complementary work, the children find out about shadow puppets and shadow plays, then make their own. In the activity, the children investigate the relationship between the distance of an object from a light source and the size of the object's shadow on a screen.

7 Shadows change direction

You may like to begin by taking the children out into the playground on a sunny day and letting them look at their shadows. Let the children compare their shadows with their body shapes in the following way. Ask the children to work in pairs. One child from each pair stands up while the other child uses a piece of chalk to draw an outline of the shadow on the ground. The first child then lies down in their shadow and the second child sees how the shadow is distorted. If possible, you could take photographs of the children in their shadows and let them look at them later. Ask the children to predict how the shadows may change if the activity is tried at another time of day, then let them try it.

This unit follows on from the previous one by considering more aspects of shadow production. Several features are clearly expressed which will help the children learn important facts about shadows. These include the direction of the shadow in relation to the light, and that there is no gap between a shadow and the object which casts it. Two large clear illustrations show the shadows of children



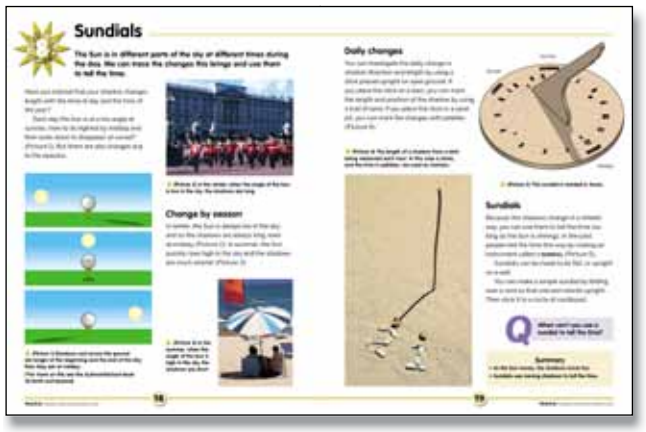
standing at different distances from the light. These illustrations demonstrate dramatically how the length of the shadow can be changed by the distance of the light source.

In the complementary work, the children discover how their shadow changes as they walk round a lamp. In the activity, the children investigate how the direction and height of a light source affects a shadow's direction and length.

8 Sundials

You may like to begin by drawing a horizontal line on the board. Tell the children that this is the horizon. Tell them that in your picture sunrise has just occurred, and ask them where the Sun should be drawn. Ask them about how the Sun appears to move in the sky during the day, and look for answers which allow you to draw an arc of the Sun's path. Ask the children why the Sun moves in this way, and make sure that they know it is due to the turning Earth and not to any actual movement of the Sun. You may like to use a globe and torch to show how one place on the Earth turns first into the sunlight, and then into the darkness during the course of a day.

This unit builds on the concept introduced in the previous unit that shadows change throughout the day. It begins by asking the children if they have noticed how their shadows change during the day and from season to season. The daily change of a shadow is clearly illustrated, and the relationship between the distance and direction of the Sun, and the length and direction of the shadow, is firmly built up by considering two photographs taken at different times



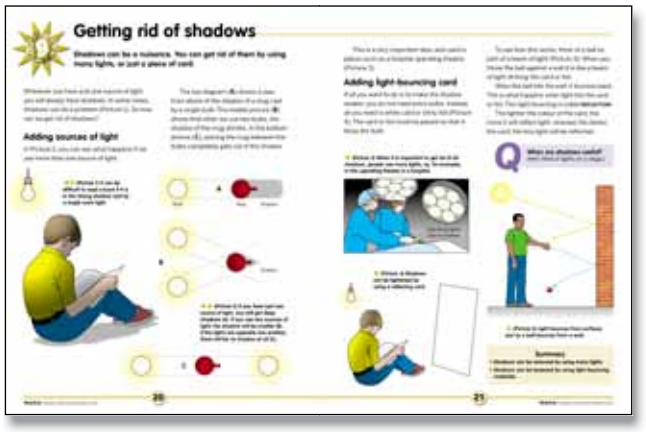
of day. Instructions are given on how to set up a shadow stick, and these are accompanied by photographs of a shadow stick in use. The unit ends by considering how sundials are built and used.

In the complementary work, the children use secondary sources to find out about how the Sun moves across the sky and the design of sundials. In the activity, the children make a shadow stick and use it to find how the Sun moves across the sky.

9 Getting rid of shadows

You could begin by reminding the children that light is reflected off the surfaces that it strikes. You could ask them which surfaces they think reflect the most light. Look for answers about smooth surfaces. Ask the children to look round the room and identify surfaces that they think are reflecting large amounts of light. Tell the children that light is reflected off all surfaces, otherwise we could not see them. It is all the surfaces in a room reflecting light which make the shadows weaker so that we do not really notice them.

Having explored how shadows are formed in the previous four units, this unit reinforces the relationship between shadows and light by showing how shadows can be eliminated. The unit opens by stating that shadows can be a nuisance, and demonstrates how reading a book is difficult if strong shadows are cast. This is followed by an illustrated account showing how two lights can be used to reduce, or even remove, a shadow. An operating theatre is shown as a place where all shadows are removed to help surgeons perform their



work. The concept of light bouncing off surfaces and the term 'reflection' are introduced. The unit ends by explaining how white card or shiny foil can be used to make shadows weaker.

In the complementary work, the children use data collected in Unit 2 to predict the kinds of shadows formed in the home. In the activity, the children investigate the effects of reflected light and shiny surfaces on shadows.

10 Letting light through

You may like to review work from other units in the introduction here. Ask the children to identify the light sources around them. Ask them how they see the light sources, and look for an answer about light entering their eyes. Ask the children about how they see the objects and look for an answer about light being reflected from their surfaces. Ask the children to identify opaque, transparent and translucent objects in the classroom and to describe how their shadows differ. Finally, remind the children about how white light is made up of different colours of light, and that these colours are seen in a rainbow.

This unit explores the way light can pass through some materials. The terms 'transparent' and 'translucent' are explained in detail. Having established that light passes through some materials, the text moves on to explain how coloured filters work. A photograph of a stained glass window shows how the filtering of light can produce a beautiful

picture. The unit ends by showing the children how they can make a window out of different coloured filters by using coloured tissue paper.

In the complementary work, the children find out how their blood acts like a red filter. In the activity, the children perform an experiment to split light into seven colours.

Index

There is an index on page 24.

Section 3: Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of light and shadows in the pupil book and in the *Teacher's Guide*. On this and the following three pages, suggestions are made on how to use the worksheets and their associated teacher's sheets on pages 18 to 57, and how to integrate them for lesson planning. On the page opposite you will find the resource lists for introductory demonstrations, the complementary work and the activity worksheets. The learning objectives are shown on pages 16 and 17.

Starting a unit

Each unit in the pupil book forms the basis for a lesson. You may like to start by reading it with the class, or begin with a demonstration (see pages 7 to 13 and List 1 on page 15). Always begin the unit by reading the introductory sentences in bold type. This helps focus the class on the content of the unit and to prepare them for the work.

The first part of the main text introduces the content, which is then developed in the headed sections. The illustrations are closely keyed to the main text, and the captions of the illustrations develop the main text content (*see* 'The units' at the bottom of page 8).

With less skilled readers, you may prefer to keep to the main text and discuss the illustrations when they are mentioned. With more skilled readers, you may want to let them read the captions for themselves. Each unit ends with a summary. The children can use this for revision work. They can also use it to test their understanding by trying to explain the points made in the summary.

You can find the learning objectives for each unit on pages 16 and 17 of this *Teacher's Guide*.

The style and content of the unit also make it suitable for use in literacy work, where the needs of both English and science are met. You may wish to use the unit as a topic study in literacy work, or you may want to perform an activity in science time and follow it up with a study of the unit during literacy work.

Using the comprehension worksheets

Each unit in the pupil book has one photocopiable comprehension worksheet in this *Teacher's Guide* to provide a test. The learning objectives on page 16 are for these comprehension worksheets and relate directly to the knowledge and understanding component of the science curriculum.

The comprehension worksheets begin with simple questions and have harder questions towards the end.

The worksheets may be used singly, after each unit has been studied, or they may be used along with other worksheets to extend the study.

The teacher's sheet, which is opposite the comprehension worksheet, shows the answers and background information to the unit. This teacher's sheet also carries a section on work complementary to the study topic. This work may feature research using other sources. It may also have value in literacy work.

Using the activity worksheets

The activities are designed to develop skills in scientific enquiry. The learning objectives for practical skills associated with each unit are given on page 17. The activities may be small experiments, may focus on data handling or comprise a whole investigation.

Each activity section is a double page spread in this *Teacher's Guide*. On the left hand page is a photocopiable activity worksheet to help the children in practical work, or it may contain data for the children to use or interpret. The page opposite the worksheet is a teacher's sheet providing a step-by-step activity plan to help you organise your work. Each plan has a set of notes which provide hints on teaching or on the use of resources. The activity plan ends with a conclusion, which you may like to read first, to help you focus on the activity in your lesson planning.

Planning to use a unit

The materials in this pack are very flexible and can be used in a variety of ways. First, look at the unit and activity objectives on pages 16 and 17. Next, read the unit in the pupil book, and the associated worksheet and activity units in this *Teacher's Guide*. Finally, plan how you will integrate the material to make one or more lessons. You may wish to add more objectives, or replace some of the activity objectives with some of your own.

Safety

The practical activities feature equipment made from everyday materials or available from educational suppliers. However, make sure you carry out a risk assessment, following the guidelines of your employer, before you do any of the practical activities in either the pupil's book or the *Teacher's Guide*.

Resources

The three lists below show the resources needed to support the photocopiable worksheets.

- List 1 shows resources for demonstrations suggested for starting a unit.
- List 2 gives resources needed for the complementary work featured on the teacher's sheet associated with each comprehension worksheet.
- List 3 details those resources needed for the 10 activity worksheets.

List 1 (Starting a unit with a demonstration)

▼ UNIT

1. –
2. Candle, large, globular wine glass, water.
3. Access to the neighbourhood of the school for a supervised walk.
4. A table lamp or desk lamp, a mirror.
5. A torch, a large object such as a ball.
6. Slide projector and screen, book showing how to make shadows using the hands; or a lamp, a screen, and a range of everyday objects.
7. –
8. –
9. –
10. –

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

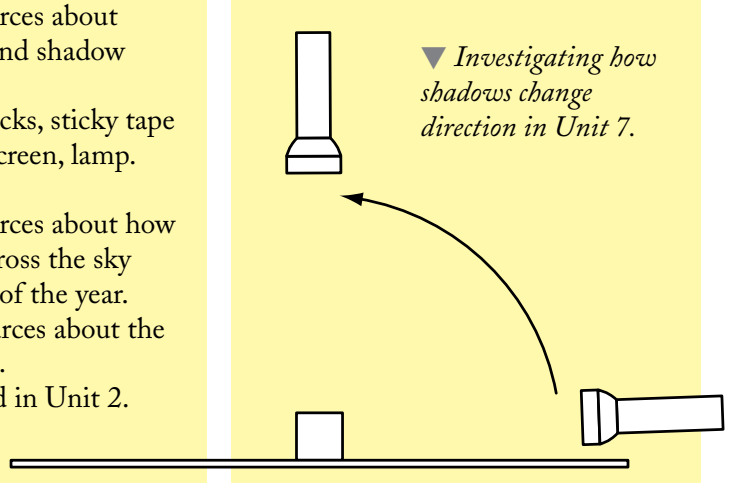
1. Secondary sources about the Sun and the stars.
2. Secondary sources about lighting used in Tudor and Victorian times.
3. Lighting-up times from a newspaper, times of sunrise and sunset from a diary.
4. (a) Secondary sources about lighthouses and how they make their light beams; (b) Large, globular wine glass, water, milk, torch.
5. Access to the outside of the school on a sunny day.
6. (a) Secondary sources about shadow puppets and shadow plays;
   (b) Cardboard, sticks, sticky tape or glue, scissors, screen, lamp.
7. A table lamp.
8. (a) Secondary sources about how the Sun moves across the sky at different times of the year.
   (b) Secondary sources about the design of sundials.
9. The data collected in Unit 2.
10. A torch.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. A collection of torches which differ in brightness, a metre rule, ruler, white card, light meter (optional).
2. –
3. A torch, two rulers and a table.
4. Card, scissors, white paper, torch, small opaque object.
5. A collection of different objects (including toys with complex shapes, chairs, etc), sheets of paper, torch.
6. A torch, small wooden or plastic block, a piece of card and a lump of Plasticine. The children may bring a torch and an object from home (optional).
7. A torch, object and piece of paper.
8. Shadow stick (may be a stick in a plant pot of soil on a school playground, or a stick in a lawn, sand to mark out shadows and predictions, or a stick in a sand pit with pebbles to mark out shadows and predictions. Compass for teacher to use.
9. A piece of white paper, white card, mirror, object, torch, scissors, sticky tape.
10. A glass of water, a piece of white paper, a torch, piece of card, scissors, sticky paper, darkened room, red filter, red pencil.



