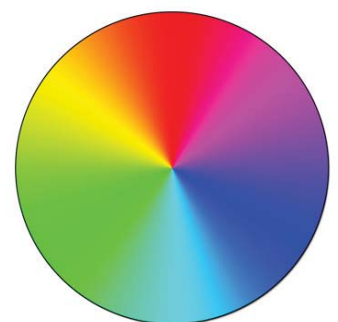


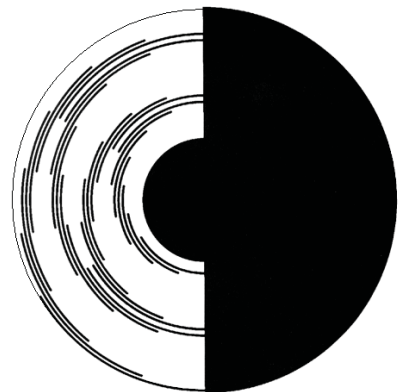
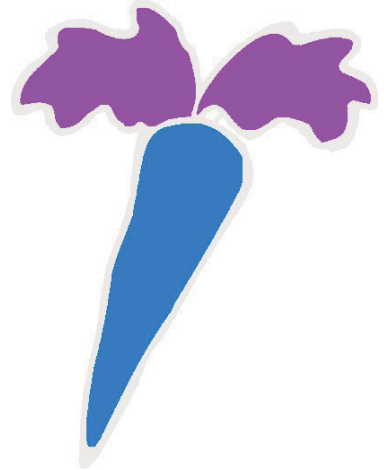
After visiting Lab in a Lorry the students should be familiar with the word 'optoelectronics'. This is basically the study of electronic devices that emit, detect and manipulate light. Common optoelectronic devices include LEDs and digital cameras. On board Lab in a Lorry the students will have investigated how a camera works and how we use lenses to gather light and focus images. This resource includes some follow-up activities which can be done in the classroom.

Activity	Information
<p>Splitting white light</p> <p>Demonstration or possible class activity.</p> <p>Equipment: Ray box Slit Triangular Prism</p>	<p>White light is made up of all the colours of the rainbow mixed together. In science we call this the visible spectrum.</p> <ul style="list-style-type: none"> Use the ray box and prism to demonstrate the above. What is happening to the path of the light as it passes through the glass? Why do the different colours get separated? <p>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.</p>
<p>Make a colour mixer</p> <p>Equipment: Card Coloured Pens String Scissors Glue Pairs of Compasses</p>	<p>In this activity the students can investigate what happens when we mix different colours together. There is a student worksheet with instructions on how to make a colour spinner provided at the end of this document.</p>
<p>How do we see colour?</p>	<p>Specialised cells in our eyes enable us to see. These photoreceptors are split into 2 groups, Rods and Cones.</p> <p>Rods are sensitive to the brightness of the light</p> <p>Cones are sensitive to colours.</p> <p>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.</p>

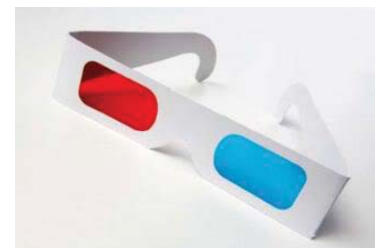
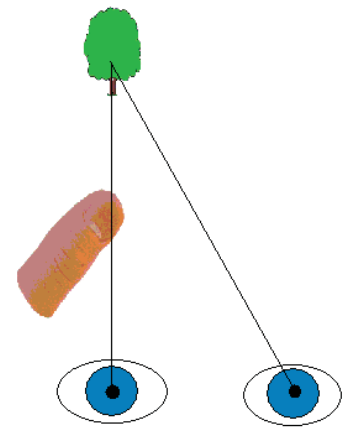


