	Science	Year 6
	Term 1	Topic Title: Light and Sight

Key Question: How does light affect the way we see things?

National Curriculum Objectives:

- Recognise that light appears to travel in straight lines.
- Use 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.

Vocabulary:
(As for Year 3 - Light, plus) straight lines, light rays
National Curriculum requirement: Pupils should read and spell scientific vocabulary correctly and with confidence, using their growing word reading and spelling knowledge. Children will need further opportunities to explore and embed key scientific vocabulary outside of Science lessons through the wider curriculum and spelling lessons/homework activities.

Prior Learning:
Recognise that they need light in order to see things and that dark is the absence of light. (Y3 - Light)
• Notice that light is reflected from surfaces. (Y3 - Light)
• Recognise that light from the sun can be dangerous and there are ways to protect our eyes. (Y3 - Light)
• Recognise that shadows are formed when the light from a light source is blocked by an opaque object. (Y3 - Light)
• Find patterns in ways the size of shadows change. (Y3 - Light)
• Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets. (Y5 - Properties & changes of materials)

Common misconceptions:
We see objects because light travels from our eyes to the object.

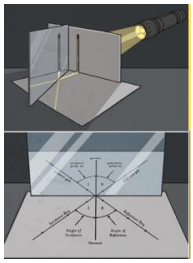
Knowledge: Light appears to travel in straight lines, and we see objects when light from them goes into our eyes. The light may come directly from light sources, but for other objects some light must be reflected from the object into our eyes for the object to be seen. Objects that block light (are not fully transparent) will cause shadows. Because light travels in straight lines the shape of the shadow will be the same as the outline shape of the object.

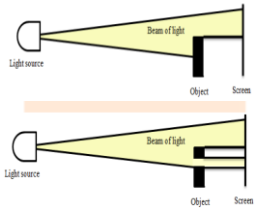
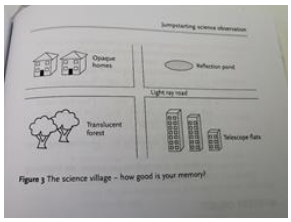
Investigative skills

Fair/comparative testing	Identifying and classifying	Observations	Pattern seeking	Research
How does the angle that a light ray hits a plane mirror affect the angle at which it reflects off the surface? *Which material is most reflective?* Use of ray model to explain imaging in mirrors, the pinhole camera, the refraction of light and action of convex lens in focusing (qualitative); the human eye. (KS3) Given resources, children decide how to gather evidence to answer a scientific question. They choose and justify the type of enquiry to carry out.	*Can you identify all the colours of light that make white light when mixed together?* *What colours do you get if you mix different colours of light together?* Colours and different frequencies of light, white light and prisms (qualitative); differential colour effects in absorption & diffuse reflection. Similarities and differences between light waves and waves in matter. (KS3) Identify causal relationships.	*Do shadows have the same shape as the object that cast them?* *How does light travel? (investigate angles/ changing light direction)* Light waves travelling through a vacuum; speed of light.Light transferring energy from source to absorber leading to chemical and electrical effects; photo-sensitive material in the retina and in cameras. (KS3) In conclusions, chn identify causal relationships/patterns and results that do not fit overall patterns from their evidence and using their subject knowledge.	*Is there a pattern between the type/appearance of a material and its reflective properties?* Investigate the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface. (KS3) Present the same data in different ways in order to help with answering the question. Identify any limitations that reduce trust in their data e.g control of variable.	*Who invented the periscope and why?* *How do we and other animals see colour?* *How do our eyes adapt to different conditions?* *Who is Patricia Bath and why is she important?* The similarities and differences between light waves and waves in matter. (KS3) Answer questions using secondary sources. Talk about how new discoveries change scientific understanding. Independent ask questions to research.

