Scattering
Quick Start Guide

What's it all about then?

This experiment lets you explore the way that light is scattered by particles and also shows the effect of polarisation.

What you can explore through this experiment

- White light is made up of all the colours of the rainbow
- Light is scattered by particles in the atmosphere and not all colours scatter at the same time
- Polarisation

How to present it

This is a guideline of how to present the experiment to the students. You do not have to follow it exactly, just as long as you allow the students to explore the concepts outlined above. You can expand or shorten this experiment as necessary to fill the time allocated.

Remember - the emphasis here is to ensure the students interact with the equipment, try things out for themselves and above all - have 'fun'.

There is a more detailed version of this doucument avilable which provides background information on the experiment. This is available from the Operations Coordinator or from the Lab in a Lorry website: http://www.labinalorry.org.uk/volunteer_information/downloads.cfm

The kit

- Light box
- Power supply - do not change this
- Plastic tubes
- Dettol
- 1 ml Syringes
- Beakers
- Polaroid filters
- Fructose

Image of equipment

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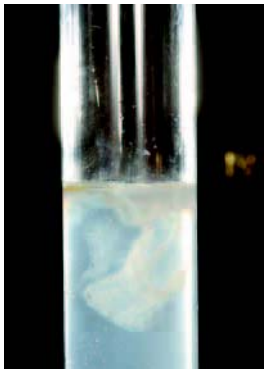
Introduction

Start the experiment by asking the students what they know about light. Ask one of the students to produce a rainbow using the prism and light box. In science we call this the visible spectrum - see if they know the colours in the correct order i.e. ROYGBIV

Part 1: Why is the sky blue?

1.1 Ask the students if they know why the sky is blue. Typical answers include 'reflection from the sea' and 'God created it like that'. The scientific approach shows that it is to do with light scattering through the Earth's atmosphere. Here we will use a tube of water to 'model' the atmosphere and make a "sky in a tube".


Adding Dettol to the water

Pour 650 ml of water into the tube and place it on top of the light box. The light on the ceiling should be white (from the bulb). Now add 1/3 syringe of 'particles' (Dettol) to the water. Where the light hits particles of Dettol, blue light will be scattered. This simulates the scattering of blue light by gases in the atmosphere.

1.2 Sunrise / sunset

Ask the students if the sky is always blue, and if not - what other colours can it be? The next part of the experiment involves producing a sunset effect in the tube. Ask if anyone knows why the sky changes colour at sunrise or sunset.

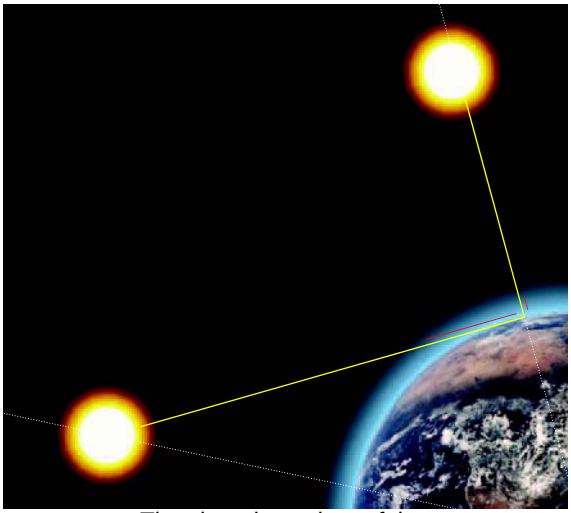
1.3 MIx the solution by gently inverting the tube a few times. Avoid shaking it as bubbles will prevent the experiment working. Use the mirror at 45 degrees to look down the tube - what colour is the 'sun'? It should be a bright yellow / white colour to begin with.

Ask the students to add another 1/3 syringe of 'particles' (Dettol) and mix the solution as before. Use the mirror again - what colour is the sun now?

Repeat this process - checking the colour each time. If done correctly the 'sun' will change from white to yellow, orange and then red. If too much Dettol is added the sun will be a dull orange-brown colour.

1.4 How does this link in with the sunset?

Ask the students what is in the atmosphere. The main constituents are oxygen, nitrogen, carbon dioxide, water vapour and dust. Light from the sun is scattered by the gases in the atmosphere. Blue light is scattered more than the other colours.


The changing colour of the sun

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At sunset the sun shines towards us from a different angle. This means the light passes through more atmosphere and the longer wavelengths of light (orange/red) are scattered.

Part 2: Creating a spiral rainbow using fructose solution

2.1 A saturated solution of fructose has been prepared. This solution is made from one box of fructose for 300-400 ml of hot water.

2.2 Hand each of the students a polaroid filter

Explain that Polaroid filters only let light through in one direction. You can use the grills to show that light can pass through when the two grills are aligned, but when they are at right angles to each other, they will completely block any light coming through.

Get the students to look through two filters and turn them until the light is blocked out.

2.3 Give the fructose tube to a student and ask them to shake it vigorously. This time we want lots of bubbles in the tube!

Slide the small polaroid filter into the light box so that it covers the beam and put the tube onto the light box. Get the students to view the fructose solution through their filters. They should be able to see the spiral rainbow in the solution. Rotate the polaroid filter to make the rainbow appear as if it is moving.

2.4 See what happens if you hold the polaroid filter up to the light of the wall mounted LCD television screen and rotate it. As you turn the filter there will be a point when the filter goes dark and no light passes through. This is because the LCD screen contains a Polaroid filter.

You can also put the layers of sticky-tape in front of the LCD and see that it also twists the light

What is making the spiral rainbow?

The molecules of fructose are like little spirals. The polarised light entering the tube hits these molecules and is rotated slightly. As different colours of light have different wavelengths they are twisted by different amounts up the tube giving a spiral rainbow effect.

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