Science@School | Book 6F

How we see things

Teacher's Guide

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Atlantic Europe Publishing

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The pupil book explained unit by unit

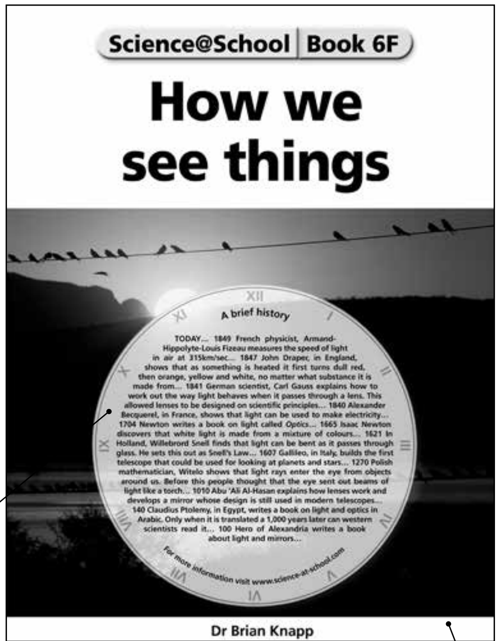
Although the pupil book – *How we see things* – is clear and simple, a great deal of care and thought has been given to the structure and the content of each double page spread or unit. The worksheets and activities in this *Teacher's Guide* also link directly to the pages in *How we see things*.

It is possible to use *How we see things,* 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 11 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.

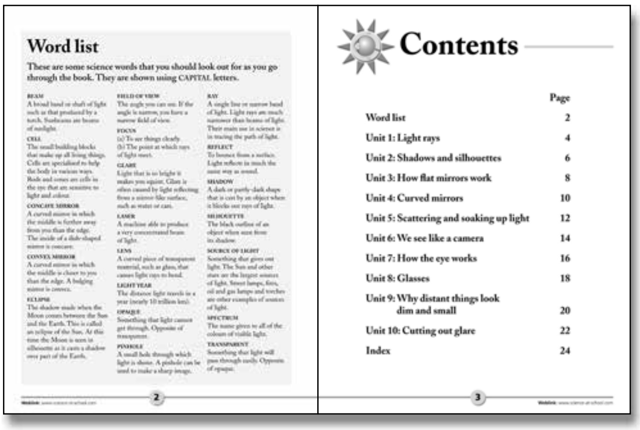
Swallows show in silhouette against a setting sun. We see the birds as black shapes because the birds block out the light from the Sun and so no light from them enters our eyes.

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.


Word list

These are some science words that you should look out for as you go through the book. They are shown using CAPITAL letters.

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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

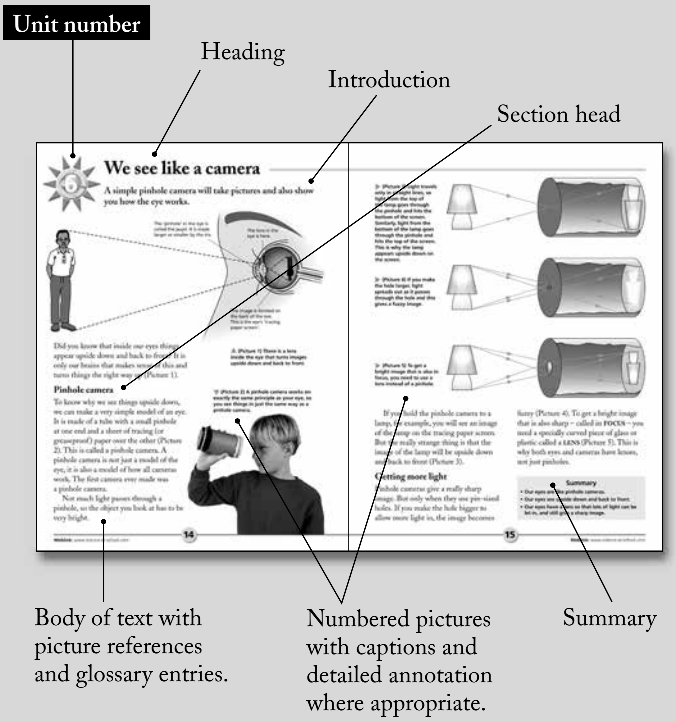
The main text of the page then follows in a straightforward, easy-to-follow, double column format.

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.

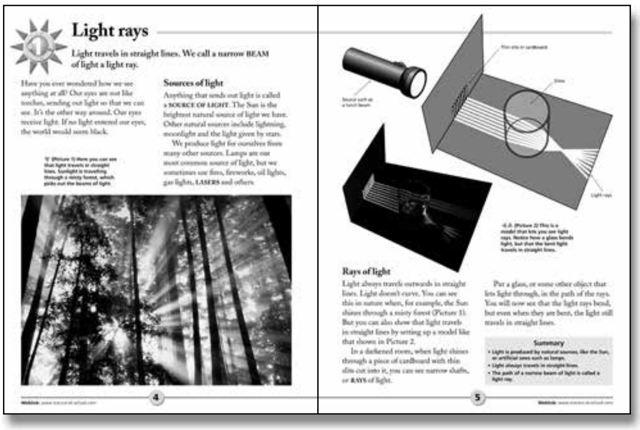
The glossary words are highlighted on the first page on which they occur. They may be highlighted again on subsequent pages if they are regarded as particularly important to that unit.

Summary

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



1 Light rays

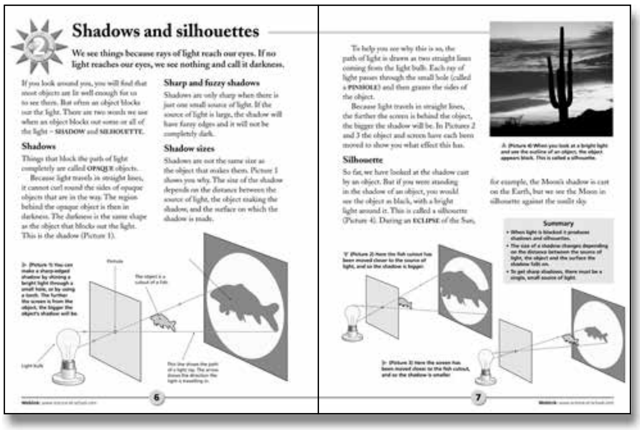


The unit opens with a striking picture of light rays shining through a misty forest to show that light travels in straight lines. To emphasise this, begin by asking the children to close their eyes and to put their hands over their eyes. Ask them what changed when they put their hands over their closed eyes. They should answer that it became darker. Now ask them why there was a change, and look for the answer that some light was getting through their eyelids, but not through their hands. Ask the children to open their eyes and tell you something which is sending light rays into their eyes. They could refer to any object in the room as they see most objects by reflected light. Now ask them to tell you the source of light that is allowing them to see everything in the room. Their answer should be electric lights, or the Sun or both.

The unit begins by correcting the familiar notion that eyes give out rays, and explains that we only see things when light enters our eyes. The meaning of a source of light is explained and examples are given before the children are presented with an experiment that shows how light rays change direction when they pass through a drinking glass. This is illustrated by a photograph of the experimental set-up and a clear diagram.

In the complementary work, the children make a survey of light sources in the home and neighbourhood. In the activity, the children use cards with holes in them and a bendy party straw to investigate how light travels away from a torch.

2 Shadows and silhouettes



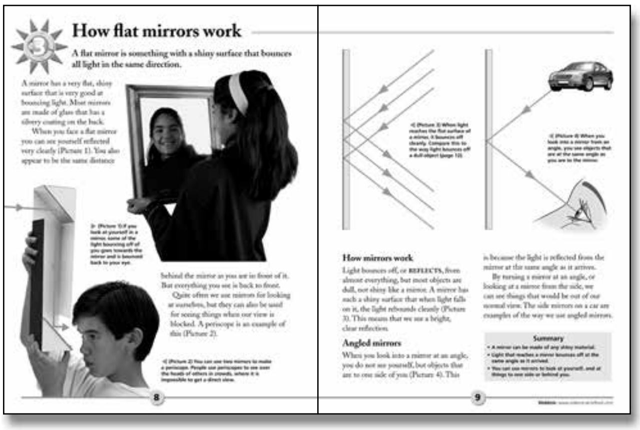
This unit builds on the previous one by showing that the fact that light travels in straight lines can be used to explain how shadows are formed. Begin by holding up different objects in turn and asking the children if they think light would shine through them if you shone a torch on them. Test the children's answers with your torch and let one of the children record the results on the board. You should try a range of transparent, translucent and opaque objects and revise the meaning of these terms with the children.

Ask the children to tell you what forms on the unlit side of an opaque object and look for the word shadow. Challenge the children to explain why shadows form, and look for an answer about light travelling in straight lines and not being able to bend round into the unlit space.

The unit starts by discussing the reason why some shadows appear to have sharp edges while others have fuzzy edges. The way that the position of an object affects shadow size is clearly explained and illustrated. The unit ends by making a clear distinction between a shadow and a silhouette.

In the complementary work, the children investigate how the height of a light source affects the length of the shadow of an object, and they use secondary sources to find out how shadows have been used to measure time. In the activity, the children investigate factors which affect shadow size, and draw line graphs of their results.

3 How flat mirrors work



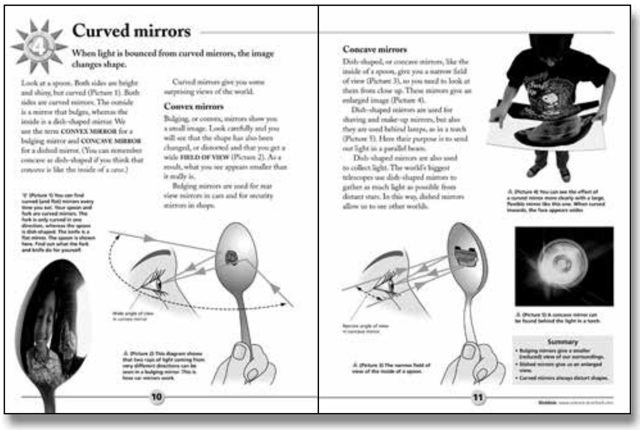
This unit builds on the previous units by reminding the children that light travels in straight lines and must enter the eye for something to be seen. You may like to begin by writing a message backwards, so that it can only be read by looking at it through a mirror. Hold up the card with the message on it and ask the children how they could read it easily. Look for an answer about using a mirror, then let the children try it using a large mirror. Issue the children with small mirrors and challenge them to write their names so that they can only be read in a mirror.

Tell the children that they are your reflection in a mirror and they must do whatever you do. Open and close your mouth then raise your right hand and make sure that they are raising their left hand. Let them check their performance using a mirror.

In this unit, a clear cutaway section of a periscope is used to show how two flat mirrors can alter the path of light. The way in which light rays strike and are reflected from a flat mirror are also described. The unit ends by showing how the view through a mirror can be improved by looking at a mirror from one side.

In the complementary work, the children make a periscope and find out how two mirrors can produce an image of themselves that everyone else sees. In the activity, the children look for a pattern in the way light rays strike a flat mirror and reflected rays leave it.

4 Curved mirrors

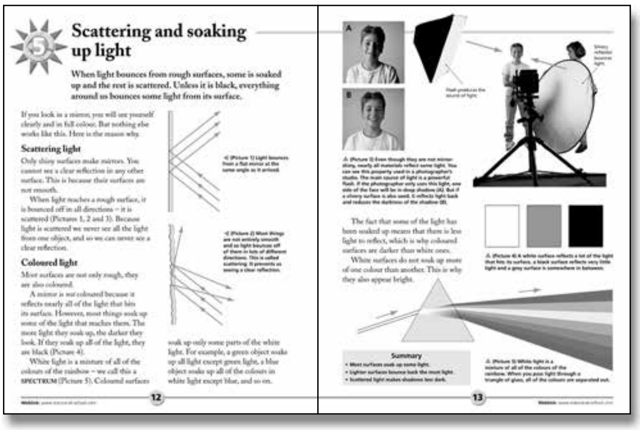


This unit builds on the last one by considering reflections at curved surfaces instead of flat ones. You may like to begin by asking the children to look around them for surfaces in which they can see reflections. They may point to the window, a mirror, the glass sides of a fish tank and its water surface, a computer screen, a television screen and so on. Ask the children about any surfaces which give reflections and are curved. Spoons may be suggested and security mirrors in shops. Ask the children about any 'hall of mirrors' amusement that they may have visited at a fairground. Make the children familiar with the word 'image', for reflection, as they describe their experiences.

The text begins by describing curved mirrors as either bulging or dished, then introduces the terms convex and concave gradually to help the children's understanding. This is followed by more detailed descriptions, with examples, and is accompanied by intriguing photographs and clear diagrams. These make the children become fully aware of the images that are produced when mirrors are curved in different ways.

In the complementary work, the children use a torch to investigate how light rays are reflected from the concave and convex surfaces of a spoon. In the activity, the children compare the images that are formed by the concave and convex sides of a spoon.

5 Scattering and soaking up light

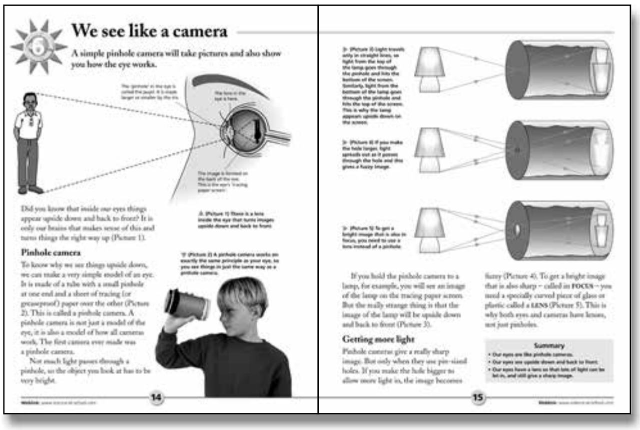


This unit follows the two previous ones in considering what happens when light strikes the surface of an object. To emphasise this, show the children a shiny metal surface. Ask the children for evidence that it reflects the light. Look for an answer that the children can see images in the surface. Shine a torch on the metal, and look for them saying that the surface shines. Now take some sandpaper and rub the surface so that it becomes rough. You may let some of the children help you with this. Show the class the newly rough surface and ask the children for their ideas about reflection now. Tell the children that the surface is still reflecting light, otherwise we could not see it, but the light is being scattered in all directions.

In this unit, the objects that are studied do not reflect light like a mirror, but instead soak up or absorb different amounts of light and scatter the rest in all directions. Explanations are given for how objects appear black, white or coloured. The unit ends by showing how a prism scatters light to produce a spectrum.

In the complementary work, the children can find out how colours form white light and why the sky is blue. In the activity, the children make a survey of surfaces to discover which ones are shiny or dull and which soak up the most and the least light.

