SIMPLE LIGHT EXPERIMENTS FOR THE CLASSROOM
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HOW WE SEE

WHAT'S HAPPENING?

At first people thought that eyes themselves were a light source and that to see, light travelled out of your eyes onto the object, lighting it up and thereby you’d see it.

Then they realised that if there was no light source then we wouldn't be able to see. But they thought that the light source shone into our eyes and then our eyes somehow reflected it onto the object.

Finally, one scientist realised that our eyes hurt when we look at bright lights and that the pupil size changes in response to the brightness, therefore the eye must be a receiver of light from a light source bouncing off objects.

NOW WE KNOW THAT WE NEED LIGHT TO SEE

INSTRUCTIONS

Ask students to explain in a diagram how we see a simple object. They will often initially omit the light source. Show them that something is missing by removing the light from the room and asking 'can you still see the object? Then they may direct the light source to the eye before the object. Shine a light towards their eyes and ask 'is this helping you see the object?
PERISCOPE

WHAT'S HAPPENING?

Light from the light source (SUN mainly usually) shines on the object. Some of the light bounces off the object and travels into the periscope top mirror and is bent down to hit the bottom mirror then is bent again in direction of your eye. When this light enters your eye, you see this object - of course this all happens instantaneously.
FIBRE OPTIC LIGHT

WHAT'S HAPPENING?

The stream of water acts like a pipeline carrying the light rays. As the rays of light travel down the stream, they bounce or reflect, off the sides, traveling along the stream even as it bends. The rays of light hit the stream's sides at such a shallow angle that they don't break through the surface of the water i.e. the light can't escape from the stream.

Real life example

Fibre optic cables - because light is SO fast, travels in a straight line and can be bent, it is now used to carry messages. In the same way, fibre optic cables carry light rays along a bendy path by reflecting them off the sides of the fibres.

INSTRUCTIONS

Locate the hole in the bottle and stop it with your finger while you fill the bottle with water. Allow the water stream to run into the sink. Shine the torch from the back to the front of the bottle level with the hole. Place your finger under the stream - notice how the light travels down the stream onto your finger.
BALLOON POP

INSTRUCTIONS
Go outside. Blow up and tie the balloon. One person stands at one of the cones with the flag. Other person goes to the far cone with the balloon and the pin. You are watching/listening to see that you see the balloon pop before you hear the pop. Hold up the flag when you are ready for the popper to pop. Feel free to swap places and repeat for the other person. Experiment with distances. Please put your popped balloons into the bin.

WHAT'S HAPPENING?

Light travels at 3 hundred million metres per second through the air. Sound travels at 343 metres per second through air. So light is roughly 1 million x faster than sound.

We see the balloon pop slightly before we hear the pop. This effect would be more noticeable the further away from the balloon you were (but you may need binoculars at some point!).

Real life example

You see lightning before you hear the associated thunder.
RULER IN WATER AND OIL

INSTRUCTIONS
Set up a large glass jar with water and run the oil over the back of a spoon to form a layer on top of the water. Experiment with moving the ruler from side to side. Try a variety of objects in the water. If you use a ruler, the numbers are stretched or magnified as the light rays bend.

WHAT'S HAPPENING?
Light travels at different speeds in different mediums - air, oil, water. When light changes speed it bends because one edge hits the surface and changes speed very slightly before the other edge causing the light ray to bend.

Real life example

The fish is closer than the illusion.
DISAPPEARING SPOT

INSTRUCTIONS
Stand about half a metre away from the container so that you can see the spot over the side of the container. Then slowly lean back until you can just no longer see the spot. HOLD YOUR POSITION. Now your partner slowly fills the container using the jug of water. What happens?

WHAT’S HAPPENING?

The spot should become visible as the added water refracts or bends the light rays reflected off the spot at a more steep upwards angle towards you.
GLOW STIX

WHAT'S HAPPENING?
Light is produced in a chemical reaction = this is called luminescence.

Inside a glow stick is a glass vial of hydrogen peroxide. On the outside is a different chemical + a fluorescent dye. When you break the tube, the glass breaks and the chemicals mix producing light.

NO HEAT IS PRODUCED WITH LUMINESCENCE

Real life example
Glow worms = bioluminescence
Set up a number of small objects on black paper. Have the person with the torch sit in front of the objects with their back to them shining the torch directly away from the objects. The other person uses small mirrors to reflect the torch light in several steps until it strikes the object. Adjust the light path to light up each object.

