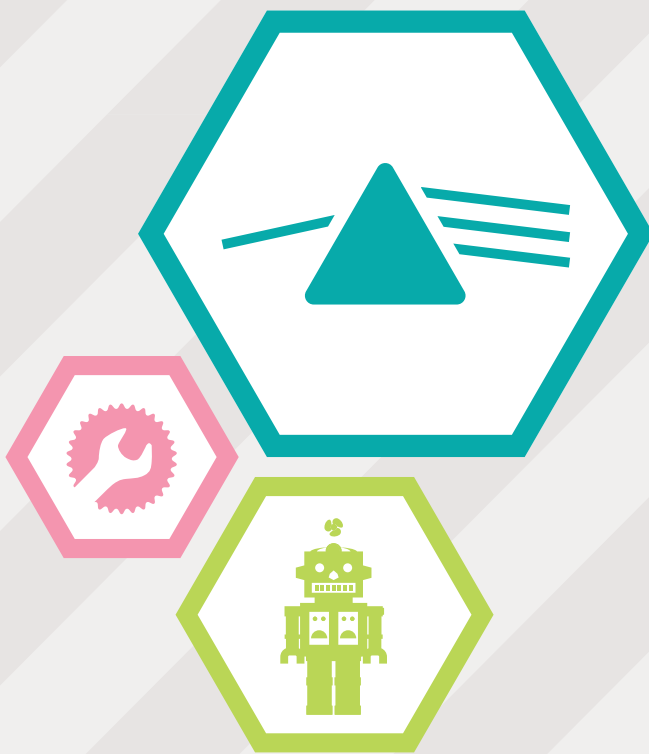


# MAKEIT

## WORKSHOP PLAN



 national science week 2015

## BENDING LIGHT

Learn what happens to light when it travels from one substance to another and how this makes rainbows optical fibers and elusive fish.



### AGE GROUP

6+



### METHOD

Group activity

(14:1 participant to facilitator ratio recommended)



### LEVEL

Introductory



### DURATION

25 minutes



### KEY LEARNINGS

Light from a source can be reflected and refracted. (Yr5:ACSSU080)  
Energy transfer through different mediums can be explained using wave and particle models. (Yr9:ACSSU182)



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12 August 2015



# BENDING LIGHT

## INCLUDED IN THIS WORKSHOP PLAN

- > Materials and equipment list
- > Preparation suggestions
- > Recommendations: General advice and opportunities for further learning
- > Full 25 minute workshop outline

## APPENDIX

- > Materials Suppliers List



## MATERIALS AND EQUIPMENT

- Opaque cup (1 per participant)
- Small flat object that does not float (a coin or washer) (1 between 2)
- 100mm square flat acrylic mirror (1 between 4)
- Shallow tray or pan (1 between 4)
- A4 White paper or card (1 between 4)
- Black paper or plastic (enough to cover the bottle)
- Torch
- Convex lens
- Water (to fill cup and shallow tray)
- Clear plastic bottle (with a lid)
- Scissors
- Sticky tape
- [MATERIALS SUPPLIERS LIST](#) (appendix)

*Required, but not included in pre-packed kits:*

- Scissors
- Sticky tape
- Clear plastic bottle



## PREPARATION

- > The facilitator should prepare for this workshop by using the instructions and materials provided to complete the tasks. Note critical angles and sources of light for viewing and advise participants accordingly.
- > Have a rubbish bin ready for the waste, and a bucket for the water.



## RECOMMENDATIONS

### GENERAL ADVICE

- > The activities in this workshop plan are brief. Be prepared to move things along quickly, but consider having time at the end for participants to return to things that have caught their interest.

### FURTHER LEARNING

- > Further learning could include adding coloured cellophane between the light source and some of the demonstrations to see how this alters the effects.

## WORKSHOP OUTLINE



00:00

### INTRODUCTION

Introduce yourself, welcome participants and cover any housekeeping.

Start the conversation.

Ask participants: Have you ever tried to grab something underwater? Have you had a problem locating the thing you were reaching for? Explain that the activities in this workshop will help them understand why they had a problem.



00:05

### THE INVISIBLE COIN

Distribute cups and ask the participants to form pairs. Give each pair a coin, and have one member fill their cup with water.

The participant with the empty cup puts the coin at the bottom of the cup, and places it on the table. They then adjust their line of sight (by moving their head up or down) so they can just no longer see the coin over the edge of the cup.

While the viewer holds steady, their partner slowly pours water into the cup. At some point, the object will appear to the viewer.