Significant Scientists: **Patricia Bath (BP website)- opthamologist and inventor** **Ibn Al-Haytham (Alhazen)- Light and our Eyes** **Percy Shaw- The Cats Eye**	**End point:** Can describe, with diagrams or models as appropriate, how light travels in straight lines either from sources or reflected from other objects into our eyes. Can describe, with diagrams or models as appropriate, how light travels in straight lines past translucent or opaque objects to form a shadow of the same shape. Can explain how evidence from enquiries shows that light travels in straight lines Can predict and explain, with diagrams or models how the path of light rays can be directed by reflection to be seen, e.g. the reflection in car rear view mirrors or in a periscope Can predict and explain, with diagrams or models as appropriate, how the shape of shadows can be varied.
Science stories: *(Guided reading suggestions to complement Science)* **Letters from the Lighthouse-** Emma Carroll **The King Who Banned the Dark-** Emily Haworth-Booth	
Cross Curricular Links: **English:** text map oral explanations, creative writing-writing in role, record findings in written explanations using scientific language. **Maths:** Solve problems relating to measures and angles, record results in tables, construct and interpret graphs and examine data relationships/patterns. **DT:** select from and use a wide range of tools and equipment and apply understanding of how to strengthen and reinforce structures to create a periscope. **ICT:** select, use and combine software on a datalogger to collect, analyse, evaluate and present data and information.	**Oracy:** Text map explanations- how light helps us to see Hot seating Patricia Bath. Plus, Minus and Interesting- What if we couldn't see colours?
Wider Reading and resources	**Enrichment/Science capital**
https://bpes.bp.com/super-scientists-patricia-bath-primary **Women in Science- 50 fearless pioneers who changed the world**- Rachel Ignotofsky **A creative approach to teaching Science**- Nicky Waller **Jumpstart Science**- R. Feasey and D fulton	See how the properties and behaviour of light have useful and relevant applications to everyday life. Investigate which of their coats are most reflective. Investigate own "wonders" about the world around them.

Sequence of Learning		
Lesson	Key Question	Key learning/notes
1	How does light help us to see?	• Complete the pre-unit quiz and KWL grid/learning circle. • Use this lesson to recap key learning from year 3 and revisit the key question "What helps us to see things?" Explore and discuss light sources (use and adapt first few slides of "STEM light" slide and Twinkl ppt in overview resources folder for your class. (*When adapting, please keep the originals as a master.)* Where can light come from? What are some reflectors of light? (Clear up misconceptions i.e the moon.) • How do we see things? Do our eyes give out light? (address and correct any misconceptions) Provide the class with cardboard tubes with sealed ends and lids e.g. shuttlecock tubes/sweet tubes. Tell them to close one eye and then look down it with their other eye (flush to the tube). What can they see? (should be completely dark.) What does that tell you about light and our eyes? • How does light travel from a light source? Model how light travels by using three pieces of thick card with holes punched into the centre and a torch. Shine the light of the torch through the holes to show how the light travels through them. Encourage chn to make predictions about what might happen if: we rearrange the cards into an uneven line? We use cards with holes punched in different positions? • Test out to prove that light travels only in straight lines. • How does light help us to see? Watch the clip then reinforce explanation on the ppt. • Provide chn with text map of how light helps us to see and a word bank. Chn have a go n partners at talking through the explanation first together, then to each other and then by presenting to another set of partners. • Collect and write up any wonders from the children to refer to through the unit.
2	Who is Patricia	• Use the introducing Patricia Bath presentation from the BP education website (super scientists) and PG 101 of Rachel Ignotofsky's book (wider reading) to introduce and

