4 Let it shine

About this topic

Curriculum link: Year 6, Light

Topic summary: The topic introduces the concept of light travelling in straight lines. It starts by looking at beams of light and how light travels to enable children to understand how we see things. This understanding is then applied to the production of shadows and starts to look at how light is reflected. The topic then takes the learning into the realm of coloured light and rainbows, using scientific skills to raise and answer questions. It builds on the work carried out in Year 3 on light, shadows and reflection.

Units

4.1 Going straight to shadows

4.2 Reflecting on seeing

4.3 Never a dull moment

Pupil video: 'Let it shine' (access on My Rising Stars)

Interactive activity: Let it shine (My Rising Stars)

Activity resource book

Page 32: My investigation

Page 33: Making a periscope

Page 34: Mirror writing

Page 35: Bending light

Page 36: Where's the coin?

Page 37: Bendy pencil

Page 38: Pouring light

Page 39: Let it shine – Test

Did you know?

Fun facts to introduce the new topic. Challenge the children to find more.

- **Insects can see ultra violet light, which we can't!**
- **Light travels nearly 1000 times faster than sound!**
- **Light takes 1.255 seconds to get from the Earth to the Moon.**
- **Sunlight can reach a depth of around 80 metres in the ocean.**
- **Photosynthesis is a process that involves plants using energy from sunlight to convert carbon dioxide into food.**

Unit 4.1

Going straight to shadows

Learning objectives

- To recognise that light appears to travel in straight lines.
- To explain how a shadow is formed.
- To explore how to change the size of a shadow.
- To represent and report on findings.
- To take accurate measurements.
- To identify and manage variables in an investigation.

Success criteria

- I can describe how light travels.
- I can explain how a shadow is made.
- I can explain how to alter the size of a shadow.
- I can measure distances accurately.
- I can explain how various factors will affect the size of a shadow.
- I can identify and control variables in an investigation.

Children might think...

- that light comes out of our eyes.
- that we can see the features on shadows.

Children already know...

- that they see with their eyes.
- that light can be reflected from some surfaces.
- how to make a shadow.
- about transparent, opaque and translucent objects.

Teacher knowledge

Visible light is a member of a family of waves known as the electromagnetic spectrum.

All waves behave similarly. They all travel in straight lines. Light travels faster than sound, (330m/s), which is why we see lightning before we hear thunder and why, when we look at someone hitting something, from a distance, we see them make the action before we hear the sound.

Because light travels in straight lines, the edges of light beams are straight and shadows are the same shape as the object casting them.

If the light source is small, the edges of the shadows are sharp. If a large light source is used, the edges of the shadow are blurred.

Cross-curricular lesson ideas

Mathematics: The children measure distances accurately.

Art & design: The children explore light and shade in greyscale sketches, the use of light in famous artists' work; look at images of search lights in the night sky and representing them. They create silhouettes.

Outdoor learning: The children explore shadows outside and how they are made. When are they sharp or blurred? Can you have shadows on dull days?

Scientific language

Light ray: the path light takes.

Cornea: the outer clear covering over the eye.

Pupil: the black hole in the centre of the coloured part (iris) that lets light into the eye.

Iris: the coloured part of the eye.

Lens: the part of the eye that focuses the light.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **Light is part of a range of waves. What do these waves look like?**
- **The Moon goes through phases because of a shadow. How is the shadow caused?**
- **Eclipses are also caused by shadows. What is causing the shadow?**

Must-see topic websites

- www.sciencekids.co.nz/light.html has interesting ideas and facts for children about light and different aspects of light.
- www.learner.org/teacherslab/science/light/ has facts about light and colour – could be useful later in the unit too.
- www.ducksters.com/science/experiment_light_travel.php has an activity to show how light travels, that you or the children could do.

Straight as an arrow

Quick challenges

- If you can black out the room, use a torch to shine on individual children and discuss why you can't see everyone at once. It is because the light travels in straight lines.
- Show images or a video of search lights from World War II and discuss what shape they are. Do they light up the whole sky?

Main activities

Whole class learning: Dim the room. Shine a torch on a wall. The children draw what they see. Place a piece of card over the edge of the torch and the children draw what they see on the wall. What has happened? Can they discuss and share why it has happened?