▼ *Investigating how shadows change direction in Unit 7.*

Learning objectives

Comprehension worksheets

The table below shows the learning objectives for knowledge and understanding associated with each unit in the pupil book, using the comprehension worksheets in this *Teacher's Guide*:

Unit 1

- The Sun is our main source of light.
- A light source has certain features which affect its brightness.
- Daylight is sunlight.

Unit 2

- People have used a variety of light sources in the past.
- Artificial light sources help us see indoors at night.
- Artificial light is much weaker than sunlight.

Unit 3

- The Moon is the major natural light source at night.
- We use artificial light to illuminate streets and other places outside that we use at night.
- Only a tiny part of the world is lit by artificial light at night.

Unit 4

- Light travels in straight lines.
- Normally, light beams cannot be seen passing through the air.
- Light beams can be seen in fog and mist.

Unit 5

- When a beam strikes a surface, it illuminates the surface.
- Light can be blocked, and when this happens shade and shadows occur.

Unit 6

- A shadow is a dark area behind an object.
- The distance between a light source and an object affects the size of the object's shadow.

Unit 7

- Shadows always face away from the source of the light.
- An overhead light source produces a squashed-up shadow.
- The length of a shadow increases when the light source is at a lower angle to the object.

Unit 8

- As the Sun moves, shadows move too.
- The relationship between the position of the Sun and a shadow can be investigated with a shadow stick.
- A sundial can be used to tell the time using a shadow cast in sunlight.

Unit 9

- Shadows can be eliminated by using more than one light.
- Shadows can be lessened by using reflective materials.

Unit 10

- A transparent material is one that lets light pass through it.
- A translucent material is one that lets some light pass through it.
- An opaque material is one that blocks light.
- A filter is a material which only lets through light of one colour.

Learning objectives

Activity worksheets

The table below shows the learning objectives for practical skills associated with each unit in the pupil book, using the activity worksheets in this *Teacher's Guide*:

Unit 1

- Devise a fair test.
- Record results.
- Give an explanation for the results.

Unit 2

- Fill in a table.
- Draw conclusions from results.
- Suggest how the investigation can be improved.

Unit 3

- Plan an investigation.
- Construct a table and fill it in.
- Identify a pattern in the results.

Unit 4

- Follow instructions.
- Interpret diagrams.
- Make predictions and test them.

Unit 5

- Plan and carry out an investigation.
- Record observations in the form of pictures or diagrams.

Unit 6

- Make careful measurements.
- Record results in a table.
- Make a bar chart of the results.
- Identify a pattern in the data.

Unit 7

- Make predictions.
- Compare results with predictions.
- Make a written account about what the results show.

Unit 8

- Perform an investigation over a long period of time.
- Make a drawing or diagram of the results.
- Draw conclusions from the results.

Unit 9

- Follow instructions.
- Make careful observations.
- Use scientific knowledge and understanding to support a prediction.

Unit 10

- Use equipment safely.
- Make careful observations.
- Use information provided by one experiment to help make a prediction in another experiment.

C

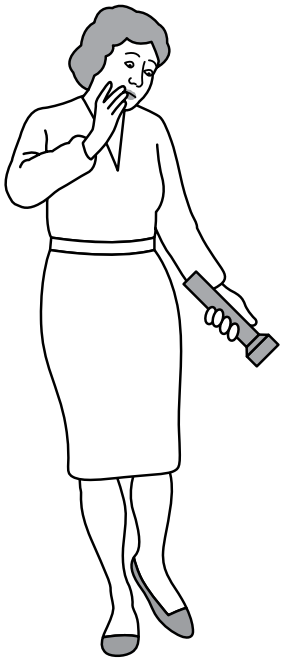
1

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

See **pages 4 and 5** of *Light and shadows*

Sunlight

Our main source of light is the Sun. Its light reaches us even when it is cloudy.



Q1. The person in the picture is about to switch on the torch. Draw in how you think the torch beam will look when the torch is switched on.

Q2. What does light do for us?

✎.....

Q3. What is needed for light to be bright?

✎.....

✎.....

Q4. What may happen to you if you looked straight at a lamp?

✎.....

Q5. Where does daylight come from?

✎.....

Q6. Which is brighter, daylight or torchlight? Explain your answer.

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 4 and 5** of *Light and shadows*

Answers

1. **The beam should spread out in front of the torch. Its edges should have straight lines. The beam should shine on the mouse.**
2. **It lets us see.**
3. **The light must be strong. The light source must be big. The light source must be close.**
4. **You may be dazzled.**
5. **The Sun.**
6. **Daylight. If you look at the light from a torch bulb in daylight, the light is hard to see.**

Complementary work

The children can use secondary sources to find out information about the Sun and about other stars.

Teaching notes

It is important, at the beginning of this unit, to assess the children's knowledge of light from previous work. In the introduction on page 8, it is suggested that you approach this by considering sunlight first, as this is the title of the unit. You may prefer to look at the children's knowledge of the properties of light first, such as the fact that light does not pass through opaque objects but can pass through translucent and transparent objects in varying amounts.

It used to be thought that the Sun was burning away in space, like a large lump of coal, but this is not the case. The Sun is a huge ball of gas. It has a force of gravity which pulls everything towards it, just like the force of gravity does on the Earth. However, the Sun's gravity is much more powerful, as it is a million times larger than the Earth. This great force squashes the gases together. In the centre of the Sun, hydrogen gas is squashed so hard that it changes into helium gas (this is the gas which makes party balloons rise). This change releases energy as heat and sunlight.

The children may have come across the idea of light as a form of energy if they have studied the growth of plants.

C 1

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

Based on **pages 4 and 5** of *Light and shadows*

How bright are torches?

Try this...

1. Make a collection of torches.

2. How could you make a fair test to compare their brightness? Write down a plan, or draw a picture, to show what you would do.

3. Show your plan to your teacher. If your teacher approves, try your investigation.

4. Write down the order of brightness of the lamps, starting with the brightest and ending with the dimmest.

✎.....

✎.....

✎.....

✎.....

✎.....

5. Why do you think some torches were brighter than others?

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 4 and 5** of *Light and shadows*

Introducing the activity

(a) This activity should be done after the children have read pages 4 and 5 in the pupil book. You may like to refer to the requirements for a bright light on page 4 of the pupil book to help the children think about how they could compare torches. If the torches in the collection differ in size, you may like the children to predict which ones they think will be the brightest and dimmest before they carry out the investigation.

Using the sheet

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

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

(d) Let the children try task 3.

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

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

Completing the activity

(g) Let the children compare their results (see note (iii)).

(h) If you asked the children to make predictions before the activity, you could now ask them to compare their predictions with their results.

Conclusion

The brightness of torches can be compared by making a fair test. The distance between the torch and the object it is shining on must be the same for all torches in the test. The comparison of brightness is made simply by judging which is the brightest and the dimmest.

The brightest light will send out the strongest light from its bulb and may have the largest reflector. The dimmest light may have a large bulb and reflector but have batteries which have almost run out of power.

Teaching notes

(i) You may like the children to bring in torches from home or provide a selection of torches used in school or by colleagues.

(ii) The children could suggest putting the torches at one end of a dark room and looking at how they shine towards an observer. They could also suggest shining each torch onto a white card and see which one makes the card look the brightest. In any test, the distance between the torch and the object it is shining on should be the same for all torches.

(iii) Draw the children's attention to the fact that they have not measured the light with any standard units. You may like to tell them that there are light meters which measure the amount of light in units called lux. You may be able to obtain one and demonstrate it.

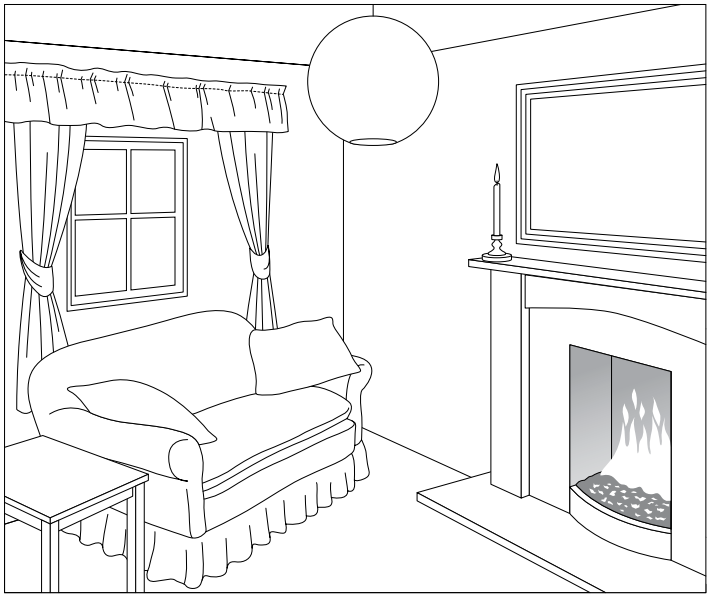
C 2

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

See **pages 6 and 7** of *Light and shadows*

Indoor lighting

We use many different sources of light for the times when it is dark.



Q1. Label the sources of light in this picture.

Q2. What is the largest source of light? ✎.....

Q3. How were the earliest kinds of light made?

✎.....

Q4. What did people use to make torches from?

✎.....

Q5. Which part of an oil lamp was lit to make it a light source?

✎.....

Q6. (i) Which two sources of light were the last to be invented?

✎..... ✎.....

(ii) How did they help people in their homes?

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 6 and 7** of *Light and shadows*

Answers

1. **Sunlight, electric light, candlelight, firelight.**
2. **The Sun.**
3. **By people burning wood or dried grasses.**
4. **A bundle of reeds.**
5. **The wick.**
6. **(i) Gas light and electric light.**

   (ii) They were so bright that people were able to read or work at night.

Complementary work

The children can use secondary sources to find out about indoor lighting in Tudor and Victorian times.

Teaching notes

The children should realise that light is given out from certain objects called light sources. When they realise this, they will also realise that most objects are not light sources and may wonder how it is that they can still be seen. You should point out that when light spreads out from a source, it strikes other surfaces and is reflected from them. Most objects in our surroundings are visible because of the light that is reflected from them.

At this stage, you may wish to introduce the idea that we can see because of the light that enters the eye. Sometimes people have the notion that rays pass out from the eyes to let us see. If that were true then we would be able to see in the dark.

The children may ask why objects are different colours. You may like to respond by showing them a picture of light passing through a prism to give the spectrum of red, orange, yellow, green, blue, indigo and violet. White light is really made up of all these colours. You can tell the children that rain drops also sometimes act like prisms to produce a rainbow. When light strikes a surface, some of the colours are absorbed and some are reflected. We see the colours that are reflected. Two or more colours may be reflected to give different shades of colours.

You may also like to link the use of lights to the consumption of energy and trends in global warming. This information could then be used in a 'switch it off' campaign.

