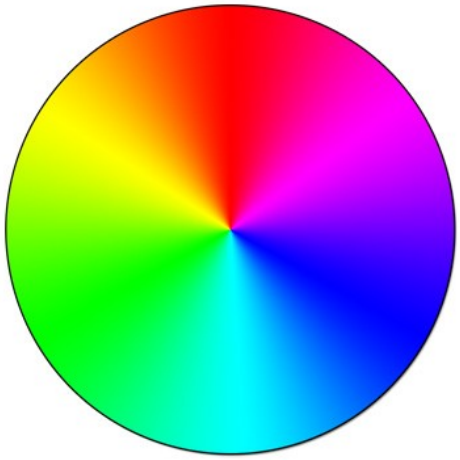
Scattering– Teacher Resource

After the scattering experiment on Lab in a Lorry, the students should know that white light is made up of a spectrum of colours, how light interacts with particles in the Earth's atmosphere to make the sky look blue, and what polarised light is.

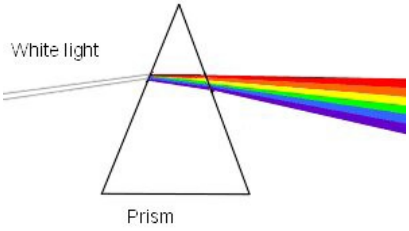
This follow-up is focused around the electromagnetic spectrum and can be adapted to suit different ages.

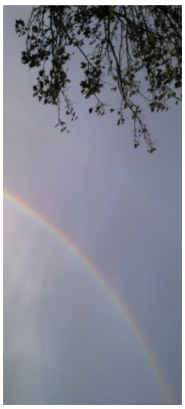
Splitting white light. Demonstration or possible class activity. Equipment: Ray box, slit, triangular prism.	White light is made up of all the colours of the rainbow mixed together. In science we call this the visible spectrum. Use a ray box and prism to demonstrate the above. What is happening to the path of light as it passes through the glass? Why do the different colours get separated? If enough equipment is available, this could be run as a class activity. Get the students to plot the path of the ray through the glass and then mark the colours produced on the other side.
How do we see colour?	Specialised cells in our eyes enable us to see. These photoreceptors are split into two groups, Rods and Cones. Rods are sensitive to the brightness of light. Cones are sensitive to colours. There are 3 types of cones and each is sensitive to a specific colour of light, either red, green or blue. All colours can be produced by mixing these 3 colours in different proportions, so our brain determines the colour of an object by comparing the amount of each of these colours.

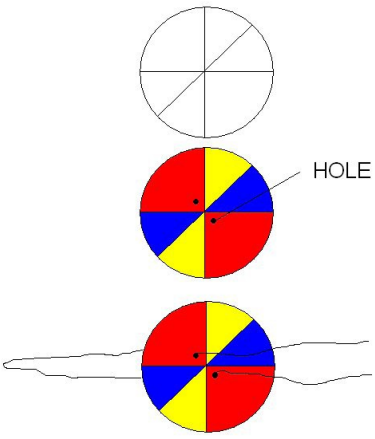


Work sheet: Investigating colour

Light and colour.	Normal light is called "white light" but white light is very special. In fact white light is made up of all the different colours mixed together. You can see this using a light source and a prism. • A common name for the different colours seen this way is a "rainbow" but in science we call it a ..... We are able to see objects because light bounces off the object and into our eyes. The colour we see an object depends on the colour of light which reaches our eyes. For example, an object which appears red is reflecting red light, and absorbing all other colours. • Complete the sentence below for a different colour. An object which looks ..... is ..... light and ..... all the other colours.
Activity: Making a colour mixer. Equipment: Card, coloured pens, string, scissors, glue, pair of compasses.	• Use the pair of compasses to draw 3 circles on the card. Each circle should be about 10cm across • On 2 of the circles draw lines that go through the middle and split the circle in half. Do several of these so that it looks like the one on the right. • Now use the pens to colour in each section of the circles • Once you have coloured in both circles glue them onto either side of the 3rd circle. Make sure the colours are pointing outwards. • Now use the compasses to make 2 holes on opposite sides of the circle but close to the centre - see the diagram • Thread the string through one of the holes, pull it through 3/4 of the way and then thread it back through the other hole. • Hold the 2 loose ends of string in one hand and the middle of the string in the other. Spin the circles around to wind up the string and then gently pull it apart. What happens to the colours? • What colours would you need to use if you wanted the colours to mix and make white? Try it and see.







