Learn to Light:

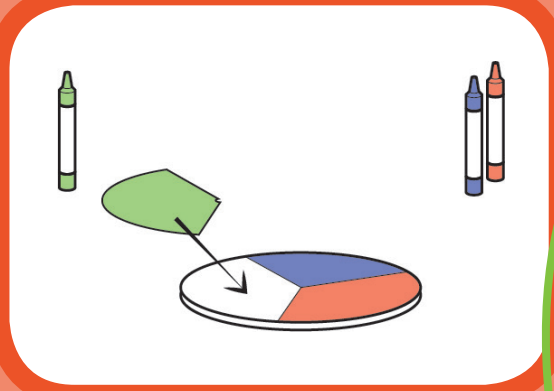
Colour White light is actually made up of lots of different colours. The 3 primary colours are red, green and blue. When light hits an object, some of it is absorbed and some of it is reflected. The light that is reflected is the colour of the object in that light. For example, a green object absorbs all the colours of the spectrum (white light) except green. The green light is reflected back and that is what we see.

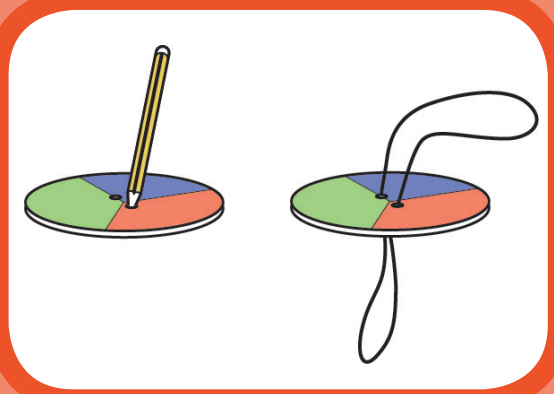
Experiment

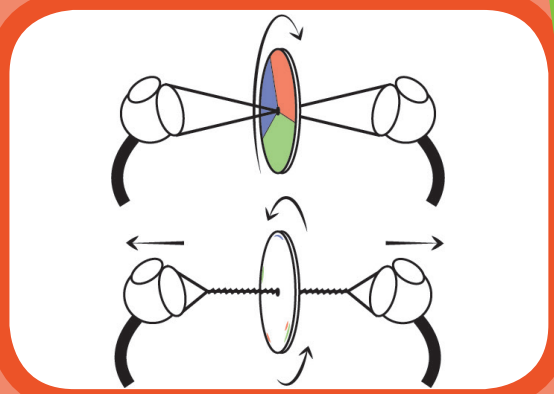
Make a Newton wheel

You will need:
A circle of card, coloured paper/pencil red, green and blue, a sharp pencil, scissors, some string

1. Divide the circle into 3 sections and colour one green, one blue and one red. *
2. Using the pencil make two holes either side of the centre. Thread the string through the holes and tie the ends together with a knot.
3. Twist up really tight, then pull the string outward and as it spins watch all the colours mix together to make white.







*You can also try colouring in the other side with each of the 7 colours in a rainbow.

When you mix coloured light this is called additive mixing. The colours add together to make white light. When you mix paint it is called subtractive mixing. The colours are absorbed leaving you with black.

Fun Facts

Objects that appear black in white light do so because they absorb all colours and reflect none.

Humans can see about 16 million different colours.

Black objects tend to get hotter in the sun than white objects because they absorb all the light. They then change the light energy into thermal (heat) energy.

Findings

What are the primary light colours ?

What colour do you get when you mix them ?

Do you get the same colour mixing paint ?

RED + GREEN + BLUE = _ _ _ _ _

Learn to Light:

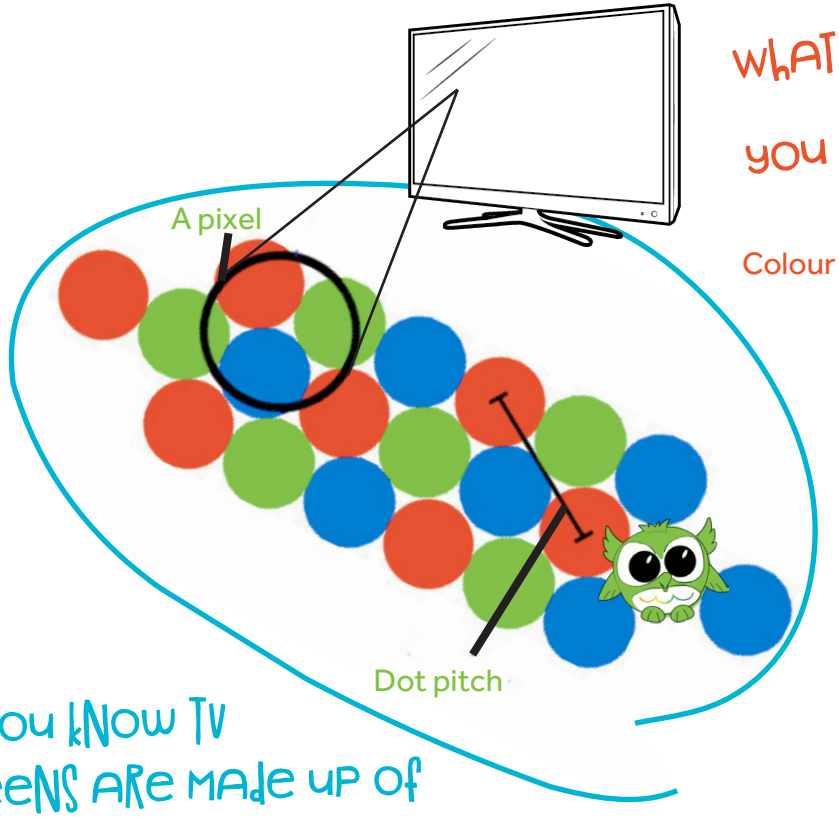
Conclusion The way coloured light mixes is very different from the way that paint does. We see light colours by the process of emission from the source (seeing the light given out from a light source) ADDITION. We see paint colours by the process of reflection (seeing the light reflected off an object) SUBTRACTION.