C 2

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

Based on **pages 6 and 7** of *Light and shadows*

Lighting survey

Try this...

1. Look at the things that are used to give out light in the kitchen and living room of your home, and in your bedroom.

2. In Table 1, fill in where the sources of light are found. Use ticks to fill in where each source of light is found.

Table 1

Position of light source	Kitchen	Living room	Bedroom
Ceiling			
Wall			
Table			
Floor			

2. In Table 2, fill in what the light sources are. Use ticks to fill in the table.

Table 2

Type of light source	Kitchen	Living room	Bedroom
Clear light bulb			
Pearl light bulb			
Fluorescent strip light			
Clear strip light			
Candle			

Looking at the results.

4. Were light sources found in the same positions in every room? Explain your answer.

✎.....

✎.....

5. Were the same types of light sources found in every room? Explain your answer.

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 6 and 7** of *Light and shadows*

Introducing the activity

(a) Use this activity after the children have studied pages 6 and 7 in the pupil book. Tell the children that they are going to make a survey about the types of lights in some of the rooms in their homes (see note (i)).

Using the sheet

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

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

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

(e) Go through tasks 4 and 5, then let the children try them.

Completing the activity

(f) You could ask the children to collate their results so that the most frequently used light source and the most frequently used position of light source could be identified. This could be used as an ICT activity.

(g) Tell the children that when scientists complete their work, they look at it again to see if it could be improved. Ask the children how they think the survey could be improved (see note (v)).

Conclusion

Although the results will depend on the home sampled, it may be found that the ceiling is the most widely used position for a light source, and that fluorescent lights are used in the kitchen. Some kitchens may also have clear strip lights, clear and pearl bulbs may be used in living rooms and bedrooms and candles may be present in some living rooms and bedrooms.

Teaching notes

(i) Any comparison of home circumstances should be treated with sensitivity. To reduce problems of this kind, just three rooms, found in almost all homes, are used in this survey.

(ii) You may like to tell the children that objects which give out light are called sources of light. At this point, do not distinguish between objects which give out light to see by from objects like televisions or computers which give out light as part of their function.

(iii) At this point, do not mention lights which may be found on shelves or windowsills.

(iv) It may be helpful to show the children a clear light, a pearl bulb and a clear strip light which has a filament (often used in concealed lighting in kitchens).

(v) The children may point out that candles may be placed on windowsills or mantelpieces and that lamps, such as an electric lamp may be on a shelf or on the floor.

Children may also ask if televisions or computers should be included, as they are also light sources.

C

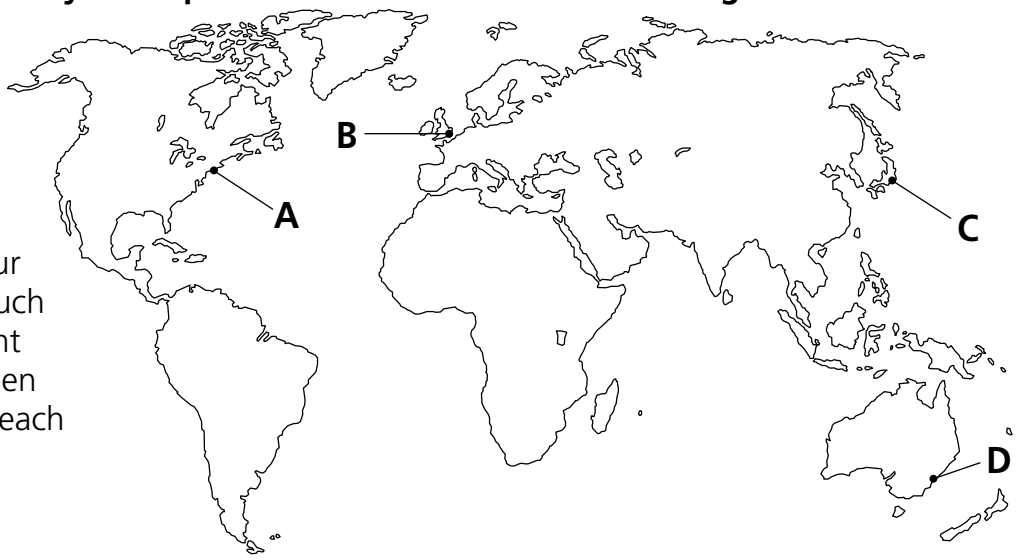
3

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

See **pages 8 and 9** of *Light and shadows*

Outdoor lighting

We can only light very small parts of the world around us at night.



Q1. A to D are four cities which have such bright lights at night that they can be seen from space. Name each one and say which country it is in.

A ✎..... B ✎.....

C ✎..... D ✎.....

Q2. What is a major source of natural light at night? ✎.....

Q3. Where may you find the most powerful outdoor lights?

✎.....

Q4. Why do cars have their own lights?

✎.....

Q5. Why are street lights not very bright?

✎.....

Q6. (i) How could you find out how much light we make on Earth at night?

✎.....

(ii) What would you see?

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 8 and 9** of *Light and shadows*

Answers

1. **A = New York, USA; B = London, UK; C = Tokyo, Japan; D = Sydney, Australia.**
2. **The Moon.**
3. **At a football stadium.**
4. **Because street lighting is really not very bright.**
5. **Because the cost of bright lighting is high.**
6. **(i) Look at a picture of the world at night taken from space;**
   (ii) There would be bright lights round the cities, but the countryside and oceans would be dark.

Complementary work

You could show the children the lighting-up times in a newspaper and make a collection of them over a month to show the children how they change. You could relate this to the times of sunrise and sunset, taken from a diary, and also relate this to the seasons of the year. This work could be linked to Unit 8.

Teaching notes

Although the Moon appears to glow in the sky it is not a light source. Sunlight strikes the surface of the Moon and is reflected towards the Earth. As the Moon moves in its orbit around the Earth, it presents a different illuminated surface to the Earth each day. At a full Moon, all the light shining on the Moon from the Sun is directed towards the Earth and we see a white disc. At other times, only part of the illuminated surface is seen – the same amount of Moon is always facing into space. At these times we see shapes such as a crescent, half moon or a shape between a half and full Moon called a gibbous Moon. These shapes of the illuminated Moon are called the phases of the Moon. They are not made by a shadow of the Earth being cast on the Moon.

Stars are also light sources in the night sky. They are made of hydrogen and helium like the Sun (see the notes to Unit 1) and produce light in the same way as the Sun.

As the Earth moves in its orbit round the Sun, each hemisphere tips towards the Sun when it is summer there and tips away from it when it is winter there. These changes in the way a hemisphere tips towards the Sun affect the time of sunrise and sunset and, in turn, affect the lighting-up times. The time for which outdoor lighting is switched on can be related to the position of the Earth in its orbit.

3

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

Based on **pages 8 and 9** of *Light and shadows*

Investigating the height of a light

Try this...

1. You are given a torch and two rulers. How can you use them to find out how the light shining on a table changes as the torch is raised higher and higher off the table top? Write down a plan, or draw a picture, to show what you would do.

2. Make a table in which to record your results.

3. Show your plan to your teacher. If your teacher approves, try your investigation.

Looking at the results.

4. When was the smallest area of the table lit up?

✎.....

5. When was the largest area of the table lit up?

✎.....

6. What happened to the lit up area of the table as the torch was moved higher and higher?

✎.....

Teacher's sheet: activity

Based on **pages 8 and 9** of *Light and shadows*

Introducing the activity

(a) You may like to use this activity straight after the introduction on page 10 of this *Teacher's Guide*, or after the children have studied pages 8 and 9 in the pupil book. Tell the children that they are going to make their own plan and their own table in this investigation, and look for a pattern in the results.

Using the sheet

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

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

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

(e) Let the children try tasks 4 to 6.

Completing the activity

(f) Let the children compare their results (see note (iv)).

(g) Ask the children if they noticed anything else about how the light changed as the torch was raised higher and higher (see note (v)).

Conclusion

The smallest area of the table was lit up when the torch was closest to the table. The largest area of the table was lit when the torch was at its highest point above the table.

As the distance between the table and torch increased, the width of the illuminated area of the table also increased.

Teaching notes

(i) The plan should show that the torch will be held at different distances above the table. At each distance, the height of the torch and the diameter, or width, of the light beam will be measured.

(ii) The table should have two columns headed: 'Height of torch (cm)' and 'Width of light beam (cm)'.

(iii) When the children are trying the investigation, look for them trying to keep the height of the torch steady while they make their measurements.

(iv) You may like the children to make bar charts of their results.

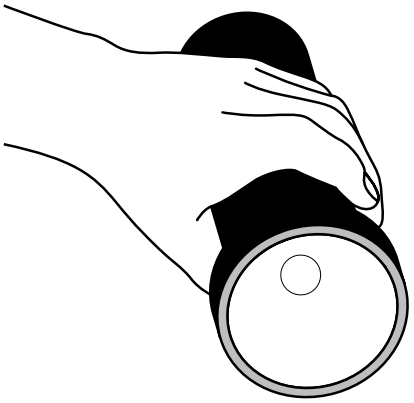
(v) They should notice that a small area was very brightly lit and a large area was more dimly lit. This is due to the same amount of light having to cover a larger area. You could also point out that when scientists are performing an investigation, they keep a look out for other things besides what they are making their main observations on.

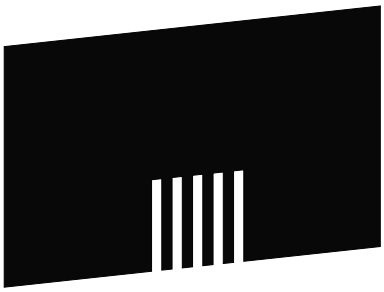
Name: ..... Form: .....

See **pages 10 and 11** of *Light and shadows*

Beams of light

Light travels in straight lines and cannot curve around things.





Q1. How does the light shine through the slits when the torch is switched on. Draw in your answer on the picture.

Q2. Which part of a car gives out a beam of light?

✎.....

Q3. What does the beam of light shine on?

✎.....

Q4. (i) Name two things which catch light, and show how it travels.

1 ✎.....

2 ✎.....

(ii) What is in these substances that shines so you can see the beam?

✎.....

(iii) What happens when these substances clear away?

✎.....

✎.....

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 10 and 11** of *Light and shadows*

Answers

1. **Rays of light should be drawn from the slits down to the bottom of the picture. They should be straight.**
2. **The headlamp.**
3. **The road.**
4. **(i) Fog and mist; (ii) Tiny droplets of water; (iii) The beam of light cannot be seen travelling from the headlamp. Only the light source and where the light lands can be seen.**

Complementary work

(a) The children could use secondary sources to find out about lighthouses and how they make their light beams.

(b) Fill a large, globular wine glass with water, add two or three drops of milk and stir it in. Shine a torch at the wine glass and observe the beam of light shining through the slightly grey, milky water. If some children have a suitable attitiude and ability, they could demonstrate this experiment to the rest of the class.

Teaching notes

Light is usually invisible when it shines through the air. We may see the light source and the objects which reflect the light, but we rarely see the passage of light from source to object. In certain circumstances light beams can be seen.

Sometimes a beam of sunlight can be seen shining through a gap in the curtains. The beam can be seen in the room due to the dust in the air. Part of the light is reflected off the dust and into our eyes. In a similar way, sunbeams can sometimes be seen shining down to the ground through gaps in clouds. This is also due to dust particles in the air.

When a car headlight shines into fog or mist, the beam can be seen clearly due to the reflection of the light off the water particles. You can point out that the light beam does not travel far because the light is being reflected away by the particles.

The children may wonder how a torch or headlamp can make a light beam. In both these devices, a light bulb is surrounded by a curved surface. When the light is reflected from this curved surface, it travels in parallel rays of light, like the light passing through the slits on page 10 of the pupil book and in the activity in this unit.

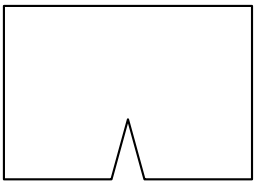
Name: ..... Form: .....