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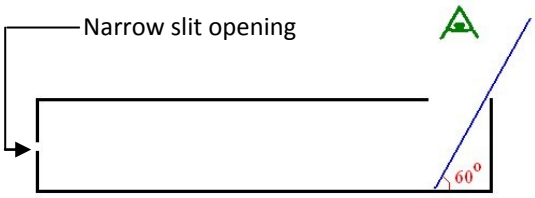
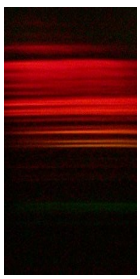
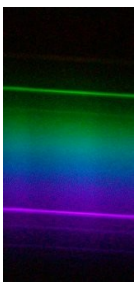
Creating a Spectrometer

Looking at Light	
Making a spectroscope Equipment: Cereal box CD/DVD Tape	A simple spectrometer can be built from a CD and a cereal box. Cut a very thin slit on the side of the box, about 0.2mm wide. If the slit is too large, the spectrum lines will look blurred. If it is too narrow, the spectrum will be too dim. Opposite the slit, at the other end of the box, insert the CD with about a 60 degree angle. When you look down onto the CD you should be able to see a spectrum created by the light coming into the slot.
What can you see?	Hold the slit in the box up to a source of light (shown by green arrow in photo). The light will be diffracted on the cd, so that you can see the different colours of light that are making up the light you can see. For example, the light from a red neon sign will look red on the cd. (See below) Investigate different types of light and see if there are any major differences. The images below are from some different light sources. What colours can you see when you look at: A) a laptop screen? B) the Sun at sunset? C) coloured LED lights?




Red neon light


Blue neon light


Candle light


Flourescent light


Incandescent light


The Sun

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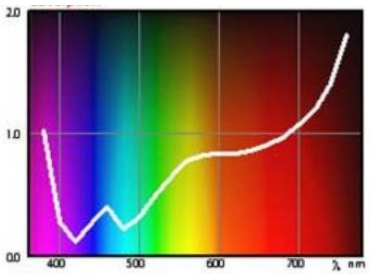
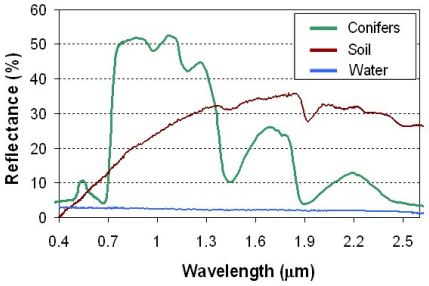
Creating a Spectrometer

What can this be used for?

Analyse the light	By analysing the light, we can see what things are made of. The spectroscope is a device that splits up the light into its component colours so that we can analyse it. Different elements make different colours when they glow. We can heat up objects or gases in a flame, or we can pass electricity through them. You will have already noticed that some forms of light will show fuzzy spectrum, with no clear lines, whereas others have very clear bright lines. Hot gasses will produce light that is made up of only a few colours. These will make bright lines in the spectrum. We can use these lines to work out what the object is made of. Every element has its own spectral 'fingerprint' or spectral signature. This image shows what a spectral signature looks like. The x-axis shows the wavelength of the light, from violet (short wavelength) to red (longer wavelength). The white line shows how much of each wavelength of light is emitted.  Astronomers use this information to work out what makes up the stars, nebulae, the sun and atmospheres of other planets. Spectral signatures have also been worked out for a lot of elements and objects on Earth. For example, the diagram to the right shows the spectral signatures of conifer trees, soil and water.  What do you think the spectral signatures of these things would look like: A) A fluorescent lamp? B) A red neon light? C) A purple flower? D) A blue car?
Did you know?	Scientists have recently discovered that the blue component of sunlight triggers us to feel more awake. They have suggested that the reason we find it hard to wake up when there is no sunlight is because not enough blue light is being emitted from lightbulbs. This is also the reason they suggest that you don't use your computer or laptop before bed, as it emits a lot of blue light that will wake you up.

If you want to know more, check out the Science & Technology Facilities Council website (www.stfc.ac.uk) where there are more experiments that you can do, and videos you can watch about their facilities.

www.stfc.ac.uk/seeingscience

There is also a template for a spectrometer at:

http://www.nationalstemcentre.org.uk/elibrary/file/10112/SpectrometerTemplate.pdf