WHAT'S HAPPENING?
Light bounces off reflective surfaces like mirrors. Because light travels in straight lines, the angle it bounces off the mirror is the same angle it is at as it hits the mirror.
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Light bounces off reflective surfaces like mirrors. Because light travels in straight lines, the angle it bounces off the mirror is the same angle it is at as it hits the mirror. The comb shows that rays of light travel in a straight not a wavy direction.
RAINBOW BUBBLE

INSTRUCTIONS
INDOORS: Stand by the windows - the more sun shining on the bubble the better. Pour a bit of bubble mixture on the lid and use a straw to gently blow a bubble on top of the lid. Look at a height just below the bubble dome across to the bubble's far side. You should see a bit of a refraction rainbow there.

OUTDOORS: Blow bubbles on a super sunny day. Notice the location of the sun and the best position to stand to see the refraction in the bubbles.

WHAT'S HAPPENING?
Light shines from the light source travels through air until it hits the bubble. There the light slows down slightly because the bubble liquid is more dense than the air and harder to travel through. The light rays which hit the bubbles’ surface not straight on, but at an angle are split into each different colour wavelength. So some of the the white light rays are split up into their component colours = refracted and we see a rainbow.
WRITE YOUR NAME IN REVERSE

Hold a mirror in front of your face. Cover your eye with your right hand. Look at the person in the mirror. Which hand - left or right - is covering their eye? Use a mirror to write your name/a sentence in reverse on the paper. Put the sentences on a high shelf. Use a metre ruler with a mirror on the end of it to read the messages.

WHAT'S HAPPENING?
Light bounces off reflective surfaces like mirrors but because the mirror causes the light to travel back in the opposite direction, the image is reversed.
Use felts to draw a design on the 1/3rd circle paper cutout. Place 2 mirrors on the 2 straight edges. How does your design look now? Experiment with changing the mirror angle. Experiment with a range of open shapes on the paper thirds. e.g. a fraction of a circle will join up to make a complete circle.

**WHAT'S HAPPENING?**

Light bounces off reflective surfaces like mirrors JUST LIKE A BALL would bounce off a wall. Another image of your design is formed each time the light from the object bounces off one of the mirrors. Because the bottom of the mirror touches the object, there is no gap in the design and it looks like a completely circular design.
MIRROR IN TRAY OF WATER

INSTRUCTIONS
The mirror sits at an angle in the tray of water leaning against the side. Shine the torch across the surface of the water towards the mirror. Hold the white card directly above the mirror. You are aiming to see rainbow edgings reflected on the white card above the mirror. Experiment with moving the torch and mirror around to get the best rainbow effects possible.

WHAT'S HAPPENING?
The water and mirror act like a prism, splitting the light into the colors of the spectrum. (When light passes from one medium to another, for example from air to water, its speed and direction change. This is called refraction. The different colors of light are affected differently. Violet light slows the most, and bends the most. Red light slows and bends the least. The different colors of light are spread out and separated, and we can see the spectrum.

YOU CAN ALSO DO THIS EXPERIMENT IN A GLASS OF WATER. REMEMBER TO PUT THE WHITE PAPER OVER THE TOP OF THE MIRROR TO CATCH THE RAINBOW.
LIGHT vs PAINT

WHAT’S HAPPENING?
The primary colours of paint are red, blue and yellow.
The primary colours of light are red, blue and GREEN (not yellow).

When the primary colours of light are mixed together, they make
WHITE light.

INSTRUCTIONS
Take a spoonful of each of the primary colours of paint and mix. Check with the paint chart.
Experiment with putting red, blue, green and yellow cellophane over the end of the torch and shining it on the white car to see what colours you get. Check with the light chart.

Real life connection: TVs are designed to mix only 3 colours Red, Green and Blue - heard of RGB cables? The human eye can only see RED, BLUE and GREEN. Using these 3 primary light colours TVs (and human eyes) can make millions of colours.
HOLES IN CARD

INSTRUCTIONS
Line up the cards using the skewer through the middle of the holes to make sure the holes are straight. Shine the torch through the holes. Light should show on the back board. Experiment with moving the holes around to see if you can get light to travel to the back board. USE A LASER POINTER from USAVE in Greerton for $2 for an awesome effect in this experiment. The laser will pass through the holes and reach the back of the classroom.

