STEM Program

Scouts AUSTRALIA

I Spy With My Little Eye

Light Waves and Refraction

Challenge scenario – You can hear some excitement over the fence but you can't see what is happening and you're curious. Can you see what's going on without going over the fence? How can you do this? Create a periscope!

There are lots of different ways to see around corners. Holding one mirror in each hand, can you use them to see around a corner? What do you have to do with each mirror? What about seeing over a wall? Can you work out how it works?

Suited to Section

Joey Scouts | Cub Scouts | Scouts | Venturer Scouts | Rover Scouts

Challenge Area

COMMUNITY | PERSONAL GROWTH | OUTDOORS | CREATIVE

Key SPICES Growth

SOCIAL | PHYSICAL | INTELLECTUAL | CHARACTER | EMOTIONAL | SPIRITUAL

Likely Scout Method Elements

COMMUNITY INVOLVEMENT | LEARNING BY DOING | NATURE AND THE OUTDOORS | PATROL SYSTEM

PERSONAL PROGRESSION | PROMISE AND LAW | SYMBOLIC FRAMEWORK | YOUTH LEADING, ADULTS SUPPORTING

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Plan

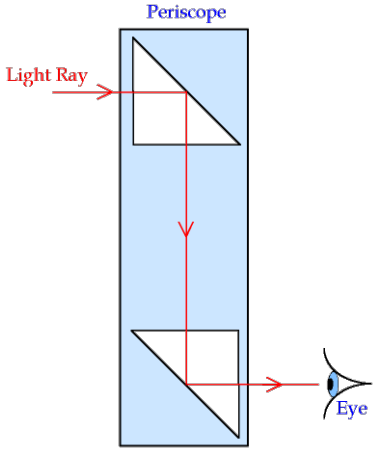
There are a few different models and options that could be used. Have a look at some of the resource options before you decide which ones you might try or if you understand the principle why don't you design your own?
Two key things you need though:

1. A long tube of some description (made from paper, cardboard, recycled toilet rolls or paper towel rolls, recycled narrow cardboard box (like from alfoil or cling wrap or baking paper).
2. 2 x Acrylic mirror tiles (you can use alfoil but it's difficult to get a smooth enough surface) – you could recycle budgie mirrors, large mosaic mirror tiles) https://www.bunnings.com.au/edge-200-x-200mm-square-acrylic-mirror_p1730152

Do

Here are some great resource sites that might assist in thinking about how to build a periscope:

1. www.stem.org.uk/rxyxt
2. https://www.stem.org.uk/elibrary/resource/31673
3. https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/22816-12_periscopes.pdf
4. https://sciencing.com/make-periscopes-toilet-paper-rolls-7764609.html
5. https://horburyprimary.accordmat.org/wp-content/uploads/sites/2/2020/06/Science-how-does-a-periscope-work.pdf
6. https://www.youtube.com/watch?v=Dj423hiRCng



1. Gather your equipment and plan to make a periscope
2. Work in a team (pairs is good, you might need some adult assistance for younger ages) to build your periscope
3. To use your periscope:
    i. Put the top of your periscope facing where you want to look (over a fence, around a corner, on top of a table when you are below it)
    ii. Look at the mirror surface at the bottom of the periscope (don't be tempted to look up the tube – this doesn't work like a telescope or microscope)
    iii. You might need to practise this a little
    iv. If you can't see an image in the bottom mirror it might be because your surface isn't shiny enough (this can happen with some alfoil) or the two mirrors are not at exactly 45°
4. Experiment with your periscope:
    i. Can you identify a mystery object on a table when you are below it?
    ii. Can you describe and action another scout is doing over a fence?
    iii. Can you make up a game using your periscope?

Review

1. How well did your construction go? Were there parts that were easier or harder to do?
2. Were you able to get the two mirrors at the right angle for it to work?
3. How might you change your design?

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Variations

Want to extend these ideas for an SIA?

- Make a giant periscope or and adjustable periscope.
- Perhaps you'd like to test different reflective surfaces or try different construction of the tubes or different lengths of tube.
- Maybe you can make the light go around multiple corners?
- Can you make a periscope out of completely recycled resources? https://www.wired.com/2014/11/genius-periscope-gives-eyes-back-head/ https://www.steampoweredfamily.com/pool-noodle-periscope/

Safety Tips

- Sharps warning: You may need to use scissors or other sharp objects during this challenge card, posing a risk for cuts. Ensure younger sections are appropriately supervised.

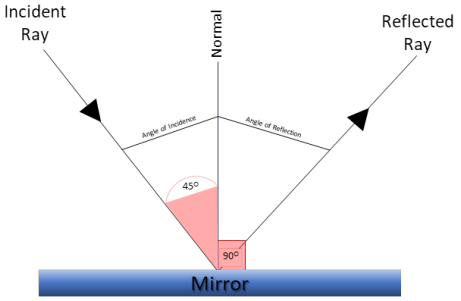
Why Does This Happen?

What is the science behind how a periscope works?

How light travels

- In electromagnetic waves
- In straight lines

Law of Reflection: Light will reflect from a smooth surface at the angle it is projected at (angle of incident = angle of reflection). So light shining at a 45^{O} angle onto a mirror will reflect at a a 45^{O} angle (total angle is a right angle $=90^{O}$). First described by the Ancient Greek mathematician Euclid around 300BCE



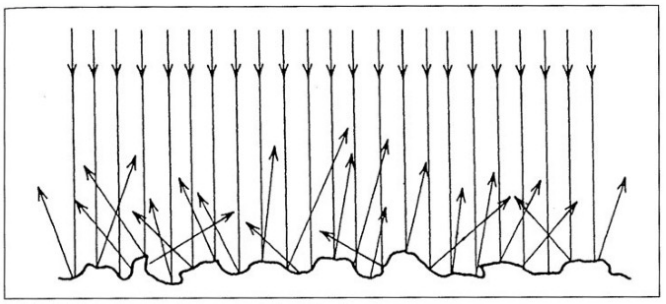
Key principles for a periscope to work:

For a surface to reflect light in a predictable way it must be smooth and flat.

For the periscope to work both reflective surfaces MUST BE at an angle of 45^{O}

This might happen if you use patterned alfoil as the mirror surface → https://www.stem.org.uk/system/files/elibrary-resources/legacy_files_migrated/22816-12_periscopes.pdf

If a surface is not smooth/flat the reflected light is scattered in many directions



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SciScouts Physics of Waves

The SciScouts Physics of Waves is a National Science Week project, undertaken in collaboration with Fizzics Education. These instructions were prepared by Scouts for Scouts. This National Science Week project is supported by the Australian Government.

Scouting has always been strong on STEM skills. Maths to calculate catering quantities and navigate, the science of water purification, the physics of abseiling, and the engineering of pioneering structures – they all have their place. In the current program for our youth members, STEM and Innovation forms one of six Special Interest Areas that enable Scouts to set goals and pursue their own ideas.