

Unit 3F Light and shadows

ABOUT THE UNIT

This unit introduces the relationship between light, an object and the formation of shadows. Children observe the apparent movement of the Sun and the associated changes in shadows.

Experimental and investigative work focuses on:

- making and recording measurements and observations
- drawing conclusions
- suggesting explanations for observations and conclusions.

Work in this unit also offers children opportunities to explain shadows using scientific knowledge and to recognise the hazards and risks in looking at the Sun.

Visually impaired children will need particular support in this unit. They will be able to take part in activities through careful use of residual vision, through their awareness that many light sources are also heat sources and through using their sense of touch. It is important for teachers to help children to be sensitive to those who are visually impaired.

This unit takes approximately 12 hours.

WHERE THE UNIT FITS IN

Builds on Unit 1D 'Light and dark'

Children need:

- to recognise that light is needed in order to see
- that there are many light sources
- that the main source of light in daytime is the Sun.

Links with Units 3C, 5E, 6F, geography and history.

VOCABULARY

In this unit children will have opportunities to use:

- words and phrases relating to light and shadow formation
eg transparent, opaque, shadow, block, direction, light travels
- expressions of reason using 'because'
- expressions of comparison
eg shortest, highest
- expressions making generalisations.

RESOURCES

- torches with powerful beams
- combs with widely spaced teeth, cardboard tubes
- objects of a variety of shapes
- shadow sticks
- metre sticks or tape measures
- compass
- collection of opaque, transparent and translucent objects and materials
eg plastic bottles, fine gauze, thin nylon, wood, acetate, foils, greaseproof paper
- white cardboard to act as screen
- overhead projector
- secondary sources *eg reference books, CD-ROMs*

EXPECTATIONS

at the end of this unit

most children will:

explain that shadows are formed when light from a source is blocked; recognise that shadows are similar in shape to the objects forming them; describe how a shadow from the Sun changes over the course of a day; make predictions about the shadows formed by different objects or materials and make careful observations and measurements of the shadows

some children will not have made so much progress and will:

recognise that shadows are similar in shape to the objects forming them, that a shadow from the Sun changes over the course of a day and make observations of changes in shadows

some children will have progressed further and will also:

explain that the changes in shadows from the Sun over the course of a day arise from the movement of the Earth and that even transparent objects block some light and form shadows

LEARNING OBJECTIVES

POSSIBLE TEACHING ACTIVITIES

LEARNING OUTCOMES

POINTS TO NOTE

Review children's existing understanding of light and dark by helping them to draw a concept map linking their ideas about light, using terms *eg light, dark, night, day, light source, seeing, shiny, Sun, Earth, lighting up, sunshine*. Discuss children's ideas with them.

A concept map shows the connections between different ideas in a particular topic and is a useful source of information about children's understanding. This activity will indicate children's understanding of light and dark. Teachers will need to take this into account in their short-term planning.

CHILDREN SHOULD LEARN

- that shadows are formed when light travelling from a source is blocked
- to make and record observations and to present information in drawing and writing

- ◆ Let children explore shadow formation using torches and other light sources *eg OHP and objects of different shapes and different materials*. Introduce children to the idea of light travelling from a source by shining a powerful torch beam through a comb with widely spaced teeth or a cardboard tube and showing that the beam is blocked and doesn't bend round corners. Show that a shadow is formed on a screen. Ask children to record what they see in drawings and writing.

CHILDREN

- recognise that light can be blocked by objects and shadows are formed
- recognise that when light from sources other than the Sun is blocked shadows are formed

The understanding of shadow formation is an important step towards establishing that light travels from a source.

- that shadows are formed when objects block light from the Sun
- that shadows are similar in shape to the objects forming them
- that shadows of objects in sunlight change over the course of the day
- to make and record observations of shadows and to try to explain these using knowledge about light

- ◆ On a bright sunny day visit the school grounds to observe shadows, possibly including those formed by clouds. Suggest children explore shadows of themselves in different positions *eg standing, crouched down, with arms extended*. Record some shadows (not of clouds) with chalk on the tarmac. Later in the day look to see if the shadows are in the same place and are the same size and shape. Talk about the shadows with the children and ask them to make drawings to show their observations and to describe what those show. Encourage children to try to explain how the shadows were formed.

- identify *eg in drawings* that the shape of the shadow is like the shape of the object and is different at different times of day
- explain that the light has been blocked by the object and this is what causes the shadow

When children trace shadows it may be helpful to draw their attention to the fact that the shadow is 'joined' to the object (but not clouds). Some children may draw 'faces' on their shadows. They need to be encouraged to look carefully at what they can actually see.