How do we see colour?

GREEN OWL + GREEN LIGHT = _____ owl

GREEN OWL + WHITE LIGHT = _____ owl

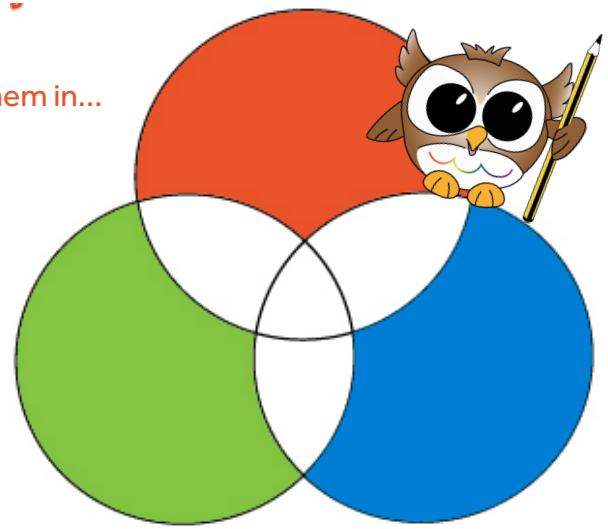
GREEN OWL + RED LIGHT = _____ owl



Did you know TV screens are made up of Red, Green and Blue dots of light?

What secondary colours do you get when mixing light?

Colour them in...



Grown-ups: Adult supervision is highly recommended for this extra task - carefully put a droplet of water or a magnifying glass on a white screen (mobile phone, tablet etc) and you will be able to see the red, green and blue lights in it. The lower resolution the screen, the clearer it will be.

Answers: FINDINGS - red green blue, white, no you get black, white SEEING COLOUR - green, green, black MIXING LIGHT - red + green = yellow red + blue = magenta green + blue = cyan all = white

Learn to Light:

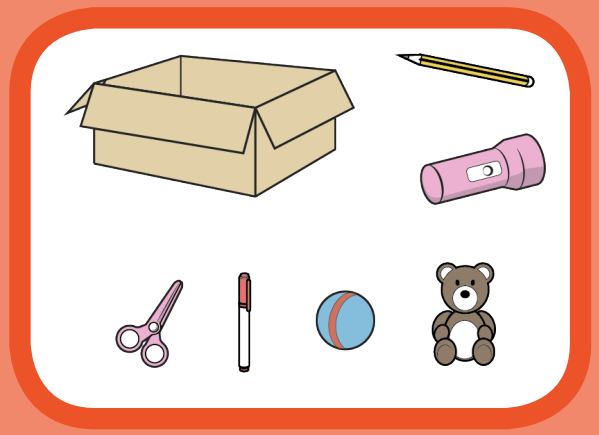
Light and Dark Light is a form of energy. Light is made up of photons and travels in a straight line as a light wave. The strength of the light depends on how much energy the photons contain. Light sources are luminous objects that give off light, like the sun, torches, TVs, candles, fireworks and some animals. We need light to see and light sources allow us to see in the dark. Dark is the opposite of light - dark is the absence of light.

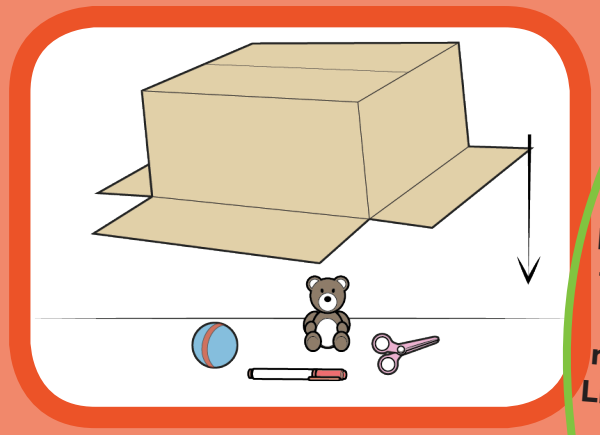
Experiment

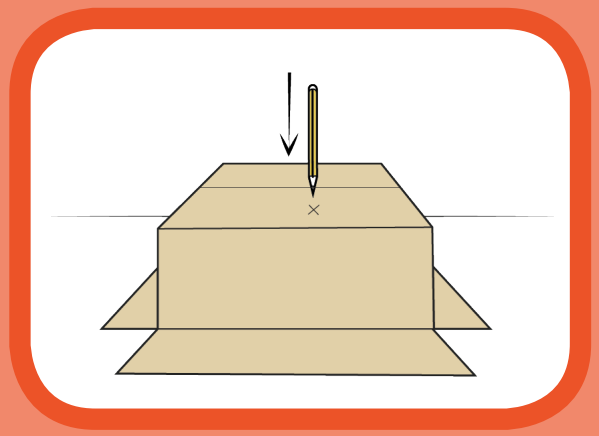
Making a dark box

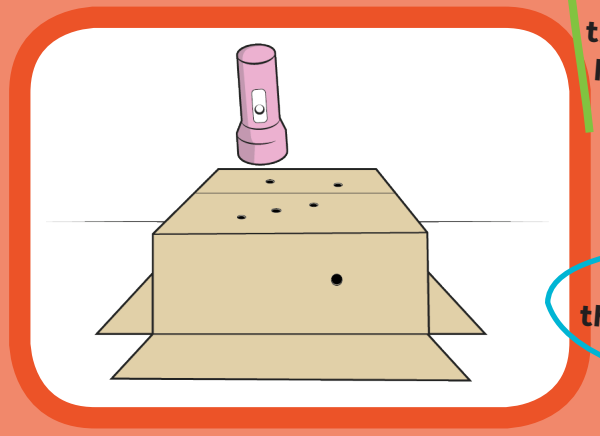
You will need:
A cardboard box, a sharp pencil, some objects from around the house, a torch

1. Turn your box face down on the table with any flaps folded out. What do you think it is like inside the box? Place your objects under the box.
2. Make a hole in the top of the box with a sharp pencil - what can you see through the hole? Make some more holes in the top - what can you see now? Try making holes in the side - can you see any of the objects?
3. Try shining a torch through one of the holes and looking through another - what can you see now?









