On reflection

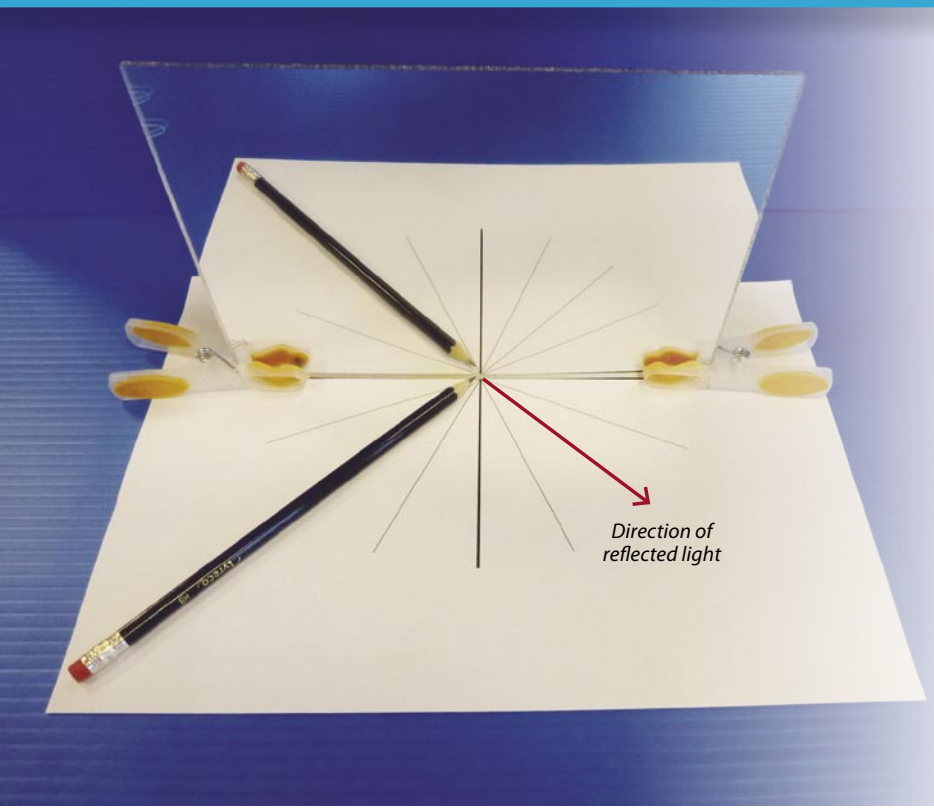

Figure 1 - *A pencil reflected in a Perspex mirror.*

Investigating reflection of light provides a great opportunity to link science and maths Experiences & Outcomes. As an introduction to the topic of reflection children can explore their local environment to determine the types of surfaces that are good for reflecting light, this may include looking at water surfaces on ponds, glass in windows, metal in vehicles, and mirrors.

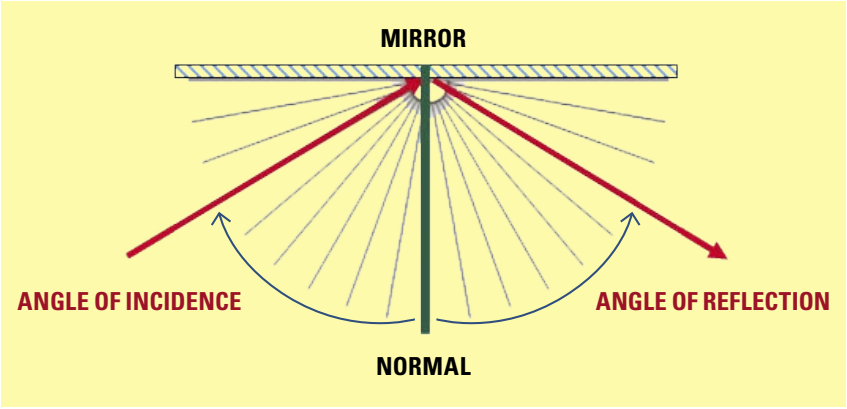

Figure 2 - *Ray diagram relating to Figure 1.*

But what is a reflection?