*Explanation: You see the object in the bottom of the cup because light is reflected from the object into your eyes. As this light is going from water into air, it changes direction, and is bent at an angle. When the height of the water gets to the right level, the light from the object is bent into from your eye, and you can see it. This is why when you look at something under water, it appears to be further from to you than it actually is, because your brain is used to light travelling directly to you in a straight line, and the light has actually been bent towards you as it left the water.*

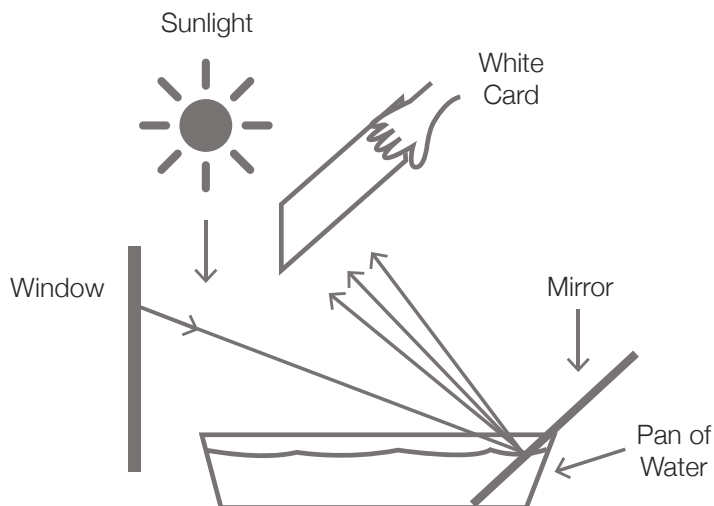


00:10

**BENDING LIGHT INTO A RAINBOW**

Ask each pair to partner with another pair. Distribute the mirrors, and shallow trays to each group of four.

Place the shallow tray near a window or other light source, and hold the mirror at an angle as the tray is filled with water (see diagram below)



Hold the white card as shown, and a rainbow will be seen.

*Explanation: The rays of light are bent as they enter and leave the water, but different colours are bent to varying degrees. This effect makes the colours spread out, and results in the rainbow effect. Similar effects are seen when light passes through fish tanks, hanging crystals or even the edge of a plate of glass.*

Try placing a sheet of coloured cellophane between the window and the tray of water, and the rainbow will disappear because only a single colour of light is being affected.

00:15

**BENDING LIGHT AROUND A CORNER**

(Requires a darkened room for best viewing)

Pierce a hole in the top of the plastic bottle using the scissors, or some other sharp tool, the rounder the hole the better.

Continued...

*This could be done prior to the workshop.*

Use sticky tape to cover the outside of the bottle with black paper, but leave the bottom clear. If you can cover the neck of the bottle (but not the lid), the effect will be better.

Fill the bottle with water, and screw on the lid.

Take the bottle and the torch into a darkened room and place the torch on the bottom of the bottle so the light shines through the water.

Hold the bottle horizontally, and squeeze: the water will make an arc, and the light will bend with it.

*Explanation: The light is travelling through the water, parallel to the edges of the bottle. If the angle of the arc of water is not too great, the light inside the water skims off the boundary with the air surrounding it, and is reflected along inside the stream of water. This is the same effect that causes light to glare off a partly opened window, or a pool of water, even though these are transparent. This effect is used in optic fibres, to trap light inside a thin cylinder of glass.*

00:20

## BENDING LIGHT WITH A LENS

Pass around the lens and allow participants to examine it. It is helpful to have some printed material at hand that can be viewed through the lens.

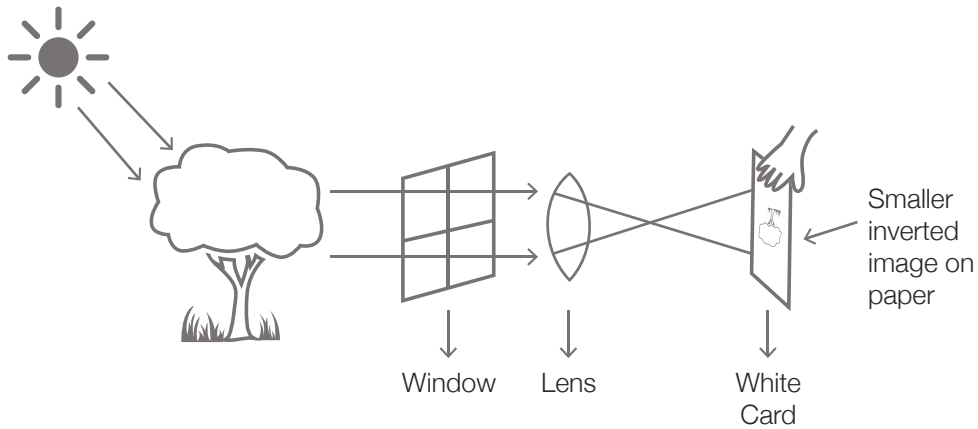
Move the lens closer or further away from the object being viewed, and the image will move in and out of focus. At the right distance, the lens will act as a magnifier.

