Spring Block 1

Light

Small steps

Step 1	How we see
Step 2	Light and straight lines
Step 3	Shadow formation
Step 4	Plan – shadow experiment
Step 5	Investigate – shadow experiment
Step 6	Evaluate – shadow experiment
Step 7	Refraction
Step 8	Explore light

How we see

Notes and guidance

In Year 3, children were introduced to the concept of "light". They identified different light sources and explored how shadows are formed. In this small step, children explore how humans are able to see objects.

Within this step, children name and identify simple parts of the human eye and discuss their functions in relation to being able to see objects. Children also explore the idea that some objects emit light while others reflect light. By the end of this step, children should identify that light travels from a light source to an object, then to the eye. The concept that light travels in straight lines will be covered in greater detail in Step 2

Key questions

- What is a light source?
- What is a natural light source?
- What is an artificial light source?
- Is _____ an example of a natural or artificial light source?
- How can we see objects that are not sources of light?
- What is the pupil/retina/lens/iris?

  What is its function?
- How can we see objects?

Things to look out for

- Some children may think that light is emitted from our eyes. Explain that objects can be seen when the light from the object enters our eyes.
- Children may initially believe that we can only see objects that emit light, such as the Sun or a light bulb. Explain that not all objects emit light themselves. Instead, we can see objects that reflect light into our eyes.

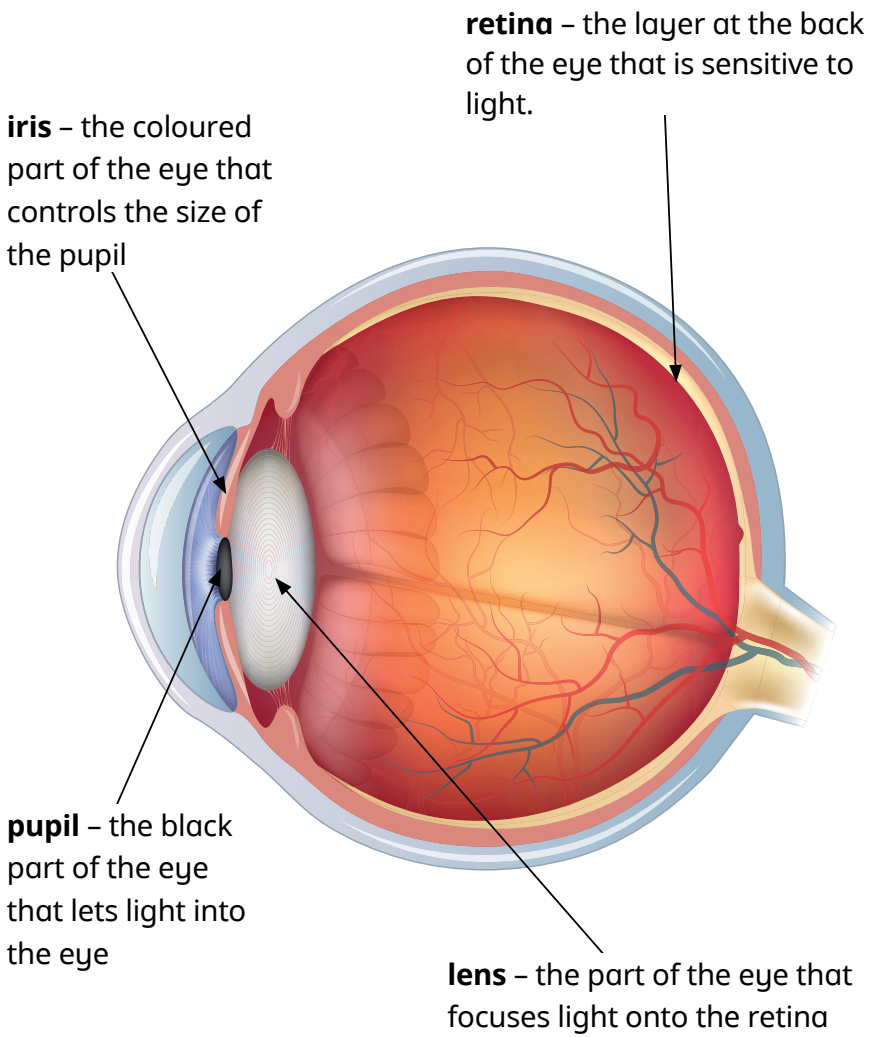
National curriculum links

- Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes.
- **Working scientifically** – Use relevant scientific language and illustrations to discuss, communicate and justify their scientific ideas (non-statutory).