Get into groups: Provide torches, an object such as a wooden block or some Lego©, some black card/sugar paper, white paper and some white chalk. Dim the room. Lay the torch on the black paper and shine it at the object. Place the screen immediately behind the object leaving only a small gap that the light from the torch can't get to. Use a pencil to draw round the torch and the object. Draw and colour in the path that the light travels on the paper, by colouring it in with chalk. Continue to draw the light that goes past the object, until it reaches the white screen where the shadow is. Remove the torch and look at the image that has been made. What can the children say about the light coming out of the torch? Was there any light behind the object?

Whole class learning: Elicit from the children that the light can't go round the block as it travels in straight lines. By looking at the black sugar paper, it should look similar to the search lights in the night sky, or even a laser show (show an image or video of this). Explain that we don't want to colour it in every time, so we draw a single straight line. Model this on the board, by drawing a torch, and two straight lines on it to the corners of the object. Discuss with the children what will happen if you move the screen further away from the object?

Get into groups: The children go back to their 'pictures' and use a different colour chalk to draw straight lines along the edges of the light beam and to take the screen further back from the object and continue their lines to reach it. (Limit the distance to about 5 cm otherwise things can get too big!)

Class consolidation: Discuss the pictures they have produced and whether they show that light travels in straight lines. Can they use them to explain how a shadow is made?

You will need

- White card
- Black sugar paper
- Small torches to make a small light source and a sharp shadow
- Chalk, several colours
- Pencils
- Wooden blocks or Lego
- Talc and duster
- 'My investigation' (Activity resource book, page 32)

Support and extend

- **Support:** Provide written instructions for the children to follow for the activity (see Activity resource book, page 35).
- **Extend:** Research the names of the different parts of the shadow and why some parts are darker than others. The children could have used close observation to discover this first.

The perfect silhouette

Quick challenges

- Show a range of shadows – can the children name the object from the shadow?
- Show some representations of shadows drawn by younger children, some not joined to the object, some with the features drawn on, etc. and get the children to 'spot the mistakes' (you can create these 'wrong' shadows yourself or ask younger children to draw shadows).

Main activities

Get into groups: The children use their hands to make shadow pictures. Can they make the shadows bigger or smaller? How?

Whole class learning: Challenge the children to find the best place to stand to get a shadow of themselves to fit into a blank picture frame you have hanging on the wall, so you can take a photo of their shadow head. They will need to be able to work out where to stand and where to put the torch beforehand; they can't just all try and stand together and keep moving. They have to be scientific. They need to plan a fair test and to measure accurately in order to have the best results. What will they need to know before they start? (The height of the frame!)

Pair up/Get into groups: Groups discuss how they could carry out this task. They should be measuring the height of the shadow and the distance of the object from the light source. This should lead to a pattern. Draw a graph (line) of the results.

Class consolidation: The children use their results to set themselves up to produce the right sized shadow for the picture frame. Take a photograph to use as proof of whether they have managed it and also take a photograph of them as they stand in the frame, to explain the pattern in their results.

You will need

- White card
- Rulers
- Small torches to make a small light source and a sharp shadow
- A blank picture frame

Support and extend

- **Support:** You may need to support some children in deciding to measure the size of the shadow and the distance from the light, while keeping the light source the same distance from the screen.
- **Extend:** The children can decide to either move themselves or the light source or the screen. The challenge will be in keeping it very still. They will need help with the line graph. Higher attaining children could also draw a diagram to show how the shadow is formed and how they changed it – can they explain the relationship? You could provide the formula and the diagram from the teachers' notes and ask them to work out the shadow height.

Unit 4.2 Reflecting on seeing

Learning objectives

- To apply the idea of how light travels to explain how we see things.
- To explore how light behaves at reflective surfaces.
- To present findings and conclusions from experiments.
- To use secondary sources to answer questions.

Success criteria

- I can explain how we see things.
- I can represent in a diagram how we see objects.
- I can use various reference sources to find out about what people thought previously.
- I can observe carefully and interpret information.
- I can present ideas from experiments in various ways.

Children might think...

- that light bounces from our eyes to the object. This is illustrated in their diagrams rather than their speech.
- that they can see round corners.
- that we have laser beams that come out of our eyes – particularly if we are super heroes.

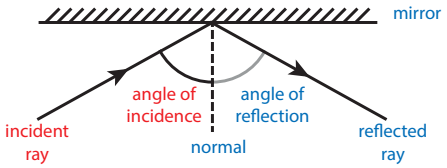
Children already know...

- that they see with their eyes.
- that light can be reflected from some surfaces.
- how to make a shadow and change its size.

