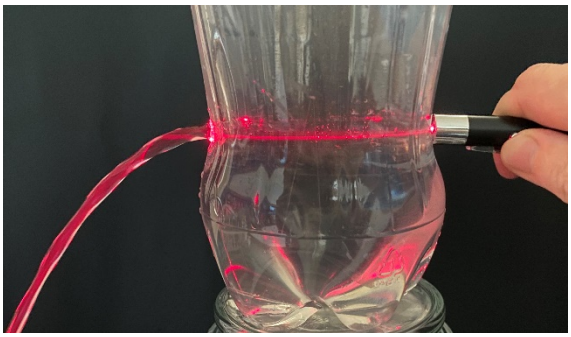
DIY Science – Light Fountain

Create a stream of water to trap a laser beam and explore water pressure

Safety
An adult must assist with using a hot metal skewer or drill to make a hole in the plastic bottle. A laser pointer is not a toy and must only be used under direct adult supervision. Avoid shining the laser beam at a person or at reflective surfaces. Never stare into a laser beam. Use a low power laser pointer, Class 1 or 2, with less than 1mW power output.

What you need
A room that can be darkened, empty plastic drink bottle with a lid (1.25 L works well), hot metal skewer or drill, tape, laser pointer, sink or tub for collecting water, two rulers, graph paper. A bright LED torch can be used instead of a laser pointer.

What to do
Part A: Total internal reflection



1. A hot metal skewer or drill to make a neat 5 mm hole about ⅓ of the way up the side of the bottle.
2. Cover the hole with tape (the tape will be removed later).
3. Fill the bottle with water and screw the lid on firmly.
4. When the tap is removed and the lid is unscrewed, a stream of water will come out of the hole. Arrange the bottle so the stream of water will be collected in a sink or tub.
5. Remove the piece of tape and darken the room.
6. Turn on the laser pointer and aim the beam of light through the bottle, pointing it straight at the hole.
7. Unscrew the lid and adjust the position of the laser until you see laser light trapped inside the stream of water. Placing your free hand in the stream of water will make the light easier to see. Adding a few drops of milk to the water in the bottle will scatter some of the laser light and make it more visible.

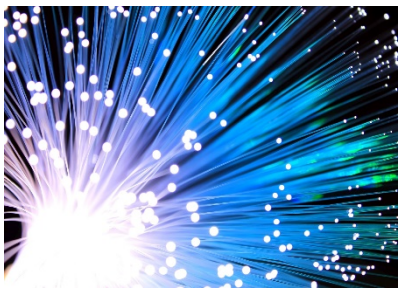
Part B: Water pressure
The stream of water leaves the bottle in an arc and the arc gets smaller as the water empties from the bottle. This length of the arc can be used to graph the change in water pressure in the bottle as the water level drops. Record the measurements in the table on the next page.

1. Place a plastic ruler in the sink or tub so you can measure the distance from the bottom of the bottle to the arc of water.
2. Repeat the activity from Part A without including the laser. Dry the area around the hold so the tape will stick before covering the hole and refilling the bottle with water.
3. Use the second ruler to measure the distance from the bottom of the bottle to the surface of the water in the bottle.

4. Work quickly to measure the distance from the bottle to the arc of water by unscrewing the lid and then screwing it back on again to stop the flow of water. Record the maximum distance the arc reached along the ruler.
5. Repeat Steps 3 and 4 three times.
6. Repeat all of the measurements three times and calculate the averages.
7. Use the average measurements to create a graph with the distance to the arc of water on the x axis and the distance to the water surface on the y axis.

What's happening?

Light can be trapped inside a clear substance such as water because of something called 'total internal reflection'. At certain angles, light will reflect off an interface between water and air. The laser light in this activity bounces off the inside of the stream of water. The same phenomenon is used in 'optical fibres' which can be made from glass or clear plastic. Glass optical fibres carry a lot of the digital information for the internet and the information is communicated as pulses of light, with the light signals being switched on and off very quickly to send huge amounts of data in a short period of time.

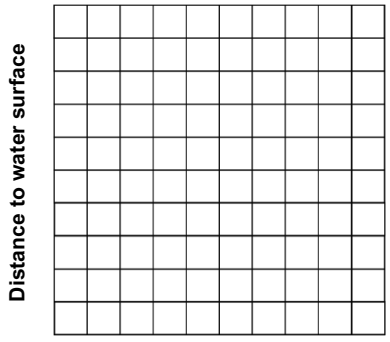


Optical fibres
Image by Chaitawat Pawapoowadon from Pixabay

Water pressure forces the water out through the hole in the side of the bottle. The pressure is created by the water above the hole pushing down on the water below it. The more water above the hole, the greater the water pressure, and the greater the length of the arc of water.

Results

	Distance to water surface (cm)	Distance to water arc (cm)
1		
2		
3		



Did you know?

Inside a plant, there are channels called xylem that carry water from the roots, through the stem, and up to the leaves. Scientists have discovered that xylem can also carry light downwards through the water channels, similar to light in an optical fibre. Light receptors have been found in plant roots, indicating that the plant roots can sense light that makes its way down through the soil as well as light that is channelled directly to the roots via the stem.

Find out more

- Learn about early advances in fibre optic technology that made high-speed internet possible: https://youtu.be/v4IjKF8LLxc
- Discover more about total internal reflection and how optical fibres are used in medicine: https://www.bbc.co.uk/bitesize/guides/zctmh39/revision/1
- Explore cutting edge Australian research in light-based technology (photonics): https://www.rmit.edu.au/news/all-news/2022/may/photonics