STEMSCOUT CHALLENGE – PROJECT- [redacted]Robert

AIM: To investigate properties of light waves using items found at home. Looking at how light travels through different substances (is transmitted), how it is bent (refracted) and how light is reflected especially within a substance that transmits light.

MATERIALS:

Part 1: Transmission of light

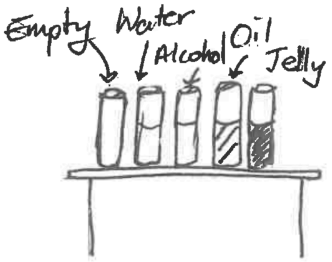
You will need:
- 5 identical glass tumblers
- 100ml water
- 100ml clear alcohol
- 100ml cooking oil
- 100ml set jelly (lemon)
- Laser pointer (SAFETY WARNING- be careful these must not be pointed at anyone's eyes)
- Graph paper with 1mm squares and blu tack
- 2 small tables and a clear wall

Part 2: Reflection of light

You will need:
- Jelly (lemon)
- Shaped moulds and rectangular carton 15cm by 5cm (minimum size)
- Black paper and cling wrap
- Laser pointer

INSTRUCTIONS:
- Make up lemon jelly- about 500ml quantity
- Pour 100ml into glass tumbler once cool
- Pour 100ml in rectangular container until at least 2 cm in depth
- Pour remainder into shaped moulds (square, circle, fluted circle- other shapes can be used) then put in fridge for 2 hours to set.

Part 1:
- Have an adult supervise and help you.
- Set up tables so their centres are 1m apart and the centre of a table is 1m from the clear wall.(see diagram below and photo 1)



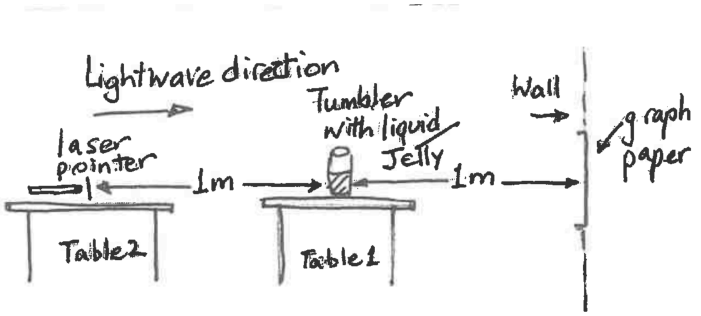


Photo 1 Part 1 Set up

Attach graph paper to wall with blu tack.
Set up glass tumblers each containing a different 100ml of liquid. (one empty, one with water, one with alcohol, one with cooking oil and one with jelly that has been set)

Place laser pointer on table 2m from wall. Then shine narrow beam of light at wall and record the size and shape of pattern of light on wall. Use the graph paper squares to measure the pattern – width and height.

In turn then place each tumbler on the first table at the 1m from wall point and shine laser pointer still at the 2m mark through the centre of each tumbler, recording the size and shape of the light pattern that appears on the wall.

Part 2:

Take jelly from fridge and remove from container and moulds. Place jelly onto a sheet of cling wrap which is over the black paper.
Ask an adult to cut the rectangular jelly with a sharp knife so the edges are straight and clean so a strip about 15cm x 2cm x2cm is made.
Remove excess jelly

Place paper and prepared jelly strip and shapes on a table. Make the room dark.

Point the laser pointer at the end edge of the strip at different angles and try to bounce the light beam off the long edge of the jelly. Try the same thing with the other shapes. Observe the patten of light transmitted through the jelly. Ask an adult to take photos.