A reflection is produced when light rebounds off an object rather than being absorbed. Figure 1 shows a pencil reflected in a mirror and Figure 2 shows the ray diagram for this image.

Angles are measured between the light ray and the "normal". The normal is a line at 90 degrees to the mirror. Normals are used because not all mirrors are flat, and measuring the angle between a ray and a curved surface is difficult.

Multiple reflections

What happens when a reflection reflects off another surface? Setting two mirrors at an angle to each other results in a reflection of the reflection. The angle between the mirrors will determine how many reflections are visible. Examples are shown in Figures 3, 4 and 5. The angle template we used here is available to download from the SSERC website [3].

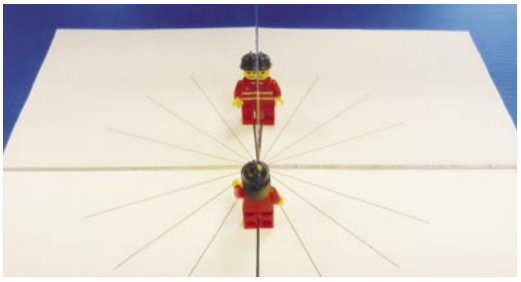

Figure 3 - *Mirrors adjacent and parallel.*

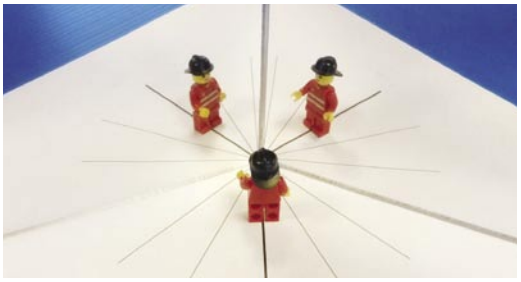

Figure 4 - *Mirrors set at an obtuse angle.*

Figure 5 - *Mirrors set at an acute angle.*

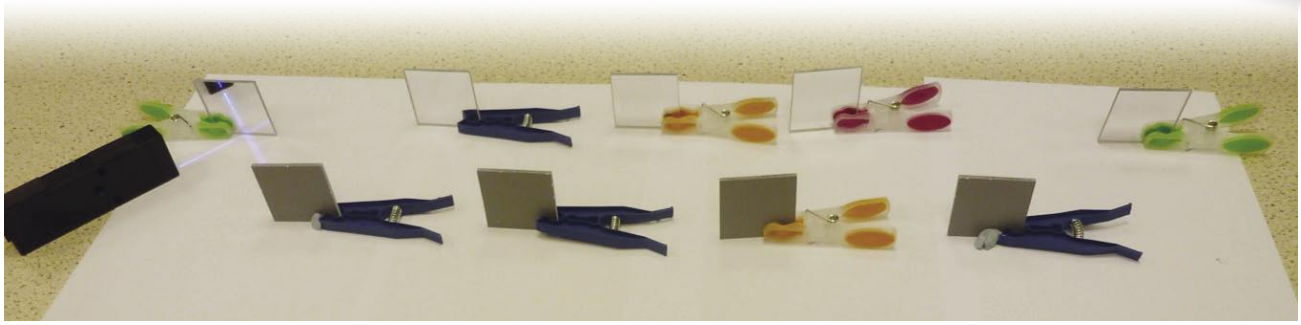

Figure 6 *- Setting up the mirror maze.*

Mirror maze

A fun extension activity to follow on from 'Multiple Reflections' is the creation of a mirror maze. We found that this worked best when we shone an LED on a mirror at an angle and then caught that reflection with another mirror. We used Perspex mirrors that measured 5 cm by 5 cm and we used clothes pegs to stand them in place (Figure 6).

How many mirrors can you use in your mirror maze and still see the reflected light of the LED?