How we see

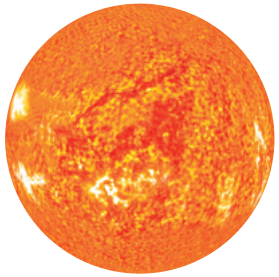
Key vocabulary

- **light source** – object that produces light



Practical ideas

- Produce a table to categorise objects as light sources (luminous) or not light sources (non-luminous).



- Give the children a simple diagram of an eye and ask them to label it using these key words.

pupil	iris	lens	retina

Factual knowledge

- Luminous objects emit light and non-luminous objects do not emit light.
- Humans can see objects because a light source produces light.
- Light reflects from an object to the eye.
- Light passes through the pupil to the retina.

Light and straight lines

Notes and guidance

In this small step, children continue to explore the concept of how humans see objects. By the end of this step, children should identify that light travels in straight lines, but that it can change direction if it is reflected from an object. Within this step, children should draw simple ray diagrams to explain how light travels in straight lines from a light source to an object and is then reflected to the eye. Children should use a ruler to draw ray diagrams to show that light travels in straight lines.

Children should explain that when light hits a smooth, shiny surface like a mirror, the rays reflect off the surface at the same angle at which they hit it. This change in direction allows us to see objects reflected in mirrors and other reflective surfaces. Children can demonstrate their understanding of this process through simple diagrams. They do not need to look at the concept of refraction in this step as it is covered later in the block.

Things to look out for

- Children may not have experienced true darkness and therefore may think that we can see in the dark. Explain to children that if there is no light, then we cannot see anything.

Key questions

- Why do we need light to see objects?
- How does light travel?
- What does "reflection" mean?
- Can light pass through objects like walls or doors?

  Explain your thinking.
- Why do we see shadows when light is blocked by an object?
- How does light reach our eyes from a light source?
- How can humans see an object in a room?
- Why can we still see some things in a dark room at night?

National curriculum links

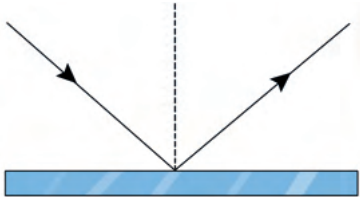
- Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Light and straight lines

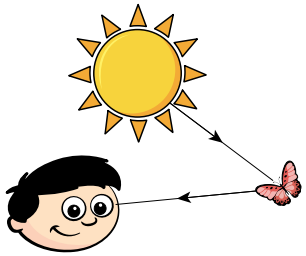
Key vocabulary

- **light source** – object that produces light

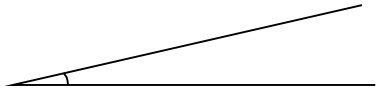
- **reflection** – when light bounces off an object



- **ray diagram** – a diagram that shows how light travels



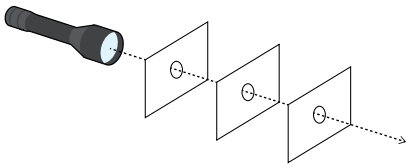
- **angle** – where two lines meet at a point



- **periscope** – an instrument that uses mirrors to make objects visible around barriers

Practical ideas

- Put a small hole in the centre of three pieces of card.



Line up the holes with the pieces of card 30 cm away from each other.

Do not look directly at bright lights. Use a dim light.

Shine a torch through all three holes.

The children should see the dot of light being shone through the three holes.

Move one of the cards.

The light should no longer be visible.

This proves that light travels in straight lines.

Factual knowledge

- Light travels in straight lines.
- Light travels from a light source to an object.
- The light rays reflect from the object to the eye.
- A reflection is where light rays bounce off an object.

Shadow formation

Notes and guidance

In Year 3, children explored the idea of shadows and found simple patterns with how shadows are formed. In this small step, children use the fact that light travels in straight lines to look at how shadows are formed. They should determine that because light travels in straight lines, the shadow will be the same shape as the object that cast the shadow. Children may need to revisit the terms opaque, translucent and transparent.