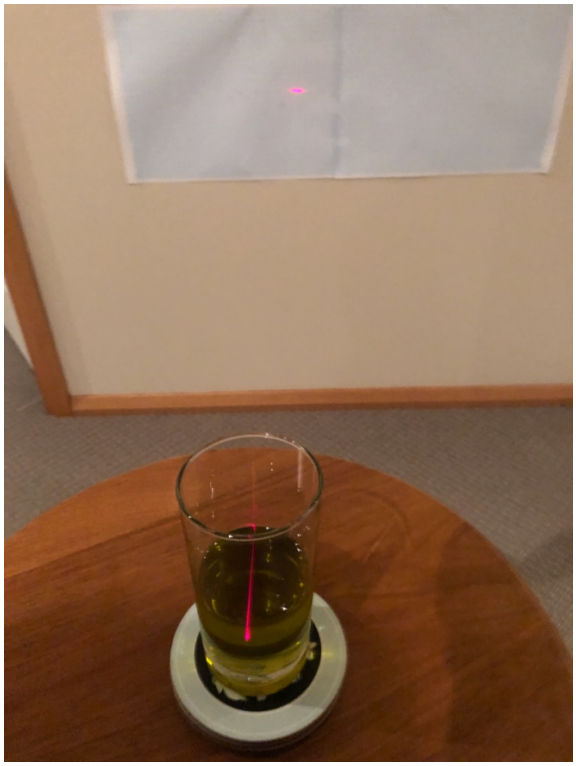
Results:

Part 1 (See Photos 2 and 3)

Tumbler	**Medium**	**Pattern**	**Measurements (HtxWdth)**
None	Air	Small circle	2mm x3mm
No1	Empty	Ellipse	3mm x 4.5mm
No2	Water	Blurred line	3mm x 25.5mm
No3	Alcohol	2 merged bands	3.5mm x 26.5mm
No4	Cooking Oil	2 bands	3.5mm x 28mm
No5	Jelly	Faint square patch	7mm x 13mm

Photo 2 Light through jelly

Photo 3 Light through oil onto graph paper



Part 2 (see diagram and photos 4-6)
The laser pointer beams when passed through the jelly at different angles was hard to see reflected except when it bounced off the side. As it went along the jelly, the zig zag line of the light beam became more blurred, fainter and looked wider.
The shapes made different patterns – a square of light in the circle; a rim of light around the fluted circle, and an angle through the square.
The beam of light going through the jelly was at a slightly different angle to the laser pointer beam of light going through the air before it was transmitted through the jelly.

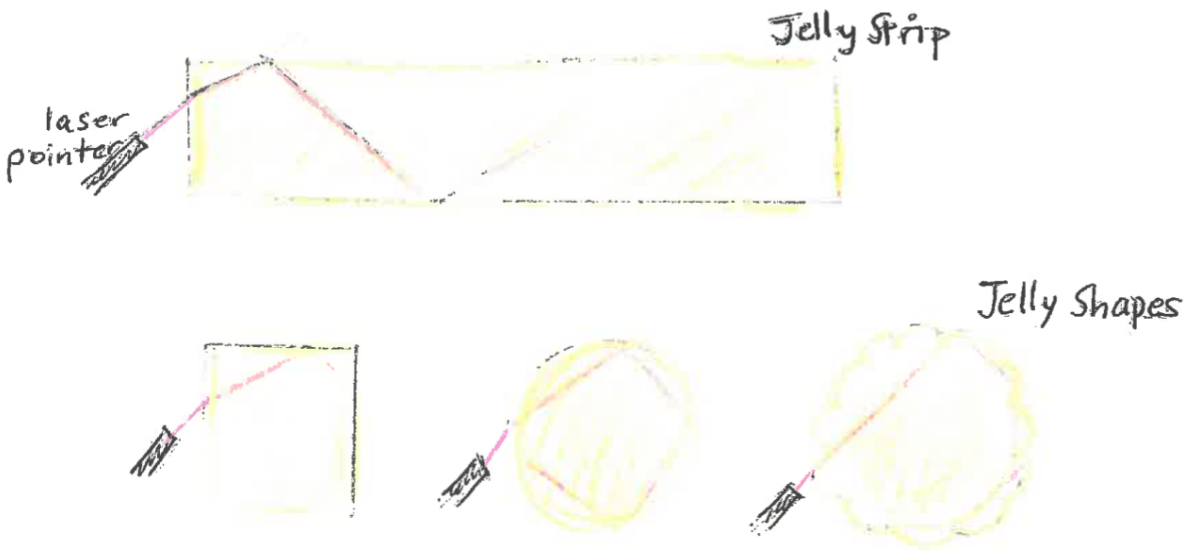
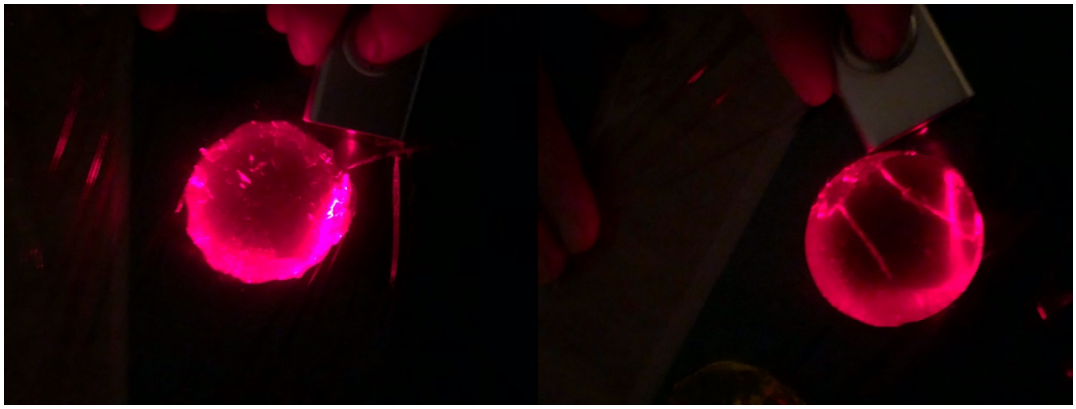


