

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

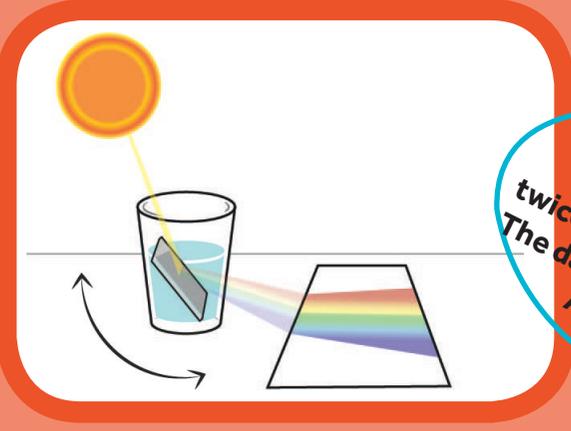
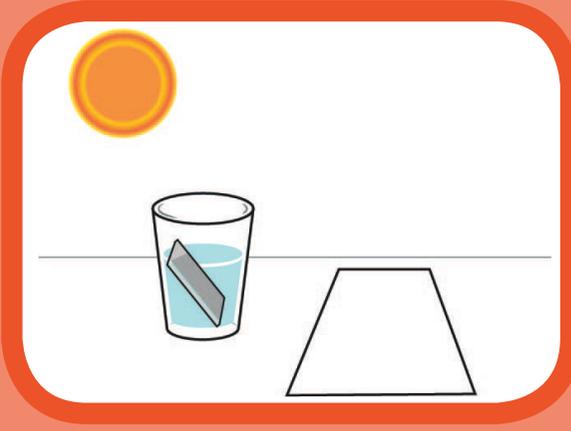
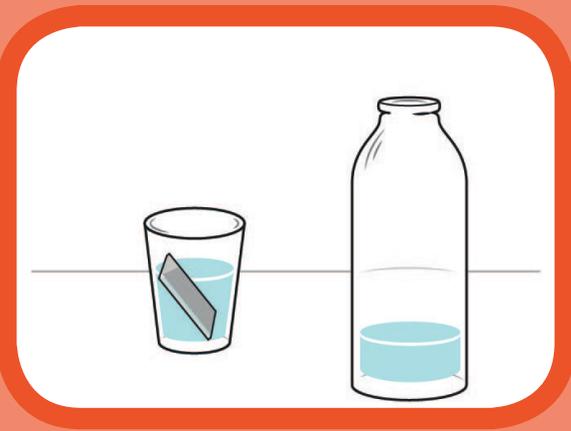
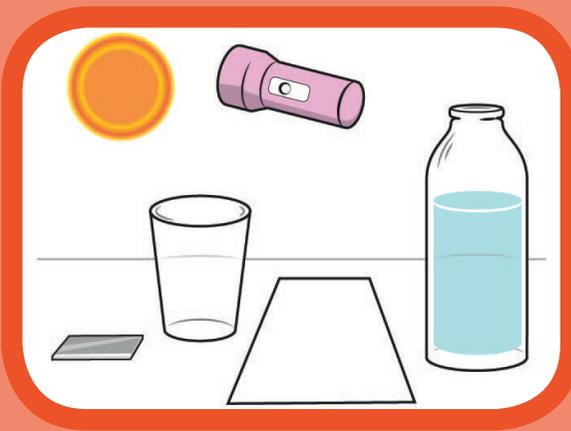
A piece of white paper

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 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 ?

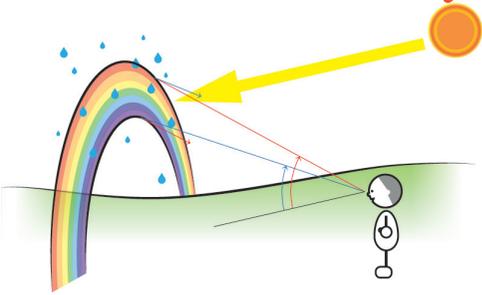
What shape is a rainbow ?