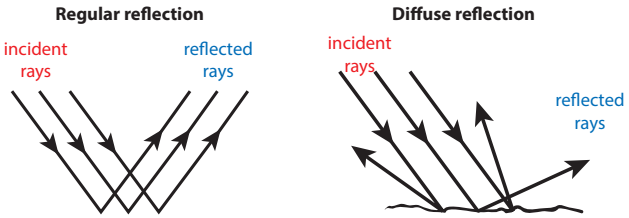
Teacher knowledge

All objects reflect light, but some reflect light more than others; that is why we can see them. Light from a luminous source, such as the Sun or a bulb, reflects from an object into our eyes. Even black objects reflect a small amount of light. Both Plato and Ptolemy developed theories which stated that we see things because the eyes emit rays. Superhero comics often show rays being emitted from the hero's eyes, which helps to generate the misconception that children may have about light coming from our eyes.

The law of reflection states: The angle of incidence equals the angle of reflection:



The children don't need to be able to draw or use this at this stage, unless they notice this as part of their investigations. However, it will help you if they are struggling to work out how to position their mirrors in the activities. It also helps with the fact that all materials reflect light.



Cross-curricular lesson ideas

Mathematics: The children look at reflective symmetry.

Art: The children draw self portraits using mirrors.

Outdoor learning: Take the children outdoors if possible. Ask them: Where can you see reflection in the outdoors? How do animals react to seeing themselves in the mirror?

Scientific language

Reflection: when light bounces off the surface of an object.

Symmetry: when one shape becomes exactly like another if you flip, slide or turn it. The simplest type of symmetry is 'reflection' (or 'mirror') symmetry.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **An eye is like a camera. Can you spot the similarities? How are they different? Compare and contrast them.**
- **Some animals have much larger eyes than humans. Why is this?**
- **Light can go round corners! But it needs a helping hand to bend. What can be used?**

Must-see topic websites

- www.sciencekids.co.nz/gamesactivities/howwesee.html has a quick game to review placing mirrors for reflection.
- www.factmonster.com/dk/science/encyclopedia/reflection.html has facts about reflections in a variety of occasions.

Mirror image

Quick challenges

- Show some writing that has been written in a mirror and explain that Leonardo Da Vinci used to use this as a secret code. Can the children work out what it says?
- Show a range of objects and challenge the children to group them as shiny or not. What did they use to tell? Is it easier if you shine a torch on them? Can they be sequenced by how shiny they are?

Main activities

Pair up: Consolidate the use of symmetry from maths to look at the mirror writing from the 'Quick challenges' section, and see if the children can write their own messages, or to decipher others.

Whole class learning: Provide mirrors to the children and discuss if they are shiny or not. What do you see when you look in them? (A reflection.) How is shininess related to a reflection. (Very shiny things have better reflections.)

Pair up: The children carry out a quick survey round the school and the grounds of all the reflective surfaces they can find. What do they notice about them all? (They are smooth.)

Use the mirrors for the children to explore how they can see behind themselves and to see round corners.

Get into groups: Use the information from exploring with the mirrors to see if the children can change where the beam of a torch goes using three mirrors. For more of a challenge, get the children to make the light go through a maze. Lay the torch on black sugar paper, and stand the mirrors up to reflect the light. They should then draw along the beam in white chalk to show the path of the light. If they take away all the mirrors, what shape have they made? What has happened to the beam?

Class consolidation: Try to produce a class definition for reflection based on the light hitting the surface of the mirror and bouncing off again, so that it changes direction, or is bent.

Pair up: Use the idea of the light changing direction to make a periscope to see over the heads of the rest of the class. Can they draw how their device works?

You will need

- Torches with black card and a small hole, to keep the beam small
- Mirrors
- Black sugar paper
- Chalk
- 'Making a periscope' (Activity resource book, page 33)
- 'Mirror writing' (Activity resource book, page 34)

Support and extend

- **Support:** Some children will need help in making the periscope and being able to explain it.
- **Extend:** Ask higher attaining children to see if they can see any patterns between the angle of the beam into the mirror and where it reflects.

Seeing is believing

Quick challenges

- Turn the lights off and make it as dark as possible. Can you see each other's eyes? Do they have light coming out of them? Explain that a long time ago, people thought that we saw things because rays were emitted from our eyes.
- Share some of the black sugar paper images from the previous lessons and recap what they show. But where does the light go after it hits the screen when making a shadow? Or when it has been reflected by the mirror?