6 We see like a camera

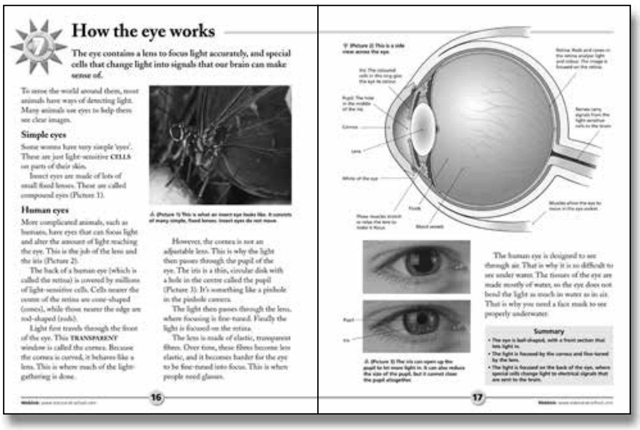


The unit opens with the intriguing facts that we actually see things upside down and back to front. To demonstrate this, ask the children to tell you how they think a photograph is made. Look for answers about pointing the camera at the object to be photographed, the camera having a lens to focus the light, the photograph being made inside the camera. If the school has a digital camera perhaps you can use it to take a picture of the class and can display it on a computer. Tell the children that a camera brings together light rays from objects in front of it to make a picture.

The revelation that we see things upside down and backwards is supported by a carefully presented account of how a pinhole camera is constructed, and how the image it makes can be changed by altering the size of the hole and by adding a lens. A photograph shows the structure of a pinhole camera and how to hold it. This will encourage the children to experiment with making their own pinhole camera. Three clear diagrams build on previous work to show how light travelling in straight lines can form an image at the back of the camera. The unit ends by introducing the words 'focus' and 'lens' in preparation for the next unit on the eye.

In the complementary work, the children find out how a pinhole camera compares with a real camera. In the activity, the children make and use a pinhole camera to find out how hole size affects the image that is produced.

7 How the eye works



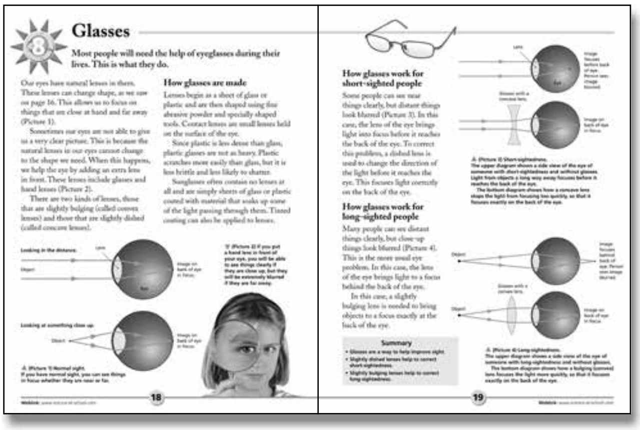
This unit builds on the simple structure of the pinhole camera to show how the components of the human eye are arranged, and how they work. You may like to begin by telling the children to stretch out one arm and point at you. Now tell them to close their left eye and see how far the finger seems to jump. Tell the children to open their left eye and close their right eye and see how far the finger seems to jump now. Whichever eye is closed when the finger moves the least is the eye they use to sight with when looking at long distance objects.

Now tell the children to move their outstretched finger to the side but keep staring ahead. Ask them to find out how far they must move their arm out to their side before they cannot see their hand. This is the limit of their field of view.

The unit opens with a short account on light sensitivity in worms and insects. This is followed by a more detailed consideration of the human eye. A colourful yet detailed diagram of the eye provides a firm foundation for children to appreciate how the components of the eye are related. The unit ends with close-up photographs of how the iris controls the size of the pupil.

In the complementary work, the children find the limit of their colour vision. In the activity, the children investigate the action of the iris and discover that they have a blind spot.

8 Glasses



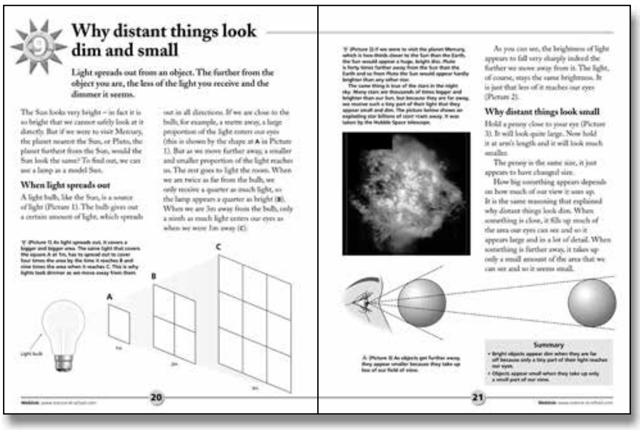
This unit shows how lenses can be used to correct short-sight and long-sight. You may like to begin by giving out glasses of water and spoons. Tell the children they are not to drink the water but are to use it to investigate light. Ask the children to lower the spoons into the water and tell you what they see. They should see that the spoon appears to be larger in water than it does in air.

Now ask the children to keep the spoon in the glass, but rest it on the side of the glass. Ask them to look at the glass from the side and tell you what they see. They should see that the handle of the spoon appears to be cut off and moved a little to one side as it leaves the water. Tell the children that these changes which seem to take place are due to the way light passes from one material (air) to another (water) and we use these changes to help some people have better sight.

The unit opens by describing how the lens in the eye may fail to give a clear image. Convex and concave lenses are introduced and this is followed by a section on how glasses are made. Contact lenses are also mentioned. The corrections for short-sight and long-sight are carefully explained by referring to how light travels in straight lines and how lenses can change the course of light rays.

In the complementary work, the children use secondary sources to find out about microscopes and telescopes. In the activity, the children make and test a water lens, and investigate images made by a range of lenses.

9 Why distant things look dim and small



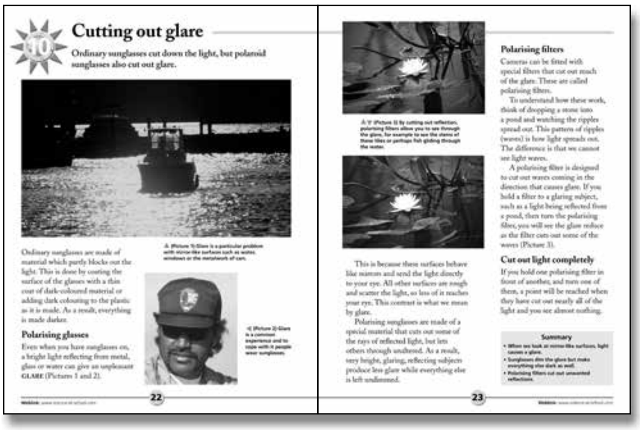
Having explored the eye and vision in the two previous units, this unit addresses the phenomenon that distant objects look smaller and dimmer than nearby objects. You could begin by setting off a loud alarm clock on your desk and telling the children that they can hear it because of the large amount of sound energy that it is giving out. Ask someone to take the clock out of the classroom and down a corridor and tell the children the clock becomes quieter because the energy has to spread out over a wider area.

Remind the children that heat is a form of energy and spreads out in a similar way. This is why you feel colder when you leave a campfire. Tell the children that in this unit they are going to find out if light behaves in the same way.

The unit opens by considering how the Sun would appear from different planets in the Solar System. A diagram shows how light spreads out from a source and how the eye picks up less and less of its light as the distance between the object and the eye increases. In the following section, the relationship between the size of an object and its distance from the eye is explored. A striking photograph of an exploding star shows how telescopes make very distant objects visible to our eyes.

In the complementary work, the children find out how light is collected from distant stars. In the activity, the children make two full investigations about how light changes with the distance from a light source and the object in view.

10 Cutting out glare



Everyone has experienced the glare from objects at some time. This unit investigates the phenomenon and shows that glare can be caused by a shiny surface. You may like to begin by asking the children about the meaning of the word glare and look for an answer about a bright shining light that keeps you from seeing properly. Ask the children for examples of when they have experienced the glare of light and look for answers which include the Sun shining on still water or the wet surface of the road. Make sure that the children realise that glare is produced by reflected light and is not due just to a strong light source such as a firework.

In this unit, the effect and control of glare is illustrated by photographs. The role of sunglasses in reducing glare is explored. The manufacture of ordinary sunglasses is described and the way polarising sunglasses work is explained. The unit ends by describing polarising filters on cameras.

In the complementary work, the children find out how light travels through two polarising filters and how stress patterns in plastic can be seen by using polarising filters. In the activity, the children plan and carry out a fair test to compare how different pairs of sunglasses reduce glare.

Index

There is an index on page 24.

Using the pupil book and photocopiable worksheets

Introduction

There is a wealth of material to support the topic of how we see things 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 12 and 13.

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 pList 1 on page 11). 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.

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 12 and 13 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 12 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 13. 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 12 and 13. 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

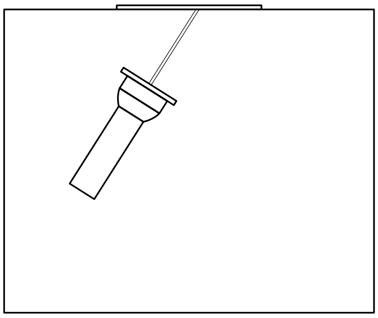
The three lists below show the resources needed to support the photocopiable worksheets.

- ▶ 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. A torch, a selection of transparent (glass or plastic) containers, with or without liquids, translucent objects (tissue paper, tracing paper or greaseproof paper) and opaque objects (books, tins, etc).
3. Card with mirror image message on it, large mirror, small mirrors.
4. –
5. A smooth, shiny metal surface, a piece of sandpaper.
6. –
7. –
8. Glasses, spoons, water.
9. Alarm clock.
10. –



▲ *Investigating light rays at a flat mirror in Unit 3 activity.*

List 2 (Complementary work)

Each group will need the following items:

▼ UNIT

1. –
2. (a) Torch, a regular shaped object such as a small rectangular wooden block, a ruler. (b) Secondary sources on how shadows have been used to measure time.
3. (a) Two mirrors (possibly plastic mirrors for extra safety), cardboard, scissors and sticky tape for making a periscope.
   (b) Two mirrors.
4. A torch, a small piece of card, scissors, sticky tape, large piece of card, spoon.
5. (a) A cardboard disk, pencil, ruler, protractor, coloured pens or pencils.
   (b) Glass bowl, water, milk, torch.
6. Secondary sources about the structure of a camera and how it works.
7. A range of coloured pens or pencils.
8. Secondary sources about microscopes and telescopes.
9. Secondary sources about how telescopes with mirrors collect light from distant stars.
10. (a) Two pieces of polarising filter. (b) Two pieces of polarising filter and a clear plastic ruler or lunch box.

List 3 (Activity worksheets)

Each group will need the following items:

▼ UNIT

1. Torch, three small pieces of card, scissors, four pieces of Plasticine, a larger piece of card, a party straw with a bendy section.
2. A torch, a piece of card with a hole in the middle, sticky paper, a regular-shaped object such as a small rectangular wooden block, a piece of card, a piece of Plasticine, ruler, graph paper (optional).
3. A torch, a small piece of card, scissors, sticky tape, large piece of card, flat mirror (without sharp edges).
4. Spoon with a shiny surface, pencil.
5. A collection of objects which have a range of surfaces from smooth, shiny and highly reflective to dull and rough, and a torch. Alternatively, the children could investigate the surfaces around the classroom and have access to other areas of the school and a torch.
6. A rectangular cardboard box about twelve centimetres long, sticky tape, aluminium foil, tracing paper or greaseproof paper, scissors, pin, bright light such as a torch (a lamp with a distinctive shade, such as a tiffany-style shade, gives images with many features.)
7. A torch.
8. Paperclip, water, magnifying glass, sheet of paper, lenses of different thicknesses.
9. A torch, tissue paper, scissors, solar-powered calculator, elastic band, darkened room or corridor, object such as a poster on a wall, metre rule and ruler.
10. A selection of sunglasses, at least one pair should be polarising sunglasses, shiny books, a sink full of water, other shiny surfaces.

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

- Light sources may be either natural or artificial.
- We see because light enters our eyes.
- Light always travels in straight lines.
- A narrow beam of light is called a light ray.

Unit 2

- When light is blocked, shadows and silhouettes are produced. The distances between a light source, an object and the surface on which the object's shadow falls affect the size of the shadow.
- A single, small light source is needed to produce shadows with sharp edges.

Unit 3

- A mirror can be made of any shiny material.
- The angle at which light is reflected from a mirror is the same as the angle at which the light strikes the mirror.
- Mirrors can be used to look at yourself, to your sides or behind you.

Unit 4

- A convex mirror produces a smaller image of the object.
- A concave mirror produces a larger image of the object.
- Curved mirrors always distort shapes.

Unit 5

- Most surfaces soak up some light.
- A rough surface scatters light in all directions.
- A coloured object scatters the colour of light we see and absorbs the other colours of light.

Unit 6

- The human eye is like a pinhole camera.
- Inside a camera, an image of an object is made which is upside down and back to front.
- A lens allows plenty of light to enter the camera and at the same time keeps the image in sharp focus.

Unit 7

- The eye is ball-shaped, with a front section that lets light enter.
- The light which enters the eye is focused to form an image on the back wall of the eye.

Unit 8

- Some defects of vision can be overcome by using glasses.
- Short-sight is corrected using concave lenses.
- Long-sight is corrected using convex lenses.

Unit 9

- Distant objects appear dim because only a small part of their light reaches our eyes.
- Distant objects appear small because they only take up a small part of our field of view.

Unit 10

- Glare is caused by shiny surfaces.
- Sunglasses dim glare and darken a scene.
- Polarising filters reduce glare but do not darken a scene as much as sunglasses.

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
- Use simple equipment safely.
- Make a prediction based on previous observations.

Unit 2
- Take careful measurements.
- Make a prediction based on previous results.
- Produce a line graph of the results.

Unit 3
- Make diagrams of observations.
- Find a pattern in results.

Unit 4
- Make careful observations.
- Report observations in written form.

Unit 5
- Use equipment and materials safely.
- Identify a pattern in observations.

Unit 6
- Use secondary sources in carrying out a procedure.
- Make comparisons.
- Plan and carry out an investigation.

Unit 7
- Follow a procedure with care.
- Make careful observations in written form.

Unit 8
- Look for patterns in observations.
- Draw conclusions from results.

Unit 9
- Plan and carry out whole investigations.
- Draw conclusions from data.

Unit 10
- Plan and carry out a fair test.
- Use equipment safely.
- Draw conclusions from results.

