Subject: Science	Year Group: 4	Unit: Light and lenses MAIN LIGHT

First- hand experience:

NC Objectives to be addressed:	Prior Learning required:
Light (Y3) • Recognise that they need light in order to see things, and that dark is the absence of light. • Notice that light is reflected from surfaces. • Recognise that light from the sun can be dangerous and that there are ways to protect their eyes. • Recognise that shadows are formed when the light from a light source is blocked by an opaque object. • Find patterns in the way that the size of shadows change.	• Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense. (Y1 - Animals, including humans) • Describe the simple physical properties of a variety of everyday materials. (Y1 – Materials)
Biology / **Chemistry** / **Physics**	
Working scientifically: **Comparative and fair testing** / **Pattern seeking** / **Observing over time** / **Secondary sources** / **Classifying and grouping**	**Where next?** • Light (Year 6)

Key Vocabulary:

light	the bright form of energy given off by a light source (e.g. the sun) that makes it possible to see	**shadow**	a dark area produced by an opaque body coming between rays of light and a surface
light source	a place/object from which light originates or can be obtained	**reflect**	to throw back (heat, light, or sound) without absorbing it.
dark	The absence of light	**mirror**	a surface which reflects a clear image
absence	the non-existence or lack of	**sunlight**	light energy from the Sun (source)
transparent	allowing light to pass through so that objects behind can be seen	**dangerous**	able or likely to cause harm or injury
translucent	allowing light, but not detailed shapes, to pass through; semi-transparent	**absorb**	take in or soak up energy
opaque	not able to be seen through; not transparent.		
shiny	a surface reflecting light, typically because very clean or polished		
matt	dull and flat; without a shine		

surface	uppermost layer of something		

Sequence of learning:

Lesson 1

Some objects are sources of light (candles the sun) and some objects are not sources of light (the moon, a table)
Sunlight can damage your eyes. Protect them by wearing sunglasses or a hat. NEVER look directly at the
Sources of light make their own light
Light - the bright form of energy given off by a light source (e.g. the sun) that makes it possible to see
Dark - The absence of light
Light source - a place/object from which light originates or can be obtained
When torches are used, the energy produced comes from the electric flow created from the battery in the torch (Y4 elec introduction)
Sunlight can damage your eyes. Protect them by wearing sunglasses or a hat. NEVER look directly at the sun

Lesson 2

Investigate torches
That torches are made up of complete circuits, involving a battery, a bulb, and a switch.

Lesson 3

reflection - to throw back energy (heat, **light**, or sound) without absorbing it.
Reflective surfaces can be very useful
Mirrors in cars help drivers to see what is behind them
Reflective strips on clothes and bikes make cyclists easier to see at night

Lesson 4

absorb - take in or soak up (energy)
Children understand that some objects are shiny because they reflect light

Lessons 5 and 6

When the light from a light source is blocked by an opaque (not see-through) object a shadow is formed
You can change the shape of a shadow by moving the light source or the object further away from, or closer to, each other
Transparent objects let all light through so no shadow is formed
Opaque objects let no light through so a shadow is formed
Translucent objects lets some light through slight shadow is formed

Lesson 7

John Michell first observed black holes 200 years before Einstein
Einstein predicted that Black holes would exist
Stephen Hawkins discovered that black holes produce “Hawking Radiation”
Katie Bouman created an algorithm to create an image of a black hole

Resources and teacher subject knowledge:
We see objects because our eyes can sense light. Dark is the absence of light. We cannot see anything in complete darkness. Some objects, for example, the sun, light bulbs and candles are sources of light. Objects are easier to see if there is more light. Some surfaces reflect light. Objects are easier to see when there is less light if they are reflective.
The light from the sun can damage our eyes and therefore we should not look directly at the sun and can protect our eyes by wearing sunglasses or sunhats in bright light. Shadows are formed on a surface when an opaque or translucent object is between a light source and the surface and blocks some of the light. The size of the shadow depends on the position of the source, object and surface.

How does a camera work? https://www.creativelive.com/photography-guides/how-does-a-camera-work

Possible misconceptions:
• we can still see even where there is an absence of any light
• our eyes ‘get used to’ the dark
• the moon and reflective surfaces are light sources
• a transparent object is a light source
• shadows contain details of the object, such as facial features on their own shadow
• shadows result from objects giving off darkness.

Possible lesson ideas:
Lesson 1 - Understand the concepts light and dark

- Ask children to come up with definitions of ‘light’ and ‘dark’ before discussing actual definitions.
- **Light - the bright form of energy given off by a light source (e.g. the sun) that makes it possible to see**
- **Dark - The absence of light**
- **Light source - a place/object from which light originates or can be obtained**
- Explain that light travels from a light source, reflects off objects into out eyes, enabling us to see things.
- In the absence of light (dark) we cannot see things.
- In less light, there is less reflecting of light happening, and therefore it is harder to see things.
- Dark box activity. Prepare a (or a number of dark boxes) – instructions below – and carry out investigation

How to make a dark box:

Using a shoebox (or similar box with a detachable lid) paint the inside of the box black. In one side of the box make two small peepholes (eye distance apart) and in the middle of the box lid cut a hole roughly 2cm x 5cm. Have another piece of card big enough to fit over the hole cut in the lid.

