Manor Primary School

Science Year 6: Investigating Light & How We See Things!

Overview of the Learning:
In this unit of learning children will investigate mirrors and shiny surfaces and how they alter the direction in which light travels and that when they see objects, light enters the eye. Children contrast reflection and shadow formation. Work in this unit also offers opportunities for children to investigate first hand refraction, colours of light and the making of a periscope. Science learning will include also the works of key scientific figures like the British scientist Isaac Newton and invention of the first reflecting telescope.

Core Aims	Pupils should be taught to work scientifically. They will:
▪ develop **scientific knowledge and conceptual understanding** through the specific disciplines of biology, chemistry and physics about humans and other animals ▪ develop understanding of the **nature, processes and methods of science** through different types of science enquiries that help them to answer scientific questions about the world around them ▪ are equipped with the scientific knowledge required to understand the **uses and implications** of science, today and for the future.	• planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary • taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate • recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs • using test results to make predictions to set up further comparative and fair tests • reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations • identifying scientific evidence that has been used to support or refute ideas or arguments **Pupils should be taught about light and how we see:** • recognise that light appears to travel in straight lines • 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 • 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 • use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.

	• explain that light can be broken into colours and that different colours of light can be combined to appear as a new colour. • use simple optical instruments.

Expectations

Children can:

- recognise that light appears to travel in straight lines
- 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
- 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
- use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them.
- explain that light can be broken into colours and that different colours of light can be combined to appear as a new colour.
- use simple optical instruments.
- planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs
- using test results to make predictions to set up further comparative and fair tests
- reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
- identifying scientific evidence that has been used to support or refute ideas or arguments.

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<tr><th>Learning Objectives</th><th>Suggested Learning Opportunities</th></tr>
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- To present scientific ideas and thinking about light and how light travels from a source.
- To consider what sources of information, including first-hand experience and a range of other sources, they will use to answer questions

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Hook for learning on light- short animated clip on light sources- http://www.bbc.co.uk/learningzone/clips/an-introduction-to-light-sources-no-narration/2421.html
Hook the children with **'Spot the light sources'**. Can they identify and circle all the light sources? Discuss responses.

Discuss with the children to elicit what do they already know about light? Interactively get children to identify what sources of light are and how they know. How many sources of light can they name? What happens when light sources shine on different objects?
Use the Discussion to highlight that the Moon is not a source of light but reflects the Sun's light back to Earth. Stars however are sources of light but do not give us the same light and heat that the Sun does (our closest star!) due to the distances involved. The stars appear to disappear in the daytime due to the brightness of the Sun.
Provide children with all or some of the key words from the PowerPoint 'Light words for concept mapping'. In small groups children can decide which word link together and why.
These words could be stuck on large sheets of paper. Children can add more ideas to this concept map as well as explaining the links between them. Children to record their finding in annotated drawing/ using ICT

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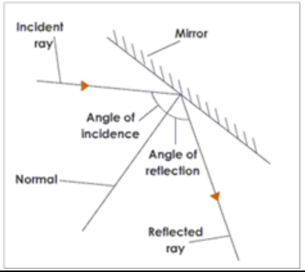
• To know how to represent light travelling and how light is needed to see things. • To know we see light sources because light from the source enters our eyes. • To know that we see objects that are not light sources only if light reflected or scattered from them enters our eyes • To be able to communicate ideas using scientific vocabulary. • To consider what sources of information, including first-hand experience and a range of other sources, they will use to answer questions	**Explore – How do we see things?** Hook- show them a picture of the eye. Prose the question – **How do we see things?**  • How can you see your pencil? • If I turned off the lights could you still see it? What if you covered your eyes tightly, could you see it then? • If it was night time and I turned the lights off could you still see it? • Would you be able to see a white cat in a dark room? Hook – Video 'Light travels in straight lines' from http://www.bbc.co.uk/learningzone/clips/- http://www.bbc.co.uk/learningzone/clips/demonstrating-how-light-travels-in-straight-lines/1625.html Discuss that light travels in straight lines, so we can think of it as a ray. So we see things because light enters the eye. Discuss the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light/bounces light into the eye. Discuss that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes. Children to create a model of this and how we can see words and pictures on a book when reading. Light source reflects on the object (book) and bounces into our eyes enabling us to see. • What happens if the rays or beams of light that are travelling in a straight line are blocked? Ask children how they can see light from a torch. Demonstrate how we can show this by using lines and arrows. Children could create dark boxes by lining a shoe box with sugar paper. You can hang a white paper man from top and view through a hole in the bottom. Children create diagrams to show how they can see the man.