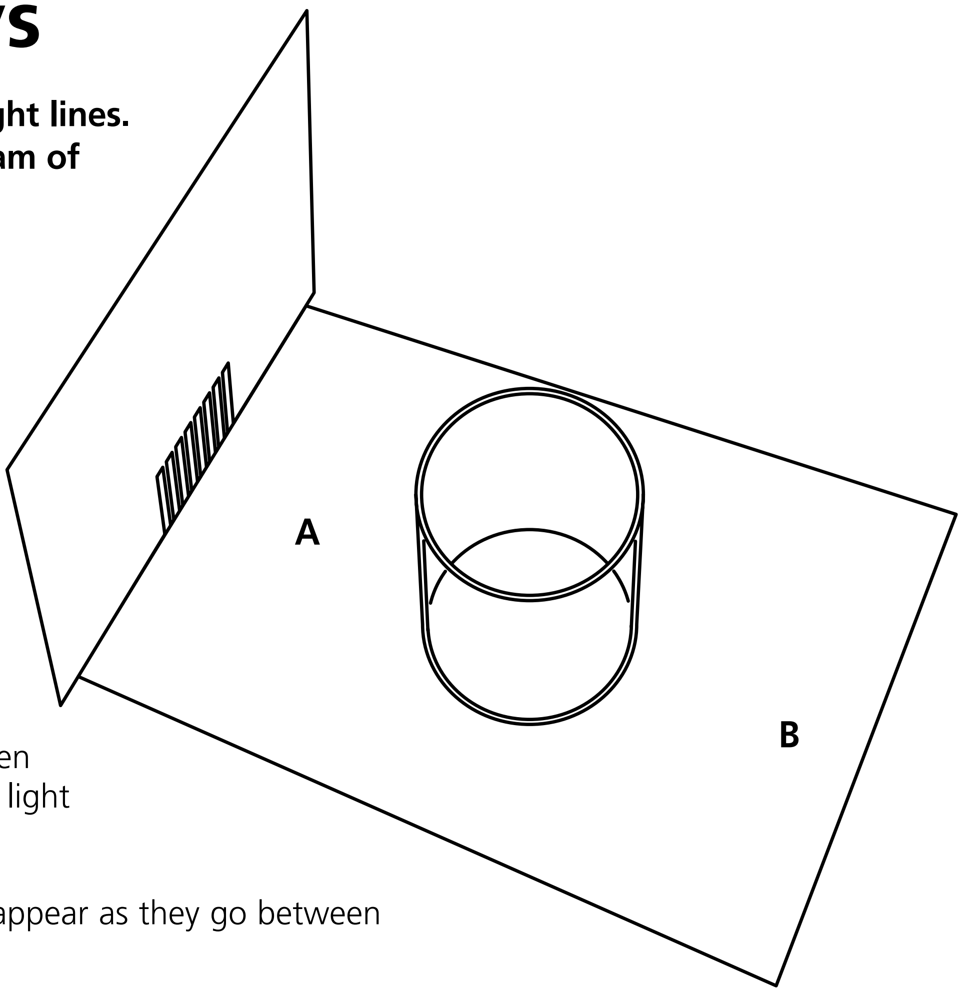
1

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

See **pages 4 and 5** of *How we see things*

Light rays

Light travels in straight lines. We call a narrow beam of light a light ray.



Q1. When a light is placed behind the screen in the diagram, rays of light shine through the slits.

(i) Draw how the rays appear as they go between the slits and glass at A.

(ii) At B, draw how the rays appear after they have passed through the glass.

Q2. What would it be like if no light entered our eyes?

✎..

Q3. What is a source of light?

✎..

Q4. Name five sources of light.

1 ✎.................................. 2 ✎.................................. 3 ✎..................................

4 ✎... 5 ✎...

Q5. How do rays of light shine through a misty forest?

✎..

Teacher's sheet: comprehension

See **pages 4 and 5** of *How we see things*

Answers

1. **(i) The lines should be parallel; (ii) The lines should be straight, but pointing to make a cone as in the pupil book; (iii) They keep going in straight lines.**
2. **The world would seem black.**
3. **Anything that sends out light.**
4. **Sun, stars, lamps, fire, fireworks, oil lights, gas lights and lasers.**
5. **In straight lines.**

Complementary work

The children can make a survey about light sources in their home. These could include electric lights, TV screens, computer screens, luminous displays on bedside clocks or ovens and standby lights on TVs and music systems. They could extend the survey to light sources in their neighbourhood.

Teaching notes

The children may not have done any formal work on light for two years, so it is worth spending some time finding out what they remember and what other notions they have picked up from other work in school or seen on television or in films.

In the introduction to this unit on page 9, the children were asked to close their eyes then cover them with their hands. They should have found that the hands blotted out more of the light than the eyelids did, and you may like to refer to the hand as being more opaque. You could use this opportunity to revise the terms transparent and translucent.

In the introduction, the children were also asked to open their eyes and say what objects were sending light rays to their eyes. This provides an opportunity to make sure that the children realise that they see because light enters their eyes, and not because they send out some magical rays from their eyes. It also allows you to discover if the children are familiar with the fact that light is reflected off objects, and that objects which produce light are called light sources. The children need to realise that most objects can be seen because light is reflected from them, and that there are few light sources by comparison.

1

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

Based on **pages 4 and 5** of *How we see things*

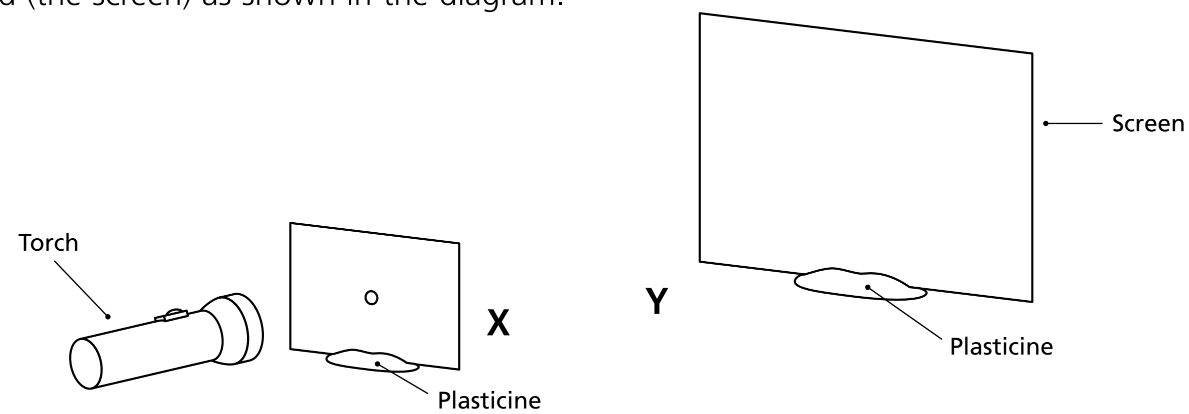
Investigating light rays

Try this...

1. Take a piece of card and make a hole in it.

2. Put a piece of Plasticine on one edge of the card, as shown in the diagram.

3. In a dark or shady place, set up a torch, the card with the hole and a larger piece of card (the screen) as shown in the diagram.



3. Switch on the torch and move the card with the hole in it until you see a bright disc of light on the screen.

4. Switch off the torch and make a second card with a hole in it. Attach Plasticine to one edge of the card.

5. Switch on the torch and put the second card at point X. Move this card about to make a bright disc of light shine on the screen, then leave it in place.

6. Switch off the torch and make a third card with a hole in it. Attach Plasticine to one edge.

7. Switch on the torch and put the third card at point Y. Move this card about to make a bright disc of light shine on the screen then leave it in place.

8. How do you have to arrange the cards to get a bright disc of light to show on the screen?

✎..

✎..

✎..

1

Teacher's sheet: activity

Based on **pages 4 and 5** of *How we see things*

Introducing the activity

(a) You may like to use this activity either before or after the children have read pages 4 and 5 in the pupil book. Remind the children that a torch is a source of light and tell them that they are going to investigate how the light moves out from it.

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.

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

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

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

(g) Go through tasks 6 to 8, then let the children try them.

Completing the activity

(h) Let the children compare their results.

Conclusion

The cards with the holes in them have to be placed so that their holes are in a straight line in order for light from the torch to reach the screen. This demonstrates that light travels in straight lines.

Teaching notes

(i) Depending on the ability and attitude of the children, you may like to prepare some cards with holes in before the lesson.

(ii) The children could work in a darkened area of the classroom or set up the activity in a large cardboard box which has its open end facing away from the window.

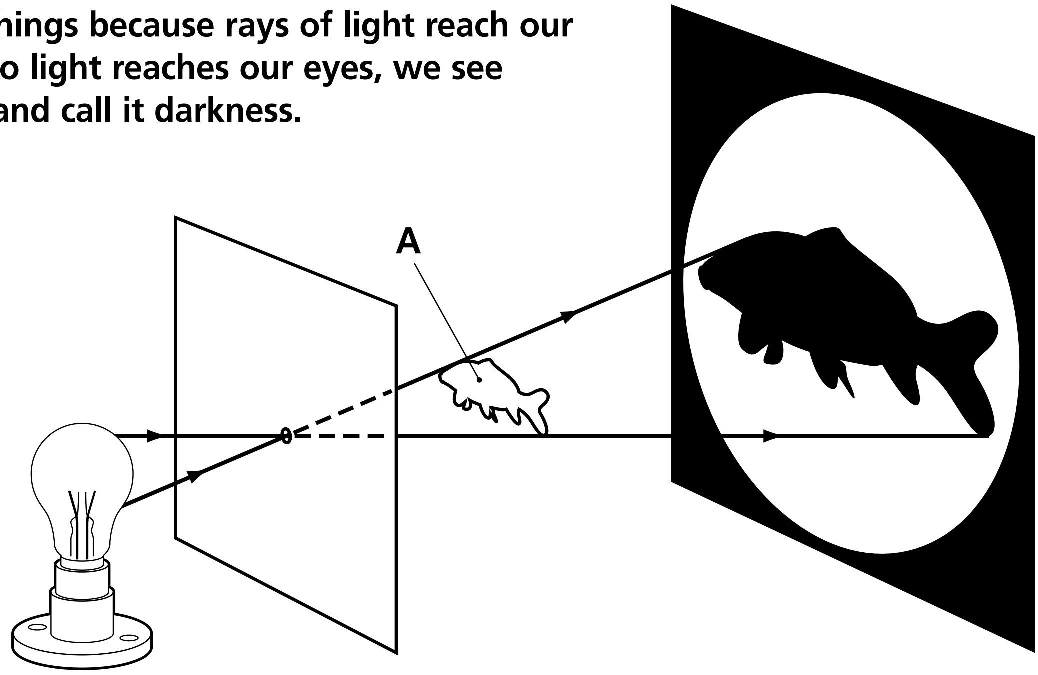
2

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

See **pages 6 and 7** of *How we see things*

Shadows and silhouettes

We see things because rays of light reach our eyes. If no light reaches our eyes, we see nothing and call it darkness.



Q1. The diagram shows how a bulb can be used to make a shadow of object A.

(i) How would the shadow change if you brought A closer to the lamp?

✎...

(ii) How would the shadow change if you brought the screen closer to object A?

✎...

Q2. What is an opaque object?

✎...

Q3. When are shadows sharp?

✎...

Q4. When will a shadow have fuzzy edges?

✎...

Q5. When is the shadow of the Moon cast on the Earth?

✎...

Teacher's sheet: comprehension

See **pages 6 and 7** of *How we see things*

Answers

1. **(i) It would become larger;**
   (ii) It would become smaller.
2. **An object which blocks the path of light completely.**
3. **When there is just one small source of light.**
4. **When there is a large source of light.**
5. **During an eclipse of the Sun.**

Complementary work

(a) The children could investigate how the height of the light source shining down on an object affects the length of the shadow.

(b) The children could use secondary sources to find out how shadows have been used to measure time.

Teaching notes

In the introduction to this unit on page 9, the children are asked about the terms transparent, translucent and opaque. Apart from their relevance in the study of light, it is important to remind the children here that these properties are also the properties of materials, and they sometimes occur as a property in a question on materials in examination questions.

A transparent object is one that lets light rays pass straight through it. A clear view can be seen through a transparent object. A translucent object scatters light but lets some light pass through. A very blurred view may be seen through some translucent objects. An opaque object does not allow light rays to pass through it. Nothing can be clearly seen through an opaque object.

Transparent materials absorb and reflect some light. This means that some light is blocked, and a faint shadow forms. Translucent materials absorb and reflect more light rays. This means that they block more light rays than transparent materials do and make darker shadows. Opaque objects block all the light rays and make the darkest shadows.

The darkness of a shadow does not simply depend on the material, but also on other light that is being reflected into the shadowed area. For example, an opaque object casts a dark shadow, but if other objects close by are reflecting light into the shadowed area, the shadow produced will be less dark.

The children should be aware that a shadow forms on the opposite side of an object to the light source. The shadow is not a reflection, and no features of the surface of the object can be seen in the shadow.

2

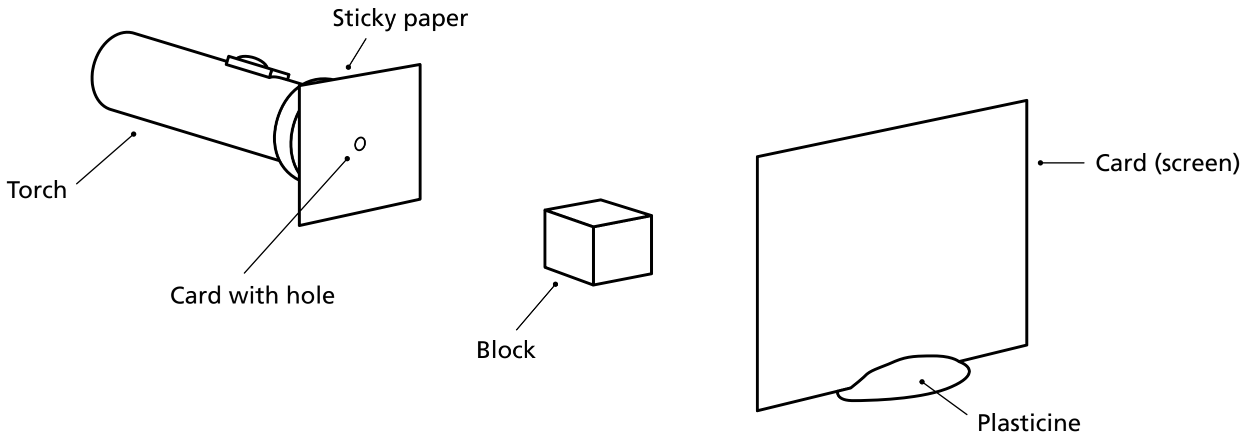
Name: .... **Form:** ....

Based on **pages 6 and 7** of *How we see things*

Investigating shadows

Try this...

1. Set up the equipment shown in the diagram.



2. Find out how the size of the shadow changes when the torch and screen are kept in place and the object is moved between them. Each time you move the object, measure the distance of the object from the torch and the width of the shadow on the screen. Record your results in a table on a separate piece of paper.

3. What do the results show?

✎...

✎...

4. Predict how the size of the shadow would change if the distance between the torch and the object were kept the same but the distance between the object and the screen was varied.

✎...

5. Perform an investigation to test your prediction. Record your results on a separate piece of paper and compare it with your prediction.

Looking at the results.

6. What do the results show?

✎...

✎...

2

Teacher's sheet: activity

Based on **pages 6 and 7** of *How we see things*

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 find out about how shadows change by taking measurements.

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 (see note (ii)).

(d) Let the children try task 2.

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

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

(g) Go through task 5, then let the children try it (see note (v)).

(h) Let the children try task 6.

Completing the activity

(i) Let the children compare their results.