Based on **pages 10 and 11** of *Light and shadows*

Investigating light rays

Try this...

Diagram 1



1. Take a piece of card and cut a slit in it as Diagram 1 shows.

2. Set up the card and white paper as Diagram 2 shows, and shine a torch where the arrow is pointing.

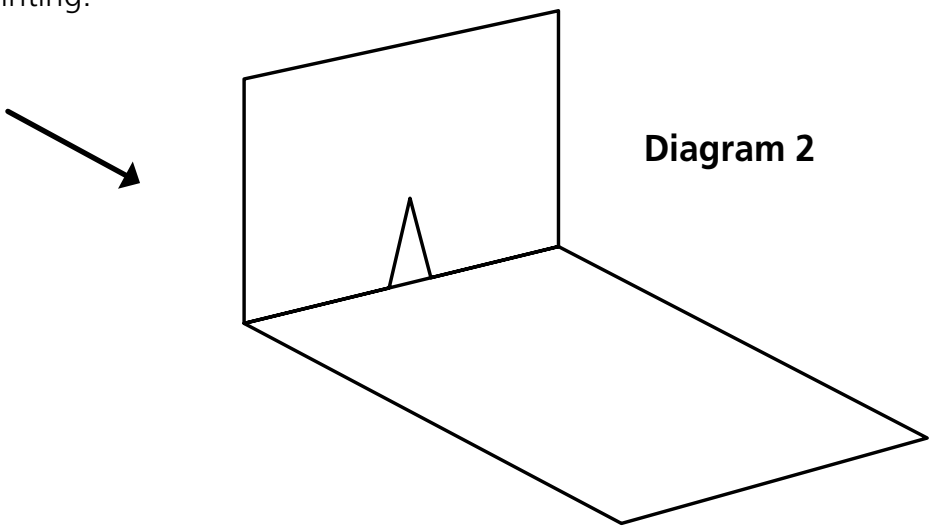
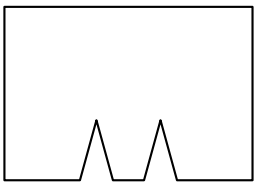


Diagram 2

3. On Diagram 2, draw how light moves over the paper.

Diagram 3

4. Cut another slit in the card, as Diagram 3 shows.



5. Predict what might happen if you shine the light through the slits onto the paper.

6. Shine the light through the slits. On a separate piece of paper, draw a diagram to show how the light travelled after it had passed through the two slits.

7. Place a solid object in front of one of the slits. Predict what might happen if you shine the light through the slits onto the paper when a solid object is in front of one of the slits.

8. Shine a light through the two slits, onto the object. On the separate piece of paper, draw a diagram to show how the light travelled after it had passed through the two slits.

Teacher's sheet: activity

Based on **pages 10 and 11** of *Light and shadows*

Introducing the activity

(a) You may like to use this activity either after the introduction on page 10 of this *Teacher's Guide* or after the children have read about beams of light on pages 10 and 11 of the pupil book. If you use it after the introduction on page 10, you may like the children to think about how they could make a small beam of light. If you use it after the children have studied the pupil book, you may like to tell them that scientists often perform experiments to confirm what they have read and that they are basing their experiments on the picture of light rays on page 11.

Using the sheet

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

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

(d) Go through tasks 4 and 5, then let the children try them.

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

(f) Go through task 7, then let the children try it.

(g) Go through task 8, then let the children try it (see note (iii)).

Completing the activity

(h) Let the children compare their results.

(i) Ask the children to predict what might happen if they shone a torch through a comb. Ask them to try it and compare the result with their prediction.

Conclusion

When light shines through a slit it forms a straight-sided light ray which moves across the paper.

When a light ray strikes a solid object it is stopped, there is no light ray on the other side of the object.

Teaching notes

(i) Depending on the ability and attitude of the children, you may have to provide them with slitted cards.

(ii) The children should make a drawing based on Diagram 2 but showing a card with two slits. The children should draw two light rays moving in parallel across the paper.

(iii) The children should make a drawing based on Diagram 2 but showing a card with two slits and an object in front of one slit.

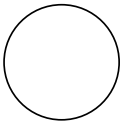
The children should draw one light ray being stopped by the object, and the other light ray continuing across the paper.

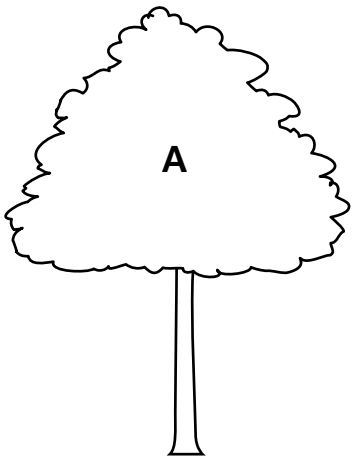
Name: ..... Form: .....

See **pages 12 and 13** of *Light and shadows*

Where sunlight reaches

When sunlight reaches something it makes it bright. This is called illumination. Other places lie in shadow.





Q1. (i) Will the person see a silhouette in area A or B?

(ii) What is found at the other place in the picture?

✎.....

Q2. Name three sources of light.

1 ✎.....

2 ✎..... 3 ✎.....

Q3. How does sunlight travel to reach our world?

✎.....

Q4. (i) When sunlight shines on a wall, the light cannot pass through the wall. What do we say has happened to the path of the light?

✎.....

(ii) Which part of the wall is in the shade?

✎.....

✎.....

Q5. How could the person in the picture see an illuminated view of the tree?

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 12 and 13** of *Light and shadows*

Answers

1 **(i) A; (ii) A shadow.**

2. **The Sun, a torch, a headlamp, a street light.**

3. **It travels in straight lines.**

4. **(i) It has been blocked; (ii) The side on which the sunlight is not shining.**

5. **Go round the other side of the tree and look at it with their back to the Sun.**

Complementary work

The children could walk around the school on a sunny day and identify shady areas. You may also like them to look for signs of plant and animal life in shady and well-lit areas, to prepare them for work on the study of habitats.

Teaching notes

The work here supports the idea that light travels in straight lines. If a light could curve easily, it would flow round an opaque object like water flows around a rock in a stream, and there would be no shadow on the unlit side of the object. The fact that shadows have very clear edges which match the edges of the objects that produce them suggests that light does travel in straight lines. Light striking the surface of an opaque object is blocked, while light which just grazes the edges of the object continues in a straight line until it reaches another surface, and then forms the sharp edges of a shadow.

The children may ask why some objects let light through while others do not. You could tell the children that tissue paper is made by fibres which have holes between them and the light shines into the holes and is then reflected off the surfaces of the fibres in all directions. You could then tell the children that some materials are made of much smaller particles, which are packed together in a special way so that they have lots of 'holes' through which the light can pass. These objects are transparent (see Unit 10). The particles are so small that they can only be seen by very powerful microscopes. You may talk about these particles when you study materials in the curriculum.

C

5

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

Based on **pages 12 and 13** of *Light and shadows*

Looking at shadows

Try this...

1. Make a collection of objects.

2. Take each object and predict the shadow it will make when a torch is shone from one side of it. Make a drawing of your predicted shadow on a separate piece of paper.

3. Take each object and shine a torch on it. Look at the shadow and compare it with your prediction.

4. Is the shadow of an object the same no matter where the light shines from?

Write down a plan, or draw a picture, to show how you would test this.

5. Show your plan to your teacher. If your teacher approves, try your investigation.

6. What did your investigation show?

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 12 and 13** of *Light and shadows*

Introducing the activity

(a) Use this activity after the children have studied pages 12 and 13 in the pupil book.

Using the sheet

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

(c) Go through task 2.

(d) Let the children try task 2.

(e) Go through task 3, then let the children try it.

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

(g) Let the children try task 5.

(h) Let the children try task 6 (see note (iii)).

Completing the activity

(i) Let the children compare their results.

Conclusion

When light shines on solid objects a dark shadow is cast.

The shape and size of a shadow of an object changes as the position of the light shining on it is changed.

Teaching notes

(i) You may like the children to bring in some objects from home. Make sure the objects are complex, such as trucks and dolls, to show the best contrast between light and shadow.

(ii) The plan should show that the light will be shone on different sides of the object. It may also show that the light will be shone from different angles – for example, overhead, along the table top.

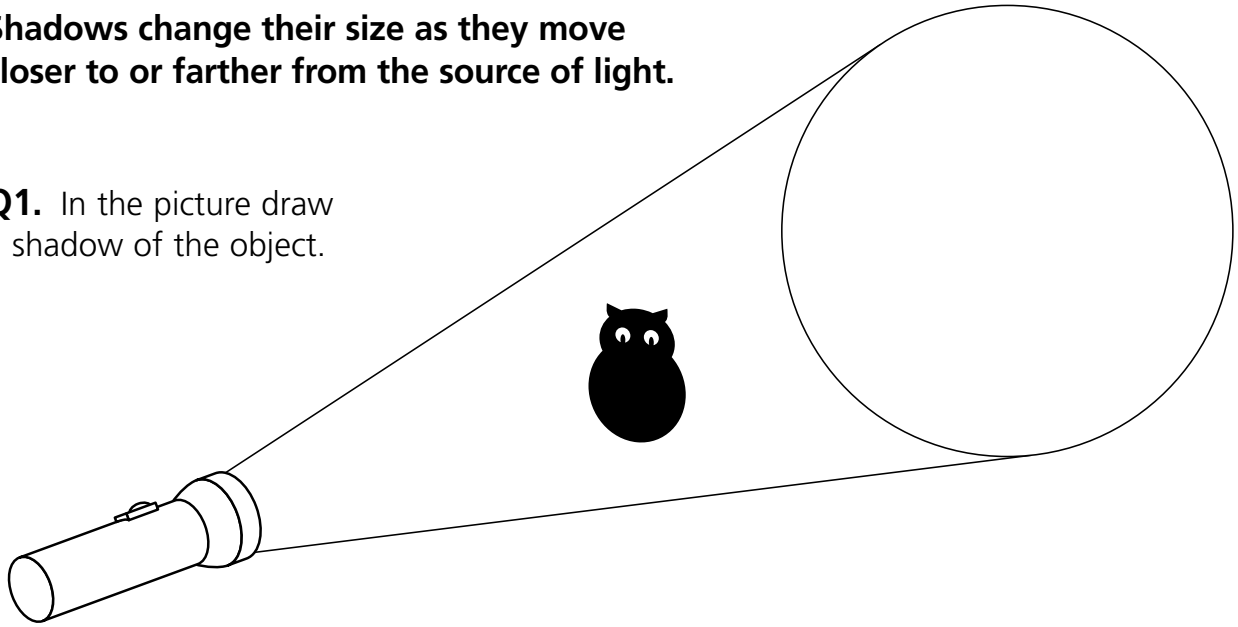
(iii) The children can record in words or in pictures. Most children may find it easier to record in pictures.

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

See **pages 14 and 15** of *Light and shadows*

Shadows that grow and shrink

Shadows change their size as they move closer to or farther from the source of light.



Q1. In the picture draw a shadow of the object.

Q2. Why is a torch good for showing what shadows are like?

✎.....

Q3. Name two places where you can make a shadow fall.

✎..... ✎.....

Q4. How would the shadow in the picture change if the object was placed nearer to the torch?

✎.....

Q5. How would the shadow in the picture change if the object was placed further away from the torch.

✎.....

Q6. (i) What are used in shadow plays?

✎.....

(ii) What happens to the shadow when an object in a shadow play changes shape?

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 14 and 15** of *Light and shadows*

Answers

1. **The shadow should be the same shape as the object, have sharp edges and be larger.**
2. **Because it makes a narrow beam of light.**
3. **On a wall or a screen.**
4. **The shadow would become larger.**
5. **The shadow would become smaller.**
6. **(i) Cutout models; (ii) The shadow changes shape to match it.**

Complementary work

(a) The children can use secondary sources to find out about the use of shadow puppets and shadow plays.