Fun Facts

Light travels incredibly fast. Nothing can travel as fast as light. Light can travel up to 300,000 km per second (186,000 miles per second). Light travels faster than sound so that's why we see lightning before we hear the thunder.

Artists and photographers often use the contrast (difference) between light and dark to create striking images.

Plants use light energy to make their 'food'. The process is called 'photosynthesis'.

The moon does not give off light. The light we see is sunlight reflecting off the moon.

Findings

Can you see in the dark ?

What do you need to be able to see ?

Does having more light make it easier to see ?

Learn to Light:

Conclusion Light lets us see things, light provides warmth and energy, light helps things to grow and animals to communicate with each other. Without light there would be no life on earth. Light from the sun can be used to help generate green (renewable) energy, called solar energy. The sun is the biggest light source. When the sun sets at night we often describe it as being dark, but it is rarely completely dark as there's always a little bit of light. This is why we can still see.

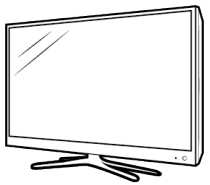
A firefly is a bioluminescent insect, which means it can make its own light. You might have even heard a firefly called a lightning bug.

The flashing part of a firefly is called a lantern. Can you colour in the lantern on the firefly...

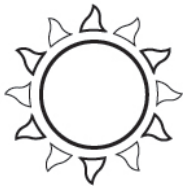
Which of these are light sources?

Colour them in...

Table lamp



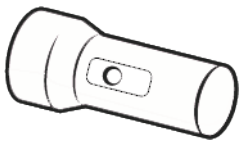
TV



Sun

Owl

Fire



Torch

Moon

Draw a circle around the one you think is the brightest (the one which gives off the most light).

Can you find these words?

				E	X	W	V				
		T	S	A	R	T	N	O	C		
	E	R	S	U	N	L	I	G	H	T	
	E	E	F	A	F	D	A	R	K	L	
W	S	F	W	A	V	E	X	X	C	F	L
J	U	L	W	T	H	S	P	E	E	D	T
P	L	E	N	O	T	O	H	P	X	A	W
Q	L	C	E	J	E	N	E	R	G	Y	X
	J	T	N	U	G	L	A	M	P	I	
	A	G	O	W	A	R	M	T	H	M	
		D	S	O	U	R	C	E	L		
				J	G	R	V				

SEE
DARK
LAMP
WAVE
SPEED
ENERGY
PHOTON
SOURCE
WARMTH
REFLECT
CONTRAST
SUNLIGHT

Grown-ups: A few other activities you can do... See how many different light sources you can find in your home; try turning each one on and discuss how the light emitted is different. Is it brighter or dimmer? Warmer or cooler? What shape is the beam? Treasure hunt in the dark; write down some words to do with light on white paper and stick up around a dark room or hide some treats. Set a challenge to find them all using just torch light.

Answers: FINDINGS - no, light, yes FIREFLY -the lantern is the last/tail section of the body LIGHT SOURCES - table lamp, TV, sun, torch, fire

Learn to Light:

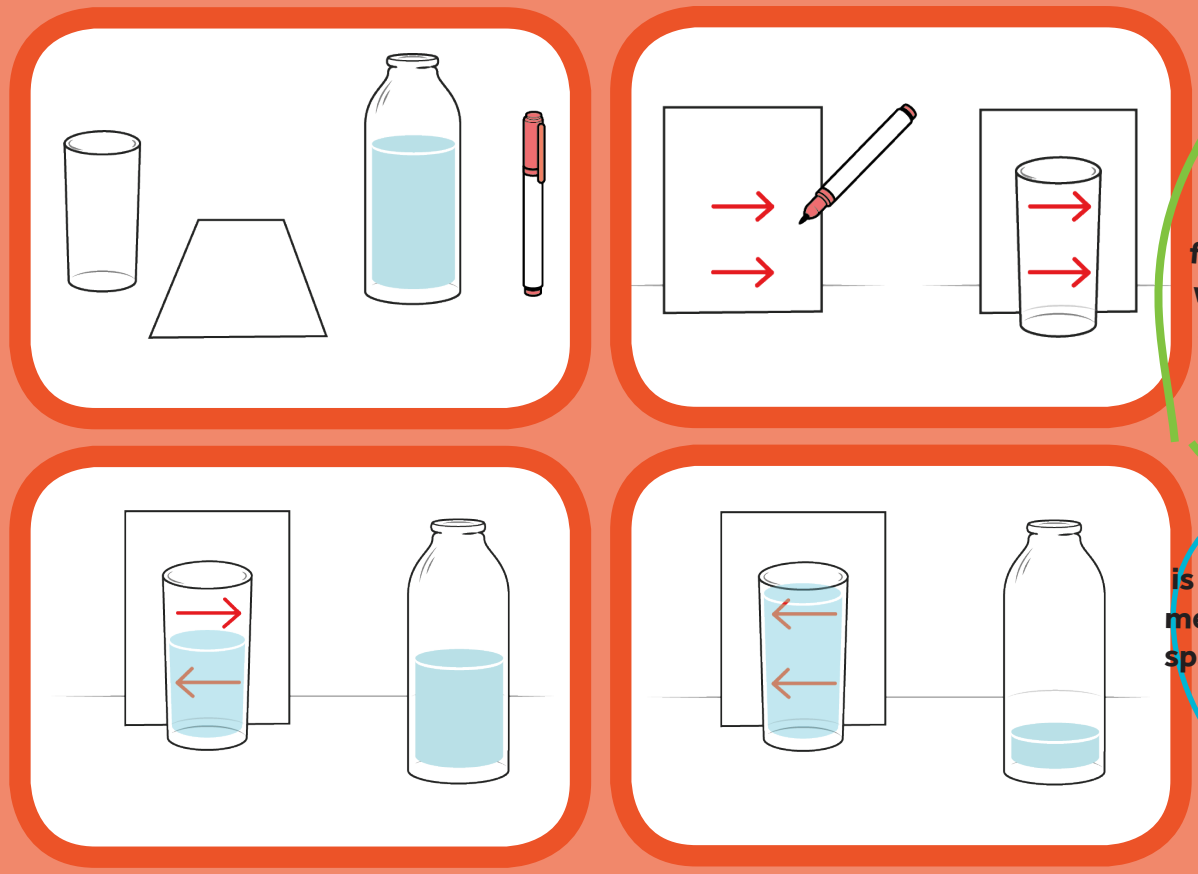
Light Waves Light travels in a straight line as a light wave. Light can travel through empty space (a vacuum) unlike sound which needs a medium like air or water. Light will continue to travel in a straight line until it hits something or travels through one medium to another. When this happens light is absorbed, reflected (bounces off), scattered (bounces off in lots of directions), refracted (changes speed and direction) or transmitted (passes straight through).

Experiment

Optical Illusion

You will need:
A clear glass, some water, a piece of paper/card, a pen

1. Draw two arrows one above the other, with both arrows pointing to the right of your card. Place the card behind your glass so you can see the arrows through the side of the glass.
2. Half fill the glass with water or until it covers the first arrow. What do you notice?
3. Now fill the glass to the top with water so the second arrow is covered. What has changed this time?



Fun Facts

Light takes about 8 minutes and 20 seconds to reach the Earth from the Sun. When we see the Sun, we are seeing what it looked like over 8 minutes ago.

The speed of light equals 300,000 km/second. Nothing else travels faster than light, not even sound!

A light-year is how astronomers measure distance in space. It's defined by how far a beam of light travels in one year – a distance of six trillion miles.

Each colour of light in the rainbow has a different length of 'wave'.

Findings

What changed when you added the water ?

If you look from the side what can you see ?

What happens when you drink the water and put the glass back ?

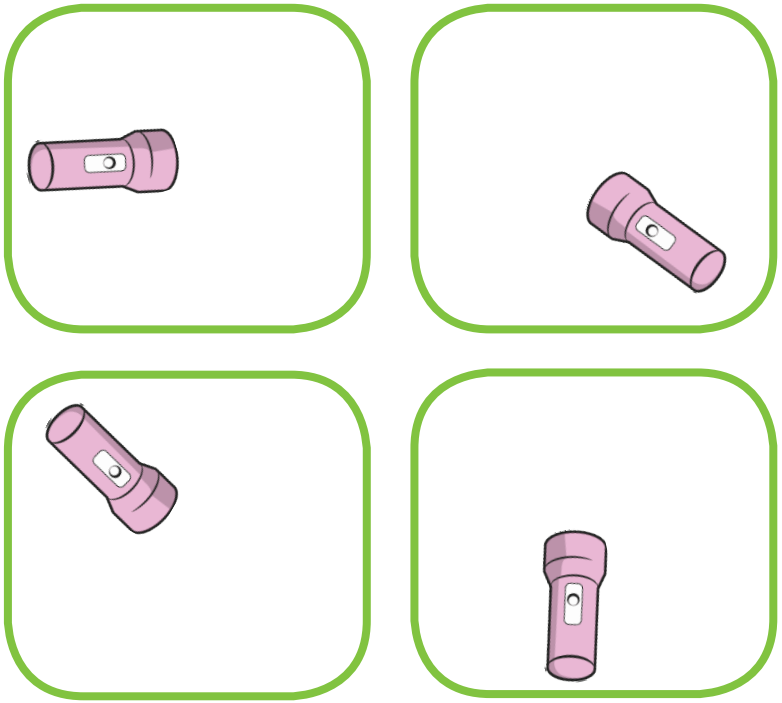
What moves faster than anything else in the world?

Learn to Light:

Conclusion Light can travel through air, water and transparent materials/ objects. If a material is transparent it means light can completely pass through it. Some materials only let some light through - we call these materials translucent or semi-transparent. Materials that let no light through are called opaque. Light travels at different speeds through different mediums and materials.

How does light travel?

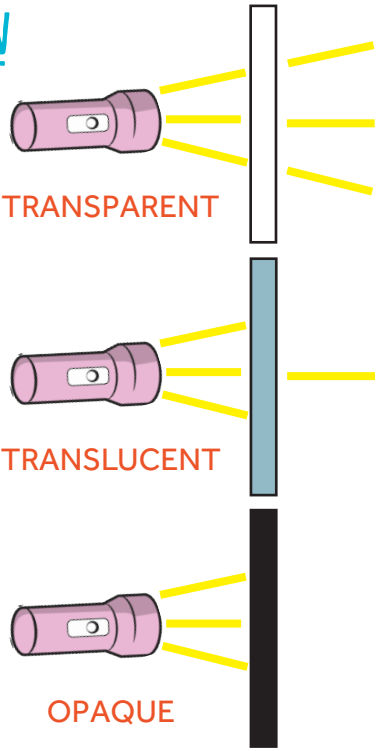
Draw how the light will travel from each torch...