Conclusion

When the torch and screen are kept in place, and the object moves towards the torch, the shadow gets larger. When the object moves away from the torch the shadow gets smaller.

When the torch and object are kept in place, and the screen is moved towards the object, the shadow gets smaller. When the screen is moved away from the object the shadow gets larger.

When the distance between the object and screen is kept the same, and the torch is moved nearer the object, the shadow gets larger. When the torch moves away from the object the shadow gets smaller.

Teaching notes

(i) The room should be darkened when the children are performing their investigations.

(ii) You may like to show the children how to measure between the object and the torch or screen. To start with, you might move the object close to the torch, measure the distance of the object from the torch and measure the width of the shadow. Next, move the object a few centimetres away from the torch and measure the width of the shadow again. This could be repeated until you are close to the screen.

(iii) You may like to show the children how to plot a line graph of the results. The X axis should be the distance from the torch and the Y axis the width of the shadow. The line begins high on the left and slopes down to a low point on the right.

(iv) Some children may notice that they can base their prediction on the results of task 2 – that the shadow will be larger when the light and object are close together.

(v) The X axis of the line graph for this is the distance between the screen and the object. The graphs shows that as the distance increases so does the size of the shadow.

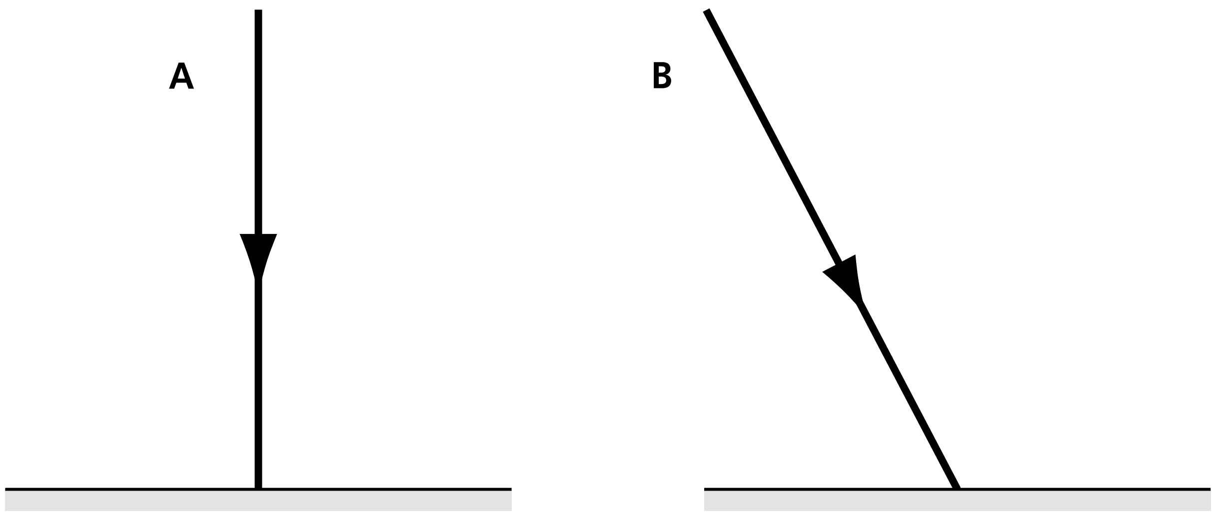
3

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

See **pages 8 and 9** of *How we see things*

How flat mirrors work

A flat mirror is something with a shiny surface that bounces all light in the same direction.



Q1. (i) Diagram A shows a light ray striking a flat mirror. What happens to the light?

✎...

(ii) Diagram B shows a light ray striking a flat mirror. Draw what happens to the light.

Q2. What are mirrors most often made of?

✎...

Q3. What is the device with two mirrors that people use to see over the heads of a crowd?

✎...

Q4. What word is used to describe light bouncing off a mirror? Use it in this sentence.

The light is ✎... from the mirror.

Q5. How can we use a mirror to see things that would be out of our normal view?

✎...

✎...

Teacher's sheet: comprehension

See **pages 8 and 9** of *How we see things*

Answers

1. **(i) It bounces back, which is why you can see yourself when you look directly into a mirror; (ii) The arrow points to the right but leaves the mirror's surface at the same angle as the arrow shown meets it.**

2. **Glass that has a silvery coating on the back.**

3. **A periscope.**

4. **Reflected.**

5. **By turning the mirror at an angle or looking at the mirror from the side.**

Complementary work

(a) The children may use the picture of the periscope on page 8 to help them design and make their own periscope. The children should make sure that the mirrors fit securely into their designs.

(b) Show the children how they can see how they really look by using two mirrors in the following way. Look into a mirror and press your left cheek with a finger of your left hand. Hold up another mirror in your right hand and place it so that it makes slightly less than a ninety degree angle with the first mirror. When you look into the mirror again, you will see a second image showing your hand on left side of your face. This is the face everyone else sees, not the face you see in the mirror.

Teaching notes

Some children can confuse shadows and reflections. Make sure that all the children know that a shadow is made when light rays are blocked, particularly by opaque objects, and that a reflection occurs at a smooth and shiny surface. Strictly speaking, these reflections are called specular reflections and form one of three groups of reflections. The other two are diffuse reflections, which are the most common type of reflection and occur on the surface of every non-luminous object (these reflections are considered in more detail in Unit 5), and reflex reflections, which are made by materials used by traffic police and on road signs.

The correct name for the picture that forms the reflection is the image. It appears to be at the same distance behind the mirror as the object is in front of it. The image in the mirror is not a true likeness of the person looking at it because all the features on the left-hand side of the person are shown on the right-hand side of the image, and all the features on the right-hand side of the person are shown on the left-hand side of the image.

3

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

Based on **pages 8 and 9** of *How we see things*

Investigating light rays at a flat mirror

Try this...

1. Cut a slit in a piece of card as shown in Diagram 1. Do not make the slit wider than two millimetres.

Diagram 1

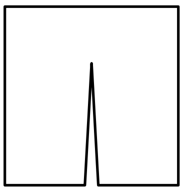
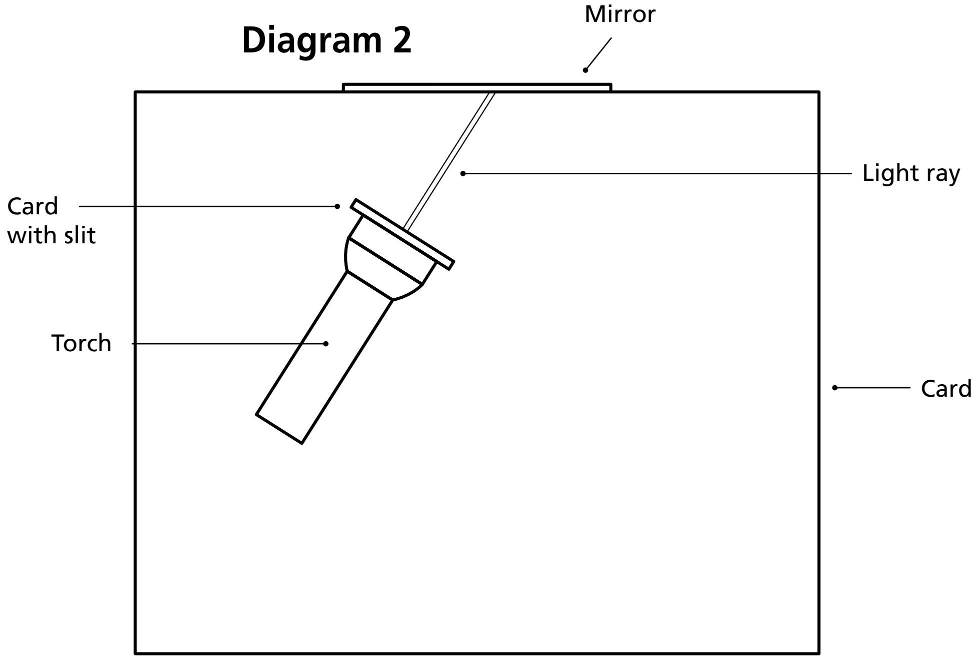


Diagram 2



2. Stick the piece of card to the front of a torch.

3. Set up the torch on a piece of white card near a mirror, as shown in Diagram 2. Check that your light ray is a thin beam, as shown in the diagram.

4. Shine the torch from different angles at the mirror and look at the angles of the rays after they leave the mirror.

5. On a separate sheet, make some drawings to show the light rays striking the mirror at different angles and the angles of the rays leaving the mirror.

Looking at the results.

6. Describe any pattern in the results that you see.

✎...

✎...

Teacher's sheet: activity

Based on **pages 8 and 9** of *How we see things*

Introducing the activity

(a) You may like to begin by showing the children the rays of light shining through the misty forest on page 4. Tell the children that when light is made into rays it can sometimes be studied more closely. Tell the children that they are going to make light rays to investigate what happens when a light ray meets the surface of a flat mirror.

Using the sheet

(b) Give out the sheet and let the children fill in their name 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 task 4, then let the children try it (see note (ii)).

(e) Go through task 5, then let the children try it (see note (iii)).

(f) Let the children try task 6 (see note (iv)).

Completing the activity

(g) Let the children compare their results.

Conclusion

There is a pattern in the results. If the ray of light strikes the mirror almost head on, then the reflected ray comes out almost head on but pointing at the opposite angle. If the ray is made to strike the mirror at larger angles, the reflected ray comes out of the mirror at the same angle but in the opposite direction.

Teaching notes

(i) If some children finish early, you could let them make slits about five millimetres wide and try the test again. They will see that their observations are more difficult to make with wider beams of light.

(ii) You may need to show some children the position of the reflected ray. You will need to tell all children to look at the light ray striking the mirror at one particular angle, and the reflected ray that is produced, then move the torch to set up a new angle and repeat the observations.

(iii) Tell the children that they should make four or more different drawings. The children should put arrows on the light rays showing which way the light is going.

(iv) At this stage the children do not need to measure the angles to find a relationship. If you want to tackle this with more able pupils, the angles are found in the following way: A line is drawn out from the mirror at right angles to it. This line, called the normal, starts at the point where the rays enter and leave the mirror. The angle of the ray striking the mirror is found by measuring the angle that the striking ray makes with the normal (not the surface of the mirror). The angle of the reflected ray is found by measuring the angle that the reflected ray makes with the normal (not the surface of the mirror). These two angles are always the same.

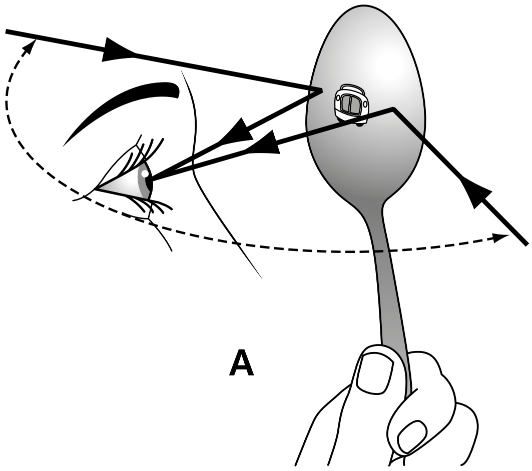
4

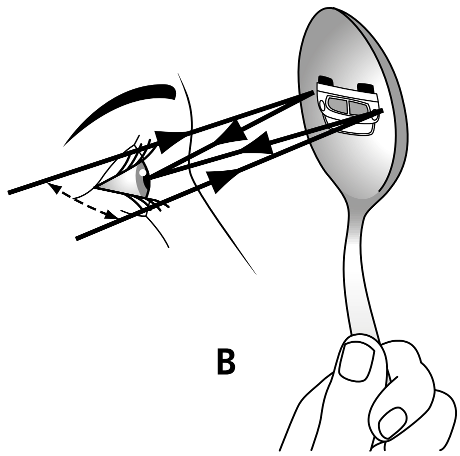
Name: .... Form: ....

See **pages 10 and 11** of *How we see things*

Curved mirrors

When light is bounced from curved mirrors, the image changes shape.





Q1. (i) Is a bulging mirror a convex mirror or a concave mirror? ✎.................................

(ii) Is a dished mirror a convex mirror or a concave mirror? ✎..

Q2. (i) Look at Diagram A. What kind of mirror does it show? ✎..................................

(ii) Look at Diagram B. What kind of mirror does it show? ✎..

Q3. Which kind of mirror gives a small image of yourself? ✎...

Q4. (i) Which kind of mirror is used to make shaving mirrors and make-up mirrors?

✎...

(ii) How do these mirrors let a person see their skin more clearly?

✎..

Q5. (i) What kind of mirror is found in a torch? ✎..

(ii) What does the mirror do?

✎..

(iii) How does the mirror help you see in the dark?

✎..

✎..

Teacher's sheet: comprehension

See **pages 10 and 11** of *How we see things*

Answers

1. **(i) Convex mirror; (ii) Concave mirror.**

2. **(i) Convex mirror; (ii) Concave mirror.**

3. **Convex mirror.**

4. **(i) Concave mirror; (ii) Makes an image of the skin that appears larger than the skin really is.**

5. **(i) Concave mirror; (ii) It sends out light in a parallel beam; (iii) By reflecting all of the torchlight forwards.**

Complementary work

The children could use the torch and the card with the slit from the activity in Unit 3 to see how light behaves when it shines on a curved surface.

A ray of light can be made to shine across the surface of a white card onto the surface of a spoon held at the edge of the card, so that half the spoon is above the card and half below. When the light is shone onto the convex side of the spoon, a wide patch of light forms back on the card with the slit. When the light is shone onto the concave side of the spoon, a small, very bright patch of light is focused on the card.

Teaching notes

When parallel light rays strike the centre of a concave mirror, they are turned back and brought to a point a little way in front of the mirror. This point is called the principle focus of the mirror, and it can be seen by trying the complementary activity in the following way: Tip the spoon a little so that the reflected rays can be seen travelling across the card. They will converge at one place on the card and make a spot of bright light.

When an object is placed between the principle focus and the mirror's surface, a magnified image which is the right way up is seen.

Concave mirrors are used in make-up mirrors and shaving mirrors where they provide a magnified view of the skin.

Torches and car headlamps have concave mirrors. The bulb is placed so that the light, which leaves it and strikes the mirror, produces parallel reflected rays which form the beam of the torch or headlight.

When parallel light rays strike the centre of a convex mirror they spread out in all directions. This produces a very wide field of view for anyone looking into the mirror. This feature makes convex mirrors particularly useful as security mirrors in shops and as rear-view mirrors on cars and trucks.

4

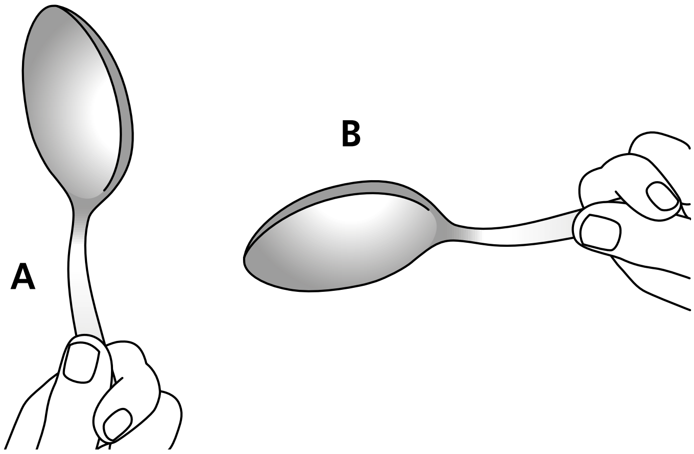
Name: .... Form: ....