Main activities

Get into groups: Provide groups with a torch, a mirror (or other large reflective surface) and some coloured wool. Can they use the wool to follow the light beam from the torch to the mirror? Stick it there with sellotape. Discuss with the groups what path the beam is taking.

Provide card arrows, or sticky notes in the shape of arrows, to stick on the wool (the notes can be stuck back to back around the wool, so that they stick better). Ask the children to stick the arrows on the wool in the direction the light was travelling. Check they are all the right way round.

Set up your own wool torch model, but make sure that you have lots of wool left over at the mirror end. What should you do with the extra wool? What happens to the light at the mirror? The children should tell you it bounces off. Give them another piece of wool, twice as long to set up the same model as you. Now ask them to stick arrows on this piece of wool to show which direction it is travelling in.

Whole class learning: But where does the light go after that? Discuss with the children how the light will get to our eyes so we can see it. Use a large cut-out face for the wool to be stuck on the eye. Turn this into a diagram on the board, with arrows on it.

Pair up: Can they turn their reflection diagrams on the black sugar paper into the same thing? Add chalk arrows and an image of an eye to show how we see. Can they do the same with their shadow pictures?

Class consolidation: Draw a quick image of a light source, a book and a face. Ask a child to draw the rays to show how we see the book. You as teacher draw on the arrows but on one going away from the eye. Discuss why this is wrong and then model it with the torch, i.e. shine the torch in the direction of the arrow, so that you have both torches shining on the book, which means the eye isn't involved.

Set small challenge: All objects reflect light – true or false? Ask the children to explain. (True, otherwise we couldn't see them!)

You will need

- Torches with black card and a small hole
- Mirror
- Coloured wool
- Arrows on sticky card or sticky notes
- Model face with large eyes

Support and extend

- **Support:** Some children may struggle with the arrows letting light enter the eye. This will need reinforcing. Get them to cover their eyes with their hands, then peep through them in a dark place. Do their partners see any light coming through their fingers?
- **Extend:** Research the hole in the centre of the eye – the pupil. Draw their own diagrams to show how light travels from an object to the eye.

Unit 4.3 Never a dull moment

Learning objectives

- To explore how light can be reflected and bent in various ways.
- To explore how white light can be split up.
- To make observations and raise further questions to investigate.
- To recognise that light is made up of more than one colour.

Success criteria

- I can explain what white light consists of.
- I can ask questions and explore the properties of light.
- I can suggest explanations of things I have explored.
- I can suggest other experiments which might help us answer questions.

Children might think...

- that light is made up of a single colour.
- that mirrors are the only thing that can bend light.

Children already know...

- how we see things.
- that light reflects at the surface of an object.
- that shiny objects are generally smooth.
- that light travels in straight lines.

Teacher knowledge

When light passes from one material into another, it changes direction. The change in direction is known as refraction.

When it passes from air into a more dense material, such as glass, Perspex or water, it changes direction towards the normal. When it passes from a more dense material into air, it changes direction away from the normal.

White light is a combination of coloured light: light at different wavelengths, ranging from the end of the infra-red through the start of the ultra violet spectra. If you shine different coloured lights onto the same spot, they will make what is known as 'white' light – the light we usually see. This can be seen at theatres, where they will have different coloured spotlights. If you look at the shadows cast by the actors, you will notice they have different coloured edges as the lights each are blocked by the actor, but the actor will look 'normal', bathed in 'white' light.

Cross-curricular lesson ideas

English: The children create mnemonics for the order of colours in a rainbow.

Art: The children look at how mixing colours in art is different to mixing coloured light.

Scientific language

Rainbow: occurs when sunlight hits rain, splitting the light into its colours.

Let's think like scientists

Use these questions to develop research skills and speaking and listening:

- **Who discovered the rainbow of colours and realised how they got there?**
- **Galileo made telescopes to look at the Sun. Why did he do it? Why shouldn't he? And what did he use to make it?**
- **What is a prism and how does it make a rainbow?**

Must-see topic websites

- www.optics4kids.org/home/tutorials.aspx/ is an interesting website that may be focused on the higher attaining or used the teacher to support them on various aspects of optics and light. www.optics4kids.org/home/content/classroom-activities
- www.optics4kids.org/home/teachersparents/classroomactivities.aspx/ has support ideas for teachers on activities about light.
- www.kidspot.com.au/kids-activities-and-games/science-experiments+10/how-to-bend-the-light+11693.htm has an activity on bending light for the children to do.