An optical illusion is something that plays a trick on your vision (your eyes and your brain). What you see is different from reality.

A straw in a glass of water looks like it is broken or bent because light travels more slowly through water than air... this is refraction. Put a straw in a glass of water and try looking at it from different angles. What do you see?

Can you complete the sentences?



ALL light travels through .....

SOME light travels through .....

NO light travels through .....

Using a torch test different materials in the house to find one of each and write them down.

Grown-ups: If you don't have time to search the house testing different materials and are looking for a one-stop shop for some quick examples of transparent, translucent and opaque materials then plastic wrap/cling film, baking paper and tin foil are good examples.

Answers: FINDINGS - the arrows look like they have changed direction, the arrows haven't changed direction, the arrows change back HOW LIGHT TRAVELS - in a straight line STRAW sometimes it looks broken and sometimes bent SENTENCES - examples would be: plastic wrap, baking paper, tin foil.

Learn to Light:

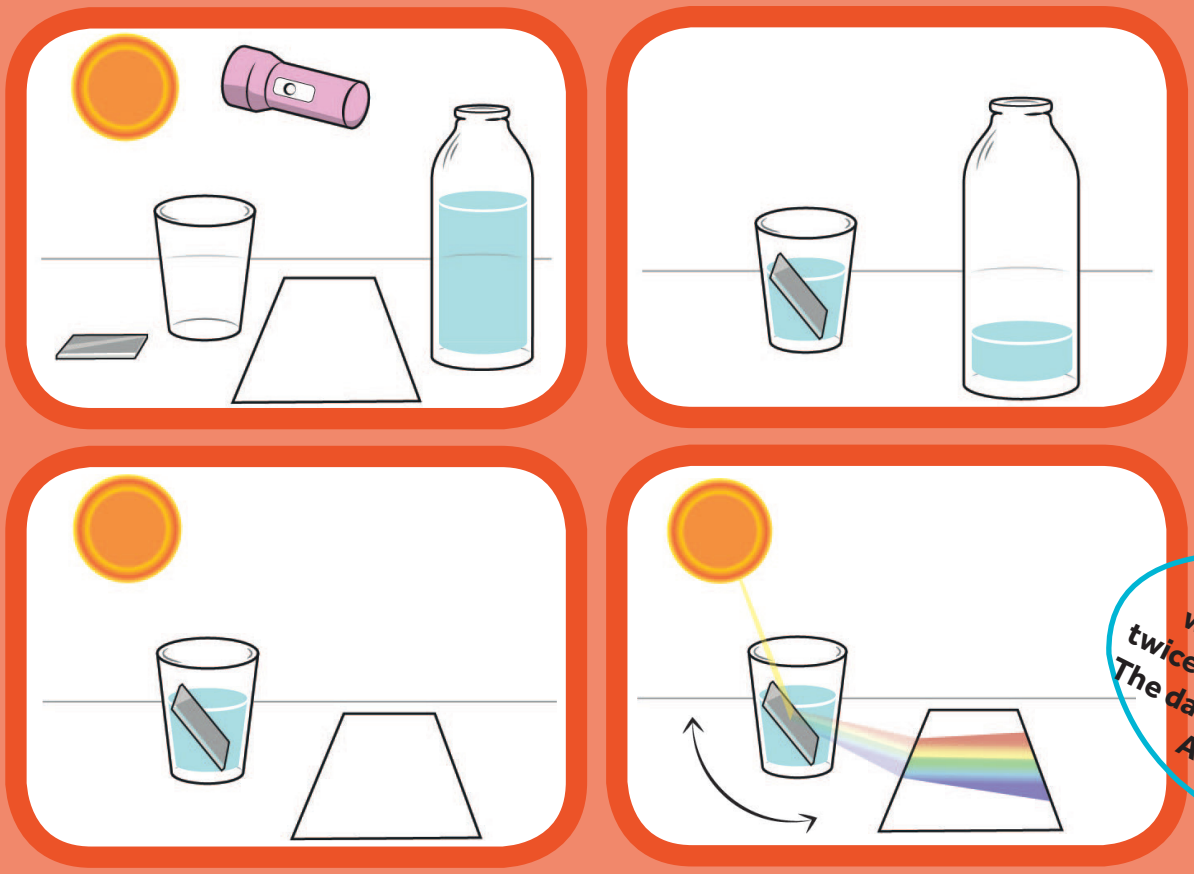
Rainbows Rainbows are formed when light shines through water, like when the sun shines through the rain. As the light passes from the air to the water, the light is bent (this is called refraction) and reflected (like a reflection in a mirror). This process splits the white light into all the colours of the rainbow. Rainbows can happen wherever light is being bent inside water droplets such as fog 'fogbows'.

Experiment

Make a rainbow

You will need:
A glass
A small mirror
A piece of white paper
Direct sunlight/torch
Some water
Some magic!

1. Fill the glass with water and place the mirror in it.
2. Place the glass in direct sunlight or shine a torch onto the mirror. Place the paper on the other side of the glass.
3. Adjust the angle of the mirror until you see the rainbow.



Fun Facts

In many cultures rainbows symbolise hope because they often appear when a storm is passing and the sun is coming out again.

There is no end to a rainbow. Rainbows are actually full circles. But from the ground we can only see part of the rainbow so we see them as an arc.

Double rainbows are very rare. You get them when the light is reflected twice inside the water droplets. The dark area between is called Alexander's Band.