Based on **pages 10 and 11** of *How we see things*

Investigating curved mirrors

Try this...

1. Hold up a spoon in front of you with the dished, or concave, side towards you. Hold it at arm's length in position A in the diagram.



2. Describe the image you see in the spoon.

✎..

3. Turn the spoon to position B. Describe the image you see in the spoon.

✎..

4. Move the spoon towards you and hold it in position A and B. How do the images in the spoon change from steps 2 to 3?

✎..

5. Hold up a spoon in front of you with the bulging or convex side towards you. Hold it at arm's length in position A in the diagram.

6. Describe the image you see in the spoon.

✎..

7. Predict what might happen if you turned the spoon to position B.

8. Check your prediction by turning the spoon to position B. How did the prediction and the result compare?

✎..

9. Move the spoon towards you. How do the images in the spoon change?

✎..

Teacher's sheet: activity

Based on **pages 10 and 11** of *How we see things*

Introducing the activity

(a) You may like to use this activity either before or after the children have read about curved mirrors on pages 10 and 11 of the pupil book. Remind the children that flat mirrors are not the only surfaces that have reflections (images) in them. Reflections are also seen in glass and on the surface of water and shiny metals. Tell the children that they are going to investigate the ways spoons reflect light.

Using the sheet

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

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

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

(e) Go through tasks 5 and 6, then let the children try them.

(f) Go through tasks 7 and 8, then let the children try them (see note (ii)).

(g) Go through task 9, then let the children try it.

Completing the activity

(h) Let the children compare their results.

Conclusion

When the concave side of the spoon is studied and the spoon is held at arms length in position A, a small image of the observer is seen. The image is upside down. When the spoon is turned to position B, the image remains the same size and upside down. When the spoon is moved towards the observer, the image of the observer increases in size and becomes more distorted.

When the convex side of the spoon is studied, the image of the observer is small but the right way up. It remains unchanged when the spoon is moved to position B. The image becomes larger as the spoon is moved towards the observer. It is less distorted than on the concave side of the spoon.

Teaching notes

(i) Some children may need help in matching the position of their hands to those shown in the diagrams. Check the children's hand positions in tasks 3, 5 and 8.

(ii) The children should say whether the result matched or did not match the prediction. They should not use phases like "They were OK".

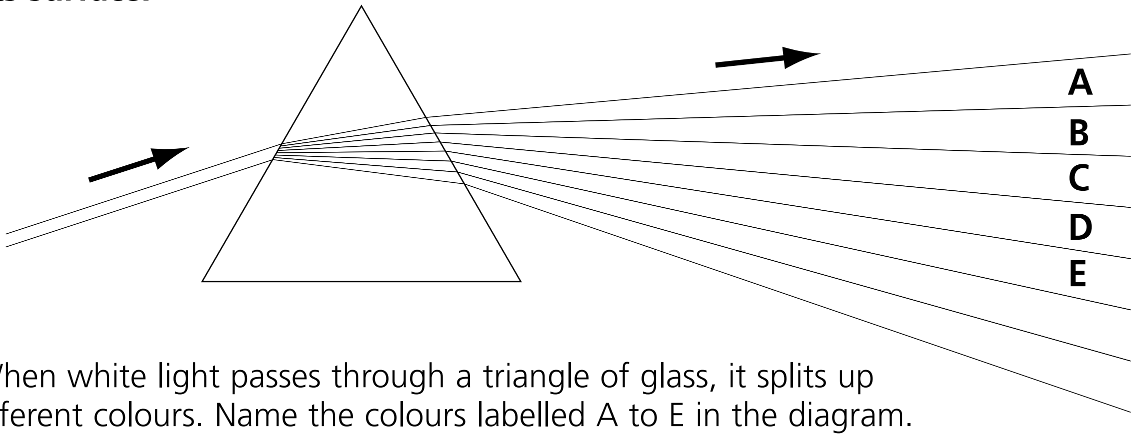
5

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

See **pages 12 and 13** of *How we see things*

Scattering and soaking up light

When light bounces from rough surfaces, some is soaked up and the rest is scattered. Unless it is black, everything around us bounces some light from its surface.



Q1. When white light passes through a triangle of glass, it splits up into different colours. Name the colours labelled A to E in the diagram.

A ✎................................ B ✎................................ C ✎................................

D ✎................................ E ✎................................

Q2. How can you tell if one object soaks up more light than another object?

✎...

Q3. What is a spectrum?

✎...

Q4. Which surfaces soak up the least light? ✎...

Q5. What kind of surface scatters light in all directions? ✎...

Q6. Why do some objects appear green and other objects appear blue?

✎...

✎...

✎...

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 12 and 13** of *How we see things*

Answers

1. **A = red, B= orange, C = yellow, D = green, E = blue.**
2. **It will appear darker than the other object.**
3. **A mixture of all of the colours of the rainbow.**
4. **White surfaces.**
5. **Rough surfaces.**
6. **Both objects have white light shining on them. This is made from a mixture of colours. A green object soaks up all the colours except green and reflects green. A blue object soaks up all the colours except blue and reflects blue.**

Complementary work

(a) Some children have difficulty in believing that there are different colours in light. If they have not already done the following activity lower down the school, they could try it now.

Make a cardboard disc. Divide it into seven sections. Colour each section with one of the seven colours of the rainbow. When all seven colours are on the disc, push a pencil through its centre and spin it. A nearly white colour will be seen as the eye receives a mixture of all the colours at once and interprets it as white.

(b) You could demonstrate why the sky is blue in the following way. Fill a glass bowl with water. Add a few drops of milk and stir them in until the water looks very pale. Shine a torch through the side of the bowl. The water should be pale blue.

Teaching notes

While the previous units concentrated on the simple behaviour of light rays, this unit focuses more on the nature of light. They may have heard of light waves. This may possibly lead to the children asking if light acts similarly to sound waves.

Light is very different from sound. Sound waves are made by vibrating objects which pass on their vibrations to the particles of solid, liquid or gas around them. Light waves belong to a group of waves called electromagnetic waves. Included in this group are radio waves, microwaves and X-rays. These waves behave as if they have some properties of electricity and some properties of magnetism. To make things even more complicated light sometimes behaves as if it is made from waves and sometimes as if it is made from particles (scientists call these particles photons, and they are sometimes mentioned in science fiction films).

It may help to remember that light is a form of energy which is given out by very hot objects and is used by plants to make food. This brief account should show that there is no simple way to explain the nature of light.

5

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

Based on **pages 12 and 13** of *How we see things*

A surface survey

Try this...

1. Look at a range of objects in your classroom and perform the following tests.

A. Put your face in front of the object and see if you can see your reflection.
B. Shine a torch on the object and notice if it appears shiny or dull.

2. Record your results in this table. Write the name of the object. Put a tick if a reflection can be seen in the object or a cross if a reflection cannot be seen. Put a tick if the object appears shiny in torchlight or a cross if it appears dull.

Object	Reflection seen	Shiny in torch light

3. If an object soaks up a large amount of light it appears dark. If an object soaks up only a small amount of light it appears light. Look at the objects in your classroom and find five which soak up the most amount of light and five which soak up the least amount of light.

Objects which soak up the most light	Objects which soak up the least light

Looking at the results.

4. What do the results show?

✎...

5

Teacher's sheet: activity

Based on **pages 12 and 13** of *How we see things*

Introducing the activity

(a) Use this activity after the children have studied pages 12 and 13 in the pupil book. Alternatively, you may like to use it with some children while studying Unit 3. They could then present their findings to the other children who have been doing the activity in that unit.

Using the sheet

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

(c) Go through task 2.

(d) Let the children try tasks 1 and 2 (see note (ii)).

(e) Go through task 3.

(f) Let the children try task 3.

(g) Let the children try task 4.

Completing the activity

(h) Let the children compare their results.

Conclusion

Some surfaces, such as glass, may show reflections easily. Other surfaces, such as white, glossy surfaces or the surfaces of pottery, may have to be examined more closely for the reflections to be seen. The number of shiny surfaces will depend on the sample of objects surveyed. In a classroom the floor, windows and radiators may produce shiny surfaces. Alternatively, just a part of a surface, such as the badges and buttons on a school uniform may have shiny surfaces.

The objects which soak up the most light are black objects, and those that soak up least light are white objects.

Teaching notes

(i) You may present the children with a wide range of objects, or let the children move around the classroom and perhaps even other parts of the school to make their survey.

(ii) The children may use the other side of the sheet to make a larger table.

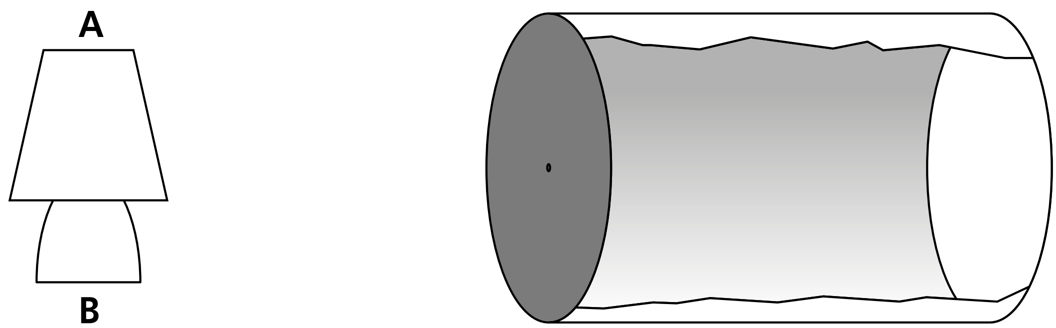
6

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

See **pages 14 and 15** of *How we see things*

We see like a camera

A simple pinhole camera will take pictures and also show you how the eye works.



Q1. (i) Draw a ray of light from A to the back of the pinhole camera.

(ii) Draw a ray of light from B to the back of the pinhole camera.

(iii) Draw how the image of the lamp appears at the back of the pinhole camera.

Q2. What is used to make the back of a pinhole camera?

✎..

Q3. (i) What would happen to the image in the camera if you made the pinhole larger?

✎..

(ii) Why does this change take place?

✎..

✎..

Q4. What is a lens?

✎..

✎..

Q5. What would happen if you put a lens across a large hole in the camera?

✎..

✎..

Teacher's sheet: comprehension

See **pages 14 and 15** of *How we see things*

Answers

1. **(i) The line should come down from A, go through the pinhole and down to the bottom at the back of the camera; (ii) The line should come up from B, go through the pinhole and up to the top at the back of the camera; (iii) The lamp should be drawn upside down.**

2. **Tracing paper or greaseproof paper.**

3. **(i) It would become fuzzy; (ii) The light spreads out as it passes through the hole.**

4. **A specially curved piece of glass or plastic.**

5. **The image would appear bright and sharp.**

Complementary work

(a) The children can use secondary sources to find out about the structure of a real camera and compare it with a pinhole camera. They can also use the secondary sources to find out how a real camera works.

Teaching notes

The first camera was invented in the sixteenth century. By comparison with today's cameras it was huge. In fact, it was a room which was darkened and had a small hole in one wall. Light entered the camera (or room) by this hole and formed an image of the view on the opposite wall. This type of camera is called a camera obscura. In time, the camera obscura was reduced to the size of a box. By the late seventeenth century, artists were using portable camera obscuras to help them make landscape pictures. The pinhole camera is a modern version of the camera obscura.

A camera has one or more lenses. It has a shutter which opens to let light in for a fraction of a second. The light is focused by the lens onto the film at the back of the camera. Digital cameras for use with a computer have electronic devices which store the image.

6

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

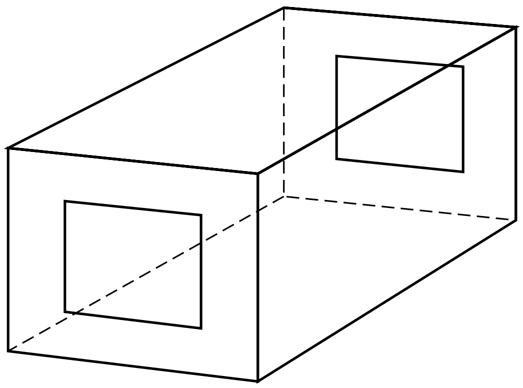
Based on **pages 14 and 15** of *How we see things*

The pinhole camera

Try this…

1. Take a small cardboard box and cut a window in either end as Diagram 1 shows.

Diagram 1

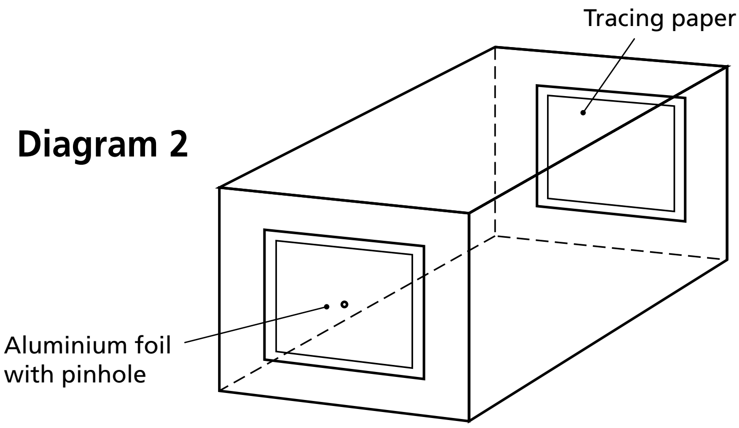


2. Stick a piece of tracing paper to one window.

3. Stick a piece of aluminium foil to the other window.

4. Use a pin to make a tiny hole in the centre of the aluminium foil. Your pinhole camera should look like the one in Diagram 2.

Diagram 2



5. Point the pinhole window at a brightly lit lamp and look at the back of the tracing paper window. Move the camera around until you can see a small bright light from the lamp on the tracing paper.

6. Describe the image of the object.

✎..

7. Make the pinhole slightly larger and repeat step 5.

8. Make the pinhole slightly larger still and repeat step 5.

9. How did the image of the lamp change as the size of the hole increased?

✎..

6 Teacher's sheet: activity

Based on **pages 14 and 15** of *How we see things*

Introducing the activity

(a) Use this activity either before or after the children have studied the unit in the pupil book. Remind the children of your discussion of how a camera works, in the introduction to the unit on page 11, and tell them that they are going to make a simple camera.

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 tasks 2 and 3, then let the children try them (see note (ii)).

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

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

(g) Let the children try task 6.

(h) Go through tasks 7 and 8, then let the children try them.

(i) Let the children try task 9.

Completing the activity

(j) Let the children compare their cameras and results.

