Working scientifically with SHADOWS

Figure 1 Children predict and explore which material is the most reflective

Andy Markwick sheds light on how year 6 children can work scientifically with light and shadows

Light is a topic that is often taught in year 3 (ages 7–8) in English schools, where children learn that light is needed for us to see, that it can be reflected from shiny surfaces and that shadows form when light is blocked by an object. They may also have some experience of how the size of shadows changes when the distance between a light source and object is changed. Helpful resources to support teaching children about light have been developed by PLAN and STEM learning (see *Weblinks*).

This short article reports on a year 6 (ages 10–11) lesson that focused on investigating shadows. Children enhanced their 'working scientifically' skills by applying mathematical knowledge. A quantitative approach was used so that children could generate, record and plot data and develop an understanding of variable correlation and causation. Table 1 lists key areas developed by the activity.

Structuring learning

Before starting the main activity, children's prior knowledge was discussed through questioning and demonstrating how the size of a child's shadow cast on a whiteboard changed as the light source (torch) moved nearer to the child.

Predicting

Groups were then given a whiteboard with strips of coloured paper and aluminium foil attached and asked to predict which surface would be the most reflective and then check their prediction by shining a torch onto each strip (Figure 1). Children invariably and correctly predicted that the aluminium foil would be the most reflective, and the brown paper the least.

As an extension, children used an iPad (or smart phone) with a lux meter app to measure the light intensity of the reflected light and so collect quantitative data to compare reflectivity of surfaces. Their results are given below.

Colour	Lux reading	Order
White	108	3
Purple	65	4
Yellow	112	2
Brown	58	5
Silver (al-foil)	129	1

The order determined by the light meter correlated well with the children's predicted order, although two groups thought white was more reflective than yellow.

Key words: Light Shadows Working scientifically

Table 1 Progression in key knowledge developed by ‘working scientifically’

Year	Working scientifically	Science knowledge
3	• Asking relevant questions • Setting up simple practical enquiries, comparative and fair tests • Making systematic and careful observations and, where appropriate, taking accurate measurements using standard units, using a range of equipment • Recording findings using simple scientific language in tables • Using results to draw simple conclusions; make predictions for new values	• Recognise that they need light in order to see things and that dark is the absence of light • Notice that light is reflected from surfaces • Recognise that shadows are formed when the light from a light source is blocked by a solid object • Find patterns in the way that the size of shadows change
6	• Recognising and controlling variables where necessary • Recording data and results of increasing complexity using tables and line graphs • Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations in oral and written forms	• Recognise that light appears to travel in straight lines • Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye • Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes • Use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them