	Bath and why is she important?	discuss the life of Patricia Bath. • Explore further into how we see, how our eyes adapt to different conditions then children research cataracts. Children imagine that they are Patricia Bath talking to a blind patient who suffers from cataracts. • Complete hot-seating activities to explore different ideas then chn independently write an account of a person who can see again for the first time in thirty years. • Complete "The story of Patricia Bath" quiz sheet (BP resources)
3	How does light travel? **Investigation** **How does the angle that a light ray hits a mirror affect the angle at which it reflects off the surface?** **(Requires double lesson/afternoon)** 	• Greet the chn with a tricky challenge to recap and test out yesterday's learning: each small group has a large piece of flip chart paper, a torch with a strong narrow beam of light fixed in position at one end of the paper, and an upright piece of card with a human eye "target" printed onto it placed at the other end of the paper but facing away from the torch. Without moving the torch or the target, groups should work together to predict and decide how they could shine the light from the torch into the "eye." (Provide a selection of additional materials at the front of the class that chn may decide to select and use to problem solve- e.g mirrors/reflective surfaces, playdough/pegs to hold things in place etc) Take photos for WS floor book. • Once successful, chn record the path taken by the light beam travelling from the torch to the target by drawing directly onto the f/c paper. (Gives a visual record to show how light travels in straight lines and can be reflect into the eye.) • Recap activity and what children discovered. Establish that light travels in a straight line. How did you get the light to change direction? What helped the light to travel? (mirrors, shiny/reflective surfaces) Children look at their flipcharts and reflect on how they carried out the investigation by recording their observations under "**I see**" '**I notice**" and "**I wonder**" to generate more questions to explore later on. • Explain reflection and introduce the term "light ray." Explain that they had to think carefully about angles and position (Maths) to complete their challenges. Why? • Explore angles of incidence/reflection using "reflecting light" Twinkl ppt (resources) • Model, then chn complete the incident ray and reflection ray activity themselves to explore the laws of light reflection. Take photo graphs for books/WS folders.
4	How does reflection help us in our daily lives? **Reflection Mini investigations** Chn record on investigation observation sheet (resources)	• Ask lesson question. Can you think of how we use mirrors to help us see things we couldn't normally see? Mirrors allow you to see things that aren't in your direct field of view. A rear-view mirror in a car reflects light coming from behind the driver into their eyes so that they can see cars and other objects behind them. At the hairdresser's a combination of two mirrors allows you to see the back of your head. What other examples can chn think of? • A periscope allows us to see things that are otherwise out of sight. We see an object when light coming from it enters our eyes. The light may have been made by the object itself, or it may have simply reflected off it. Light travels in straight lines – so normally you have to look straight at something to see it. When light hits a mirror, it "bounces off" at the same angle it hits. Light travelling horizontally meets the first mirror in the periscope at 45 degrees, and bounces off at 45 degrees, making 90 degrees altogether – so it travels vertically down. Johannes Gutenberg, invented the periscope in the 1430s, so pilgrims could see over people's heads at religious festivals. • Explain method of making periscopes. (overview resources) Chn create and try out their own periscopes. Ideas from Science Museum (here.) How much taller can you make your periscope before you stop seeing the reflection? Shine a torch into the periscope's eyepiece and place the other end next to a wall. What do you see? Can you make a periscope with three/more mirrors? Chn record notes on the mini investigation sheet (resources) Chn can also create their own question to investigate. • Encourage the class to experiment with different designs of their periscopes, e.g. what's the longest periscope they can make? How would it be different to a shorter one? What's the best size and shape for the mirror? (use mirrored card to cut) • Think about ways a periscope could be used in everyday life – how might it help us? • Can chn explain reflection and how mirrors reflect light?
5	Which materials are the most reflective? Full investigation	• Create a Science village (map of a town/village with roads, stations, parks, building, river etc. Each feature should be labelled with a scientific term relating to the light topic for children to draw and recall key vocabulary. E.g. light ray road, reflection pond, periscope park, lux hotels etc (Pg30 Jumpstart Science.) • Building on Yr 3 *What is reflection?* Lesson, chn now **formally investigate which materials are the most reflective**, using data loggers to take readings of reflected