Activity	Information
Negative Images	<p>The cones in our eyes can be overstimulated by staring at the same colour for a long period of time, this causes them to become desensitized to that particular colour. For this reason surgeons often wear green clothing. Occasionally looking at the green maintains the ability to see red whilst operating inside the body.</p> <p>Overstimulation of the cones can lead to the production of so-called Negative images (sometimes called After images). By staring at a particular image for a long time your eyes become desensitized to the colours in the image and if you then gaze at a white background for a few seconds you will see the same image but the colours will be opposite. This is a common optical illusion and a few examples are given on the right. Try staring at them for around 30 seconds and then look at something white. You might like to use these as an introduction to the lesson.</p>
Investigating Negative Images	<p>Included is a worksheet for the students to complete. This involves looking at some negative images of well known flags. The students should stare at each image for 30 seconds and then look at a blank piece of paper to produce an after image of the flag in its original colours. They can then write down what country the flag belongs to (you may need to provide a book of flags or use of the internet etc)</p> <p>As an extension the students can draw/colour their own negative flag and challenge others to identify it.</p> <p>A similar activity can be run using anything that incorporates different colours, for example, identifying negative sports shirts. To produce your own versions paste the images into MS Paint or other graphics software and select either "invert colours" or "negative image". Images with 2 or 3 colours work best, avoid images with many different colours.</p>
<p>Optical Illusions</p> <p>Class Activity</p> <p>Make a Benham's Disk</p> <p>Equipment:</p> <p>Worksheet</p> <p>Scissors</p> <p>Card</p> <p>matchsticks</p>	<p>In 1894 Charles Benham discovered that a rotating black and white disk can produce the illusion of colour. Whilst the reason behind this is not fully understood, the most likely explanation concerns the response rate of the different cones in our eyes. When we see white or black the cones are all registering equal amounts of red, green and blue light. By quickly swapping between white and black the receptors in our eyes are essentially being turned on and off. Since the cones respond at different rates a residual colour can be seen. The colour itself depends on the ratio of black to white and the speed at which the disk is spinning.</p> <p>There is a photocopyable worksheet with instructions on how to make the disk and another optical illusion.</p>

stare for
30
seconds



Activity	Information
How do we see in 3D?	<p>The world around us is 3D - this means we can move forward and back, left or right, and up or down. We call these 3 different axes. A normal picture is only 2D - it doesn't move in or out of the page, so how can we create the illusion of 3D?</p> <ul style="list-style-type: none"> • First of all - let's look at how we see things in 3D. Ask the class to hold up a thumb, shut one eye, and then line it up with an object in the distance. Now ask them to keep their thumb still, and swap eyes - the thumb is no longer lined up with the object. This is because the other eye is looking from a different position or angle.
Why is 3D vision useful?	<p>Being able to see in 3 dimensions enables us to judge distances between objects, we call this depth perception. This is particularly useful when trying to navigate around obstacles without bumping into things.</p> <ul style="list-style-type: none"> • Split the class into groups of 2. Give each group a soft ball. One person is the thrower and the other the catcher. The catcher must cover an eye with their hand and then attempt to catch the ball using their other hand. Catching with one hand can be tricky, but without the depth perception provided by both eyes it becomes very difficult indeed.
<p>Class Activity</p> <p>Making stereoscopic images</p> <p>Equipment: 2 Cameras Mount for the cameras</p>	<p>Ask the students if they've ever seen a 3D picture in a book or a 3D film at the cinema? How do they work? This activity explains how and gives the students the chance to make their own pair of stereoscopic images.</p> <p>You'll need to mount the 2 cameras side by side on a piece of wood etc and secure them to prevent them falling off.</p> <p>Whilst taking the pictures it's easier to get the class to work in pairs since the pictures need to be taken by both cameras at exactly the same time. You will need to download the pairs of pictures and distribute them to the students for viewing. The pictures must be placed side by side and can be viewed on a screen or printed off.</p>
<p>Class Activity</p> <p>Make a 3D Anaglyph</p> <p>Equipment: Red and Blue crayons, Acetate sheet, Red and Blue permanent markers, sticky tape</p>	<p>After making a pair of stereoscopic images the students can now have a go at making their own 3D anaglyph. These are the kinds of 3D pictures often seen in books, with typically red/blue outlines. They will also need to make some improvised 3D glasses to view the pictures. Before handing out the crayons you will need to experiment with the different colours to find the shades of blue and red which work best. Draw lines using each shade on a piece of paper and then view them through one of the home-made filters. The line which is the least visible will be the best colour to use.</p>



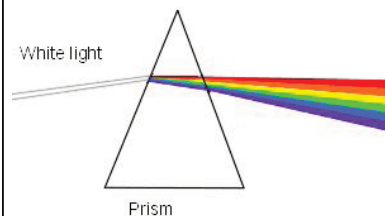
Forces, Electricity and Waves

Second	Third
<p>By exploring reflections, the formation of shadows and the mixing of coloured lights, I can use my knowledge of the properties of light to show how it can be used in a creative way.</p> <p style="text-align: right;">SCN 2-11b</p>	<p>By exploring the refraction of light when passed through different materials, lenses and prisms, I can explain how light can be used in a variety of applications.</p> <p style="text-align: right;">SCN 3-11a</p>

