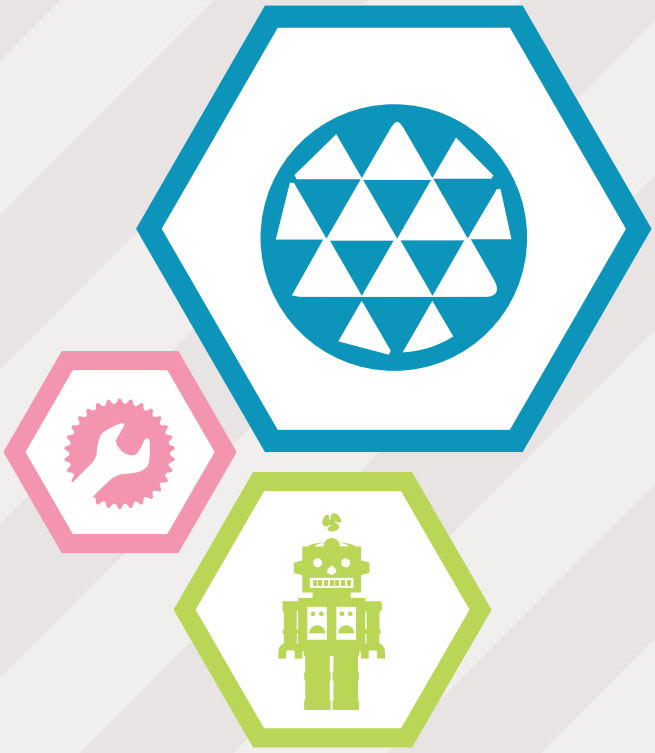
The Edge

MAKEIT

WORKSHOP PLAN



national science week 2015

KALEIDOSCOPE

Create an ever changing world of colour with this classic optical toy you can make in a few minutes.

AGE GROUP
8+ (scissors required)

METHOD
Group activity
(14:1 participant to facilitator ratio recommended)

LEVEL
Introductory

DURATION
30 minutes

KEY LEARNINGS
Light from a source forms shadows and can be absorbed, reflected and refracted. (Yr5:ACSSU080)
Use equipment and materials safely, identifying potential risks. (Yr5:ACSSI088)

Version 1.0
12 August 2015

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KALEIDOSCOPE

INCLUDED IN THIS WORKSHOP PLAN

> Materials and equipment list
> Preparation suggestions
> Recommendations: General advice and opportunities for further learning
> Full 30 minute workshop outline

APPENDIX

> Materials Suppliers List
> Explanation Sheet

MATERIALS AND EQUIPMENT

- ☐ A4 card stock, or a recycled cardboard cylinder 100mm to150mm long - you could use one from inside a toilet roll or kitchen paper (1 per participant)
- ☐ Sheet of black paper, the same length as the cylinder, or a similar sized piece of black plastic (eg. garbage bag) (1 per participant)
- ☐ Sheet of stiff acetate transparency film, the same length as the cylinder (1 per participant)
- ☐ Mixture of small (<8mm) plastic or glass beads (about 1 teaspoon per participant)
- ☐ Ruler (can be shared between a few participants)
- ☐ Scissors (1 per participant)
- ☐ Sticky tape (can be shared between a few participants)
- ☐ Cling wrap (can be shared between participants)
- ☐ Sharp pencil or biro (something to poke a small hole in the paper)
- ☐ Felt pens, coloured pencils or stickers for decoration (optional)
- ☐ MATERIALS SUPPLIERS LIST (appendix)
- ☐ EXPLANATION SHEET (appendix)

Required, but not included in pre-packed kits:

- *Ruler*
- *Scissors*
- *Sticky tape*
- *Cling Wrap*
- *Sharp pencil*
- *Felt pens*

PREPARATION

> The facilitator should prepare for this workshop by making their own kaleidoscope using the instructions and materials provided. Note critical stages in fixing the device together, and advise the participants accordingly.

> Have a rubbish bin ready for the cardboard waste.

RECOMMENDATIONS

GENERAL ADVICE

> Depending on the age and skill levels of the participants, they may need assistance in forming a cylinder and taping parts together. It is important to tightly fix the shiny acetate film to the black paper, and fitting the triangle of mirrors inside the tube might require some fine adjustments.

> Almost any coloured objects will work inside the kaleidoscope, as long as they move freely. Less transparent items may work if the light is strong enough. You could try using natural materials such as fragments of leaves or small seeds, small coloured stones etc.

FURTHER LEARNING

Further learning could include designing and constructing a kaleidoscope with two or four mirrors (different patterns will result). Curved mirrors will also change the effect, and could be made by bending the black-backed acetate strips.

WORKSHOP OUTLINE

00:00 INTRODUCTION

Introduce yourself, welcome participants and cover any housekeeping.