	Children to record their finding in annotated drawings and explanations to explain scientifically how light travels and how we see. Suggested interactive web links for children to explore ..... http://www.bootslearningstore.com/ks2/eyesight.htm http://www.bbc.co.uk/learningzone/clips/the-human-eye/1626.html A video clip with lots of information about the human eye
• To know how we see things. • To be able to describe how we see different colours using scientific terminology.	**Exploration – How can we see different colours?** • Why does a post box look red and a leaf looks green? • What would happen if we shone a red light onto a green patch? This is an opportunity for children to find out that white light is actually made up of lots of different colours. Place the mirror in the glass of water at an angle so that it is leaning against the side of the glass. Put this on the windowsill and turn the glass so that the mirror is directly facing the Sun. Hold the mirror at a slant in front of the glass. Move the paper around until you see the rainbow colours. Alternatively pass a beam of light (torch with card cover on with a small slip made in) into prism, move around on white paper until it splits the light You may need to move the paper around until the colours come into full focus. Explain to children that 'light' is made up of lots of different colour of light. Some surfaces absorb some of the colours but not others. It is the combination of the reflected ones that we see.

	The colour of light depends on how long its waves are, so we see different colours because each colour has a different wave length. In other words, when we see colours, we are really seeing light of different wavelengths. Red light has the longest waves, orange is slightly shorter, and so on. Violet has the shortest wavelengths. **Further experiment – Making different colours** Divide the inside of the polystyrene cup into quarters. Colour the quarters green, red and blue (leave one white) Use a pencil to punch a hole in the bottom of the cup. Plug in the small bulb in the hole. Takes turns to cover the bulb with red, blue or green translucent chocolate wrappers (e.g. from Quality Street or Roses) Look at the red, blue, and green sections in the cup. (NOTE: For better results, turn off the room light.) Children can note down each time the colour of the wrapper and what colours can be seen. The more able might be able to explain what is happening in terms of the colours of light being absorbed and those that are being reflected. Objects appear one colour or another because of how they reflect and absorb certain colours of light. For example, a red letter box looks red because it reflects red light and absorbs blue and green light. A yellow banana reflects red and green light, and absorbs the rest.
• To know how we see things. To be able to describe how we see different colours using scientific terminology	**Exploration – Can we make different colours of shadows?** • What is a shadow? How are shadows created? • Can we create different colours of shadows? • What happens when we combine different colours of light?

	http://www.learner.org/teacherslab/science/light/color/shadows/index.html This is a useful website for children to experience a simulation of shining red and green light on a yellow background.  1. Place the red cellophane over the torch so that the light is **coloured red**. Secure with a rubber band. 2. Repeat the process, so that you have a '**green torch**' a '**blue torch**' and a '**red torch**' to use. 3. Shine all of the torches onto the wall - what colour does it make? 4. Try shining the torches onto an object, what colour shadows do you make? Children can record the colours that are produced each time and write up their investigation Notes for staff: White light is comprised of all of the colours of the rainbow i.e. the light spectrum. Combining the three different colours should have produced a small white area on the wall. **This is called colour addition** i.e. adding up to **white light.** Your object creates areas where the light from each torch cannot pass. As each torch is shining from a different angle some light can still reach the wall, creating coloured shadows. When you put more light in, the colours **add**. The more colours you put in, the closer you get to white, the mixture of all colours. With light, though it seems weird, red and green make yellow. The other two combinations are more intuitive: Red and blue make MAGENTA; blue and green make CYAN.