Move to a window and hold the lens vertically, so the incoming light is focused through it.

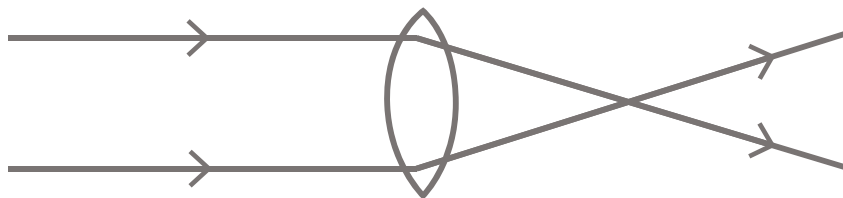
Get an assistant to hold a piece of white paper or card about 20cm behind the lens, observing as an image of the view outside is formed on the paper. Is the image the right way up? Does this change if the paper is moved?

Continued...

Move the paper slowly back or forwards to bring the image into focus.



*Explanation: The light coming from the object being viewed is bent as it passes from the air into the glass of the lens, and again as it moves from the glass back into the air. Because the surface of the glass is curved, the bending focuses the rays of light onto a single point (the focus of the lens). If a viewing screen is placed beyond this point, the rays of light cross over, and the image will be inverted (as shown in the diagram below)*



00:25

THE END

# APPENDIX

## MATERIALS SUPPLIERS LIST



## BENDING LIGHT MATERIALS SUPPLIERS

MATERIAL	SUPPLIER	COST	LINK
Opaque disposable cup (15 per kit)	Staples (pk of 50)	\$2.05 + \$5.50 shipping <\$55	<a href="http://www.staples.com.au">http://www.staples.com.au</a>
10mm Washer (10 per kit)	Supa Cheap Auto (pk of 10)	\$5.99	<a href="http://www.supercheapauto.com.au">http://www.supercheapauto.com.au</a>
100mm square acrylic mirror (5 per kit)	Scientrific (each)	\$9.00 + \$30 <\$100	<a href="https://www.scientrific.com.au/product.php?p=1752">https://www.scientrific.com.au/product.php?p=1752</a>
	Acrylics online	\$10 + \$15 shipping	<a href="http://www.acrylicsonline.com.au/shop-product/acrylic-sheet/acrylic-perspex-silver-mirror-1220-2440-2mm-cast-sheet-supply-cut-to-size">http://www.acrylicsonline.com.au/shop-product/acrylic-sheet/acrylic-perspex-silver-mirror-1220-2440-2mm-cast-sheet-supply-cut-to-size</a>
Shallow tray (5 per kit)	Pronto Packaging	\$9.50+ shipping	<a href="http://www.prontopackaging.com.au/rectangle-container-1000ml-sleeve-p-871.html">http://www.prontopackaging.com.au/rectangle-container-1000ml-sleeve-p-871.html</a>
A4 200gsm card (5 per kit)	Officeworks (pk 50)	\$10.98 + \$5.95 shipping <\$55	<a href="http://www.officeworks.com.au/shop/officeworks/p/quill-a4-board-200gsm-white-50-pack-qubxlawe">http://www.officeworks.com.au/shop/officeworks/p/quill-a4-board-200gsm-white-50-pack-qubxlawe</a>
A4 black paper	Officeworks (per 500)	\$8.73 + \$5.95 shipping <\$55	<a href="http://www.officeworks.com.au/shop/officeworks/c/paper/coloured-paper/a4-coloured-paper">http://www.officeworks.com.au/shop/officeworks/c/paper/coloured-paper/a4-coloured-paper</a>
Torch	Bunnings Arlec 9 LED (with batteries)	\$5.46 ea	<a href="http://www.bunnings.com.au/arlec-9-led-watchman-metal-torch-with-batteries_p4410346">http://www.bunnings.com.au/arlec-9-led-watchman-metal-torch-with-batteries_p4410346</a>
Convex lens (5 per kit)	Scientrific	\$2.00 ea	<a href="https://www.scientrific.com.au">https://www.scientrific.com.au</a>

### ABOUT THIS LIST

We've put this list of suppliers together to help make the planning and preparation process a little easier. We don't receive any kick-backs or benefits from sharing this list with you.

If you've downloaded this workshop plan from [edgeqld.org.au](http://edgeqld.org.au) then you'll require all the materials and equipment listed at the beginning of this document (and above).

If you've received this workshop plan through the National Science Week kits distributed by your public library, then all the above materials are supplied in the kit.

# The Edge

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for National Science Week 2015  
[www.scienceweek.net.au](http://www.scienceweek.net.au)

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