R _ _ O _ _ _ Y _ _ _ G _ _ _ B _ _ _ I _ _ _ V _ _ _

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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?

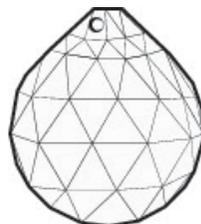


WHERE ELSE CAN YOU SEE A RAINBOW?

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

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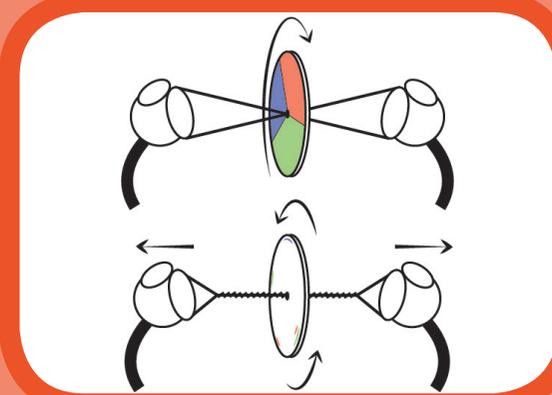
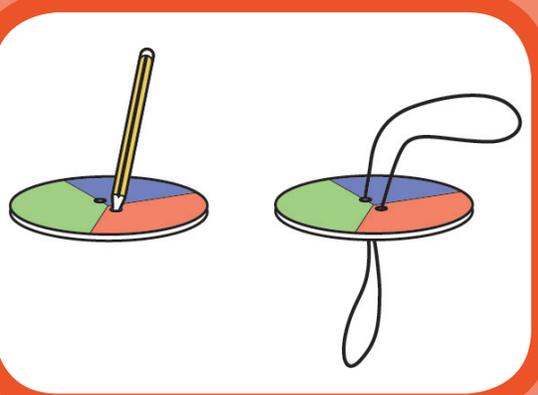
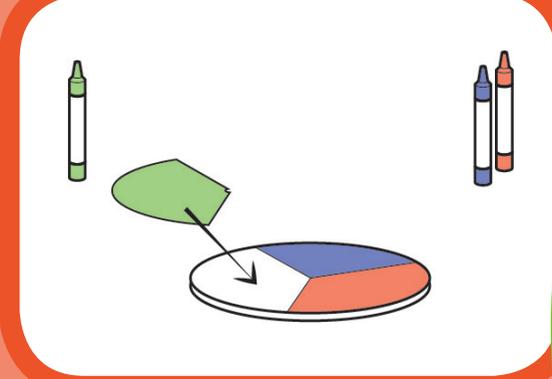
Colour White light is actually made up of lots of different colours. The 3 primary colours are red, green and blue. When light hits an object, some of it is absorbed and some of it is reflected. The light that is reflected is the colour of the object in that light. For example, a green object absorbs 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.

FUN FACTS

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.

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 ?