Using the dark box:

Children put objects in the dark box and look through the peepholes. They can move the piece of card covering the hole in the lid and discover what they can see when there is no light, some light etc. Torches can be shone through the hole to increase the light even more. For the more able children they can look at different coloured objects to see which are the easiest to see in low light.

Children are to record (draw and write) what they can see in the box when the hole is covered, and when the hole is uncovered, with torchlight also added. Underneath they are to explain why this is happened, using the key words discuss earlier (light, reflect, dark, absence, eye etc.)

Lesson 2 - Understand how light reflects

- Recap yesterday's learning about the concepts of light and dark.
- Discuss the term **reflection -** to throw back energy (heat, **light**, or sound) without absorbing it.
- Ask children where they may have seen their own 'reflection' (water, mirror, cars etc.) and discuss what these surfaces have in common.
- Explain the reflection is caused by light travelling from the source, bouncing off the object (you in the case of a mirror), travels to the mirror, which then reflects the image back into your eye.
- **Explain that light itself can be reflected off a mirror, and redirected (much like sound – T1 L5 – cones)**
- Task is for class/groups to guide a light through a maze (could be tables, could be blocks on the floor, Lego etc.) to reach a target (lego man, paper etc) on the other end of the maze.

For example 

- Allow children to explore and have a play around, without much instruction, to allow them to learn independently.

N/B rooms need to be as dark as possible; remind children to not shine or redirect light into other children's eyes (or their own).

Lesson 3 - Find patterns between surfaces that reflect and absorb light.

- Recap learning and knowledge from yesterday's lesson about reflection.
- Introduce term **absorb -** take in or soak up (energy
- Where might the children have seen this word before? Sponge? Rocks topic Y3?
- Investigation into which materials from a selection are able to reflect light, and which aren't .
- Have a selection of materials e.g. paper of different colours, tin foil, cling film, wax wraps, plates, slate, plates, table, cardboard etc, to test, and ask children to think about whether each will reflect light, or not before thinking of reasons **why**.
- Record hypothesis (refer back to the introduction to the word in Y3) in table, and write the reason why they have predicted that.
- Test materials by shining torch on the material. If it reflects, the light will bounce back onto another surface, e.g. a wall. If it absorbs, then it will not.
- Allow the children to make observation of reflections.

Material	Hypothesis – will it reflect or absorb light?	Reasoning for hypothesis	Did it reflect light?	Was my hypothesis correct?	Observations

Lesson 4 - Understand how shadows are created

Children need to know that shadows are created when an **opaque** (refer to vocab above) object blocks the **light** from a **light source**, creating an absence of light (darkness) behind it.

They need to understand that **transparent** (allowing light to pass through so that objects behind can be seen) objects let light through, so there is no shadow.
They need to understand the **translucent** (allowing light, but not detailed shapes, to pass through; semi-transparent) objects let some light through, but block some, so a fainter shadow is created.

They should be allowed to investigate to learn this knowledge (e.g. the picture below), discuss observations, and

Lesson 5 - Find patterns between shadow length.

Carry out an investigation into how shadows change when opaque objects are closer or further away from a light source.

Within the investigation children should see that when a light source is closer to an object, the shadow should be longer. They should also see that when the light source is further away from the opaque object, the shadow should be smaller.

Lesson 6 - Use secondary sources to research

Investigate how cameras and photography has changed over time. Why did the old cameras have a cloth that the photographer have to stand underneath? What do the modern-day lenses in cameras do to the light?

Provide feedback to the rest of the class as to your findings.

Link to topic

Lesson 7 – Understand the dangers of sunlight

- Discuss the key terms sun, source, light etc. that we have learned about in previous lessons.
- Discuss the sun as being the Earth's main **light source** (as well as a heat source

Children will know the dangers of the sun's light on our bodies – skin (sun burn, skin cancers etc) and eyes (cataracts, eye cancers, growths) in particular. Children will learn about what we can do to prevent these things – sunglasses, shade, suncream, etc.

Task – create a sun safety information video/poster, warning children of the dangers of sunlight on the body and eyes, and identifying the ways in which they can protect themselves.

Ongoing investigation over the whole term or half-term/term holiday.

See how coloured paper changes over time, when left in the window.
Cut out a shape in black paper. Place coloured paper underneath. Stick the two pieces of paper together, with masking tape. Attach the paper to the window, black side facing the sunlight.
Over time the black paper will remain the same, whereas the coloured paper will fade. This will allow children to observe changes over time.