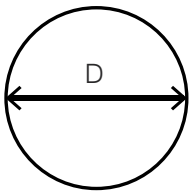
Ask participants if they know what happens when they look in a mirror, and then if they have ever looked into two mirrors at once. They might recall that if the angle is correct, an infinite series of reflections is seen.

OPTIONAL: If you have access to a couple of large flat mirrors, you could demonstrate this effect (place the observer between the two mirrors set at an angle to each other so that the observer can look into one mirror and see their reflection in the other). Explain that they will be using this effect to make their device.

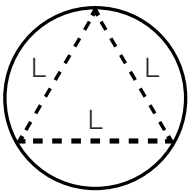
00:05 PREPARING THE CYLINDER

Find a cardboard cylinder to make the body of your kaleidoscope. The tube from inside a roll of toilet paper works well, and needs fewer materials than the longer tubes from cling wrap or alfoil. Alternatively, you can make a cylinder by rolling up some stiff card, and taping it together down the long side.

Measure the inside diameter of the cylinder, and use this to find the size of the equilateral triangle that fits inside the cylinder.



Measure this = D
(inside diameter)

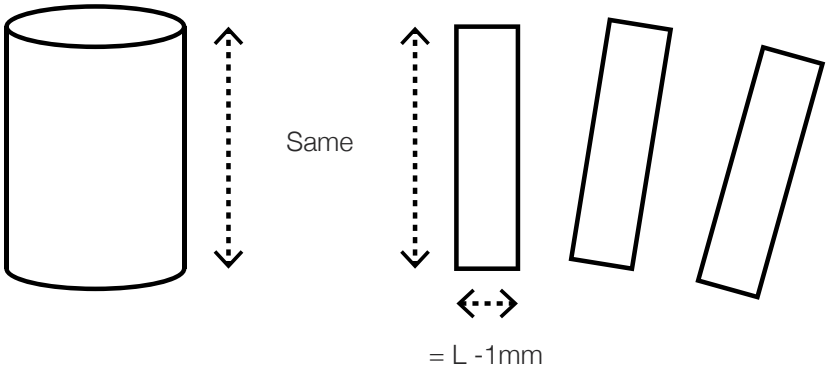


Calculate L (the length of each side) using the formula

FORMULA
L = D x 0.866

00:15 MAKING THE MIRRORS

Cut 3 strips of card as long as the cylinder, and almost as wide as the length 'L' you calculated. Cut the strips a millimetre or two narrower than the calculated width, to allow for folding later.



Cut 3 strips of black paper and glue or tape them to the strips of card.

Black plastic cut from a garbage bag will do too, if it is very flat.

If you use sticky tape, make the black paper a bit longer than the card, and fold the ends over to tape at the back. Try not to get too much sticky tape on the front (black) side of the strip.

Trim the black paper to the size of the card if necessary.

Cut three strips of shiny plastic transparency film, and tape them on top of the black paper. These will make mirrors when you look along them.

Try sticky taping along the edges.

Get the plastic sheets as flat as possible, and make sure they are no larger than the pieces of card.

You might need to trim the plastic a bit.

Place the three strips black side down, and tape them together lengthwise. Make sure they can fold into a triangle, with the shiny side inwards, without bending.

The flatter the triangle sides are, the better the final effect will be.

Continued...

Fold your triangle (with the shiny side inwards), and slide it into the cylinder. You can trim the outer edges a bit to make it fit, but try to get the inner surfaces as flat as possible, with no gaps.

It should not be necessary to tape the triangle down the third side, since the cylinder will hold it in place. It is good if the triangle comes a millimetre or two past the end of the cylinder.

00:25 FITTING THE ENDS

Cut a circle of black paper a bit larger than the cylinder, and tape it tightly over one end. It might help to make some radial cuts in the paper to make some flaps that you can fold down the sides of the cylinder for taping.

Use a pen or pencil to poke a hole in the middle of the paper, about 2 – 3 mm in diameter.

Cut a circle of cling wrap (or some other clear soft plastic film) a bit bigger than the cylinder and tape it over the open end.

Push the middle of the film down a bit to make a depression in the centre of the triangle. This has to be deep enough to hold some beads and allow them to move around a bit.

Fill the depression with beads, jewels or other small transparent coloured objects. A mixture of large and small beads works well, and a mix of light colours is good.

Confetti won't work very well as it tends to stick to the film - the objects need to roll around a bit.

The more beads, the better the result, but leave enough space for movement to occur.

Cut a piece of the stiff transparency film a bit larger than the cylinder, and tape it over the beads. Radial cuts will allow you fold the edges down for taping, but make sure there are no gaps big enough to let the beads fall out.

Hold the kaleidoscope up and point the end with the beads towards a source of light. Look through the small hole and rotate the cylinder to change the pattern you see.