	Investigate Bubbles – exploring colour Together watch the video at http://www.canon.com/premium-lib/movie/k013/ describing how different colours appear in soap bubbles and then at http://www.exploratorium.edu/science_explorer/bub_dome.html see how you can see these colours for yourself. Challenge children to blow some soap bubbles on top of a torch and plastic lid as described and identify which colours they can see.  **Things you need:** • Small clear plastic lid (e.g. from yoghurt container) • Tape, Torch, Washing up liquid, Water • Measuring cylinder or beaker, Spoon, Straw • A darkened room **Method:** 1. Mix 2 or 3 squirts of washing liquid in 200ml water (you may wish to experiment with this to get the best bubbles!) 2. Tape the plastic lid onto the end of the torch 3. Dip your finger in the bubble liquid and wet the lid 4. Switch on the torch after making the room dark 5. Put a spoonful of the bubble liquid on the lid 6. With a straw dipped into the bubble liquid on the lid, blow one big bubble dome that covers the whole lid

	7. Hold the torch so that the bubble dome is just above your eyebrows 8. Watch the swirling colours 9. If you place the end of a wet straw into the bubble dome & blow very gently, you can move the colours around 10. Which colours can you see?  
	Exploration – Reflections Remind children that we have already discovered that we see objects because they reflect light from a source into our eyes. Tell the children that reflections occur when a light beam changes direction on hitting a surface. Children don't need to know at this point that angle of incidence is equal to angle of reflection, though some may discover this later in the session. Using model below to discuss. 

Darken the room and switch on a high-powered torch to create a beam of light. Point the beam at a drawn target pinned to a wall, reminding the children that light travels in straight lines from its source. The 'normal' line is at 90 degrees (right angles) to the mirror.

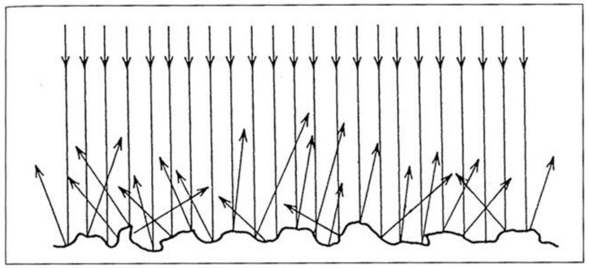
Leave the torch on but shining away from the target. Provide a child with a mirror.

Can they reflect the beam so that it hits the target?

Try different angles of the torchlight reflecting off the mirror to hit the target. Try bouncing the beam off more than one mirror; can they still hit the target? Can any children draw simple conclusions about the angle that the light reflects? If so draw a diagram to show this. Show a simple animation at http://www.physicsclassroom.com/mmedia/optics/lr.cfm.

What happens if the surface from which the light reflects isn't flat?

Tell the children that sometimes its effects can be humorous, like a Hall of Mirrors (have children been to one at a fairground?)! If a surface is not smooth/flat the reflected light is scattered in many directions.



Use the Discussion Drawing to stimulate discussion about the effects created by smooth concave and convex surfaces. Provide the class with spoons to test the ideas of the children shown in the drawing.

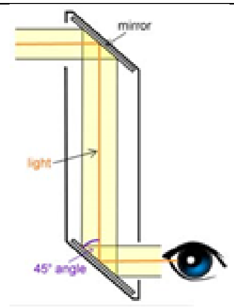
Exploring – How does a mirror work?

Set up a target on the board. Children asked to use light from a torch and a mirror in order for the light beam to hit the target. Children could use 2 mirrors to view a mystery object on the table top from below the table/or try to use mirrors to read a post-it note on their back Children can draw and label diagrams to record the passage of the light beam in both activities.

- Encourage the children to use lines with arrows to represent the passage and direction of the light.

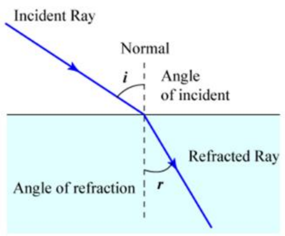
Pattern-seeking – How can we increase the number of reflections?