 **SAFETY** – Warn children NEVER to look directly at the Sun. Blindness can result. See 'Be Safe' section 13.

- that shadows change in length and position throughout the day
- to measure the length of the shadow in standard measures
- to make a table and bar chart to show how the length of the shadows changes during the day

- ◆ At different times during a bright sunny day visit the playground and set up a stick. Ask children to measure and record the length of the shadow at different times of day. Ask children to predict *eg by drawing on the ground* the height of the shadow at intermediate times. Help children to present their results in a table and to make a bar chart showing the length of the shadow at different times of day.

- describe what happens to the shadow of the stick during the course of the day *eg it gets shorter and then longer again* and predict *eg by drawing* what the shadow will be like at an intermediate time
- make accurate measurements of the length of the shadows
- with help, present results in a table and construct a bar chart

This activity focuses on the changes in length of the shadow of the stick. A later activity will focus on the direction of the shadow and how its position and length relate to the apparent movement of the Sun across the sky.

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- to record and identify a pattern in the observations of the Sun
- that the Sun appears to move across the sky during the day

- ◆ Remind children of earlier work and ask them to think about where (or whether) the Sun shines into the classroom or room at home in the same place all through the day. Ask children whether it follows the same pattern every day and suggest they observe it every sunny day over a period of two weeks. Ask them to think of a way of recording their observations *eg by putting stickers on the window at the same time each day or by making sure an object is always in sunlight*. At the end of the period question children about observations and whether the Sun appears to move in a regular way.

- describe how the position of the Sun appears to change in relation to their classroom (or room at home) during the day

Children sometimes think the Sun moves across the sky in one direction one day and moves back the next day.

- that when the Sun is behind them their shadow is in front
- that the Sun appears to move across the sky in a regular way every day
- that the Sun appears highest in the sky at midday
- that the higher the Sun appears in the sky the shorter the shadow

- ◆ Take the children out in the playground on a sunny day and ask them to mark the direction their shadow is pointing in and the direction of the Sun. Remind them of the dangers of looking at the Sun. Ask children to explain what these marks show. Set up a shadow stick in the playground and mark south, east and west in relation to it. At regular times *eg 9.00, 12.00, 15.00* over a period of several days mark the direction and length of the shadow and the direction of the Sun.

- generalise that when the Sun is behind an object the shadow is in front
- state that the shadows change in a similar way each day and that shadows are shortest in the middle of the day

If children are not aware of the directions north, south, east and west then a circular dial without these labels but with four marked directions at right angles to each other can be used.

LEARNING OBJECTIVES

CHILDREN SHOULD LEARN

- that the Sun does not move, its apparent movement is caused by the spinning of the Earth on its axis

- that shadows can be used to tell the approximate time of day

- that opaque objects/materials do not let light through and transparent objects/materials let a lot of light through
- to use their knowledge about light and shadows to predict which materials will form a shadow and to plan how to test this
- to compare the shadows formed by different materials and to draw conclusions from their results
- to decide whether the results support their predictions and to use knowledge about shadow formation to explain the conclusions

POSSIBLE TEACHING ACTIVITIES

- ◆ Use a model *eg a powerful torch and a short shadow stick* to illustrate that the higher the light source is the shorter the shadow, and how changing the relative position of the torch and stick causes the length and position of the shadow to change. Talk with children about whether they think the Sun does in fact move. Illustrate using models *eg a model person stuck on a globe* or secondary sources that the shadows can change as we move and the Sun stays still.

- ◆ Use secondary sources *eg reference books, CD-ROMs* to investigate how sundials were used and constructed. Make a poster illustrating how they worked and some of their limitations.

- ◆ Remind children of earlier work when they saw shadows of wide-toothed combs and possibly demonstrate this again. Present children with a collection of objects/material including some that are opaque, some that are transparent *eg plastic bottles, colourless and coloured acetate sheets* and some that are translucent *eg fine net, thin nylon, greaseproof paper*. Ask children to make a prediction about what will happen when a strong torch is shone on to them. Ask children to test their predictions, to record their results and to compare them with the predictions made. Help children to write an account of what they did and what they found out.

Review work on shadow formation and light by asking children to think of questions a younger child might ask and what answers they would give. Try out the questions and answers with the class.

LEARNING OUTCOMES

CHILDREN

- recognise that the higher the Sun appears in the sky the shorter the shadow
- recognise the apparent movement of the Sun is due to the movement of the Earth

- describe how a sundial was used to tell the time and explain their limitations in our climate

- predict that the opaque materials will form shadows
- identify results that were unexpected *eg the plastic bottle made a pale shadow, the nylon and greaseproof paper let some light through*
- make a generalisation *eg opaque materials form dark shadows because they do not let any light through, and even transparent materials can make a faint shadow because they block some light*

POINTS TO NOTE

To avoid misconceptions move the stick relative to the torch rather than the torch relative to the stick. At this point children should be told that it is not the Sun that moves but the Earth. This can be illustrated using models or secondary sources *eg video*. This idea will be revisited in Year 5.

This activity offers children the opportunity to carry out a whole investigation. It may be helpful to concentrate on the aspects of investigation highlighted in the learning objectives.



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