(k) Challenge the children to predict what might happen if a pinhole camera was made with five pinholes in it. Let the children replace the aluminium foil on their cameras and test their ideas.

Conclusion

When a pinhole camera is pointed at a bright object, a small upside-down image of the object is formed at the back of the camera.

As the size of the hole in the camera is increased the image becomes less clear.

A camera with five pinholes produces five images.

Teaching notes

(i) You may previously have asked the children to bring in small boxes from home. The length of the box should be about 12 centimetres. The windows should be about 4 centimetres square.

(ii) The children could cut out squares of aluminium foil and tracing paper for themselves.

(iii) The pin should be pushed carefully into the aluminium foil so that its point makes the hole. The pin can then be pushed in about a centimetre so that the hole is the diameter of the shaft of the pin. The children must take care not to tear the aluminium foil at this stage.

(iv) The room should be in darkness. A torch or a lamp with a distinctive shade, such as tiffany glass, may add a few features to the image.

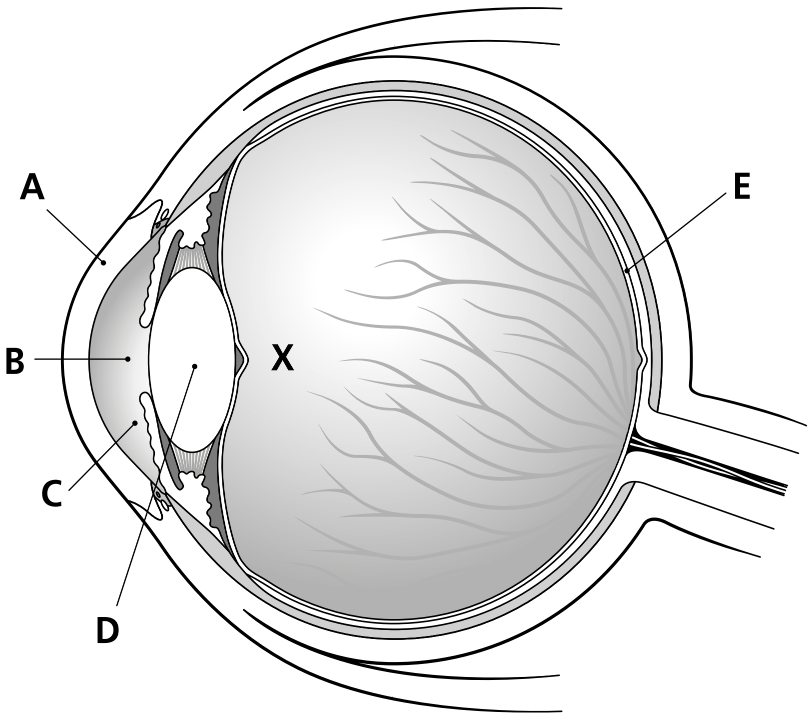
7

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

See **pages 16 and 17** of *How we see things*

How the eye works

The eye contains a lens to focus light accurately, and special cells that change light into signals that our brain can make sense of.



Q1. Name the parts of the eye labelled A to E.

A ✎.................................

B ✎.................................

C ✎.................................

D ✎.................................

E ✎.................................

Q2. What is found in the part of the eye labelled X?

✎...

Q3. Name the parts of the eye through which light passes to reach the back of the eye.

✎...

Q4. Which part of the eye, besides the lens, gathers light?

✎...

Q5. What allows the eye to move in its socket?

✎...

Q6. How does the brain become aware there is light in the eye?

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 16 and 17** of *How we see things*

Answers

1. **A = cornea, B = pupil, C = iris, D = lens, E = retina.**
2. **Fluid.**
3. **Cornea, pupil, lens.**
4. **Cornea.**
5. **Muscles.**
6. **The light lands on light-sensitive cells at the back of the eye. Nerves send signals from these cells to the brain.**

Complementary work

The children could build on the activity in the introduction on page 12 in the following way:

The children should work in pairs. One child sits down, stares straight ahead and holds out his or her right or left hand to the side. The other child in the pair selects a coloured pen or pencil and gives it to the first child to hold. The first child, still staring forwards, swings their hand slowly towards their front. At some point, they should become mindful that they can see the shape of a pen in their hand, but not its colour. As they swing the pen round to the front of their face, they should become aware of the colour.

The difference in the time it takes to be aware of colour is due to the fact that the colour sensitive areas inside the eye are directly behind the lens and pupil, while areas which are sensitive to light and dark only are on the sides of the eye.

Teaching notes

The iris is the coloured ring at the front of the eye. It contains two sets of muscles. They work as antagonistic muscles, just like the biceps and triceps in the upper arm. When the radial muscles, which are arranged like the spokes in a wheel, contract they make the pupil larger. When the circular muscles, which are arranged in concentric circles in the iris, contract they make the pupil smaller.

The cone-shaped cells, or cones, in the retina are sensitive to colour and detail. They are clustered at the back of the eye directly behind the lens and iris. This can be demonstrated by the complementary work.

The rod-shaped cells, or rods, are sensitive to light. Unlike cones, rods are sensitive to light of a low intensity. They are located further out from the cones on the retina, around the side walls of the eye.

You can demonstrate the effectiveness of the rods by using a dim source of light such as a group of stars (for example, try the *Pleiades* or Seven Sisters). First look directly at your chosen group of stars. Then look at the same group of stars out of the corners of your eyes. By looking out of the corners of your eyes you are using more rods in your vision and so you should find that you can see more stars.

7

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

Based on **pages 16 and 17** of *How we see things*

Investigating the eye

Try this…

1. Find a friend to work with you in steps 2 to 7.

2. Cover your eyes with your hands. Ask your friend to time you for one minute.

3. As your friend is timing you, ask him or her to be ready firstly to shine a torch past your face, and secondly to watch your eyes when you open them.

4. After one minute, remove your hands, open your eyes and look past the torch but not at the light. While you are doing this your friend should be looking for any change in your eyes.

5. What did your friend see?

✎..

6. Repeat steps 2 to 5 but, this time, let your friend cover his or her eyes and you use the torch, keep the time and watch for a change in your friend's eyes after a minute.

7. How did your friend's eyes change when they were opened?

✎..

8. Hold this sheet about 30 centimetres from your face.

9. Look at the two circles, then close your left eye.

10. Look only at the circle on the left.

11. Very slowly bring the sheet of paper towards your face. Do not take your eye off the circle on the left.

12. After you have moved the paper a few centimetres you should be aware of a change. What is this change?

✎..

✎..

Teacher's sheet: activity

Based on **pages 16 and 17** of *How we see things*

Introducing the activity

(a) You may use this activity after the children have studied the unit in the pupil book. Remind them that the eye has some features in common with a camera. Tell the children that the back of the eye is sensitive to light and it is here that pictures of the view form. However, the eye cannot function if it receives too much light and so has a way of controlling this. Also, part of the back of the eye is taken up with a nerve that carries information to the brain. Tell the children that they are going to investigate how their own eyes control light, and how the nerve in the eye affects their vision.

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.

(c) Go through tasks 2 to 5 with each pair of children (see note (i)).

(d) Let the children try tasks 2 to 5.

(e) Let the children try tasks 6 and 7.

(f) Go through tasks 8 to 12 and let the children try them (see note (ii) and (iii)).

Completing the activity

(g) Let the children compare their results.

Conclusion

When eyes are in the dark their pupils open wide. When the eyes come from dark conditions to light conditions the pupils become smaller to stop too much light entering the eye and spoiling the formation of images.

When the sheet has been moved a few centimetres towards the face, the image of the right-hand black circle disappears. The paper to the right of the left-hand spot appears to be blank.

Teaching notes

(i) You may like to demonstrate these tasks with two children, working as a pair. Make sure that the children understand that they do not shine the torch into their friend's eyes.

(ii) You should go through this slowly, so that the children concentrate on what they have to do. Emphasise that the sheet must be moved towards the face slowly and the children should not take their eyes off the left circle. If they do, they will not see the change.

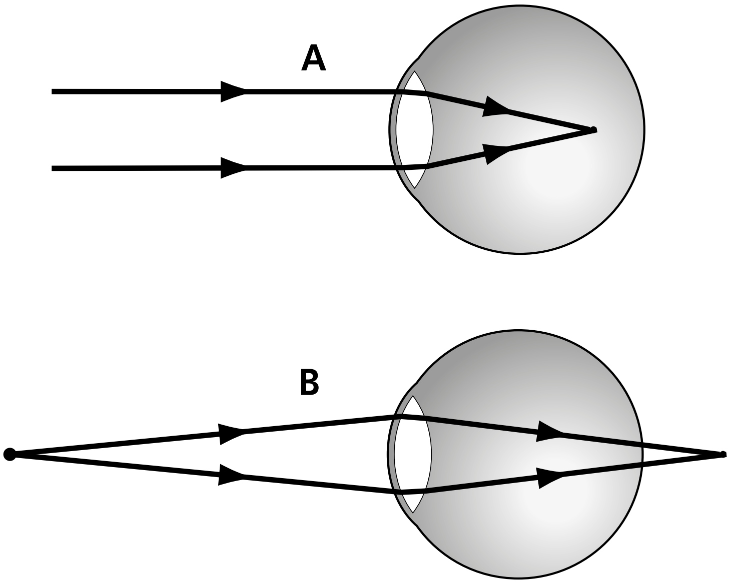
(iii) The back of the eye is covered in a light-sensitive material (actually a tissue of light-sensitive cells). At one point, where the nerve enters the back of the eye, there is no room for light-sensitive material. If an image forms on this spot it cannot be detected. The place where this happens is called the blind spot.

8

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

See **pages 18 and 19** of *How we see things*

Glasses



Most people will need the help of eyeglasses during their lives. This is what they do.

Q1. In eye A, the lens of the eye brings the light rays into focus before they reach the back of the eye.

(i) What kind of eye disorder is shown in eye A?

✎...

(ii) What kind of lens is needed to correct this disorder? Draw and label its shape next to the eye.

(iii) How will the lens alter the place where the light rays focus?

✎..

Q2. In eye B the lens brings the light rays into focus after they reach the back of the eye.

(i) What kind of eye disorder is shown in eye B?

✎...

(ii) What kind of lens is needed to correct this disorder? Draw and label its shape next to the eye.

(iii) How will the lens alter the place where the light rays focus?

✎..

Q3. Name two things which are used in making lenses from glass.

✎..

Q4. How do plastic lenses differ from glass lenses?

✎..

✎..

Teacher's sheet: comprehension

See **pages 18 and 19** of *How we see things*

Answers

1. **(i) Short-sightedness; (ii) A concave lens should be drawn; (iii) It will move the point of focus to the back of the eye.**
2. **(i) Long-sightedness; (ii) A convex lens should be drawn; (iii) It will move the point of focus to the back of the eye.**
3. **Fine abrasive powder and specially-shaped tools.**
4. **Plastic lenses are not as heavy, scratch more easily, are less brittle and are less likely to shatter.**

Complementary work

The children could use secondary sources to find out about how lenses are arranged in microscopes and telescopes.

Teaching notes

Light travels at a certain speed through the air but when it passes through another transparent material, such as glass or water, it slows down. This change in speed, either from air to glass or glass to air, causes the light ray to change course. This process is called refraction, but the children do not need to know this term at this stage. When light passes through a prism at a certain angle, the different colours in the light, which travel at slightly different speeds, are split up and spread out to make a spectrum.

When parallel rays of light from an object pass through the curved surfaces of a glass or plastic convex lens, they are refracted and brought together so that they form an image of the object on a screen. In the eye, the lens has muscles around it which allow the lens to change shape. This allows it to focus light both from distant objects and nearby objects onto the retina at the back of the eye. This lens is unusual, as all other lenses are fixed and cannot change their focus in this way.

When lenses are used to correct vision, they refract the light in such a way that when light passes through the lens in the eye, this lens can focus the rays of light on the retina.

Optical instruments, such as microscopes and some telescopes, use a combination of lenses, set at specific distances, to provide enlarged images. Some telescopes use a concave mirror and lenses to provide a magnified image. You can tell these telescopes from 'all lens' telescopes because they have a much larger diameter tube.

8

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

Based on **pages 18 and 19** of *How we see things*

Looking at lenses

Try this…

1. Bend a paperclip as shown in Diagram 1.

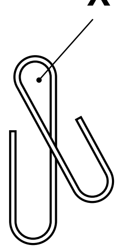


Diagram 1

2. Put a drop of water in the space labelled with an X.

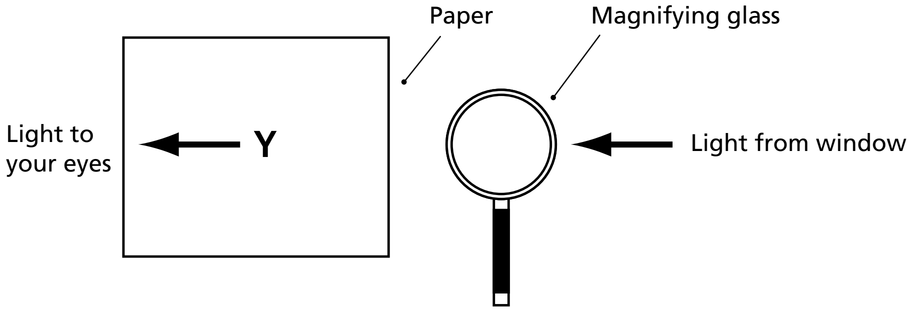
3. Hold the paperclip over your arm and lower it while looking through the water droplet. Move the paperclip so that your water lens is lowered over a hair on your arm. Move the water lens until the hair comes into focus.

4. How does the view of the hair through the lens compare with how the hair looks without the lens?

✎...

5. Hold a magnifying glass up to a window and put a piece of paper behind it, as Diagram 2 shows.

Diagram 2



6. Look at the piece of paper and move the magnifying glass until a clear picture (image) is focused at point Y.

7. How does the picture (image) differ from the view that you see when you look out of the window?

✎...

✎...

8. Repeat step 6 with lenses which have different thicknesses. What do you find?

✎...

✎...

Teacher's sheet: activity

Based on **pages 18 and 19** of *How we see things*

Introducing the activity

(a) The children should be familiar with magnifying glasses, and if they have done the activity in Unit 6 they may be familiar with the idea that a magnifying glass is a lens which can gather light and make an image. This concept is also reinforced in the previous unit about how the eye works. You may like to spend some time drawing these experiences together.

If you have done the introduction to this unit on page 12, you may like to extend the work there by saying that lenses are specially shaped so that when light rays travel from one material to another their paths are changed to produce clear images. Tell the children they are going to begin this activity by making their own lens.

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 (i)).

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

(d) Let the children try task 4.

(e) Go through task 5 with the children, then let them try it (see note (ii)).

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

(g) Let the children try task 7.

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

Completing the activity

(i) Let the children compare their results.

(j) If you have a concave lens you can show the children that it will not make an image of a view on a screen, and that when you try and use it like a magnifying glass it makes an image which is smaller than the object.

Conclusion

A water-drop lens gives a magnified view of a hair. When a lens is made to focus light from a window, it produces a smaller image of the view and the image is upside down and back to front.