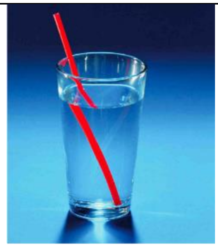
	Hinge two mirrors together using some Blue tac. Place the object in front of the mirrors. The children can start by having a whole 180 degrees angle between the two mirrors. They must then continue by decreasing the angle by 10 degrees each time. They must record the number of reflections seen. Children to record results and patterns using tables, observations and explanations.
	Exploration – Making a periscope and investigating how it works by reflecting light between mirrors. Ask the children what a periscope is? A periscope lets you see over the top of things, such as fences or walls that you aren't tall enough to look over. You can also use it to see around corners. People first started using periscopes in submarines in about 1860, to allow the sailors to see above the water. Later, soldiers in the First World War used them to look out of the trenches without having to put their heads out of the trench. Periscopes are still used today in tanks and some submarines. A periscope is an optical instrument that uses a system of prisms, lenses, or mirrors to reflect images through a tube. Light from a distant object strikes the top mirror and is then reflected at an angle of 90 degrees down the periscope tube. At the bottom of the periscope, the light strikes another mirror and is then reflected into the viewer's eye. This simple periscope uses only flat mirrors as compared to the periscopes used on submarines, which are usually a complex optical system using both lenses and mirrors. A simple periscope is just a long tube with a mirror at each end. The mirrors are fitted into each end of the tube at an angle of exactly 45 degrees (45°) so that they face each other. In the periscope, light hits the top mirror at 45° and reflects away at the same angle. The light then bounces down to the bottom mirror. When that reflected light hits the second mirror it is reflected again at 45°, right into your eye. You can see this in the picture on the right. Light is always reflected away from a mirror at the same angle that it hits the mirror.

	 Challenge children to create a periscope to see round corners/over the heads of a crowd/through a narrow opening into a container, etc. *Can children add improvements to the basic design?* Provide materials such as card, tubes, mirrors, tape, etc. Visit http://www.planet-science.com/categories/under-11s/our-world/2012/06/make-a-periscope.aspx, http://www.webinnate.co.uk/science/week8.htm or http://www.sciencemuseum.org.uk/educators/teaching_resources/activities/360_degree_periscope.aspx for inspiration! These sites explain how periscopes work and inspire periscope design!
	Exploration of a key scientific figure – Isaac Newton and his reflecting telescope Show the children a picture of Isaac Newton  Can they name who he was? What was he famous for?

	Share that it is Isaac Newton and had developed pioneering work in link with light. The **first reflecting telescope** built by Sir Isaac Newton in 1668 is a landmark in the history of telescopes, being the first known successful reflecting telescope It was the prototype for a design that later came to be called a Newtonian telescope. Children to further investigate the first reflecting telescope created by Newton and create a presentation of findings.
• To know which materials are best at reflecting light. • To identify scientific evidence they have used in drawing conclusions. • To make predictions based on everyday experience • To repeat measurements to gain more accurate results. • To provide conclusions that are consistent with the evidence	**Fair-test investigation – which materials are the most reflective?** • Why can we see some things better than others at night time? • How could we find out which material is best at reflecting light? Problem – children in the winter need to be seen by motorists. Which material reflects the most light? In groups the children could plan how they will solve this problem. The children then carry out their scientific enquiry and record their results in a table and as a bar graph. The children could either use a light sensor or see how many thin sheets of paper they can see through when looking at the material being illuminated by a torch.
	Exploration - What happens when light travels through air through water? Tell the children that the light is bent when it passes through a convex or concave lens to correct people's long or short sight. This needs to be explored further.Show children a spoon or pencil and a beaker of water and ask what they predict will happen if you place the spoon or pencil half into the water. ***What will they be able to see?*** Children to discuss their predictions. Children to investigate this an record their observations. Look down on the object as well as from the side. Watch the video clip at http://www.bbc.co.uk/learningzone/clips/what-is-refraction/7912.html which shows light being bent by passing through water and glass. This is called refraction.

- To be able to plan a fair-test on refraction.
- To be able to use scientific language to explain what was found out.
- To report findings from investigations, including written explanations of results, explanation involving causal relationships, and conclusion





Demonstrate the effect of passing a beam of light through a rectangular prism. Use a torch to shine rays/beams of light through the glass prism and see how the glass lets the light through like water as it is transparent but you will see the light bend as it passes through. Most of the bending will take place at the edges of the glass where light moves from air to glass or vice versa. This is refraction. Mirages are also caused by refraction – light is bent by layers of air at different temperatures, so the puddle seen in the desert is actually an image of the sky.

Illustrative fair-test – How does the type of liquid affect the angle at which the light refracts?

- When looking at a pencil in a glass of water what does the part in the water look like? Why do you think it looks like this?

What does the world around us look like when we view it through a glass or water? Why? Place the torch on the table and lean the comb against it. Turn the torch on and turn off the lights in the room. Notice the light beams that are shining through the comb's teeth.