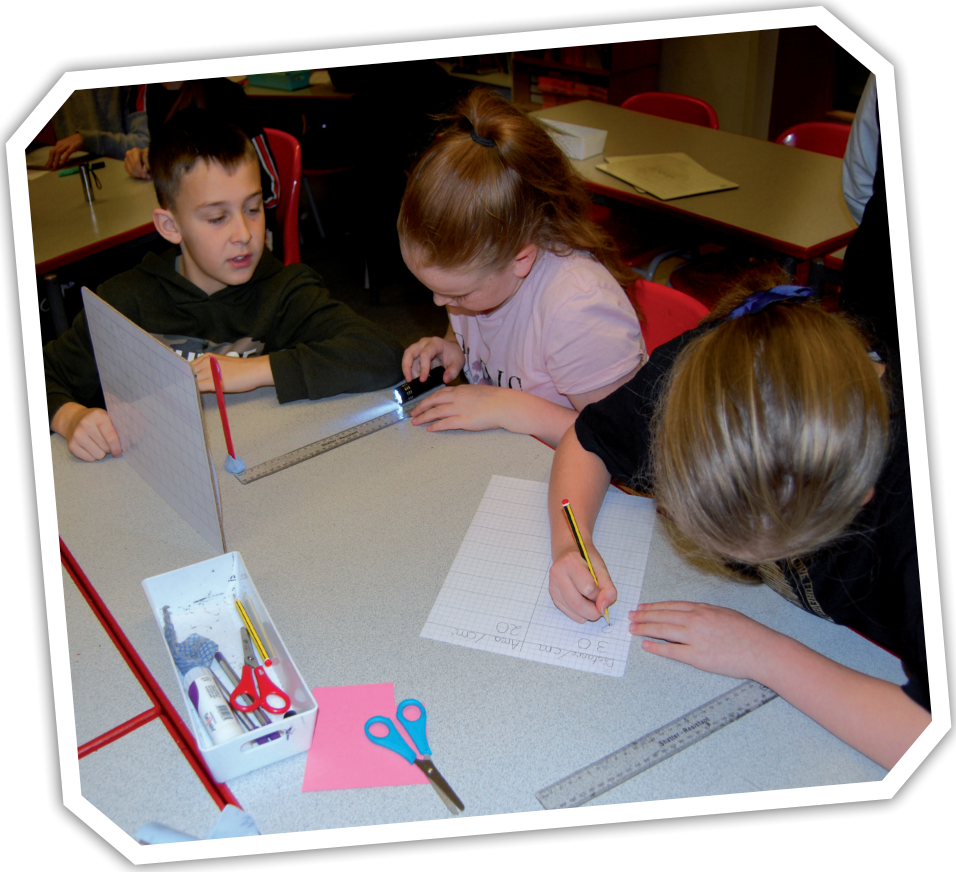

Figure 2 The children set up their equipment to investigate shadow size

Testing

The lesson then moved onto the main activity, introducing it with a problem to solve:

What happens to the size of a shadow when the distance of a light source to an object is changed?

The children set up their equipment as shown in Figure 2. The shadow was cast onto a sheet of squared paper (attached to a whiteboard) so that shadow areas could be estimated. A ruler was used to measure the distance between the torch and object (a square shape was used to make area estimation easier). To ensure that the shadow’s area was sharp enough to measure the room was darkened (Figure 3). The children moved the torch towards the object in 5 cm stages, counting the number of squares in the shadow each time. This activity draws out the opportunities to apply maths in science wonderfully!

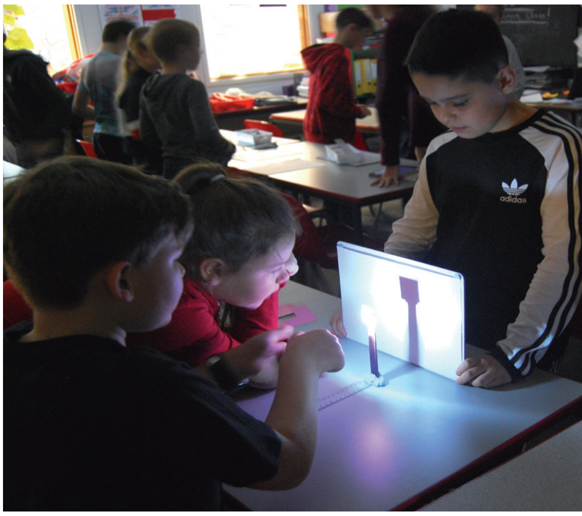

Figure 3 Gathering data in the darkened room

Recording

Children were introduced to the terms *independent* and *dependent variable*. They were able to make their own decisions about the distance the torch was from the object (as the independent variable) and the shadow area (as the dependent variable).

They drew tables and recorded their results with relative ease. However, they needed additional help