(b) The children can make their own shadow puppets and shadow plays using a screen, lamp and cardboard cutout models they have made themselves.

Teaching notes

This unit builds on the previous one by challenging the children to look more closely at shadow formation.

Up to this point, the children may think that a shadow is always the same size, although from films and cartoons they may be aware that shadows can be much larger than the objects that cast them.

It is important to let the children see how moving an object about in front of a lamp can alter its shadow and to find a relationship, such as the nearer the object to the lamp the larger the shadow. It should then be emphasised that, in science, an observation such as the one just made is then investigated more closely by taking measurements.

Shadow puppets are made and used in shadow plays in Java.

6

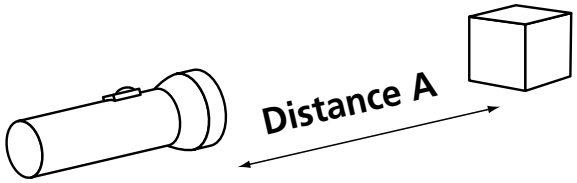
Name: ..... Form: .....

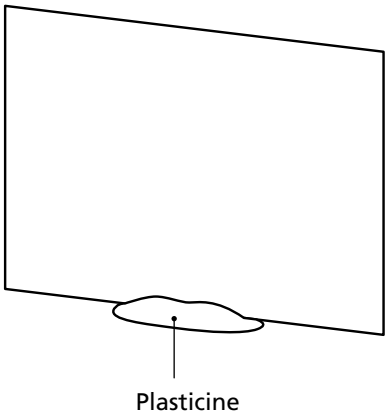
Based on **pages 14 and 15** of *Light and shadows*

Why shadows change size

Try this...

1. Take a torch, small wooden or plastic block, a piece of card and a lump of Plasticine and set them up as shown in the diagram.





2. Move the block a few centimetres from the torch and write the distance between the block and the torch (distance A) at the top of the left hand column in the table below.

3. Measure the width of the shadow on the screen and write your measurement at the top of the right hand column of the table.

Distance of object from torch (cm)	Width of shadow (cm)

4. Move the block a little further from the torch and measure the width of the shadow on the screen. In the table, record the new distance of the block from the torch (distance A) and the new width of the shadow.

5. Repeat step 4 three more times.

6. Make a bar chart of your results on a separate piece of paper.

Looking at the results.

7. What do the results show?

✎.....

Teacher's sheet: activity

Based on **pages 14 and 15** of *Light and shadows*

Introducing the activity

(a) If you have used either of the two activities suggested in the introduction to this unit on page 11, you may like to use this activity straight afterwards. You could ask the children if they noticed how they could change the size of the shadow, and look for an answer about changing the distance of the object from the light and the screen. Tell the children that they are now going to investigate this observation in greater detail.

Alternatively, you could use this activity after the children have studied the unit on pages 14 and 15 of the pupil book, and use the activity to confirm what the children have learned.

Using the sheet

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

(c) Let the children try task 1.

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

(e) Go through task 3, then let the children try it.

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

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

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

(i) Let the children try task 7.

Completing the activity

(j) Let the children compare their results.

(k) Challenge the children to predict what might happen if they moved the screen back while keeping the object in the same place. Let the children test their predictions.

Conclusion

When the object moves further away from the torch, the width of the shadow on the screen becomes smaller.

The width of the shadow never becomes smaller than the width of the object.

When the object is kept in place, and the screen is moved further back, the width of the shadow increases.

Teaching notes

(i) You may ask the children to bring in torches and objects from home for this activity. The object must have a dimension to its shadow that can be easily measured (not a wavy outline).

(ii) Some children may need help with relating the diagram to their experimental set-up, and identifying distance A.

(iii) Let the children choose how many measurements they wish to make. You can point out later that the activities with the most measurements are more reliable because they give a clearer picture of how the shadow changed when the distance between the torch and object was changed.

(iv) The distance between the torch and object should be on the X axis, and the width of the shadow should be on the Y axis.

7

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

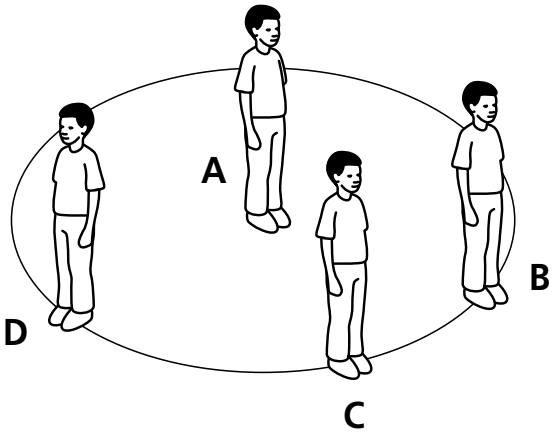
See **pages 16 and 17** of *Light and shadows*

Shadows change direction

When the source of light moves, the shadows it makes change length and direction.

Q1. Which person in the picture has the shortest shadow?

✎.....



Q2. What would happen to the shadows of the people if the light was lowered?

✎.....

✎.....

✎.....

✎.....

Q3. Which way does a shadow face?

✎.....

Q4. Where does your shadow begin?

✎.....

Q5. How does the length of your shadow change as you move further away from a light?

✎.....

Q6. What would happen to your shadow if you moved around a lamp?

✎.....

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 16 and 17** of *Light and shadows*

Answers

1. **A.**
2. **The shadow of A would stay the same but the shadows of the others would become longer.**
3. **It always faces away from the light.**
4. **At your feet.**
5. **It gets longer.**
6. **It would change direction. It would change shape to match the changes in shape of your body as your body moved.**

Complementary work

A table lamp could be set up in the classroom and the children could move around it to see how their shadows change direction and move from one wall to another.

Teaching notes

Having gradually built up ideas about shadows in this, and the two previous units, you may find it useful to review the children's knowledge. If the children have spent some time in the past considering reflections, they may think that the shadow is a reflection of them on the ground. This is not the case. The shadow is dark because there is an absence of light. This is due to the light striking the object (the person) being blocked. A reflection is due to light bouncing off a very shiny surface.

The children may think that they can see features in a shadow, such as a face, as they can in a reflection. This is not the case. The shadow is dark and shows no features of the surface on which the light shines.

A shadow always matches the outline of the object. If the object changes shape, then so does the shadow. The shadow cannot have a different outline from that of the object, although the shadow may be longer or shorter than the object.

The light and the shadow of the object that is casting the shadow are on opposite sides. There is no gap between the base of the object and the shadow it casts.

7

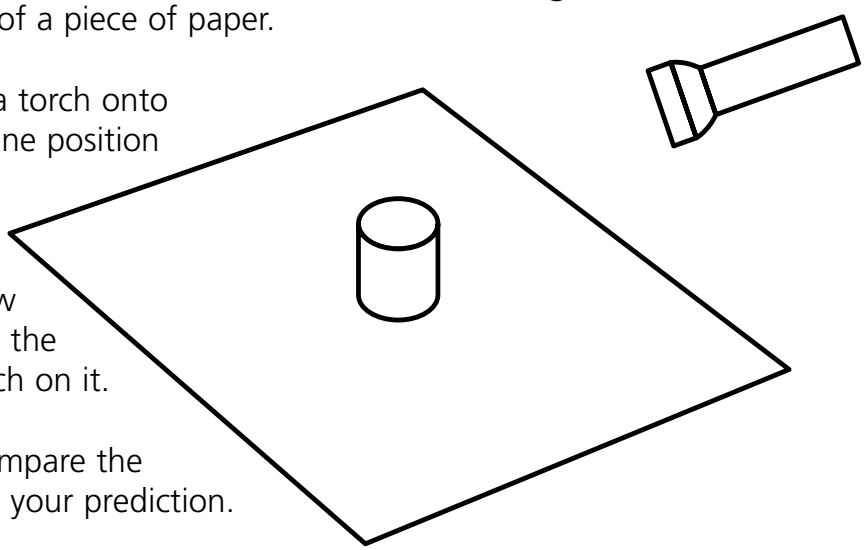
Name: ..... Form: .....

Based on **pages 16 and 17** of *Light and shadows*

How shadows change direction

Try this…

Diagram 1



1. Put an object in the centre of a piece of paper.

2. Decide how you will shine a torch onto the object. Diagram 1 shows one position of the torch you could use.

3. On your piece of paper, draw the outline of the shadow that you think will be made by the object when you shine the torch on it.

4. Switch on the torch and compare the shadow the object makes with your prediction.

5. Repeat steps 2, 3 and 4 a few more times with the torch in different positions.

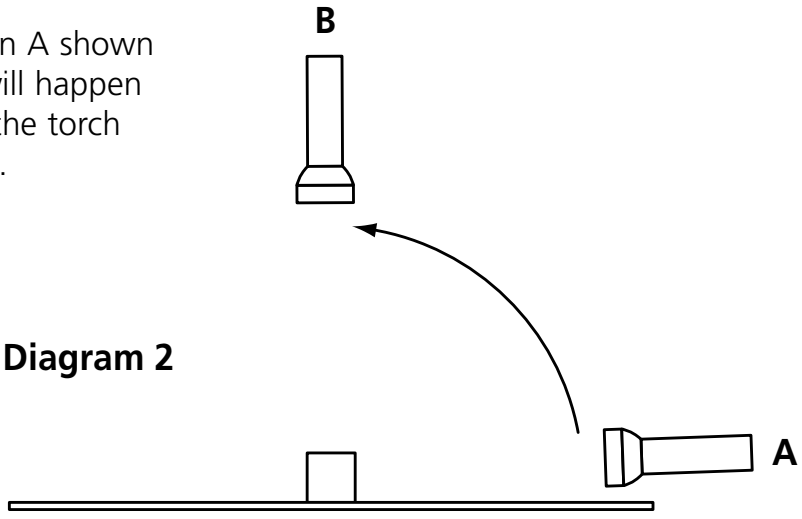
6. What do your results show?

✎.....

✎.....

7. Place your torch in position A shown in Diagram 2. Predict what will happen to the shadow as you move the torch from position A to position B.

Diagram 2



8. Shine your torch at position A and then move it up to position B.

9. How does the shadow change as you move your torch from position A to position B?

✎.....

Teacher's sheet: activity

Based on **pages 16 and 17** of *Light and shadows*

Introducing the activity

(a) If you have used the activity in the introduction to this unit on page 12 of this *Teacher's Guide*, you may like to follow it with this activity before the children study the unit in the pupil book. Alternatively, you may like to use this activity after the children have studied the unit in the pupil book to confirm what they have learned.

Using the sheet

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

(c) Let the children try tasks 1 and 2.

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

(e) Go through tasks 4 and 5 then let the children try them.

(f) Go through task 6 and let the children try it (see note (ii)).

(g) Let the children try tasks 7, 8 and 9.

(h) Let the children compare the predictions in task 7 with their answer in task 9 (see note (iii)).

Completing the activity

(i) Let the children compare their results.

Conclusion

When a light is shone on one side of an object, a shadow forms on the opposite side of the object. If the light is low down, the shadow is long. If the light is high up, the shadow is short.

When a light is raised from a low position to one directly over the object, the shadow changes from being long to being extremely short. When the light is directly overhead a shadow is not cast on the paper.

Teaching notes

(i) Give the children a blank sheet of paper on which to place the object. You may like to demonstrate how you can have the torch shining from different heights and from different directions. Make sure that the children realise they can move around the object to make their investigations.

(ii) You may have to rephrase this for some children to "What did you find out?"

(iii) The children should say that their prediction matched, partly matched or did not match the result, and describe how. They should not use phrases like "They were OK".

C

8

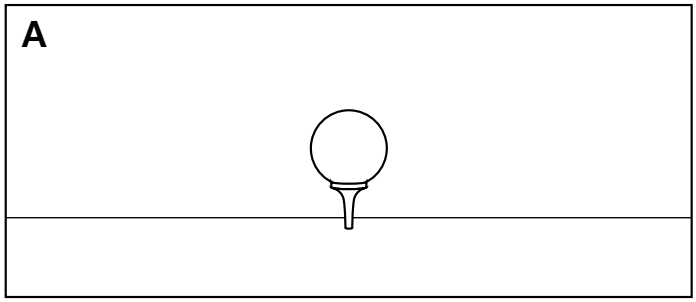
Name: ..... Form: .....