Fill the small glass bottle or glass halfway with water and place it in front of the beams of light shining through the comb's teeth. What happens to the beams of light? Do the beams of light change direction? A focal point is where beams of light meet. Where is the focal point?

Now fill your glass bottle or glass with cooking oil instead of water and try the experiment again. Are the results the same? Do the light beams refract differently through the cooking oil than in water? Is the focal point the same?

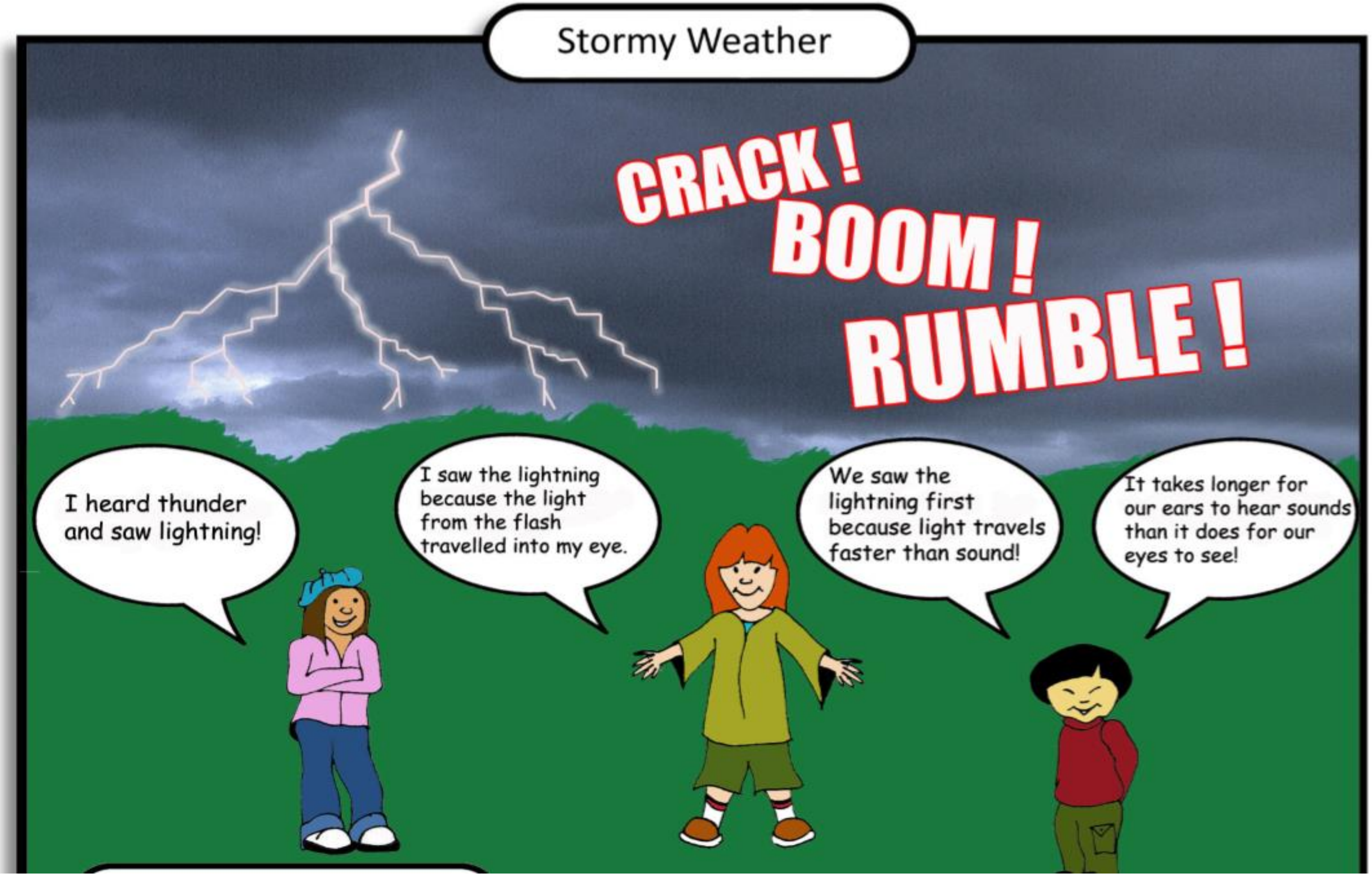
Further questions to investigate…..