Within this step, children use opaque objects to produce shadows with different shapes. They should be encouraged to draw scientific diagrams to explain why a shadow has the same shape as the object that cast it. There are also opportunities to link to previous learning, where children looked at the Earth, Sun and Moon. They could explore the idea of a solar eclipse to explain that the Moon passes between the Earth and the Sun and blocks the sunlight from reaching the Earth. This casts a shadow of the Moon on the Earth.

Things to look out for

- Children may think that shadows are always the same size. The shape and size of the shadow formed depend on the size of the object blocking the light and the angle of the light source.

Key questions

- How does light travel?
- What does transparent/translucent/opaque mean?
- What is a shadow?
- What causes a shadow to form?
- Are there objects that don't create shadows?

  Why?
- Can shadows have different colours? Why/why not?
- How does the shape of an object affect the shape of its shadow?

National curriculum links

- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Shadow formation

Key vocabulary

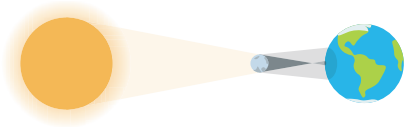
- **shadow** – a dark area caused by an object blocking a source of light

- **opaque** – an object or material that does not allow any light to pass through it

- **translucent** – an object or material that allows some light to pass through it

- **transparent** – an object or material that allows all light to pass through it

- **solar eclipse** – when the Moon passes between the Earth and the Sun and blocks the sunlight from reaching the Earth. This casts a shadow of the Moon on the Earth



Practical ideas

- Use a variety of cut-out shapes, objects and a torch to make shadows on a piece of paper or the wall. Children should explore the idea that as light travels in straight lines an opaque object blocks the light and forms a shadow the same shape as the object.
- Look at how a shadow in the playground changes in size and shape at different times of the day. Discuss why this happens.
  - When is the shadow the shortest?
  - When is the shadow the longest?

Factual knowledge

- Light travels in straight lines.
- When light rays from a light source travel to an opaque object, they cannot pass through and a shadow is formed.
- The blocked light rays create an area of darkness behind the object, which is the shadow.
- The shape of a shadow is determined by the shape of the object that blocks the light.
- Shadows are always dark because they are areas from which light has been blocked.

Plan – shadow experiment

Notes and guidance

Over the next three steps, children undertake a fair test to explore whether the distance from a light source affects the size of the shadow. Children should choose an opaque object and explore how the size of the shadow changes as the distance between the object and the light source increases. They should choose to measure either the length or the width of the shadow during each experiment attempt. The distance from the opaque object to a light source must be varied enough to create a measurable difference in the sizes of the shadows cast, but it must not be so close that the shadow is too large to measure.

In this step, children plan their experiment and identify the independent, dependent and controlled variables. At this stage in Year 6, children should plan their experiment more independently.

Things to look out for

- Children may measure the length or width of a shadow that has been cast by another object. Care must be taken to ensure that the shadow is cast from the opaque object and not from other objects in the room.
- Children may need support converting between units, e.g. centimetres and millimetres.

Key questions

- What do you predict will happen?
- How will you set up your experiment?
- What distances are you choosing to use in your experiment?
- What are the independent, dependent and controlled variables?
- What equipment will you use?
- How will you record your results?

Enquiry question

- How does the distance from a light source affect the size of the shadow?

National curriculum links

- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
- **Working scientifically** – Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary.

Plan – shadow experiment

Experiment variables

- **independent variable** (what will change) – the distance between the light source and the opaque object

- **dependent variable** (what will be measured) – the size of the shadow on the wall

- **controlled variable** (what is kept the same) – the size of the opaque object and the distance from the object to the wall

Equipment needed

- torches
- tape measures or rulers
- mopaque objects used to create shadows
- space on a wall, or paper to act as a screen

Practical activity

- Put children in small groups.

  Give each group the equipment needed for the experiment.

  Children should identify what the equipment is and why it is used within the experiment.

Planning sentence stems

- I predict that ...

  I think this will happen because ...
- We are changing the _____ .
- We are measuring the _____ .
- We are keeping the _____ the same.

Investigate – shadow experiment

Notes and guidance

In this small step, children carry out an investigation to see how the distance of an object from a light source affects the size of the shadow. In the previous step, children were encouraged to create an experiment plan more independently. Within this step, children set up practical equipment and make systematic and careful observations throughout. Children should use the distances they chose within the plan step. It is important that children are aware that the object will move but the position of the torch will remain the same.