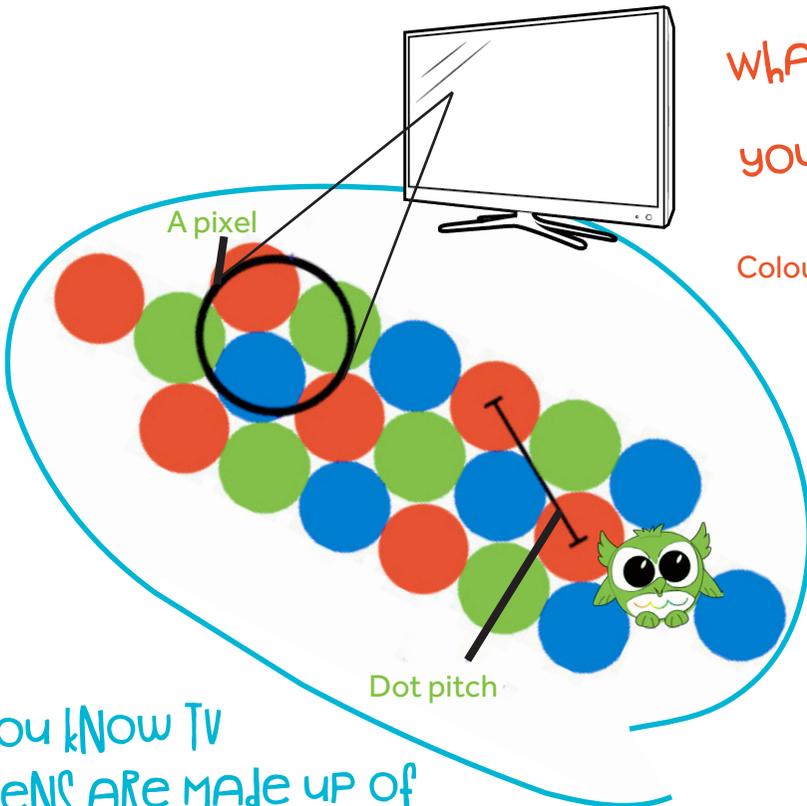
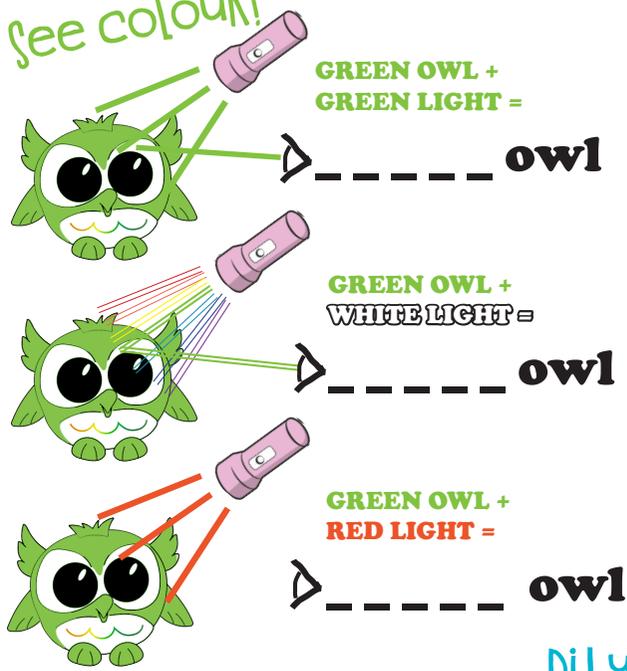
RED + GREEN + BLUE = _ _ _ _ _



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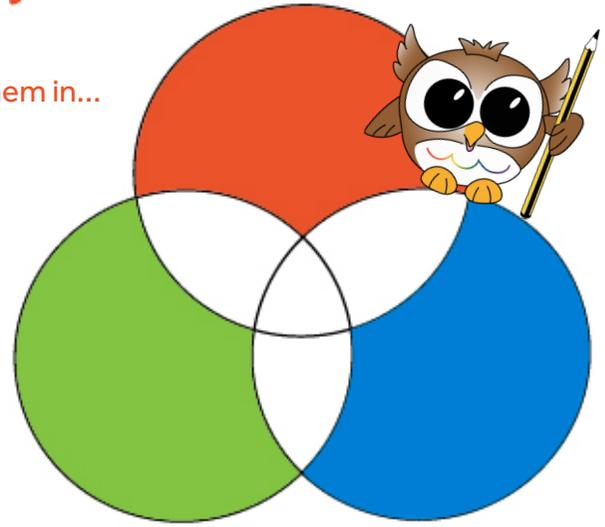
Conclusion The way coloured light mixes is very different from the way that paint does. We see light colours by the process of emission from the source (seeing the light given out from a light source) ADDITION. We see paint colours by the process of reflection (seeing the light reflected off an object)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

How do we see colour?



WHAT SECONDARY COLOURS DO YOU GET WHEN MIXING LIGHT?

Colour them in...



Did you know TV SCREENS ARE MADE UP OF Red, green AND blue dots of light?