We have tried this in a classroom setting with blinds drawn and it is possible to see the light from the LED reflected along a maze of at least 6 mirrors. However, it was difficult to photograph, so the photograph in Figure 7 was taken at slow shutter speed in a windowless room to illustrate how effective a mirror maze can be. We also tried different colours of LED and found that blue was visible along the highest number of mirrors in a windowless room, but red was visible along the highest number of mirrors in a classroom setting with blinds drawn.

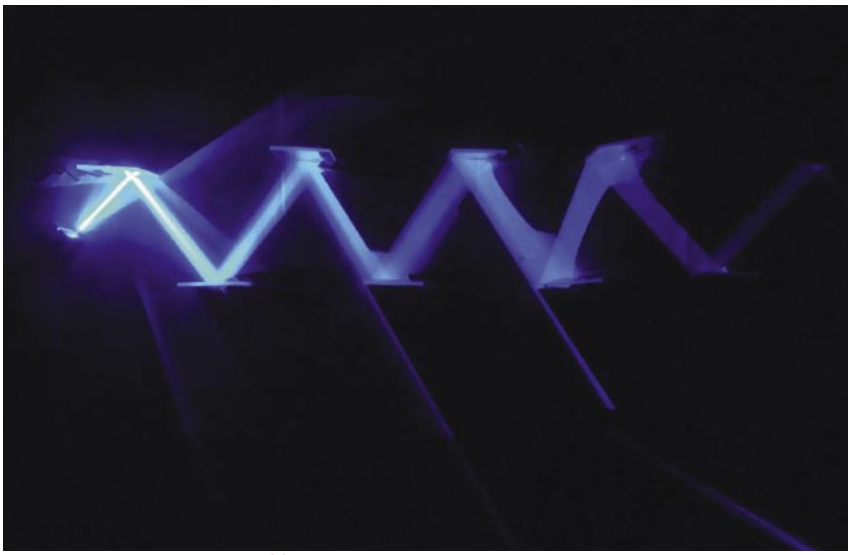

Figure 7 *- Mirror maze using a blue LED.*

Mirror writing

By exploring mirror writing you can examine a practical application of lateral symmetry. Ambulances often have the word 'Ambulance' written on the front in mirror writing (Figure 8). This is so that drivers on the road ahead of them can easily read the word in their rear-view mirror and make space for the ambulance to pass.

Some words show lateral symmetry and so their reflection looks the same as the original text when viewed through a mirror that is placed to one side of the original text (Figure 9). These work best when all letters are printed in upper case.

Other words show horizontal symmetry when viewed through a mirror. Here is our favourite (Figure 10), but there are lots of

Figure 8 *- Examining lateral symmetry.*

Figure 9 *- The reflection looks the same.*

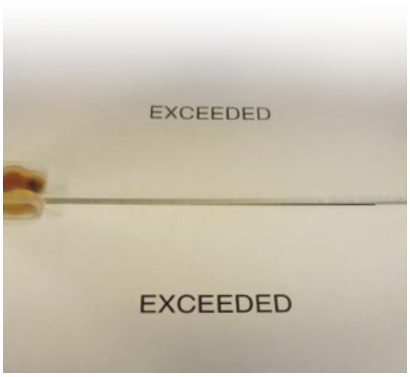

Figure 10 *- Showing horizontal symmetry.*

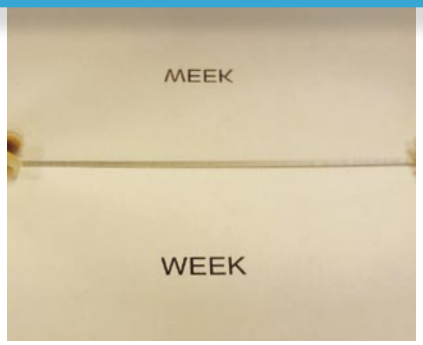

Figure 11 *- 'WEEK' viewed through a mirror.*

others to try, including COOKBOOK, DECIDED, DIOXIDE and CHOICE. It's also fun to try words that change when viewed through a mirror (Figure 11).