	write-up. Reinforce that objects that do not produce light but can still be seen in the presence of a light source are called 'reflectors' They are not light sources. Note: **mirrors** simply reflect/redirect light and always reflect less **light** than falls on them as the rest gets absorbed in the material.	light ("lux") and the **UKS2 template for writing a full investigation**. Use bbc use of reflective materials for safety clip as inspiration. (Ext: Chn repeat readings and take averages to use and apply their Maths skills and increase accuracy/trust in results) • Provide chn with a variety of materials and a torch to predict and investigate which ones are the most reflective. Make it personal to them by bringing in their winter coats to do further comparison to see which ones are reflective too. • Children use main investigation sheet (resources) then choose to record results in charts/ appropriate graphs and look for patterns in data. Is there a pattern between the type/appearance of a material and its reflective properties? Encourage children to think about this when writing conclusions. • Once finished, encourage chn to relate reflective quality of the materials to their purpose- *Mirrors used in toilets, Mirrors to make spaces bigger, Polished floors not only look clean but also reflect light making a room appear brighter! We* often consider polished objects more valuable than dull objects! – *The shiny new car, sporting trophy etc.* Chn should conclude that polished surfaces reflect light better than other surfaces, shiny surfaces can be used as mirrors, dull surfaces don't reflect as much light – they absorb it! Explore Percy Shaw- invention of the cat's eye. • **Homework task:** Pupils may be inspired to design posters encouraging people to wear reflective clothing when cycling/walking at night, • Games to explore and extend: http://laser.narr.as/ or on BBC Bitesize.
6	Do shadows have the same shape as the objects that cast them? *Diagrams of paper shadows:*  	• Unscramble the Science words. Challenge children to unscramble key vocabulary- once unscrambled, recap the definitions. (For chn with spelling difficulties, provide answers at the side of the board or allow personal Science word mats for support. • Using items from the classroom, topic related artefacts or shadow puppets, encourage pupils to form interesting shadows with light from a torch or projector. • What is happening to the light when a shadow is made? (Recap yr3 but ensure chn use more sophisticated vocabulary including new knowledge of how light travels) • Model drawing a simple 2D diagram of a sheet of paper casting a shadow. Point out that you can tell what an object looks like from observing its shadow. Tear a hole in the middle of the paper and demonstrate. Adapt diagram to show new shadow. • Explain that light is only blocked within the outline of the object. Because light travels in straight lines, the resulting shadow will mimic the shape of the object. • Chn select one of the objects that they were exploring to draw a new diagram depicting the light source, object and the shadow formed. Chn write explanation sentences underneath to explain their diagrams using scientific language. • How are some shadows colourful? Cast shadows using coloured objects, such as purple sunglasses or a glass of squash. Ask the pupils to describe how the shadows are different from normal shadows. Pupils could build on the Yr 3 activity using more advanced materials to create their own stained-glass art by applying glass paint to clear sheets of acetate, then shining light through to create colourful shadows. • Complete the "What if we couldn't see colours?" activity on Explorify as a class. • Extend by exploring how different animals see colour. The Natural History Museum has an interactive article. Ask a Biologist has an interesting table listing colours an even wider variety of animals can see.
7	How does light affect the way we see things?  Assessment lesson	• Chn to recreate the Science village in their books by/under their initial KWL grids. Can they add what they have learned into their grids or around their Science village in a different colour? • Complete the end of unit quiz. Can they answer any of their wonders that were generated through the topic? What new questions do they have? • Natural wonders: Using a Pyrex or glass prism in a dark room, split white light into the spectrum of colours. Where have you seen this before? (rainbows, light split by gems). • Introduce the idea that these colours are hidden inside white light. (Pupils could draw a diagram of the white light being split into a rainbow.) • Use acetate to explore What colours do you get if you mix different colours of light together? • Use these extra-curricular questions on this resource to briefly discuss rainbows, refractions and light waves/energy to spark pupils' interest in **preparation for KS3**.