The brighter the better, but don't aim it at the sun.

00:30 **THE END**

APPENDIX

MATERIALS SUPPLIERS LIST

EXPLANATION SHEET

KALEIDOSCOPE MATERIALS SUPPLIERS

MATERIAL	QTY	SUPPLIER	COST	LINK
A4 card	100	Officeworks	$10.98 + $5.95 shipping <$55	http://www.officeworks.com.au/shop/officeworks/p/quill-a4-board-200gsm-white-50-pack-qubxlawe
A4 Black paper	100	Officeworks	$8.73 + $5.95 shipping <$55	http://www.officeworks.com.au/shop/officeworks/c/paper/coloured-paper/a4-coloured-paper
OHT transparencies (10 per kit)	100	Staples	$33.99 + $5.50 shipping <$55	http://www.staples.com.au/main-catalogue-browse?N=4294526729
Beads (60g per kit)	1000 acrylic 4mm mixed	Qld Bead Co	$6.95 + $13.95 shipping	http://www.queenslandbeadcompany.com.au/index.php?cPath=280_38
	100g bugle seed beads mono	All about beads	$4.00 + $5 to 10 for shipping	http://www.allaboutbeads.com.au/seed-beads/bugle

ABOUT THIS LIST

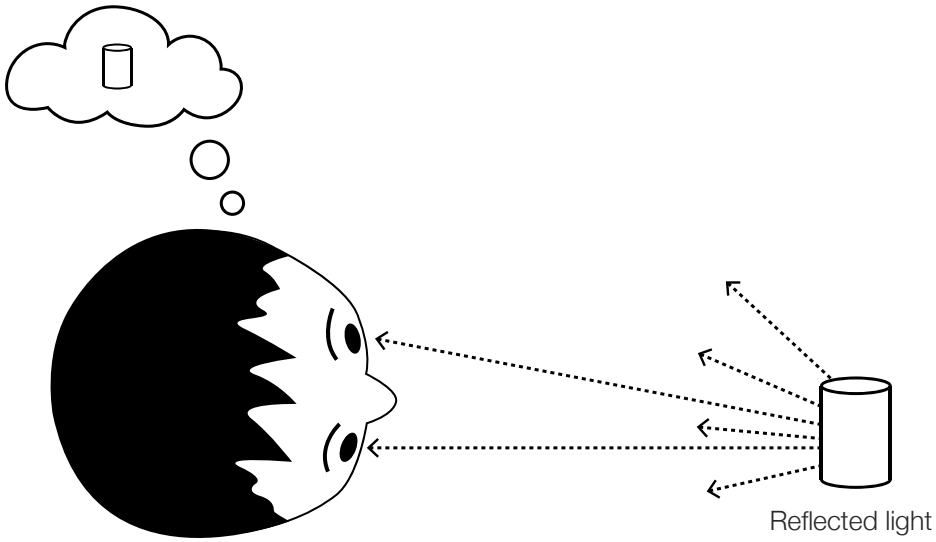
We've put this list of suppliers together to help make the planning and preparation process a little easier. We don't receive any kick-backs or benefits from sharing this list with you.

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

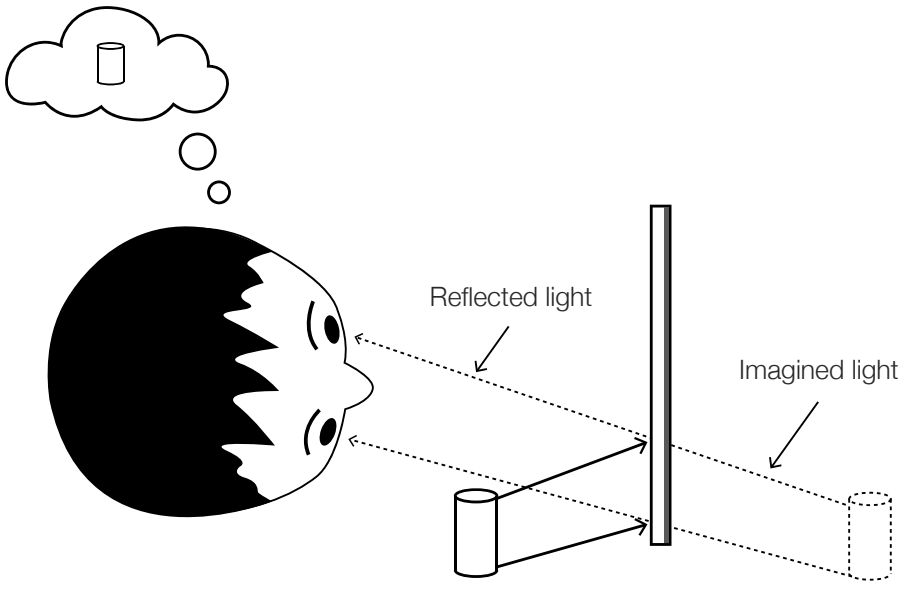
If you've received this workshop plan through the National Science Week kits distributed by your public library, then all the above materials are supplied in the kit.