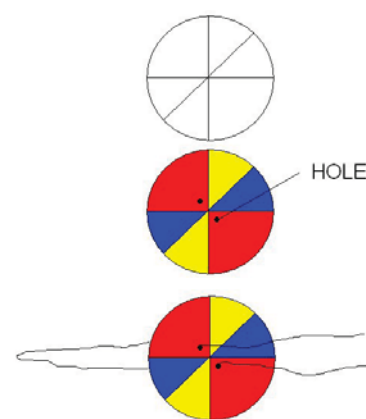
Biological Systems

First	Second
<p>I have explored my senses and can discuss their reliability and limitations in responding to the environment.</p> <p style="text-align: right;">SCN 1-12b</p>	<p>I have explored the structure and function of sensory organs to develop my understanding of body actions in response to outside conditions.</p> <p style="text-align: right;">SCN 2-12b</p>

Light and Colour	<p>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.</p> <ul style="list-style-type: none"> 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. <p>An object which looks is</p> <p>light and all the other colours.</p>
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Activity	<ul style="list-style-type: none"> 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
Make a Colour Mixer	<ul style="list-style-type: none"> 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
Equipment: Card Coloured Pens String Scissors Glue Pair of Compasses	<ul style="list-style-type: none"> 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? <p>What colours would you need to use if you wanted the colours to mix and make white?</p> <p>..... Try it and see.</p>



Worksheet - Negative Images

Can you identify which countries these Flags belong to?
Write your answer under the flag.

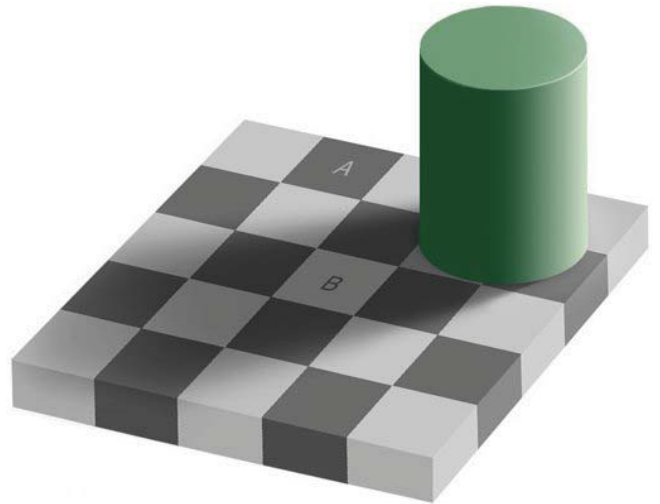
Stare at each flag for 30 seconds then look at a blank piece of paper, what do you see?



Sometimes our brain can be tricked into seeing colours differently. To judge different colours the brain compares an objects colour with the colour of other objects around it. Along with the information from our eyes, the brain also uses information it has learnt from everyday life.

- Look at the picture on the right. Is square A darker or lighter than square B?