Photo 4 Different Jelly shapes

Photo 5 Beam through Jelly rectangle

Photo 6 Fluted jelly Round jelly



CONCLUSION and DISCUSSION:

Part 1: I found that the light as it was transmitted through different liquids changed. The air and empty glass acted as my control measures.

Liquids that had some particles in it or weren't pure made the light beams scatter and thus the pattern was wider and a bit taller. Alcohol is less dense than water when physical density is measured (mass/volume) however light passes through water with a smaller pattern on the wall compared to alcohol suggesting water is clearer and more transparent. Light is not necessarily more transmissible through physically dense substances; it depends on how clear and pure is a liquid.

The jelly which was solid and translucent let light through but had a very faint, wide and taller pattern. Jelly is not a pure solid it contains more particles, so it looks cloudy. The particles have caused the light to scatter far more than any of the other liquids. This is caused by light hitting particles and being reflected off each one in differing directions. As the light is scattered there are less rays of light travelling together so the light is less bright after passing through the jelly.

Liquids caused the light to be bent. As the laser pointer beam went through an empty glass it was only widened by 1mm. However, after going through a liquid the light pattern was like a band that was nearly 6 times wider -the liquid has caused the light beams to be refracted.

Part 2: I found it hard to get the light to bounce off and reflect within the jelly. I managed to bounce the light beam only off one edge of the jelly strip. It looked like a right angle. Only at one angle to the edge was I able to get light to bounce along the jelly strip and look quite bright. From my reading this is likely the critical angle when light does not pass out through the other edge of the jelly but most of the light waves are reflected back into the jelly. The jelly strip is a simple model of how a fibre optic strand works. When light is reflected it follows a straight line, the angle of which is equal to the angle at which the light beam hits the edge of the jelly.

Other shapes lead to different light patterns. The circle made a pattern of light like a square and the fluted circle the light seemed to bounce around the edges.

The properties of light waves I have displayed include:

- Transmission
- Scattering or diffusion
- Refraction
- Reflection especially internal reflection.

Acknowledgements and references:

Photography – Mr D Finkelde
Research and photocopying information- Mr Finkelde and my mum

STEMSCOUT Milk bottle lamp stem challenge – explanation re scatter and law of reflection
Scienceweek.net.au/schools/2022-resource-book-links/ - worksheet for fibre optic jelly

Encyclopaedia Britannica – Electromagnetic Spectrum and light – 11th March 2019
www.brittanica.com/scienelectromagnetic-spectrum