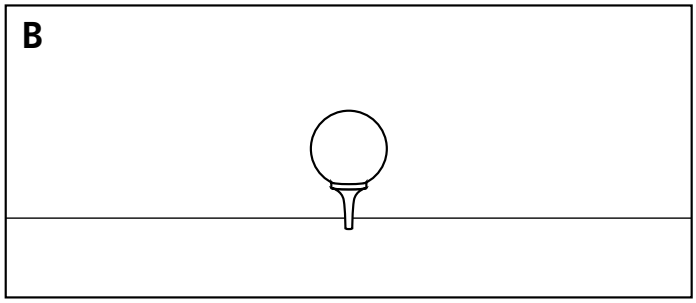
See **pages 18 and 19** of *Light and shadows*

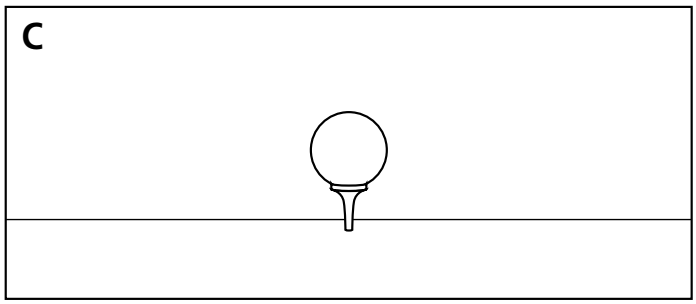
Sundials

The Sun is in different parts of the sky at different times during the day. We can trace what changes this brings and use them to tell the time.

Q1. Picture A is a golf ball and tee at the beginning of the day, Picture B is a golf ball and tee at midday and Picture C is a golf ball and tee at the end of the day. Draw in the Sun's position and the shadow made by the golf ball and tee in each picture.







Q2. What happens to the Sun in the sky during the morning?

✎.....

Q3. What happens to the Sun in the sky in the afternoon?

✎.....

Q4. Where could you place a stick to investigate how shadows change during the day?

✎.....

✎.....

✎.....

Q5. (i) What is a sundial used for? ✎.....

(ii) When can a sundial be used? Explain your answer.

✎.....

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 18 and 19** of *Light and shadows*

Answers

1. **In A the Sun is low and on the left, and a long shadow is pointing in the opposite direction. In B, the Sun is above the tee and the shadow is short and points down the sheet. In C, the Sun is low and on the right, and a long shadow is pointing in the opposite direction.**

2. **It rises.**

3. **It goes down.**

4. **Place it upright on open ground, such as a lawn or sand pit.**

5. **(i) For telling the time; (ii) When the Sun is shining. The shadow cast by sunlight is used to tell the time. If the Sun is not shining, no shadow is cast and the sundial does not work.**

Complementary work

(a) The children could use secondary sources to find out about how the path of the Sun across the sky varies through the year. They could link this work to the complementary work in Unit 3.

(b) The children could use secondary sources to find out about the design of sundials.

Teaching notes

This unit links shadow formation with the turning of the Earth and the apparent movement of the Sun across the sky.

The children must be reminded that they must not look directly at the Sun, as this will cause damage to the eyes.

If the children have secure knowledge, from work in earlier units, of how the length and direction of a shadow varies with the position of a light source, you may wish to use it now to show them how it can be used to track the path of the Sun across the sky. In the morning, the long shadows pointing to the west indicate that the Sun is low in the eastern part of the sky. The short shadow at midday, pointing north in the Northern Hemisphere and south in the Southern Hemisphere, indicates that the Sun is high in the sky. In the afternoon, the long shadows pointing eastwards indicate that the Sun is low in the western sky.

If you have mentioned in Unit 3 how the Earth tips towards and away from the Sun as it moves in its orbit, you may like to remind the children of it again in this unit to provide a firm foundation for work in *5E Earth and beyond*.

8

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

Based on **pages 18 and 19** of *Light and shadows*

Investigating shadows with a shadow stick

Try this...

1. Set up a shadow stick on an open piece of ground.

2. Mark the position of the shadow made by the stick.

3. Mark the ground near the stick to predict how you think the shadow may look in an hour's time.

4. Return to the stick in an hour and compare the actual shadow with your marked prediction.

5. Mark the new position of the shadow and the time.

6. Repeat steps 3, 4 and 5 a few more times during the day.

7. How did your predictions compare with the shadows that were actually made?

✎.....

8. On a separate piece of paper, make a drawing of the shadows made by your shadow stick during the day. Label the shadows with the time each one was made.

9. Ask your teacher which directions are north, south, east and west.

10. Write down how the shadows of the shadow stick changed during the day.

✎.....

✎.....

✎.....

✎.....

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 18 and 19** of *Light and shadows*

Introducing the activity

(a) You may like to use this activity after the children have studied pages 18 and 19 in the pupil book. You should begin by reminding the children that they should not look directly at the Sun in the sky. However, the path of the Sun across the sky can be investigated by studying the shadows that it makes (see note (i)).

Using the sheet

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

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

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

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

(f) Let the children try task 5.

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

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

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

(j) Let the children try task 10.

Completing the activity

(k) Let the children compare their results.

Conclusion

The shadow points in the opposite direction to the position of the Sun in the sky. The Sun makes long shadows when it is low in the sky and short shadows when it is high in the sky.

Teaching notes

(i) The children have studied how the position of the light affects the shadow in the previous units. Here you can use the idea that the size and direction of the shadow can tell something about the light that is making the shadow.

(ii) You may like the children to look at the photograph of the shadow stick on page 19 while they begin the activity.

(iii) If the children have set up the shadow stick in a plant pot and put it on a Tarmac or flagged school playground, the shadow positions and predictions can be marked out in chalk. If the shadow stick is set up on grass, the shadow positions and predictions can be marked out with lines of sand. If the shadow stick is set up in a sand pit, the shadow positions and predictions can be marked out as shown in the photograph on page 19 of the pupil book.

(iv) The children do not need to write down any comparisons, but just judge the difference between the shadow and the prediction and use it to make a more accurate prediction of the shadow in the next hour.

(v) The children should make more accurate predictions as they become more familiar with the speed of the Sun across the sky.

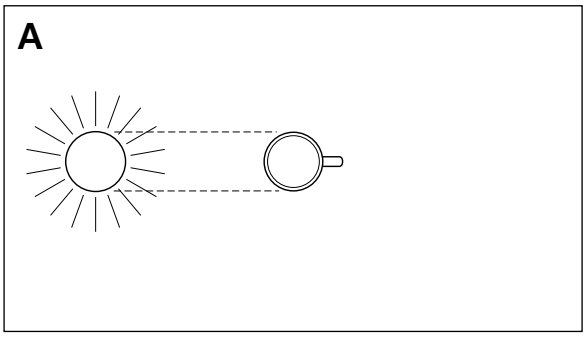
(vi) Show the children a compass and use it to find the directions they need.

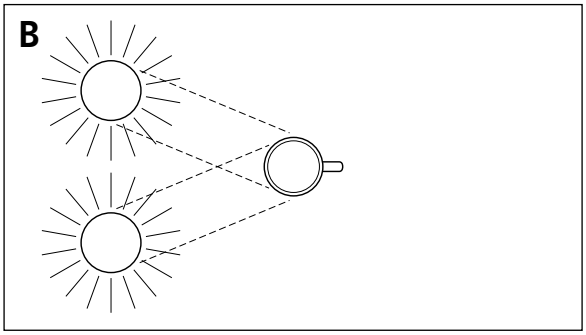
Name: ..... Form: .....

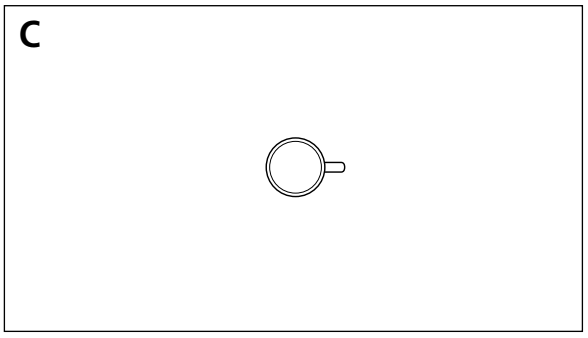
See **pages 20 and 21** of *Light and shadows*

Getting rid of shadows

Shadows can be a nuisance. You can get rid of them by using many lights, or just a piece of card.







Q1. (i) In box A, draw in the shadow of the mug.

(ii) In box B, draw in the shadow of the mug.

(iii) In box C, draw where you should place lamps so that the mug does not have a shadow.

Q2. When will you always have shadows?

✎.....

✎.....

Q3. (i) What do people do when they want to get rid of all the shadows?

✎.....

✎.....

(ii) Name a place where it is important to remove all shadows.

✎.....

Q4. When light strikes a surface, it bounces back. What is this bouncing back called?

✎.....

Q5. How does the colour of a surface affect the light that bounces off it?

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 20 and 21** of *Light and shadows*

Answers

1. **(i) The shadow should be to the right of the mug; (ii) The shadow should be to the right of the mug and come to a point; (iii) The lamps should be placed equidistant, at either side of the mug.**
2. **Whenever you have just one source of light.**
3. **When it is in the strong shadow cast by one room light.**
4. **(i) Use many lights; (ii) Operating theatre in a hospital.**
5. **Reflection.**
6. **The lighter the colour, the more it will bounce or reflect light. The darker the colour, the less light will be reflected.**

Complementary work

If the children have done the activity in Unit 2 they can use the results of the lighting survey to predict where dark shadows with sharp edges are found in the home, and where paler shadows with less-sharp edges are found. This provides an opportunity to show the children how data collected for one investigation can be useful in other ways.

Teaching notes

You can use this unit to remind children that darkness is an absence of light. When a shadow is cast, it is because there is an absence of light due to light being blocked by an object. If light then shines into the place where the shadow has formed, or is reflected from a shiny surface, the shadow will become paler and its edges will become less distinct. If enough light enters the space where the shadow has formed, the shadow can be eliminated.

While the children have been doing work on shadows they may have found that sometimes the shadow is very dark when the object is close to the surface on which the shadow has formed, yet when the object is moved towards the light source, the shadow becomes paler and may have a dark inner part and a paler outer part. These changes are due to the light source being large compared to the object. Light from the central part of the light source, such as the filament in a light bulb, forms the dark central part of the shadow, called the umbra. Light from other parts of the light bulb, such as the top and bottom of the light bulb, forms the paler outer part, called the penumbra. The children do not need to know about the details of the umbra and penumbra, but they may ask why the shadows change as they move objects about.

9

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

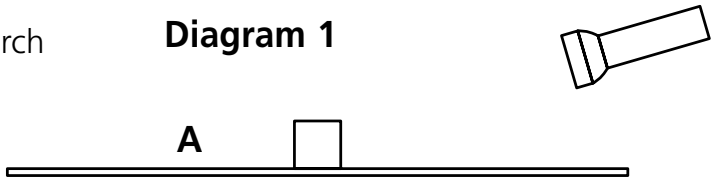
Based on **pages 20 and 21** of *Light and shadows*

Can shadows be removed?

Try this…

1. Set up an object, white card and torch as Diagram 1 shows.

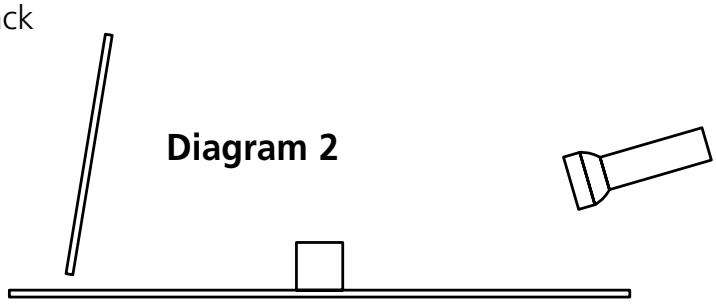
Diagram 1



2. Look at the shadow that the object makes in region A.

3. Place a piece of white card as shown in Diagram 2 so that it reflects light back into region A.

Diagram 2



4. Look at the shadow again. How has it changed?

✎.....