Moonbows are created by moonlight rather than sunlight and normally appear white.

Findings

How many colours can you see in your rainbow ?

Can you touch a rainbow ?

What shape is a rainbow ?

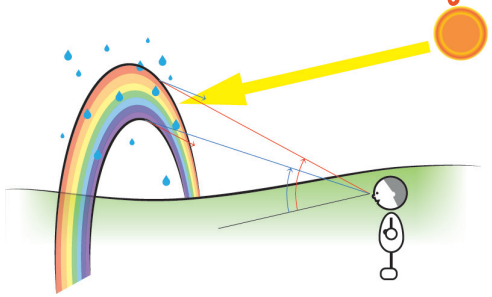
R_ _ O_ _ _ _ _ Y_ _ _ _ _ G_ _ _ _ B_ _ _ I_ _ _ _ _ V_ _ _ _ _

Learn to Light:

Conclusion The angle of the light hitting the water effects how we see rainbows. The sun needs to be behind us and the rain in front of us in order to see a rainbow. The sun needs to be low in the sky, at an angle of less than 42° above the horizon. What makes rainbows so special is that no two people see exactly the same thing.

CAN YOU DRAW A RAINBOW?

WHERE ELSE CAN YOU SEE A RAINBOW?

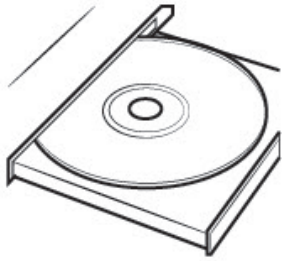


Colour them in...

A ribbon

A crystal

A fountain



A CD

A bubble

An owl

WHAT DO YOU THINK A LEPRECHAUN LOOKS LIKE?

Leprechauns, small fairies dressed in green, are known to be practical jokers who love to play tricks on humans. Irish legends hold that leprechauns hide their gold in a pot at the end of a rainbow. Do you believe the legend or is it one of their tricks?

Grown-ups: You can also try creating a rainbow in the following ways; shining a light source on a CD or through a prism - if you are using a torch rather than the sun try doing it in a dark space. Using a water hose in very bright sunlight - stand with your back to the sun, put your thumb over the end of the hosepipe to get a fine spray of water, look at the spray against a dark background such as a fence and adjust your position until you can see a rainbow.

Answers: FINDINGS - 7, no, circle, red orange yellow green blue indigo violet LEPRECHAUNS - it's a trick, rainbows are circular so there is no end WHERE ELSE - a crystal, a fountain, a CD, a bubble

Learn to Light:

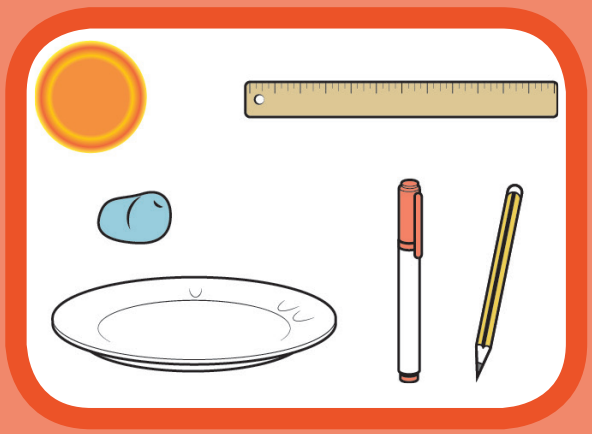
Shadows Shadows are formed when the light from a light source is blocked by an opaque object. Light rays travel from a source in straight lines. If an opaque object gets in the way, it stops some of the light rays travelling through it, and an area of darkness appears behind the object. The dark area is called a shadow. Shadows are not totally black. If you look closely at a shadow, you will see a dark area in the centre (the umbra) and a lighter area around it (the penumbra).