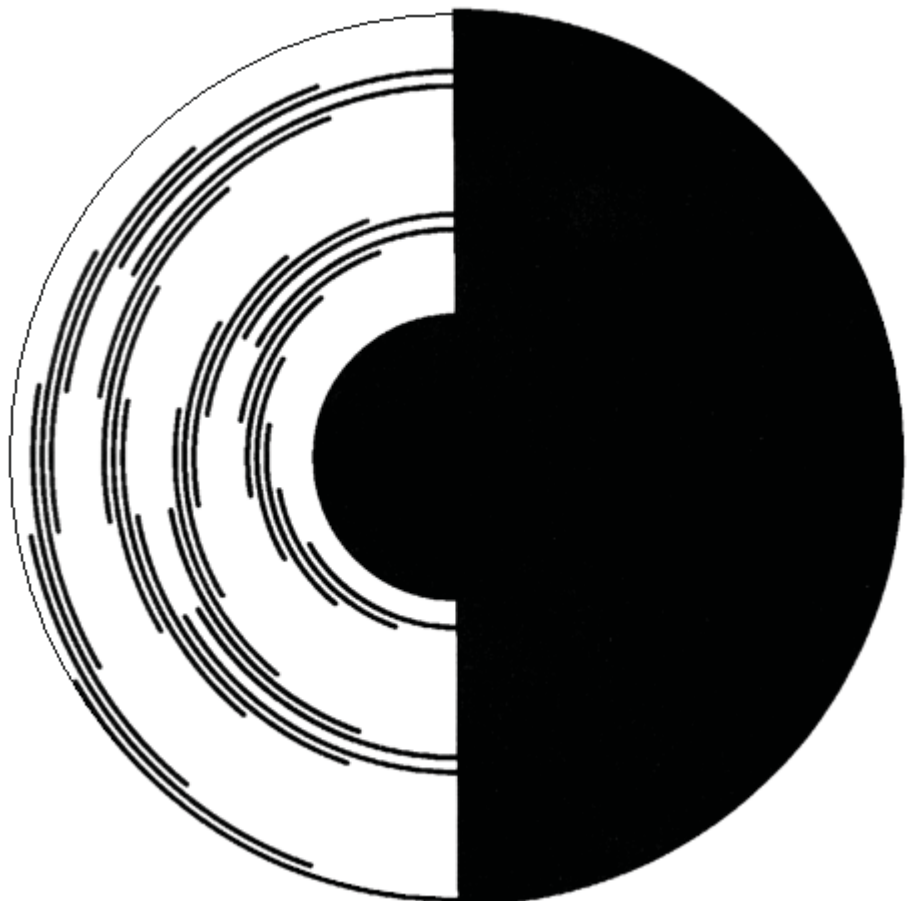
In fact they are exactly the same colour! Try covering up the other squares if you dont believe it.



So how does it work? Square B is in the shadow of the green cylinder so our brain expects this area to be dark. The squares around B and the letter itself are all very dark so this makes square B appear lighter in comparison. Square A is surrounded by lighter squares and the letter is light too, so in comparison with these it appears much darker. Overall square B appears light and A appears dark, but they are identical.

The picture on the right is called a Benham's Disk.

- Cut it out and stick it onto some card to make it stronger
- Push a matchstick through the centre to make it into a spinner.
- Spin the disk and look at it - what do you see? Try spinning it at different speeds and in the opposite direction. What do you notice?



Worksheet - Investigating 3D Images

Our brain uses the information from both eyes to see the world in 3D. To create a 3D picture we need 2 images of the same object, but from slightly different positions.

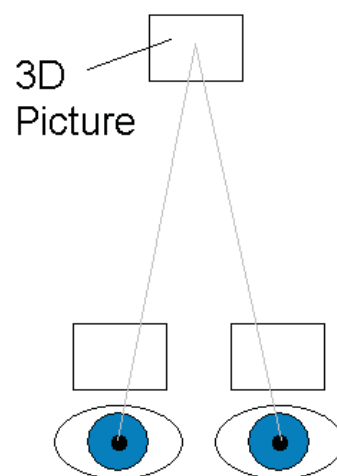
The first and simplest 3D pictures were called stereoscopic images and were produced using 2 cameras - this is the kind we're going to make now.

Taking the Picture(s)

To make a simple 3D picture all you need is 2 cameras side by side. You must take a pair of pictures - ie a picture with both cameras at exactly the same time. Work with a partner, with one person controlling each camera. Once you have taken a pair of pictures pass on the cameras to the next group.