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

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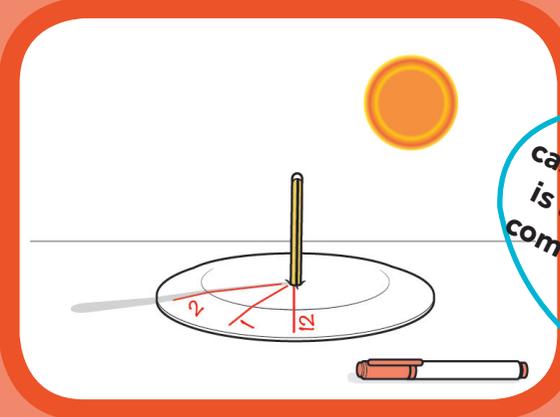
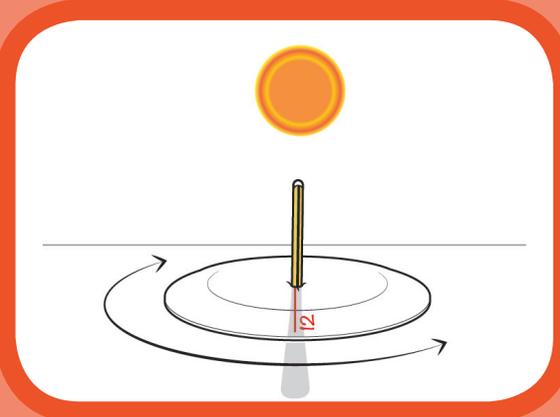
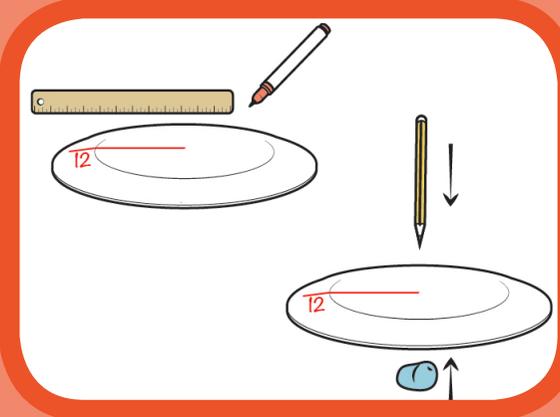
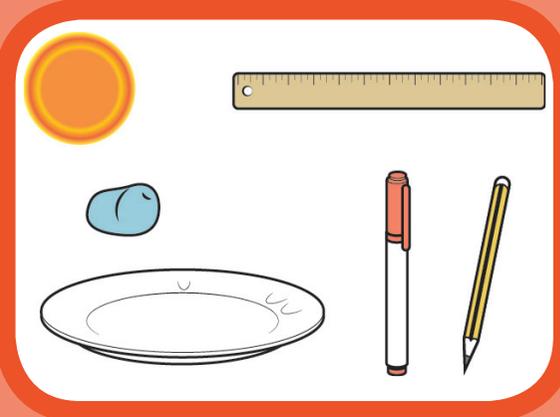
Shadows Shadows are formed when the light from a light source is blocked by an opaque object. Light rays travel from a source in straight lines. If an opaque object gets in the way, it stops some of the light rays travelling through it, and an area of darkness appears behind the object. The dark area 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?

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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.

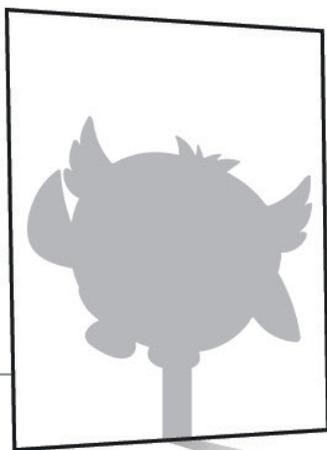
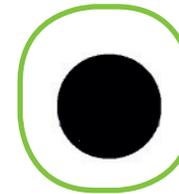
Shadow Play

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 MATCH THE OBJECT TO ITS SHADOW?



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.

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.



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.

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.