Light misbehaviour

Quick challenges

- Provide children with mirrors to carry out some actions in. Then pair up and mirror each others actions. What do they notice?
- Demonstrate the magic glass-making liquid. It's purex rather than glass, but the best way to perform this trick is shown on www.youtube.com/watch?v=AlfsFpI1fVY where the lecturer shows how she can make broken glass disappear and then reappear intact.

Main activities

Pair up: Run the activities here as a circus for the children to explore. They should state their observations and apply what they know. If they feel confident, they could draw a ray diagram to show how they saw each activity, with arrows on the rays. All instructions are in the Activity resource book (pages 35–38). Possibly have a set of questions for each activity, such as:

- Make observations of what happens.
- Try to explain it.
- Can you draw how you saw it?
- Where could this be useful in everyday life?

Bending light: The path of the light through the block should show deviation towards the normal as the light enters the block and away from the normal direction as it leaves.

Bending pencil: Light from the bottom of the pencil is refracted as it enters the air. An observer sees the light appear to come from a point above the bottom of the pencil.

Where's the coin? Similarly, light from the coin is refracted as it enters the air. An observer sees the light appear to come from above the coin. The cup appears shallower than it is.

Pouring light: The angle of incidence along the edge of the pouring water is quite large, so the light is totally internally reflected. The light beam should light up the bowl.

Class consolidation: Share some examples of what was observed and why they think it happened. If ray diagrams have been drawn share these and peer assess.

You will need

Bending light
- Rectangular Perspex or glass block
- Torch
- White paper

Bending pencil
- Clear plastic tumbler
- Jug of water
- Pencil
- Bowl

Where's the coin?
- Opaque cup or mug
- Jug of water
- 2 p coin
- Adhesive putty
- Bowl

Pouring light
- Clear drinks bottle
- Torch
- Black paper
- Jug of water
- Bowl

Rainbows

Quick challenges

- Show a picture of a rainbow. Ask the children to listen to the rainbow song as they look at the picture and think about the mistakes in the song.
- Use a torch and a prism to produce a rainbow. Ask the children why they can see the colours.

Main activities

Pair up: Give the children prisms and a white card screen and let them explore how to make a rainbow. (Link to art: can they make a representation of it?) Children note what happens when they move the torch to the prism. Explore whether the rainbow effect is clearer when the prism is made bigger or small or how close the screen is to the prism.

Pair up: The children will have blown bubbles in the past, especially if they have done the bubbles topics from Year 4. Blow bubbles and explore the colours they can see. Which is the most common? How does changing the soap solution change the colours? Or changing the size of the bubble?

Go it alone: Make a colour spinner so that when it is spun it looks as if it is white. What does this show?

Go it alone: Use a selection of sweet wrappers that have coloured cellophane as part of the covering. Children should look through these at different coloured objects and record what they see. What colour does the white card like? What colour does an object of the same colour as the wrapper look like? (It should appear black!)

Class consolidation: Discuss what has been found out and what questions they also explored. Come up with a mnemonic for the order of colours in the rainbow.

You will need

- Torches with a black card over the light and a slit cut into it
- White card
- Glass or perspex prisms
- Bubble mixture
- Sweet cellophane wrappers
- Coloured objects
- Spinning tops to colour in
- Rainbow song

Support and extend

- **Support:** Provide a set of instructions and questions for each of the activities.
- **Extend:** If the children haven't already researched the electromagnetic spectrum or waves, they could do this. If they have, then they could consider the reason why the rainbow is produced, linked to the wavelength of the light colours. Is there a pattern?

Assess the topic

Now you have reached the end of the 'Let it shine' topic. Use the statements below to assess the children in your class. Assess them further with the 'Let it shine' topic test (see Activity resource book, page 39).

Some children can...

- explain the difference between shadow formation and reflection in terms of the path of light.
- explain using ray diagrams how light enables us to see objects.

Most children can...

- recognise that light travels from a source, and that when it is blocked, a shadow is formed.
- describe how when light hits a shiny surface, it is reflected.
- explain that light sources are seen when light from them enters the eyes.
- make careful measurements of shadows.
- describe a pattern in shadow size and distance to source.
- identify and manage variables in an enquiry.
- present findings and conclusions from experiments in various ways.
- use results to make predictions and suggest further tests to carry out.

All children can...

- recognise that when light is blocked, a shadow is formed.
- describe that reflections can be seen in shiny surfaces.
- take measurements and present these in a table.