HOW IT WORKS

You see an object when light bounces from the object into your eyes. From experience, your brain learns to interpret these sensations as a way to locate an object in the world around you – the object appears to be located at the point the light rays are coming from. Because light travels in straight lines, and we have two eyes to give slightly different angles of view, back-tracking to where these two apparent sources coincide allows us to estimate an object's location in three dimensional space.

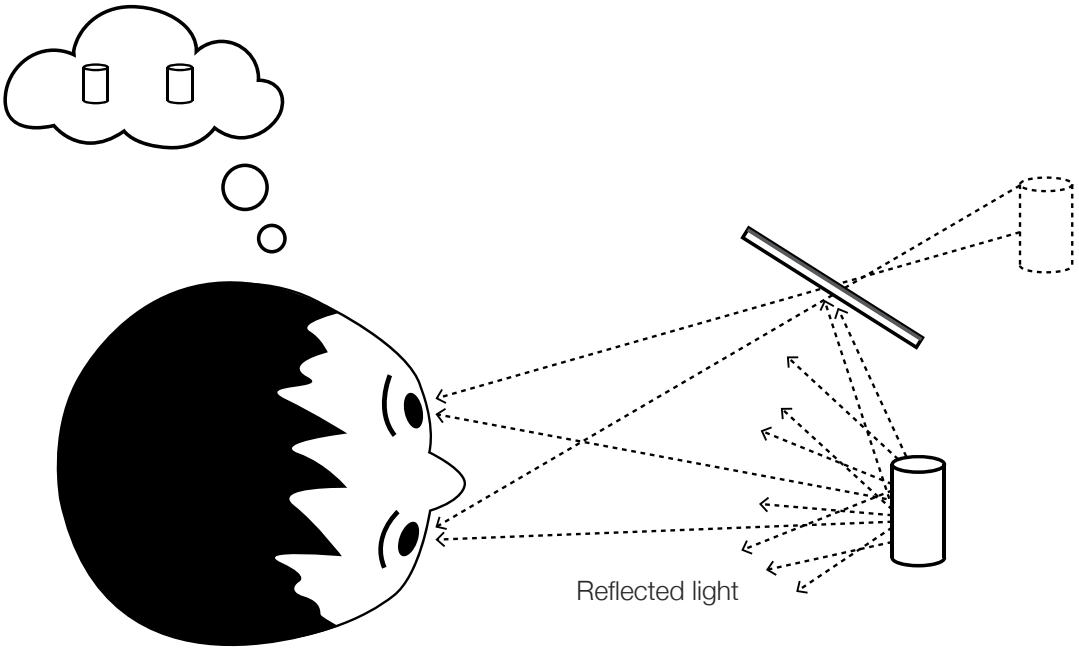


When light bounces off a mirror, our brain imagines the incoming light has come directly from a real object, and it concludes that the source of the light is located somewhere behind the mirror. This is why things look as far behind a flat mirror as they actually are in front of it.



Light comes from an object in all directions at once – this is why you can still see something even if you move to the side – but we only see the light that comes into our eyes.

When a flat mirror is placed parallel to our line of sight, some of the light we usually do not see coming from the object will bounce off the mirror and into our eyes, and our brain sees an object behind the mirror. We see two objects: one with the light coming directly from the object into our eyes; and another apparently to the side, from the reflected light from the mirror.



Add another couple of mirrors, and we will see four objects: one in the centre, and three around the outside. Arrange the mirrors into an even (equilateral) triangle, and the outside images will be equally spaced around the centre, but because the angles are different, the apparent arrangement of the objects will be slightly different (see here for a more detailed explanation). The central view will be brightest though, because this has the most light coming from it.

The view down a kaleidoscope is even more complicated (and theoretically infinite) because each of the mirrors reflects some of the light coming from the object into the other mirrors as well. A bit of this light can also be reflected into our eyes, and so we see another series of objects, though fainter than the first set of reflections. Some of this reflected light is also bounced back into other mirrors, making another fainter image, and so on. This continues until the amount of light being reflected is too small to register, and the image gets progressively darker towards the outside of the kaleidoscope until we can no longer make it out.

The Edge

Author/Developer

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for National Science Week 2015
www.scienceweek.net.au

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Help us improve the MAKEIT Workshop Plans!
Tell us what you think, and what you'd change.

Take the 2 minute questionnaire:

goo.gl/yBV2uw

This Inspiring Australia initiative is supported by the Australian Government as part of National Science Week.

Inspiring Australia

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