5. Predict what might happen if you used a mirror instead of the card.

✎.....

6. Give a reason for your prediction.

✎.....

✎.....

7. Replace the card with a mirror and shine the torch again so that light is reflected back into region A.

8. What did you see? How did it compare with your prediction?

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 20 and 21** of *Light and shadows*

Introducing the activity

(a) If you have used the introduction to this unit on page 13 of this *Teacher's Guide* you may like to use this activity straight afterwards, before the children study pages 20 and 21 in the pupil book. Alternatively, you may like to use this activity as an extension of the work on page 21. In either case, tell the children that you are challenging them to try and get rid of a shadow.

Using the sheet

(b) Give out the sheet and let the children write their names and form, then go through tasks 1 and 2 and let the children try them (see note (i)).

(c) Go through tasks 3 and 4, then let the children try them.

(d) Go through tasks 5 and 6, then let the children try them (see note (ii)).

(e) Let the children try tasks 7 and 8 (see note (iii)).

Completing the activity

(f) Let the children compare their results and explanations.

Conclusion

A dark shadow with sharp edges is produced when a torch shines on an object. A piece of white card reflects light from the torch back into the region where the shadow has formed. This makes the shadow much paler. When a mirror is used instead of a card, it reflects even more light and can cause the shadow to disappear.

Teaching notes

(i) You may wish to point out that the torch has got a bright piece of wire called a filament that produces the light yet many light bulbs have got a pearly surface which masks the filament and makes the bulb glow. Fluorescent lights produce light in a different way, but they also have a surface which gives a more diffuse glow.

(ii) You may like to remind the children about how smooth surfaces reflect light, and that a shadow is dark because there is an absence of light. They may use these facts when giving a reason for their prediction.

(iii) The children should say that the prediction matched, partly matched or did not match the result and why.

C

10

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

See **pages 22 and 23** of *Light and shadows*

Letting light through

Some objects let light through. When these objects are perfectly clear, we call them transparent. Otherwise we call them translucent.

Q1. You have an opaque block the size and shape of a domino, a transparent block the same shape and size and a torch.

In the space above, draw how you would show that the transparent object makes a weaker shadow than the opaque one.

Q2. Name three materials that are transparent.

✎..... ✎..... ✎.....

Q3. Name two things which are translucent.

✎..... ✎.....

Q4. Name two coloured materials which act as filters.

✎..... ✎.....

Q5. If you look through a red filter, what colour of light passes through it and into your eyes? ✎.....

Q6. Explain how you can make a light bulb shine with a green light.

✎.....

✎.....

✎.....

✎.....

Teacher's sheet: comprehension

See **pages 22 and 23** of *Light and shadows*

Answers

1. **There should be two pictures. One showing a torch shining on the opaque block and making a dark shadow. The other picture should show the torch shining on the transparent block and making a weaker shadow.**
2. **Air, glass, water, certain kinds of plastic.**
3. **Greaseproof paper, thin materials on roller blinds, material from which a handkerchief is made.**
4. **Coloured wrapping paper, coloured glass.**
5. **Red light.**
6. **You could simply cover the light with green tissue paper; or make a cardboard framework and stick green tissue paper (or green transparent sweet wrappers) to it. When the light is switched on, only green light will pass through the tissue paper and make the light shine with a green light.**

Complementary work

The children could close their fingers over the front of the torch then switch it on. They should see that the light shines with a red glow. This is because the skin is translucent and the blood underneath absorbs all the colours in the light except red, which it lets pass through. In this activity, the blood is acting like a red filter.

Teaching notes

When light passes through a material, the path of the light ray changes. When a light ray strikes a surface at an angle and then moves through a transparent material and escapes again, the different colours in the light separate and form a spectrum.

When white light strikes an opaque object, some of the colours are absorbed, and some may be reflected. For example, a red apple absorbs all the colours in the spectrum and reflects red. If an object reflects all colours equally we see it as white. If an object absorbs all colours we see it as black.

When light passes through a filter, all the colours of the spectrum are absorbed except the colour of the filter. This colour then passes through the filter to shine on nearby objects. If the colour strikes an object which absorbs it, that object appears as black. A white object will reflect the colour. At this stage the children do not need to know details about how colours are reflected, but they may ask some questions which may be answered simply using some of the information here.

10

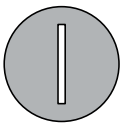
Name: ..... Form: .....

Based on **pages 22 and 23** of *Light and shadows*

Coloured light

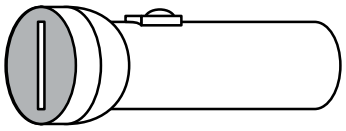
Try this…

Diagram 1



1. Make a slit in a piece of card as shown in Diagram 1.

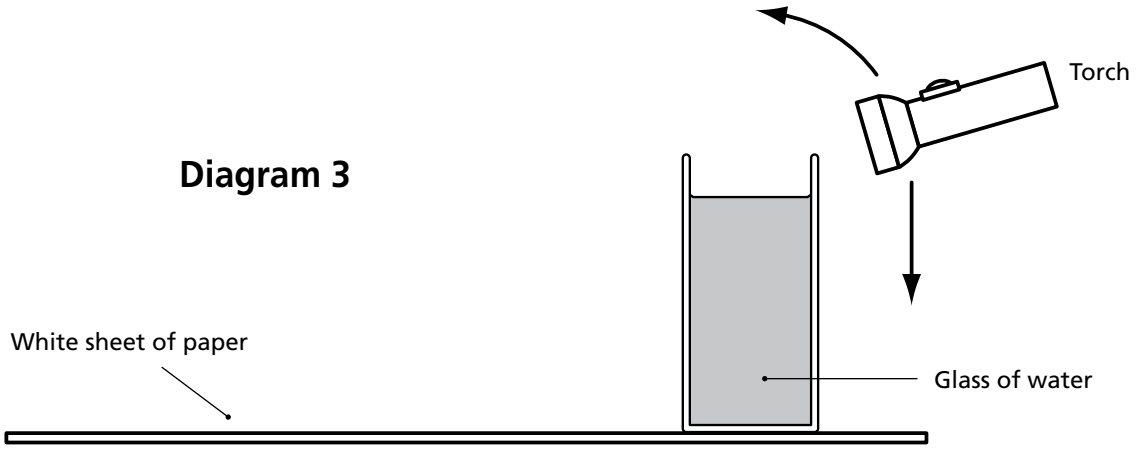
Diagram 2



2. Tape the card to the front of a torch as Diagram 2 shows.

3. In a dark place, set up a glass of water on a white sheet of paper, as Diagram 3 shows.

Diagram 3



4. Switch on the torch and move it up and down in the region shown by the arrows.

5. While you are moving the torch, look in area A of the white paper. What do you see?

6. In a dark place put a red pencil on a piece of white paper.

7. Shine the torch on the pencil.

8. Put a red filter in front of the torch and shine it on the pencil again.

9. How did the paper and the pencil change when you shone the torch and filter on them?

✎.....

✎.....

✎.....

Teacher's sheet: activity

Based on **pages 22 and 23** of *Light and shadows*

Introducing the activity

(a) Remind the children that in certain circumstances white light splits up to show the different coloured light it is made from. Ask the children to name the colours of the rainbow and tell them that in part of this activity they are going to split light to show its different colours. Tell them that they are also going to make an investigation on one colour of light.

Using the sheet

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

(c) Go through task 2 with the children, then let them try it.

(d) Go through tasks 3 to 5 and let the children try them (see notes (ii) and (iii)).

(e) Go through tasks 6 and 7, then let the children try them.

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

Completing the activity

(g) Let the children compare their results.

Conclusion

When a narrow beam of light is shone into a glass of water at an angle to its surface, the light which emerges from the glass is split into the colours of the spectrum: red, orange, yellow, green, blue, indigo and violet.

When red light shines on a white surface it is reflected.

Teaching notes

(i) Depending on the attitude and ability of the children you may have to make the slits for them.

(ii) It is important for the experiment to be tried in a dark place so that the colours can be seen. Darken the room or use a room which can be darkened.

(iii) The children will have to move the torch around in the area shown by the arrows. They should look on the paper in region A and should see a small spectrum of colours. They may even see two spectra. The children could write about what they have seen, or draw a small spectrum from memory. It would be too difficult to hold the torch in place while a drawing was made. If you feel the children do not have the correct attitude or ability to use a glass container you could demonstrate this part of the activity.

(iv) The children should see that the pencil became paler due to the red pencil reflecting red light.

REVISION QUESTIONS

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

Q1. What is the main source of light in our lives?

Tick one box: Sun ☐ Moon ☐ Electric lamp ☐ Candle ☐

Q2. Here are four sources of light: **electric lamp, candle, gas lamp, oil lamp**.
Arrange them below in the order in which they were invented.

1 ✎.....

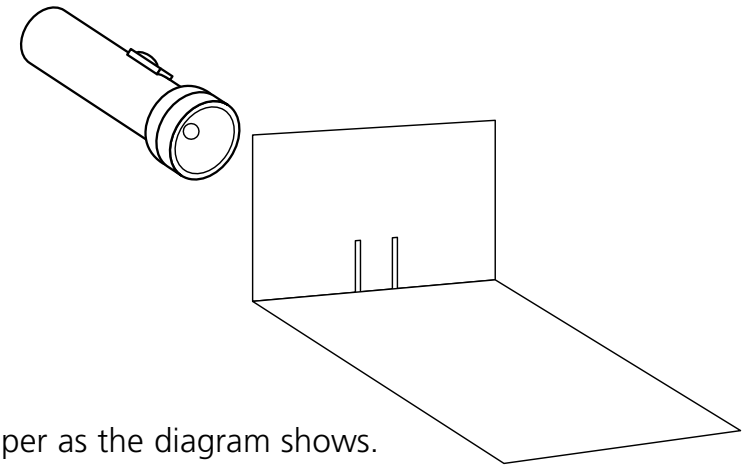
2 ✎.....

3 ✎.....

4 ✎.....

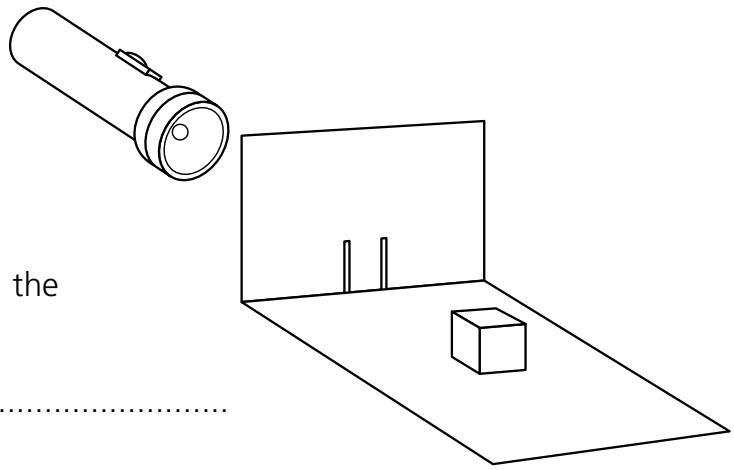
Q3. Paul shines a torch through two slits in a card.

(i) Draw how the light appears on the sheet of paper in front of the slits.



Sarah puts a block of wood on the paper as the diagram shows.

(ii) Draw how the light appears on the sheet when Paul switches on the torch again.



(iii) Explain why there is a change in the way the light appears.

✎.....