When lenses of different thicknesses are tested, the thickest lenses form the smallest images nearest the screen.

Teaching notes

(i) If the loop at X is too large the drop will not stay in place. If it is too small they will not be able to make a view of the hair.

(ii) Some children become confused when using a magnifying glass in this way. They think they should look down the magnifying glass. You may like to demonstrate how the observations of the image are made from the side.

(iii) You should point out that the thicker lenses bulge out more or have a more curving surface. With more able children you may like them to measure the distance of the lens from the paper and the size of the image.

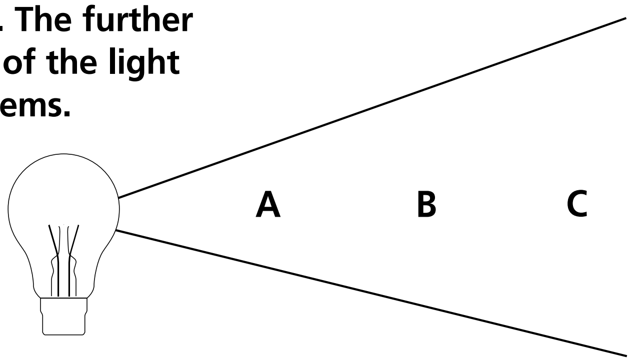
9

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

See **pages 20 and 21** of *How we see things*

Why distant things look dim and small

Light spreads out from an object. The further from the object you are, the less of the light you receive and the dimmer it seems.



Q1. (i) How much further is B away from the light source compared to A – twice as far, four times as far, ten times as far?

✎..

(ii) How much further is C away from the light source compared to A – twice as far, three times as far, four times as far?

✎..

(iii) How much light does an eye at B receive compared to an eye at A?

✎..

(iv) How much light does an eye at C receive compared to an eye at A?

✎..

Q2. Which planet in the Solar System receives the most sunlight? ✎............................

Q3. On which planet does the Sun appear hardly brighter than any other star?

✎..

Q4. If you could travel on a spaceship across the Universe:

(i) How would the Sun appear to change as you left it behind?

✎..

(ii) How might some of the other stars appear to change? Explain your answer.

✎..

✎..

9 Teacher's sheet: comprehension

See **pages 20 and 21** of *How we see things*

Answers

1. **(i) Twice as far; (ii) Three times as far; (iii) A quarter as much; (iv) A ninth as much.**

2. **Mercury.**

3. **Pluto.**

4. **(i) It would get smaller and dimmer; (ii) They would get larger and brighter because you are coming closer to them.**

Complementary work

The children could use secondary sources to find out how telescopes with mirrors are used to gather light from very distant stars so that we can see them.

Teaching notes

The children may already have done some work on sound and have studied how sound diminishes with distance from the sound source. Sound and light are both forms of energy. You could use this relationship to discuss with the children how they think the intensity of light changes as it spreads out from a light source. When they reply that sound energy diminishes with distance, and as light is energy it may behave the same way, point out that this is how scientists generalise from one set of observations. Scientists then test their ideas to make sure.

This gives you an opportunity to show that children should use what they already know in predictions. It does not matter that a prediction or even an explanation turns out to be inaccurate. It is the process of taking knowledge and testing it that is an important concept for the children to realise at this stage.

The children may refer to ripples on a pond. This only shows energy moving in two dimensions. When light spreads out, it spreads out in three dimensions. The 'ripples' of light can be imagined as concentric globes having the light source at the centre.

9

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

Based on **pages 20 and 21** of *How we see things*

Investigating light and distance

Try this…

1. Collect the following items: a calculator which uses solar cells, a torch, some tissue paper, scissors and an elastic band.

2. Plan an investigation to find out if there is a change in light energy at different distances from the torch.

✎...

✎...

✎...

✎...

3. Predict what you may find.

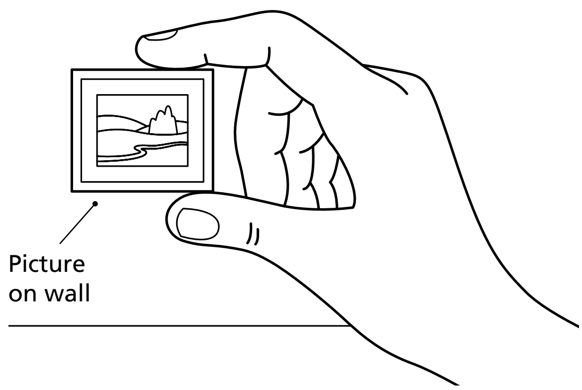
✎...

4. Show your teacher your plan. If your teacher approves, try your investigation.

5. How did your results compare with your prediction?

✎...

6. You can measure the size of an object in your field of view in the following way. Put your finger and thumb up in front of an object as the diagram shows. Measure the distance between the finger and thumb.



7. On a separate piece of paper, plan an investigation to find out how the size of an object in your view changes as you move away from it.

8. Show your teacher your plan. If your teacher approves, try your investigation.

9. Make a line graph from your results.

10. What does the graph show?

✎...

Teacher's sheet: activity

Based on **pages 20 and 21** of *How we see things*

Introducing the activity

(a) You may like to use this activity either before or after the children have studied pages 20 and 21 in the pupil book. Tell the children that they have to plan and carry out an investigation on how light energy travels from a light source, and how the size of an object changes when we move away from it.

Using the sheet

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

(c) Go through tasks 2 to 4, then let the children try them (see note (ii)).

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

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

(f) Let the children try tasks 7 and 8 (see note (v)).

(g) Let the children try tasks 9 and 10 (see note (vi)).

Completing the activity

(h) Let the children compare their results.

(i) If the children found they had to review their plan for the first investigation you may wish to point out that scientists often have to do this in their work.

Conclusion

As an object moves further from a light source it receives less energy from the light source.

As a person moves further away from an object the size of the object in view becomes smaller.

Teaching notes

(i) If the batteries in the torch are weak there may be no need to use the tissue paper as a filter, but if the batteries are strong a piece of tissue paper will need to be cut and secured across the front of the torch with an elastic band.

(ii) The children should be able to use a darkened room or corridor. The solar cell stores up light when it receives it. The children may produce a plan which says they put the calculator at different distances from the torch and compare the brightness. This is fine, but when they come to do it they may find that it is better to cover the solar cell so it is drained of energy and then bring it slowly forwards, stopping at each point for a short time. When they do this, they will see the numbers on the display gradually become clearer.

(iii) The prediction and result should be compared showing more detail than just saying "they matched".

(iv) You may have to demonstrate this technique. Make sure the children do not move their finger and thumb until each measurement has been made.

(v) They should take measurements of the image at about six different distances from the object. The units for both measurements should be in centimetres. The results should be recorded in a table headed: 'Distance from object (cm)' and 'Size of object in view (cm)'.

(vi) The distance between the object and the viewer should be on the X axis and the size of the object in the view should be on the Y axis.

10

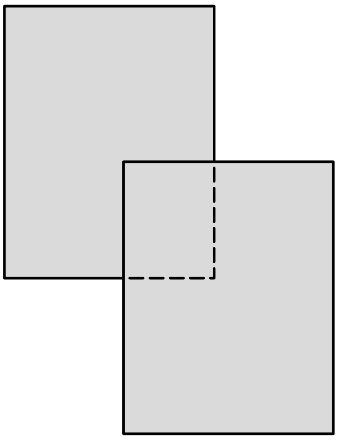
Name: .... Form: ....

See **pages 22 and 23** of *How we see things*

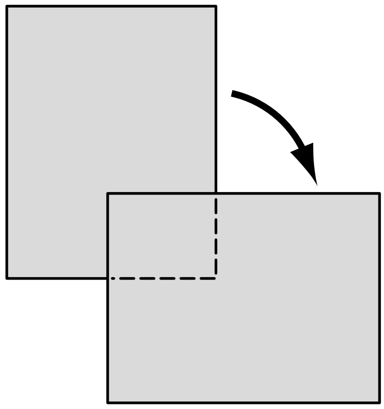
Cutting out glare

Ordinary sunglasses cut down the light, but polaroid sunglasses also cut out glare.

A



B



Q1. Picture A shows one polarising filter in front of another. Picture B shows the same filters but one has been turned so that together they stop light passing through them.

(i) Shade in the place where the filters stop the light.

(ii) What would you see at this place? ✎..

Q2. Describe the two ways that ordinary sunglasses are made.

1 ✎..

2 ✎..

Q3. Why can a surface cause glare?

✎...

Q4. Name two materials which can cause glare.

1 ✎.. 2 ✎..

Q5. How could you see fish just below the surface of a sunlit pond? Explain your answer.

✎...

✎...

✎...

Teacher's sheet: comprehension

See **pages 22 and 23** of *How we see things*

Answers

1. **(i) The place where the two filters overlap should be shaded in; (ii) A black patch.**

2. **Adding a thin coating of dark material to the glasses, or adding a dark colouring to plastic as the sunglasses are being made.**

3. **Because it behaves like a mirror.**

4. **Metal, glass or water.**

5. **Using polarising sunglasses. They cut out the glare and let you see into the water.**

Complementary work

(a) The children could take two pieces of polarising filter and turn them so that some light is let through, then turn them so that no light is let through.

(b) A piece of clear plastic, such as that used to make a ruler or a lunch box, could be put between two pieces of filter. When the plastic is viewed through the filters, differently coloured regions are seen owing to the way forces are being applied to the plastic.

Teaching notes

A ray of light is made up from many light waves. They all move in the same direction but they are arranged at different angles to each other. If you could look at a ray of light head on, you would see each light wave as like a spoke in a wheel.

A polarising filter is a material which acts like a grid. It lets through only one kind of light ray – the one that is lined up with the gaps in the grid. These light rays pass through the filter but the other ones are stopped. The light which leaves the polarising filter is called polarised light. All the waves from all the different rays move up and down in the same direction.

If a second filter is put across the path of the polarised light and turned so that its grid is at right angles to the up and down movement of the waves, none of the light can pass through.

If a piece of plastic is placed between two polarising filters, colours may be seen in the plastic. This happens because the polarised light is turned by particles (molecules) in the plastic. When the light waves emerge from the second filter they mix in such a way as to make the colours.

The colours show how the forces inside the material are acting on the material. These forces are called stresses. When engineers want to understand the stress forces that might be in a new kind of aircraft or building, they make plastic models of it and test them with polarised light.

10

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

Based on **pages 22 and 23** of *How we see things*

Investigating glare

Try this…

1. Make a collection of sunglasses.

2. Use a torch to shine light on a number of different surfaces. Find those that produce the most glare and use them for your test. Try to select some surfaces which have a very bright background with some writing on them.

3. Work out a sequence of looking at each surface in turn, using every pair of sunglasses.

4. Decide on a 'seeing clearly scale' such as 1 = difficult to see, 2 = easier to see, 3 = very easy to see.

5. Make a table for recording the amount of glare you see through each pair of sunglasses.

6. Test each pair of sunglasses with each surface.

Looking at the results.

7. What do the results show?

✎...

✎...

Teacher's sheet: activity

Based on **pages 22 and 23** of *How we see things*

Introducing the activity

(a) Use this activity after the children have studied pages 22 and 23 in the pupil book. Tell the children that they are going to make a full investigation about how sunglasses reduce glare.

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 (see note (ii)).

(d) Let the children try task 3.

(e) Let the children try task 4.

(f) Let the children try task 5 (see note (iii))

(g) Let the children try task 6 (see note (iv)).

(h) Let the children try task 7.

Completing the activity

(i) Let the children compare their results.

Conclusion

The ways different sunglasses reduce glare can be compared by making a fair test. The glare from several surfaces helps to provide more reliable results.

Polarising sunglasses should be found to reduce glare yet allow other things to be seen easily. Other sunglasses may reduce the glare but darken the view, making other things difficult to see.

Teaching notes

(i) The children may like to bring in sunglasses from home. If they do, there must be somewhere secure to keep them as some pairs may be expensive. Make sure that the children have at least one pair of polarising sunglasses in their collection.

(ii) The children should realise that it is useful to test glare on a number of different shiny surfaces. The shiny surface of a book cover is useful, as the children can compare the ease with which words may be read using the different sunglasses. A sink full of water with a shiny metal object in the bottom can also show differences in clarity seen through sunglasses and polarising sunglasses.

(iii) The table should have a left-hand column headed 'Sunglasses'. The next column should be headed with the type of glare-producing surface, such as 'Shiny book', and be divided into three smaller columns sub-headed 1, 2 and 3. The next column should be given a heading such as 'Water surface' and be similarly divided into three smaller columns. The children may decide to test just three surfaces. This is satisfactory.

(iv) The children should put a tick in one of the three columns for each surface they test.

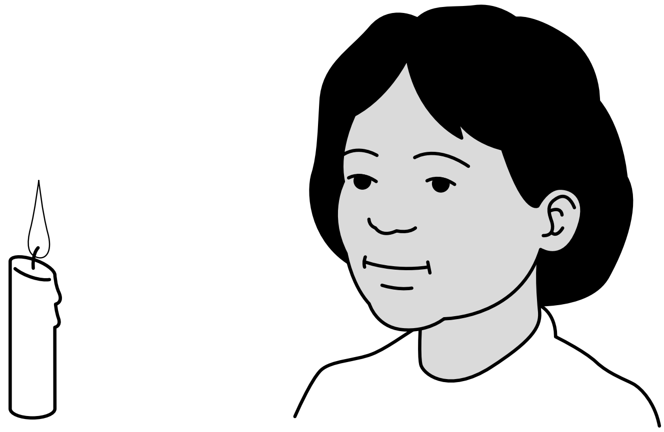
QUESTIONS

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

Q1. Which one of the following is not a light source.

Tick one box: Sun ☐ Mirror ☐ Lamp ☐ Television screen ☐

Q2. Mina is looking at a candle flame. Draw an arrow to show the direction that light takes between her and the candle flame.



Q3. Paul shines a torch on a piece of tissue paper. He sees a pale grey shadow form behind it. Paul now shines his torch on a piece of cardboard and sees a much darker shadow form behind it. Why are the two shadows different?

✎..

✎..

✎..

✎..

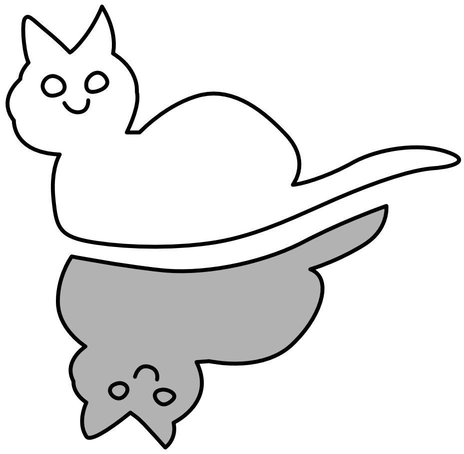
Q4. Match these terms to their explanations by drawing a line between them.

Transparent materials	**None of the light can pass through.**
Opaque materials	**Some light passes through but most is scattered.**
Translucent materials	**Most of the light passes through without scattering.**

QUESTIONS

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

Q5. Arif has drawn a picture of his cat with its shadow.



