Science@School Book 6F

How we see things

Activity worksheets

Peter Riley

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.

© 2011 Curriculum Visions

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 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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

3 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.

© 2011 Curriculum Visions

3 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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

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".

© 2011 Curriculum Visions

5 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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

6

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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

8 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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions

9 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.

© 2011 Curriculum Visions

10 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.

© 2011 Curriculum Visions

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.

© 2011 Curriculum Visions