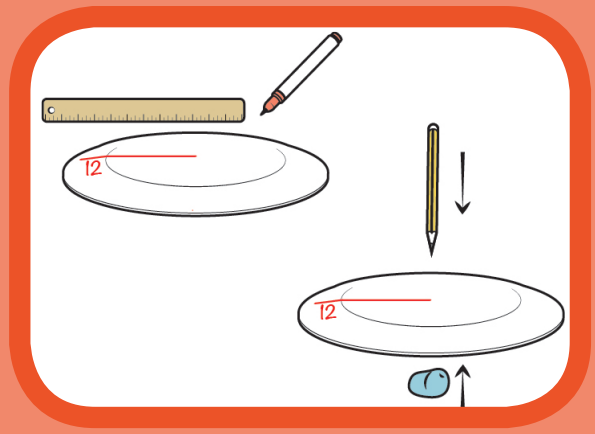
Experiment

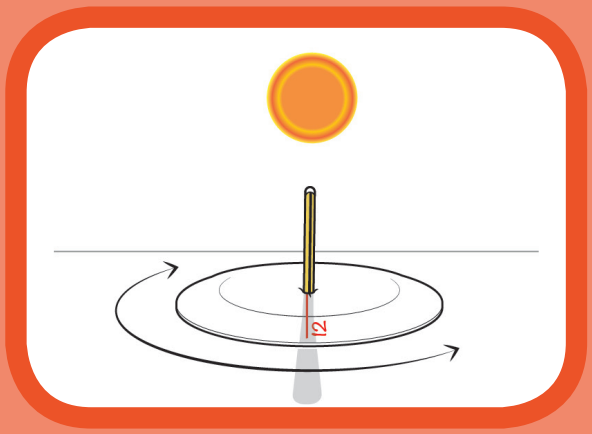
Make a sundial

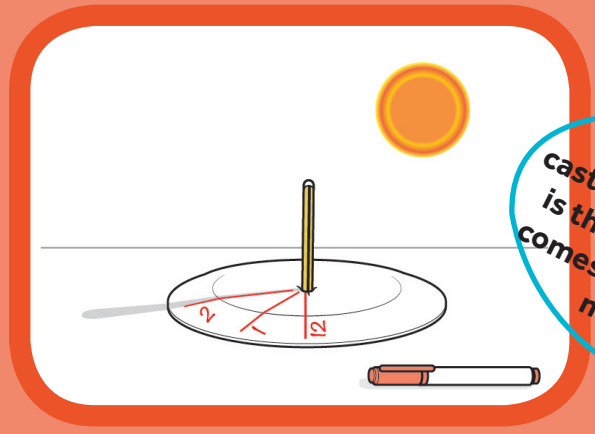
You will need: A paper plate, sharp pencil, pen, ruler, sunlight, blu tack

1. Make a hole in the centre of the plate. Write the number 12 on the edge of the plate and draw a straight line to the hole. Put the pencil through the hole and secure with blu tack.
2. Place your plate in the sun and at 12pm turn so the shadow lines up with the line to the number 12.
3. An hour later draw a line where the shadow is now and write the number 1, repeat every daylight hour until you have a complete sundial to tell the time by.









FUN FACTS

The sundial was the first time keeping device and is one of the world's oldest scientific instruments.

Shadow play, also known as shadow puppetry, is an ancient form of storytelling. Chinese legends state that the first shadow puppet was made more than 2,000 years ago.

A gnomon is the pointer on a sundial that casts the shadow (your gnomon is the pencil). It is a word that comes from ancient Greek and means 'indicator'.

A solar eclipse occurs when the Moon passes in front of the Sun casting a huge shadow across the earth.

Findings

Is the shadow always the same shape and size ?

At what time is the shadow longest ?

Do all things have a shadow ?

Riddle: I follow you around in the light, I say goodbye to you in the night? What am I?

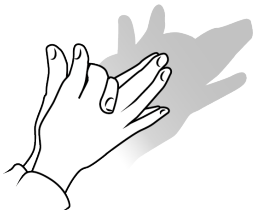
Learn to Light:

Conclusion The size and shape of a shadow depends on the position and size of the light source compared to the object. Moving an object nearer a light source will make the shadow bigger and moving it further away will make it smaller. Changing the angle between the object and the light source will change the length of the shadow.

Shadow Play

Can you make an owl shadow using your hands?

As far back as prehistoric times people have used their hands to help tell stories creating simple shadows reflected on the walls of fire-lit caves.



Can you put on a shadow puppet play?

Choose a favourite book, create puppets for each of the characters by cutting out paper shapes and attaching them to the end of a pencil/straw with some sticky tape. You can also make pieces of scenery and props in the same way, then you're ready to act out the story.

Create a screen by putting a white bed sheet/large piece of white paper in front of a window or light source. Make sure the rest of the room is dark. Place objects behind the screen but in front of the light source to create shadows on your screen.

Can you guess what the shadow is?

Each person finds an object from around the house, making sure no one else sees what it is. When it's your turn you place your object behind the screen and everyone else has to guess what it is from the shadow it creates. The person to get the most correct is the winner.

Can you match the object to its shadow?

Grown-ups: It doesn't take very long to set up a screen and once it's done kids can have hours of fun playing different games and learning a lot. For best results, make sure the sheet is as taut as possible. Filming a shadow puppet play to send to grandparents is also a lovely way of keeping in touch.

Answers: FINDINGS - no, early morning or late afternoon, no transparent objects do not have shadows MATCHING THE OBJECTS - the glass should be matched with the empty box

Learn to Light:

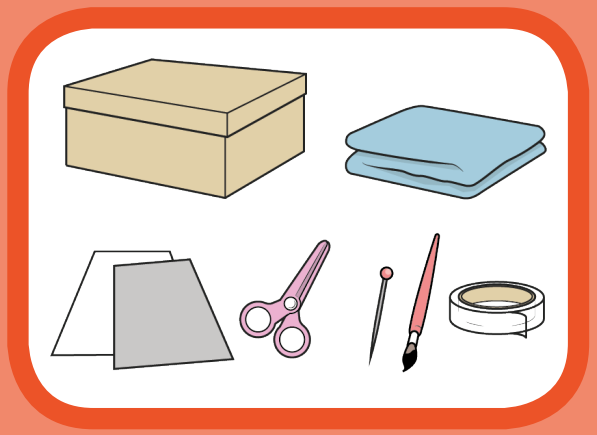
Vision We see things when light enters our eyes. The pupils in our eyes change size to let more light in when it's dark and less light in when it's bright. Too much light can damage our eyes, whilst too little light makes it hard to see. Not all objects give off light; we see most objects because light is reflected off their surface and into our eyes. Our eyes focus the light from an object to form an image of it at the back of our eye (the retina) and our brains then interpret the image as a vision.