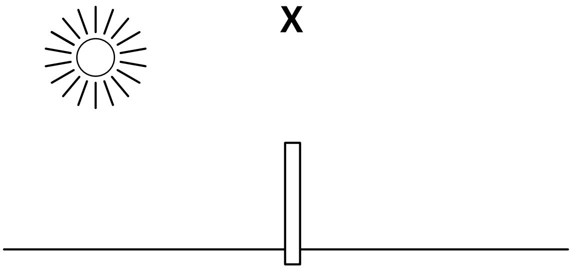
State three things that are wrong with Arif's drawing of the shadow.

1 ✎...

2 ✎...

3 ✎...

Q6. Paul puts a stick in the middle of the playground on a sunny day.



(i) Draw the shadow cast by the stick.

(ii) Draw the shadow cast by the stick when the Sun has moved to point X in the sky.

(iii) Why does the stick make a shadow?

✎...

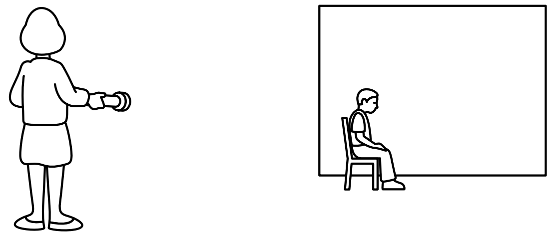
(iv) Name a material which would have made a fainter shadow.

✎...

QUESTIONS

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

Q7. Jane is shining a torch at Paul and making a shadow on a wall.



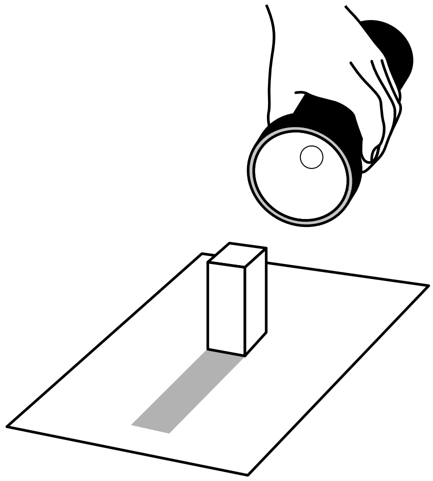
Would the size of the shadow increase or decrease if:

(i) Jane stayed where she was and Paul moved his chair closer to her? ✎....................

(ii) Paul stayed where he was and Jane came closer to him? ✎....................

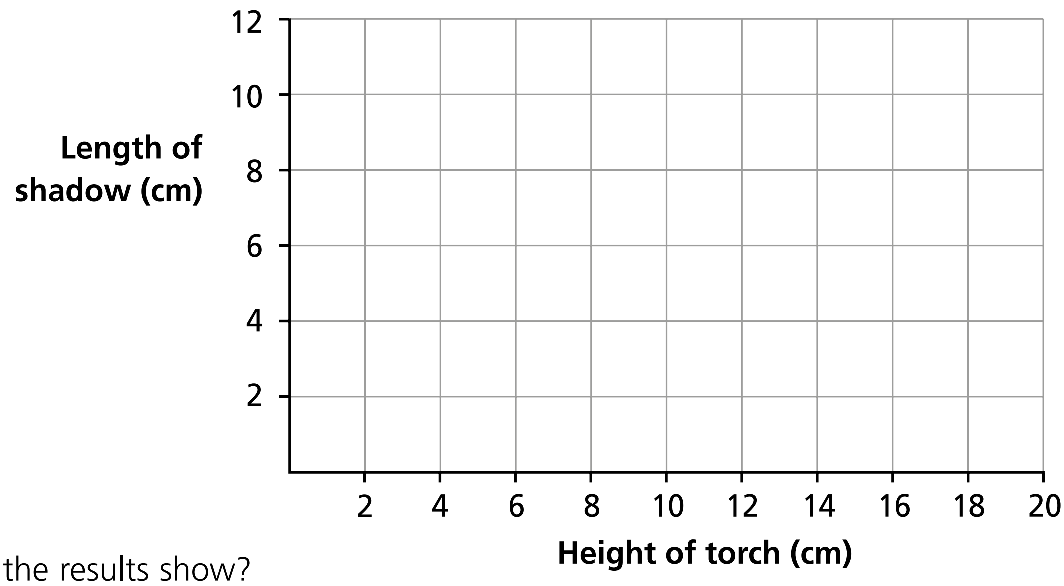
(iii) Paul stayed where he was and Jane moved further away from him? ✎.................

Q8. Mina is finding out how the length of a shadow changes when she shines her torch from different heights above an object.



Height of torch (cm)	**Length of shadow (cm)**
4	10
8	8
12	6
16	4

(i) Make a line graph of Mina's results.



(ii) What do the results show?

✎...

QUESTIONS

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

Q9. Paul is looking at a gold ring. The ring is shiny. Why does the ring shine?

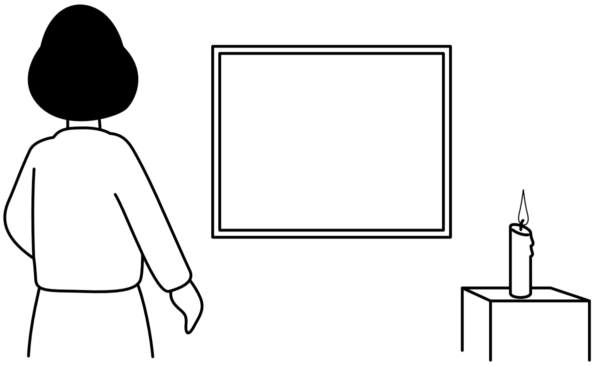
Tick one box:

It gives out light ☐ It lets some light pass through it ☐

It reflects light ☐ It is yellow ☐

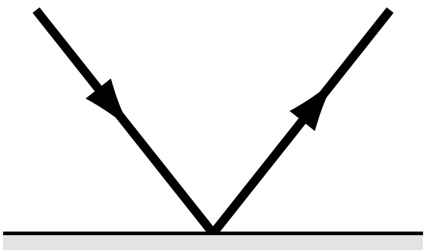
Q10. When Mina looks in a mirror she can see a candle burning.

Draw in arrows to show how light travels to allow her to see the burning candle in the mirror.

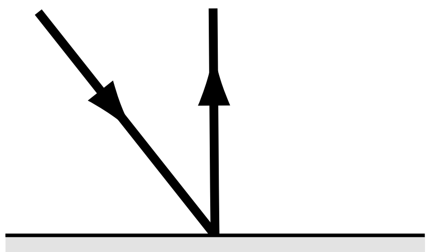


Q11. Which diagram below best shows the way a ray of light leaves a mirror after it strikes the mirror at an angle?

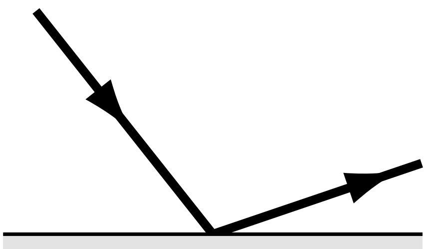
Tick one box:



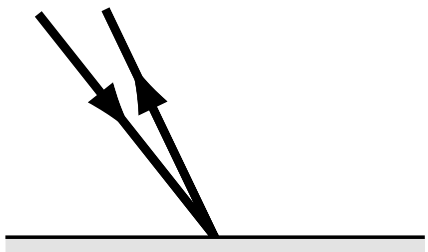
A ☐



B ☐



C ☐



D ☐

Q12. How could you use two mirrors to see the back of your head? Explain your answer.

✎...

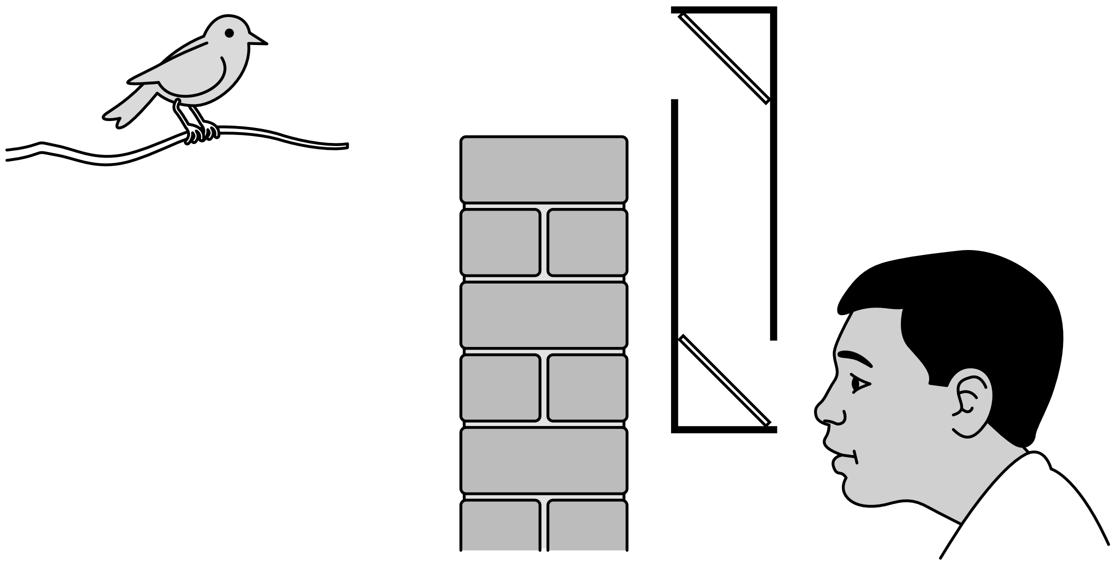
✎...

QUESTIONS

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

Q13. Arif is using a periscope to look at a bird on the other side of a wall.

Draw in arrows to show the path that light takes from the bird to his eyes.



Q14. Jane is looking at a reflection of a pencil in a dish-shaped, or concave, mirror. Is the reflection:

Tick one box: Larger than the pencil? ☐ Smaller than the pencil? ☐

The same size as the pencil? ☐

Q15. Mina has a piece of shiny metal.

(i) What is making the metal shiny?

✎..

When Mina rubs the metal with some sandpaper a change takes place.

(ii) Describe the change.

✎..

✎..

(iii) Explain the change.

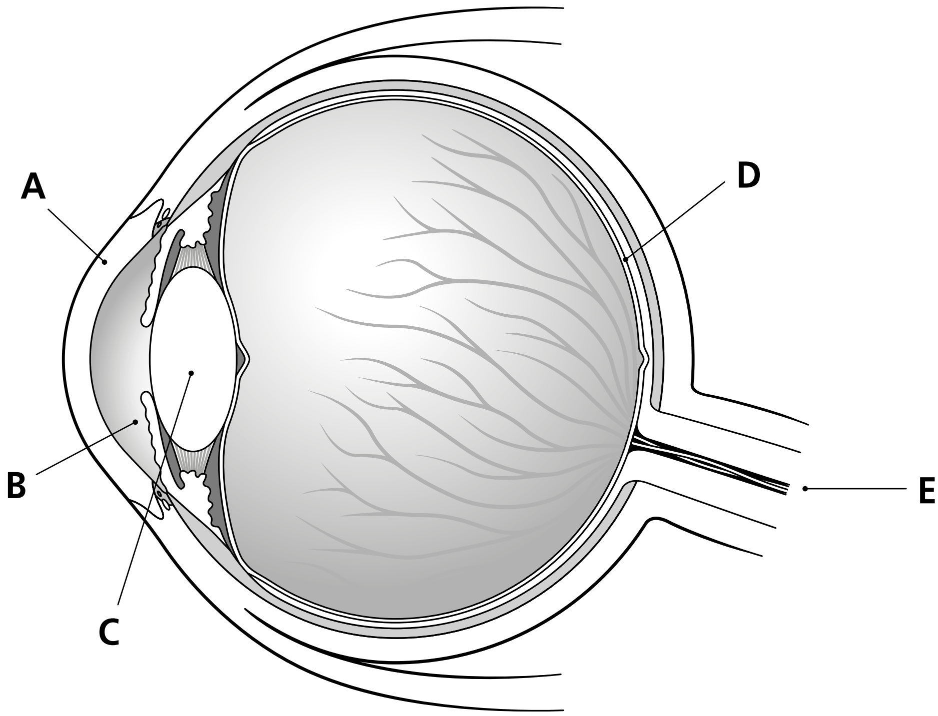
✎..

✎..

QUESTIONS

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

Q16.



(i) Which part of the eye controls the amount of light entering the eye?

✎...

(ii) Which part of the eye changes shape to focus light?

✎...

(iii) On which part of the eye is a picture made of what the eye sees?

✎...

(iv) Paul's brother is short-sighted. What shape of lenses does he need in his glasses?

✎...

(v) Mina is going on holiday. What kind of sunglasses does she need to reduce glare but still see clearly?

✎...

Q17. Some children are going to a bonfire. How does the bonfire seem to change as they walk towards it?

✎...

✎...

ANSWERS

1. Mirror. *1 mark*

2. Arrow pointing from the candle to Mina's eyes. *1 mark*

3. The tissue paper stops some light getting through it but not all light and so the shadow is grey. The cardboard stops all the light passing through it so the shadow is much darker. *2 marks*

4. Transparent materials – Most of the light passes through without scattering. Opaque materials – None of the light can pass through. Translucent materials – Some light passes through but most is scattered. *3 marks*

5. In any order: 1. There is a gap between the shadow and the cat. 2. There should not be a face drawn on the shadow. 3. Part of the tail does not have a shadow. *3 marks*

6. (i) The shadow should be pointing away from the Sun and be on the opposite side of the stick to the Sun. *1 mark*
(ii) The shadow should be vertical and shorter than the other shadow. *1 mark*
(iii) It blocks light rays (is opaque). *1 mark*
(iv) Clear glass or plastic, tissue paper, greaseproof or tracing paper. *1 mark*

7. (i) It would increase in size. *1 mark*
(ii) It would increase in size. *1 mark*
(iii) It would decrease in size. *1 mark*

8. (i) The four points should be plotted accurately and a line drawn between them. *4 marks*
(ii) As the height of the torch increases the length of the shadow decreases.
2 marks

9. It reflects light. *1 mark*

10. There should be an arrow drawn from the candle to the mirror and an arrow drawn from the mirror to Mina's eyes. *2 marks*

11. A. *1 mark*

12. Look into one mirror and put the other one behind your head. Light from the back of your head strikes the mirror behind you, travels to the mirror in front of you and then into your eyes. *4 marks*

13. There should be an arrow from the bird to the top mirror, an arrow from the top mirror to the bottom mirror and an arrow from the bottom mirror into Arif's eye. *3 marks*

14. Larger than the pencil. *1 mark*

15. (i) The smooth surface. *1 mark*
(ii) It is no longer shiny. *1 mark*
(iii) A rough surface had been made which reflected the light in all directions.
1 mark

16. (i) B. *1 mark*
(ii) C. *1 mark*
(iii) D. *1 mark*
(iv) Concave lenses. *1 mark*
(v) Polarising sunglasses. *1 mark*

17. The bonfire seems to get larger and brighter. *2 marks*

Total marks: 45