What other liquids can we test? Does the density of the liquid effect at what point light refracts? Children to plan and devise their own test with a range of liquids e.g. syrup, oil, Treacle, honey, water….

Notes for staff

	The speed of light isn't always the same. It actually slows down when it moves through some transparent materials, like glass or water. When light slows down, it changes direction. This "refraction" of light is the reason a straw in water looks bent or broken and why objects viewed through a glass bottle appear distorted. Children to record their investigation write up with observational drawings and recording. Children to draw comparisons to link to their scientific conclusion drawing.
• To be able to evaluate results in terms of accuracy and reliability. • To be able to identify risks when doing science.	**Problem-solving – What colour acetate is best for lenses for sunglasses?** • Are more expensive sunglasses more effective than cheaper ones? • How do sunglasses work? Could we find out which materials are best for lenses? The children can plan a fair test to find out which type of material would be best for making the lenses in sunglasses? This could begin with children bringing in different sunglasses and finding out which ones are best at blocking light – using a data logger. Encourage the children to take repeated measurements. Which children are able to understand that this is to improve the 'reliability' of the results?


Funny Reflections
What happens if you hold the spoon further away?
Does it matter how curved the spoon is?
Are you sure you're not upside down too?
If I look at myself in the back of this spoon I am back to front!

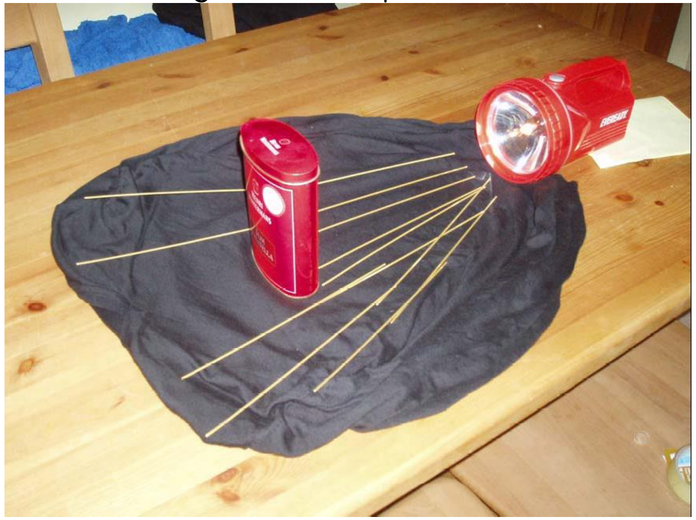

Stormy Weather
CRACK !
BOOM !
RUMBLE !
I heard thunder and saw lightning!
I saw the lightning because the light from the flash travelled into my eye.
We saw the lightning first because light travels faster than sound!
It takes longer for our ears to hear sounds than it does for our eyes to see!

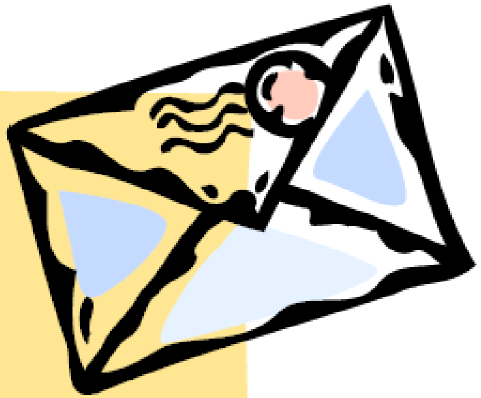
Modelling the travelling of light

Use the spaghetti to represent the light.

Place an object in the path of the light to show how shadows are formed.

Demo how light cannot pass round corners.





Dear Scientists,

I have been reliably informed that you are the type of trendy kids who will be able to help me with a little problem that I have.

I have been making sunglasses for years, but I have recently been having complaints from children because the glasses either let in too much light or they do not let through enough and the children can't see clearly.

Can you therefore find out what would make the best lenses for my sunglasses?

Many thanks for your anticipated help.

Mr Son E. Glasses

PLANNING YOUR INVESTIGATION

- What are you changing?
- What are you keeping the same?
- What are you measuring/observing?
- How are you going to record your results?
- Which equipment will you need?