Other activities that show how light can be used in a creative way include making a periscope and making a kaleidoscope. Full instructions for both of these activities can be found on the SSERC website [4].

A periscope is an instrument the allows the user to see around corners by using two mirrors to reflect the image. This demonstrates a creative use of light to solve a problem.

Figure 12 *- Periscope.*

There are lots of templates available on the internet to help you to make your own periscope. One template we have tried can be downloaded from the Science Club website [5].

Kaleidoscope

Scottish scientist Sir David Brewster invented the kaleidoscope in 1816. A kaleidoscope is an optical instrument that uses mirrors to produce ever changing symmetrical designs [6].

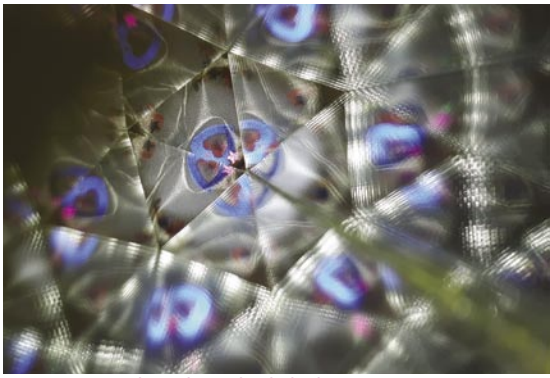

Figure 13 *- Looking through a kaleidoscope.*

Health & Safety

- For all the activities in this bulletin article, we used Perspex mirrors, not glass. Perspex mirrors are available from Amazon [1] and from SciChem [2].
- For the mirror maze we used coloured LED ray boxes, but you could also use a regular torch (partially cover the beam with insulation tape to produce a narrow beam). Lasers are not suitable for use in the primary classroom.
- Advise children and adults to take extra care if working in a darkened room.

Experiences & Outcomes

- By exploring reflections, the formation of shadows and the mixing of coloured lights, I can use my knowledge of the properties of light to show how it can be used in a creative way - *SCN 2-11b*.
- I have had fun creating a range of symmetrical pictures and patterns using a range of media - *MTH 0-19a*.
- I have explored symmetry in my own and the wider environment and can create and recognise symmetrical pictures, patterns and shapes - *MTH 1-19a*.
- I can illustrate the lines of symmetry for a range of 2D shapes and apply my understanding to create and complete symmetrical pictures and patterns - *MTH 2-19a/MTH 3-19a*.

References

[1] Perspex mirror available from Amazon at https://www.amazon.co.uk/Acrylic-Mirrored-ACRYLIC-PERSPEX-PLEXIGLAS/dp/B005QUKRJI/ref=sr_1_1?ie=UTF8&qid=1505735900&sr=8-1&keywords=perspex+mirror (accessed 18th September 2017).
[2] Plastic mirrors available at Sci Chem at https://primary.scichem.com/Catalogue/NavigateProduct/xop490020-mirrors-plastic-100x150mm. Sci Chem also sell LED ray boxes at https://education.scichem.com/Catalogue/NavigateProduct/xop680010-3-colour-led-light-source-device?categoryId=physics-light (accessed 18th September 2017).
[3] Mirror Angle Template at http://www.sserc.org.uk/images/Primary_Bulletins/80/Mirror angle template.pdf.
[4] Periscope Instructions at http://www.sserc.org.uk/index.php?option=com_content&view=article&id=4249&catid=1527. Kaleidoscope Instructions at http://www.sserc.org.uk/index.php?option=com_content&view=article&id=4248&catid=1527.
[5] Periscope template from Science Club at http://www.webinnate.co.uk/science/images/periscope_pattern.jpg (accessed 22nd September 2017).
[6] http://www.kaleidoscopesusa.com/about/sir-david-brewster/ (accessed 18th September 2017).

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