When conducting this experiment, the room must be dark so that the shadow can be easily seen. Additionally, the light source must be strong enough so that the experiment is not affected by light sources from other groups.

Things to look out for

- Children may choose an opaque object that is too large. State to them that the object should not be too large, as it will produce a very large shadow that is difficult to measure.
- Children may find it difficult to measure the size of the shadow. Care must be taken when measuring to ensure that the shadows from other light sources in the room are ignored.

Key questions

- What is your prediction?

  Why do you predict this will happen?
- Which variables will you control to make it a fair test?
- How will you prevent any other light sources in the room from affecting the investigation?
- What did you find out in the experiment?

Enquiry question

- How does the distance from a light source affect the size of the shadow?

National curriculum links

- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
- **Working scientifically** – Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate.

Investigate – shadow experiment

Key vocabulary

- **light source** – object that produces light

- **shadow** – a dark area caused by an object blocking a source of light

- **opaque** – an object or material that does not allow any light to pass through it

Equipment needed

- torches
- tape measures or rulers
- opaque objects used to create shadows
- space on a wall, or paper to act as a screen

Method

1. Shine the light source onto a piece of paper or a wall.
2. Position the light source 1 m away from the paper or wall.
3. Place the opaque object at the first distance away from the light source so that it casts a shadow on the paper or wall.
4. Measure the length/width of the shadow at the first distance.
5. Repeat, but move the object further away from the light source each time.
6. Ensure the intervals are equal each time.
7. Measure the length/width of the shadow each time.

Evaluate – shadow experiment

Notes and guidance

In this small step, children should be given the opportunity to answer the enquiry question and discuss how the distance from a light source affects the size of a shadow.

Children should conclude that as the object is moved closer to the light source, the size of the shadow will increase. This is because the object blocks a larger portion of the light rays, resulting in a larger shadow. If the object is further away from the light source, the size of the shadow will decrease. This is because the object blocks less of the light, resulting in a smaller shadow.

Children should be encouraged to draw scientific diagrams to explain their findings from this experiment. They should use the fact that light travels in straight lines as part of their explanations. By considering the straight-line path of light, they can accurately explain how the shadow's size changes when the object is moved closer to, or further away from, the light source.

Things to look out for

- Children are encouraged to draw a line graph to show their findings from this investigation. They may need support with drawing an accurate line graph to plot data.

Key questions

- How does light travel?
- What was your prediction for this experiment?
- What conclusions can you make from your data?
- If you were to repeat this experiment, how could you improve your results?
- What questions do you have for further investigation?

Enquiry question

- How does the distance from a light source affect the size of the shadow?

National curriculum links

- Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
- **Working scientifically** – Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs.

Evaluate – shadow experiment

Key vocabulary

- **light source** – object that produces light

- **shadow** – a dark area caused by an object blocking a source of light

- **opaque** – an object or material that does not allow any light to pass through it

- **conclusion** – what has been found out during an investigation based on experimental measurements and observations
- **evaluate** – to consider the quality of the results obtained and suggest improvements to the investigation

Practical ideas

- Encourage children to experiment with moving objects between a light source and a surface. They can observe how the shadows change in shape, size and direction as the objects are moved.
- Introduce different light sources or different types of lens and compare the characteristics of the shadows they produce. Children can investigate how the size, brightness and colour of the light sources affect the shadows cast. They can also explore the shadows cast by objects of different materials, such as transparent, translucent and opaque objects.

Evaluation sentence stems

- I predicted that …

  My prediction was correct/incorrect because …
- From looking at our results, I can see that …

  This happened because …
- Our results are/are not reliable because …
- To make our investigation more accurate, we could …
- For future investigation, I would like to find out …

Refraction

Notes and guidance

In this small step, children develop their knowledge and understanding of light travelling in straight lines from Step 2 to look at refraction. Up until this step, children have identified that light travels in straight lines. In this step, they explore how light can change direction when it travels from one medium to another.

They should explore how refraction occurs and create simple explanations of why this happens. By the end of this step, children should explain that light passes through different materials at different speeds. For example, light travels faster through air than it does through water. When light moves from air to water, it slows down and that can cause it to change direction. This change in direction is what we call "refraction". Children should observe refraction first-hand using simple equipment such as a pencil in a glass of water or a transparent plastic block.