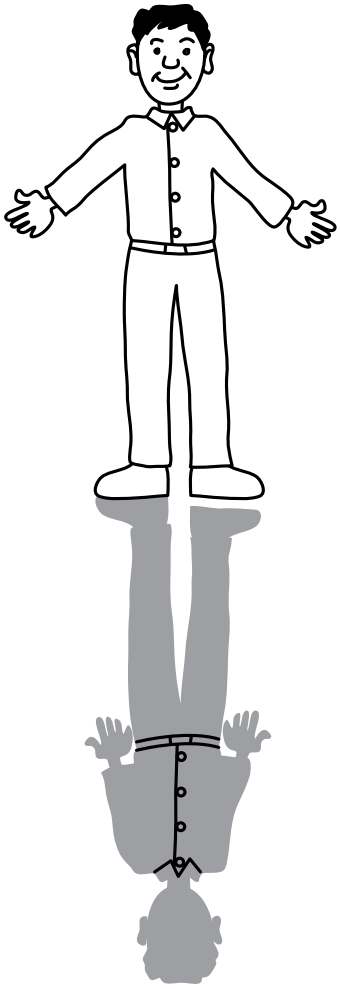
✎.....

✎.....

REVISION QUESTIONS

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

Q4. Sarah has drawn a picture of Mohammed and his shadow. The Sun was shining in front of him when she made the drawing.



State four things that are wrong with Sarah's drawing of the shadow.

1 ✎.....

.....

2 ✎.....

.....

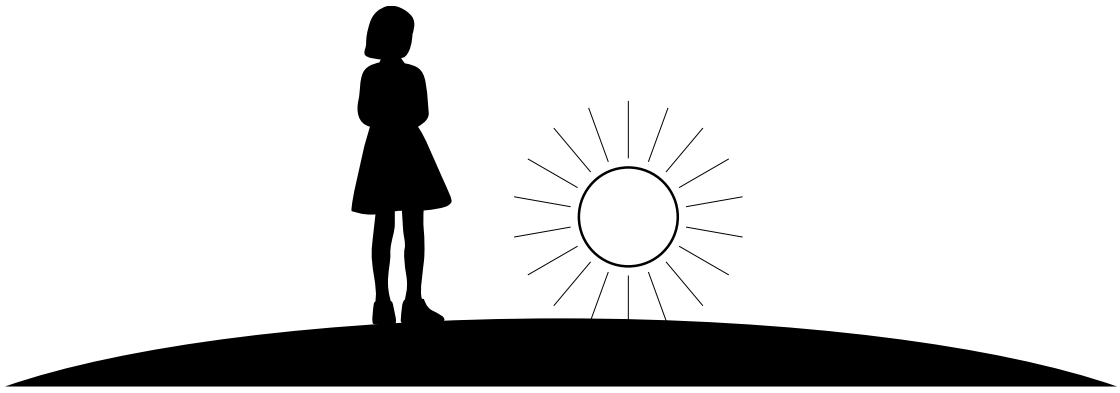
3 ✎.....

.....

4 ✎.....

.....

Q5. Siobhan stands on a hilltop at sunset.



How do we see her?

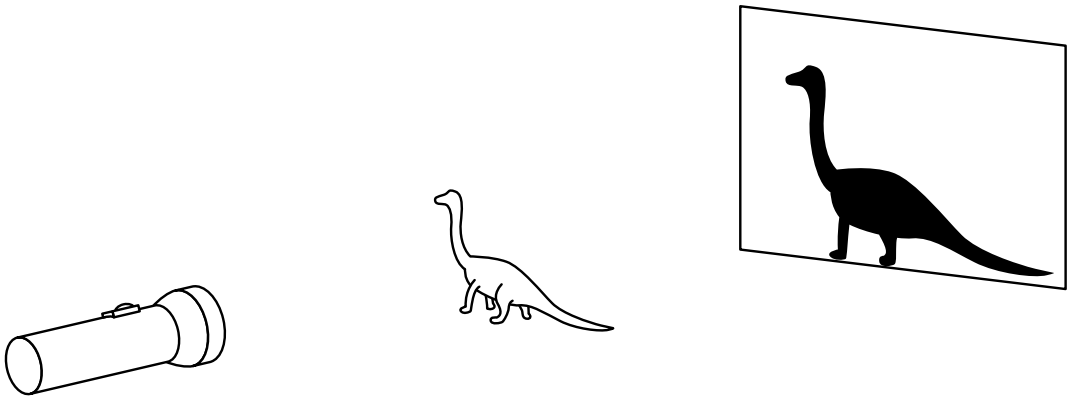
Tick one box: As a shadow ☐ As an outline ☐

As a silhouette ☐ As an object in the shade ☐

REVISION QUESTIONS

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

Q6. Marcus has set up a model of a dinosaur, a torch and a screen as the picture shows.



Sarah moves the model dinosaur closer to the torch.

(i) How does the shadow of the dinosaur change?

✎.....

Siobhan moves the model of the Dinosaur closer to the screen.

(ii) How does the shadow of the dinosaur change now?

✎.....

Mohammed thinks he has found out a rule for changing the shadow of an object.

(iii) Complete the missing parts of his rule.

The size of an object's shadow depends upon the:

✎.....

Marcus keeps the torch and model dinosaur in place but moves the screen further away.

(iv) What happens to the shadow of the model dinosaur?

✎.....

Marcus keeps the model dinosaur and screen in place but moves the torch further away from the model dinosaur.

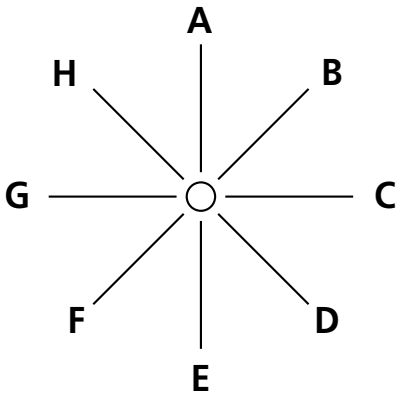
(v) What happens to the shadow of the model dinosaur?

✎.....

REVISION QUESTIONS

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

Q7. Mohammed sets up an object in the centre of a sheet of paper. He draws eight directions from his object labelled A to H as the diagram shows.



(i) Mohammed shines a torch from direction A. In which direction does the shadow point?

✎.....

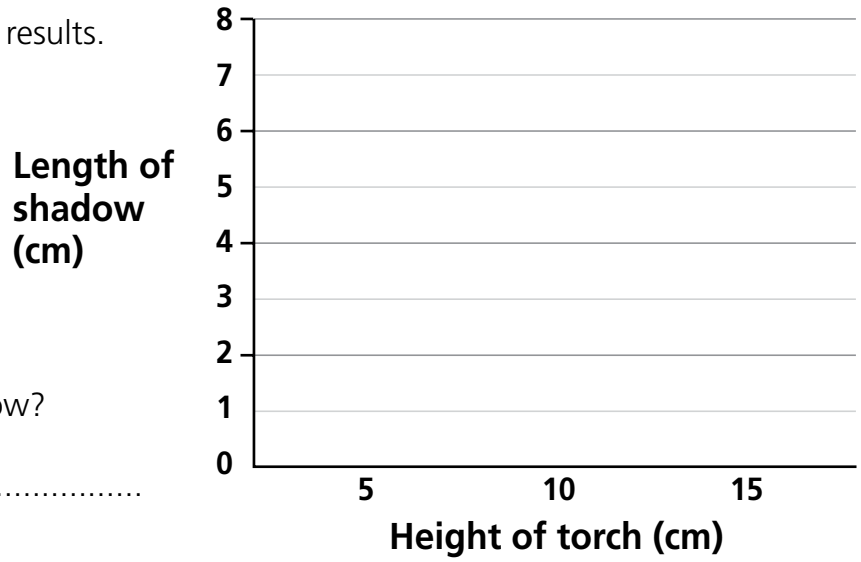
(ii) Mohammed shines a torch from direction G. In which direction does the shadow point? ✎.....

(iii) Arif shines a torch from direction D. In which direction does the shadow point? ✎.....

Q8. Siobhan set her torch at three different heights near an object and measured the length of the object's shadow at each height. Here are her results.

Height of torch (cm)	Length of shadow (cm)
5	6
10	4
15	2

(i) Make a bar chart of the results.



(ii) What do the results show?

✎.....

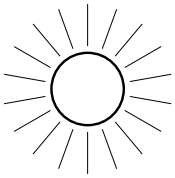
✎.....

✎.....

REVISION QUESTIONS

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

Q9. The picture shows the Sun just rising above the horizon. It is early morning.



(i) Draw where the Sun would be in the sky at midday.

(ii) Draw where the Sun would be in the late afternoon.

(iii) The Sun does not really move across the sky. What makes it appear as if the Sun is moving across the sky?

✎.....

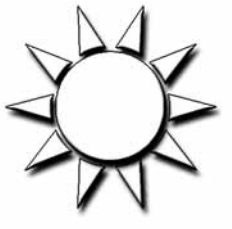
Q10. Marcus puts a stick in the ground early in the morning on a sunny day. The diagram shows the stick and the shadow.

(i) Why does the stick make a shadow?

✎.....

(ii) Draw the shadow you think the stick will cast at midday.

(iii) Draw the shadow that you think the stick will cast in the early evening.



REVISION QUESTIONS

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

Q11. When light hits a surface and bounces off, what is the process called?

Tick one box: Reflecting ☐ Illuminating ☐ Shading ☐ Filtering ☐

Q12. A is a translucent material. B is a transparent material. C is an opaque material.

(i) Which material does not let any light through?

✎.....

(ii) Which material lets the most light through?

✎.....

(iii) Arrange the materials by the darkness of their shadows, starting with the object with the darkest shadow.

✎.....

(iv) Which material could be used to make a screen for a shadow play?

✎.....

(v) What kind of materials are air and water – transparent, translucent or opaque?

✎.....

Q13. Marcus looks at Sarah through a green filter.

What colour of light passes from Sarah to Marcus?

✎.....

Q14. What colour of filters are used at traffic lights?

✎.....

ANSWERS
REVISION QUESTIONS

1. Sun. *1 mark*

2. Oil lamp, candle, gas lamp, electric lamp. *2 marks*

3. (i) There are two straight lines of light across the paper. *1 mark*
(ii) There is one straight line of light across the paper, the other line is stopped by the wood block. *1 mark*
(iii) The wood block is opaque. It does not let the light ray pass through it. *2 marks*

4. In any order. The shadow should be behind Mohammed. The shadow should be attached to both feet. The shadow should have its arms sticking out.
The collar, buttons and belt should not be seen in the shadow. *4 marks*

5. As a silhouette. *1 mark*

6. (i) It gets larger. *1 mark*
(ii) It gets smaller. *1 mark*
(iii) Distance between the object and the screen (or torch). *1 mark*
(iv) It gets larger. *1 mark*
(v) It gets smaller. *1 mark*

7. (i) E. *1 mark*
(ii) C. *1 mark*
(iii) H. *1 mark*

8. (i) The three columns should reach the correct heights of 6, 4 and 2cm. *2 marks*
(ii) As the height of the torch increases, the length of the shadow decreases. *2 marks*

9. (i) It would be at its highest point in the sky in the middle of the picture. *1 mark*
(ii) It would be on the right of the picture, higher than the Sun drawn in the picture and nearer the centre of the picture. *1 mark*
(iii) The turning of the Earth. *1 mark*

10. (i) Because the stick is made from an opaque material which blocks the Sun's rays. *1 mark*
(ii) The shadow should be vertically down in front of the stick and should be short. *1 mark*
(iii) The shadow should be pointing in the opposite direction to the early morning shadow and should be the same length. *1 mark*

11. Reflecting. *1 mark*

12. (i) C. *1 mark*
(ii) B. *1 mark*
(iii) C, A, B. *1 mark*
(iv) A. *1 mark*
(v) Transparent materials. *1 mark*

13. Green light. *1 mark*

14. Red, amber, green. *1 mark*

Total marks: 38