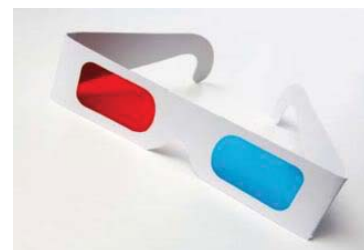
Seeing the picture in 3D

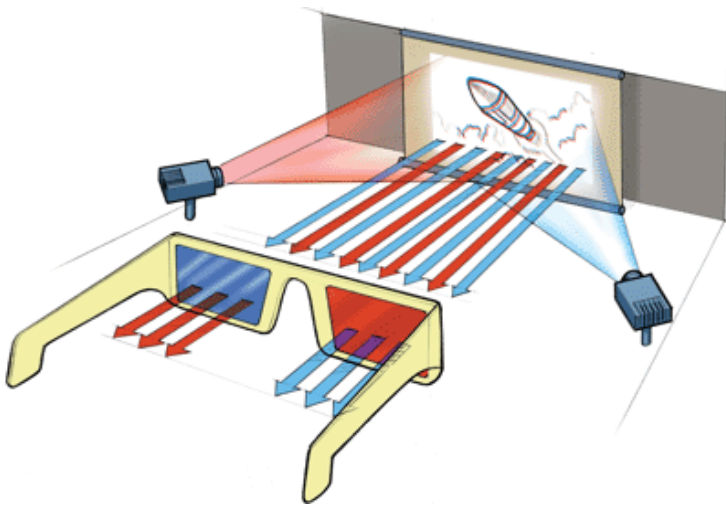
The pictures need to be placed side by side - like the ones below. To see it in 3D hold the paper up to your face (or move your head very close to the monitor) so that your left eye sees the left picture and your right eye sees the right picture. When this happens you will only be able to see one overall picture - but it will probably be very blurry. If the image isn't clear slowly move away from the screen or paper until it becomes clear and in 3D.



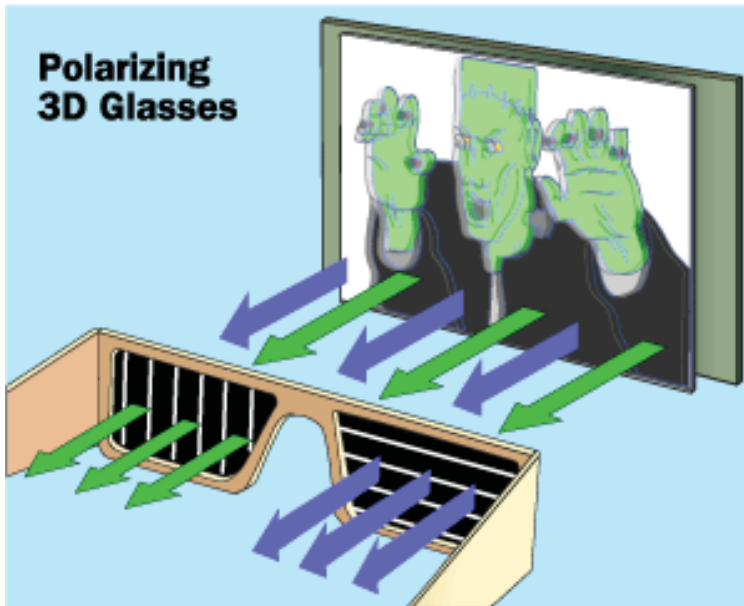
If you've ever seen a 3D picture in a book or at the cinema you probably had to wear some special glasses. These glasses work by forcing each eye to see a different picture. The pictures are of the same objects but from a slightly different angle - exactly like the pictures above. The difference is that using the glasses makes it easier to see the 3D images and the pictures don't need to be as far apart.

There are two main types of glasses, ones with coloured lenses and ones with dark "polarised" lenses. The lenses act as filters which block out one of the images, allowing each eye to see a different picture.





With these coloured lenses the left eye sees the red image and the right eye sees the blue image. This type of 3D image is called an 'anaglyph'. 3D pictures using this method often lack colour since the pictures need a blue and red outline. Also some people may struggle to see them depending on their eyesight.



The polarised glasses work by only allowing light through if it's lined up correctly with the lens. In this picture the colours are green and blue but this is only to highlight the difference between the orientation of the light. The green light is horizontal and the blue is vertical. In real life the colours aren't important since all the colours are 'polarised' either one way or the other. This means that 3D films using this technology are much better because the colours appear normal and don't have a red/blue tinge. They are also easier to see, especially for people with sight problems.

Make and View a 3D Anaglyph

- Use the sticky tape to stick the two crayons together - side by side. Make sure they both reach the paper at the same time.
- Draw a simple picture using the two crayons together. Don't make it too complicated because it will be difficult to see in 3D.

To view your 3D picture you will need some 3D glasses. If you don't have any here's how to make your own.

- Use the permanent markers to colour in two bits of acetate sheet. Remember the colours need to match the two colours you used to draw the picture. In this case you'll need blue and red - one of each.
- To see the picture in 3D cover each eye with the coloured plastic - if it's not working try swapping the colours around.

Equipment List

Red and Blue crayons,
Acetate sheet,
Red and Blue permanent markers,
sticky tape