Things to look out for

- Children may become confused as to why light refracts. Clarify to them that light can change direction when it travels from one medium to another.
- Children may think the processes of refraction and reflection are the same. Recap reflection in this step and clarify how it is different from refraction.

Key questions

- What is refraction?
- What happens to light when it travels from air to water?
- Does light always travel in straight lines?

  Why do you think this?
- Why does a pencil look bent when you put it in a glass of water?
- What causes the change in direction of light during refraction?
- What are some examples of refraction in everyday life?
- How do different materials affect the speed of light?

National curriculum links

- Recognise that light appears to travel in straight lines.
- **Working scientifically** – Identifying scientific evidence that has been used to support or refute ideas or arguments.

Refraction

Key vocabulary

- **refraction** – the changing of direction of light when it passes from one medium to another.

- **medium** – any substance which can allow sound or light to pass through it

- **transparent** – an object or material that allows all light to pass through it

- **lens** – a piece of glass or other transparent material which refract light using curved surfaces

Practical ideas

- Place a pencil into a glass of water.

  Describe what happens to the appearance of the pencil.

- Draw an arrow on a piece of paper.

  Fill a glass with water.

  Position the glass of water in front of the arrow.

  Observe the arrow through the glass of water.

  Describe what happens.

- Pass a thin beam of light through a transparent plastic or glass block. Note what happens to the beam of light.

  A thin beam of light can be made by passing torch light through a thin slit cut into a card.

Factual knowledge

- Light travels in straight lines.
- When light passes from one medium to another, it can change direction. This is called refraction.
- Refraction happens because light travels at different speeds in different substances.
- A pencil looks bent when it is put into water, because light travels at a different speed in water than it does in the air.

Explore light

Notes and guidance

In this small step, children look at different properties of light and how some ideas about light were developed. Children explore the concept of "white light". In this step, children should identify how white light can be separated into different colours. They can use their understanding of refraction from Step 7 and use a prism to separate white light into its different colours. Children should identify that the prism changes the direction of each colour at slightly different angles. This allows us to see the colours individually.

Within this step there is also an opportunity for children to research the work of influential scientists such as Isaac Newton. Children should identify that Newton made significant contributions towards the concept of the light spectrum. Through his experiments with prisms, Newton showed that when white light passes through a prism, it refracts and the different colours within the light spread out to form a spectrum.

Key questions

- What is refraction?
- What are some of the colours that make up white light?
- What is a spectrum of light?
- What is a rainbow?
- How are rainbows formed?
- Who was Isaac Newton and what did he discover about light?
- Who was Ibn al-Haytham and what did he discover about light?
- How can we make white light appear a different colour?

Things to look out for

- Children may find it difficult to understand that white light is composed of different colours.

National curriculum links

- Recognise that light appears to travel in straight lines.
- **Working scientifically** – Talk about how scientific ideas have changed over time (non-statutory).

Explore light

Key vocabulary

- **refraction** – the changing of direction of light when it passes from one medium to another

- **rainbow** – an arc of colours in the sky, caused when light from the Sun passes through raindrops

- **prism** – a triangle-shaped block of glass or transparent plastic

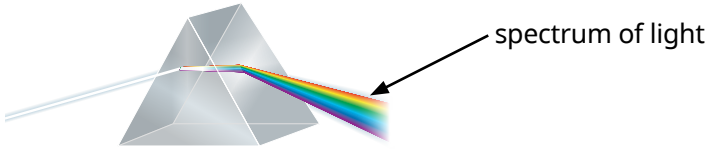
- **coloured filter** – a plastic or glass sheet that can filter some of the colours out of white light

- **spectrum of light** – the range of different colours seen when white light is passed through a prism

Practical ideas

- Pass a narrow beam of light through a glass prism.

  Move the beam around to see if a spectrum of light can be produced. The narrow beam of light can be made by cutting a thin slit into a piece of card and shining a light through it.



- Put different–coloured translucent sweet wrappers over a torch light. Record the effects on the light.

- Experiment with two different-coloured sweet wrappers on top of each other.

  What are the effects of this?

Factual knowledge

- White light is composed of a mixture of colours.
- Isaac Newton and Ibn al-Haytham discovered that white light is made up of different colours.
- A rainbow is a spectrum of light formed when sunlight passes through, and is refracted by, raindrops.