WHAT'S HAPPENING?
When the holes are not in a straight line, none of the light shows on the back board. This proves that light must travel in a straight line.
WHAT'S HAPPENING?
Students sometimes haven’t given thought to the difference between something which produces light and objects which are shiny/reflective but are not actually a source of light themselves.

Incandescence = hot light = light from heat sources = sun, fire, heaters, light bulbs
Luminescence = cold light - light from chemical sources = florescent lights, TV, Neon lights, luminous bugs, glow stix
CAN LIGHT GET THROUGH?

INSTRUCTIONS

Transparent = 100% see through objects
Translucent = some light can get through, but you can't look through the object to see what is on the other side
Opaque = no light can get through the object
Collect a range of transparent, translucent and opaque objects. Test with the torch. What is happening to the light in each case? Why?

WHAT'S HAPPENING?

Clear materials offer no barrier to the light rays and will **TRANSMIT** all of the light rays.

Opaque materials will stop light by **REFLECTing** all the light rays (as in mirrors) or **ABSORBing** all the light rays (as in black paper)

Translucent materials will **REFLECT** SOME of the light rays and **TRANSMIT** SOME of the light rays.
BLIND SPOT

INSTRUCTIONS

On a piece of card draw a red square and a green circle spaced apart about 8 cm. Hold the page at arm's length. Close your left eye and stare hard at the square with your right eye. Slowly bring the paper closer to your face. Does the green spot disappear? Now close your right eye and try again, looking at the green spot instead. What happens?

WHAT'S HAPPENING?

Your retina - the screen at the back of your eye onto which all incoming images are projected, has a little gap where the optic nerve joins the eye. This is your blindspot. Normally though one eye compensates for the other eye's blindspot because you see from slightly different angles with each eye. But this is not the case when you have one eye covered.
HOLE IN HAND

INSTRUCTIONS

Make a tube by rolling up a sheet of stiff paper. Tape the edge so the tube holds together. Hold the tube up to your right eye. Hold your left hand up beside the tube. Stare hard down the tube keeping your left eye open. Do you see a hole in your hand?

WHAT'S HAPPENING?
One eye is looking down the tube and the other is looking at your hand. The two views mix together so you see a hand with a hole in it.

When we use our eyes to see, our brain puts the two images together and they overlap.
ARE YOU LEFT EYED OR RIGHT EYED?

INSTRUCTIONS
Make a circle with your thumb and first finger. With both eyes open look at an object on the wall or in the distance, and centre it inside the circle. Now close one eye, and then the other. What happens?

WHAT’S HAPPENING?
When you closed your left or right eye you should have found that the object jumps outside the circle. If the object seemed to move when you closed your left eye - then you have left eye dominance. If the object moved more when your right eye was closed, then your right eye is the dominant one.

Your brain builds up an image of the world around you using slightly different views from your right or left eye. Most people tend to have a dominant eye so that even when both eyes are open, one is giving priority information.

The object you chose was lined up to be in the circle using information from your dominant eye. When you close this one you can see that the object was not lined up for your other eye. About 80% of the population are right-eyed, and a very small percentage seem to have no eye-dominance at all.

So what…?
If you take part in any sport that involves shooting at a target (eg archery or darts) then you should know your eye-dominance. Left eyed people should shoot with their left hand and vice versa.
OPEN AND CLOSE

INSTRUCTIONS - sit in a very dimly lit room with both eyes open. After 2-3 minutes observe the pupils in both eyes. Carefully bring a penlight up alongside the eye and shine into the eye for no longer than 1 second. Turn the penlight off. Compare the size of the pupils before and after shining the light into the eyes.

NOTE: This video shows quite freakish close ups of the eye and is excellent for showing that the pupil is actually a hole.

WHAT'S HAPPENING?
The pupil area is a hole where the light enters. There are eye muscles around the pupil which can change the size of the hole to cut down the amount of light getting in to stop the light hurting our eyes and damaging our retina.

Just behind the pupil (we can’t see it) is an oval shaped lens. The light reflected off the object enters our eye, hits the lens and is angled to the retina on the back of the eye. (The retina is like a screen at the back of our eye that the image is projected onto). Because the lens is not flat but curved (convex), the light is bent at an angle when it hits the lens and what we see is actually tipped upside down on the retina. But luckily the image travels up the optic nerve to the brain which can turn it up the right way for us.