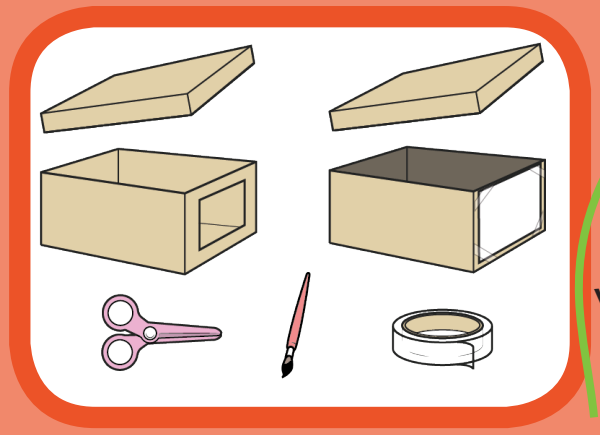
Experiment

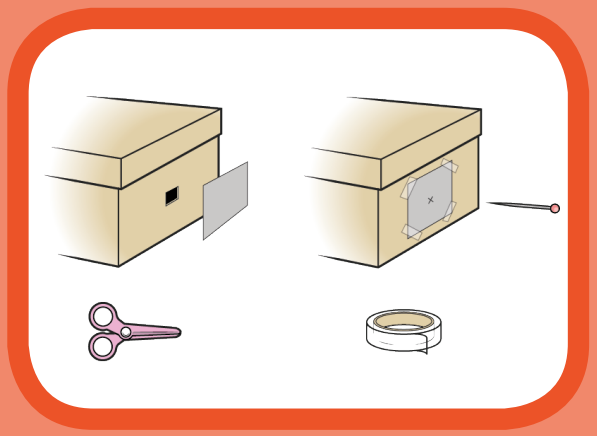
Making a pinhole viewer

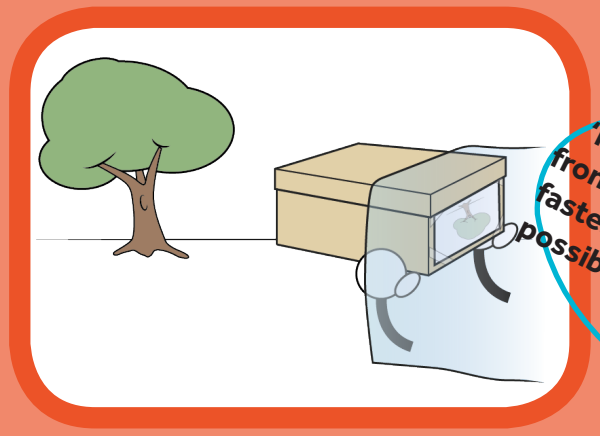
You will need: A shoe box, a piece of tracing/baking paper, a pin, scissors, tin foil, tape and black paint

1. Cut a large oblong hole at one end of the box and cover with tracing paper. Paint (or line with paper) the inside of the box black.
2. Cut a smaller opening at the other end of the box and cover with tin foil. Using a pin carefully pierce a hole in the centre.
3. Cover yourself and the box with a thick blanket leaving just the tin foil end of the box poking out. Point it at an object and look at the tracing paper screen to see the image.*









*Make sure light is only entering through the pinhole, so tape up any gaps and use a thick enough blanket.

Fun Facts

During World War II the RAF started a myth that carrots helped their pilots see in the dark. Eating carrots won't enable you to see in the dark but they do contain vitamin A which keeps your eyes healthy.

Cats eyes glow in the dark because the back of their eyes act like a mirror. This helps reflect and absorb more light making it easier for them to see at night.

The saying 'in the blink of an eye' comes from the fact that the eye is the fastest muscle in our body. It's possible to blink up to 5 times a second.

Newborn babies see upside down until their brain learns to turn the image the right way up.

Findings

What can you see and what is unusual about the image ?

What happens if you cover the pinhole ?

What happens if you make the pinhole a little bigger ?

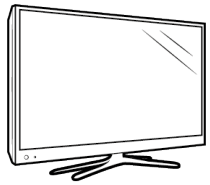
I'm closed at night, I give you sight, what am I?

Learn to Light:

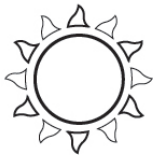
Conclusion We need light to see. Light travels in a straight line from an object and into our eye where the image appears upside down - our brain then flips the image the right way up. The more light the easier it is to see. Some people are afraid of the dark, especially at bedtime, but it's very rarely completely dark in our bedrooms. When we change from a light space to a darker space it just takes a few seconds for our eyes to adjust and let more light in so we can see again.

How do we see these objects?

Draw a line to show how the light reaches our eyes...



How does inquisitive owl see the TV?



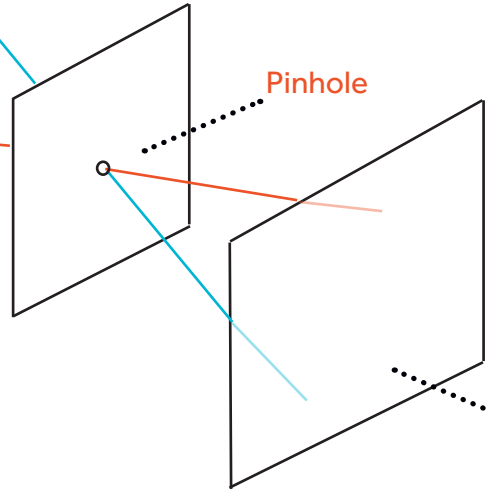
How does inquisitive owl see the football?

How does inquisitive owl see the tree?

Which way up will the image be?

Draw the image...

Object



Owls are nocturnal and hunt for food at night. They have big eyes to help them see in dim light. They can see a mouse moving over 15meters away by just the light of a candle.

Bright Light

Dim Light

Get a mirror and look at your eyes, then close the curtains and turn the light off. Wait for 30 seconds, then turn the light back on and look at your eyes again - do they look different?

Grown-ups: If you have / buy some photographic paper then you can easily convert your pinhole viewer into a pinhole camera and take real photos with it. Another quick activity to show how vision also helps us to keep our balance: try standing on one leg with your eyes open then try again with your eyes closed - it's much harder to keep your balance when your eyes are closed.

Answers: FINDINGS - an image, it's upside down, the image disappears RIDDLE - an eye HOW DO WE SEE - tv>eye, sun >football>eye, torch>tree>eye IMAGE - draw the owl upside down NOCTURNAL - your pupils change size.