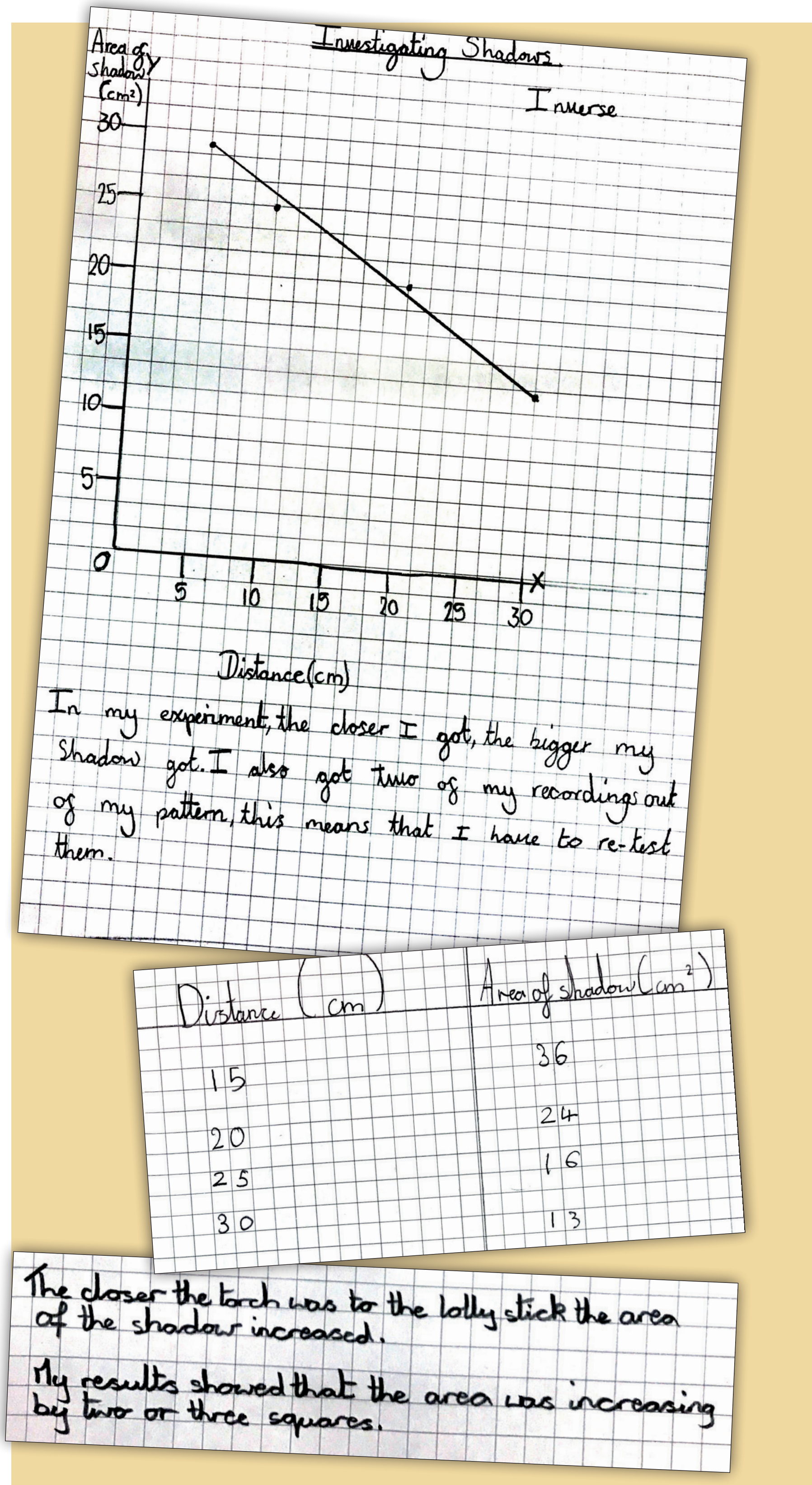

Figure 4 Examples of the children's recording of their results and conclusions

in constructing their axis scales for plotting graphs, although most were able to independently plot their data points accurately and draw a line of best-fit (Figure 4).

Discussion

Once graphs had been plotted the class were asked to discuss their results in their groups and share what they had learned, trying to ascertain the extent to which the results agreed. Most groups were able to conclude that as the torch was moved closer to the object the size of the shadow increased; those that didn't had some great discussions! Being able to explain how changing the torch-to-object distance (independent variable) changed the shadow size (dependent variable) infers an understanding of both correlation and causation. Some groups were able to state that this was an inverse relationship and also to recognise anomalous results and suggest repeating these measurements (Figure 4).

Conclusion

This relatively simple activity progressed children's knowledge and understanding of light gained in year 3 and adapted investigations so children could quantify relationships between variables. This helped them to understand correlation and causation, which is a key skill in science and also to apply knowledge from maths in a meaningful way. With a little creativity, many other well known investigations can be adapted in the same way (see *Weblinks* for more activity ideas).

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Weblinks

PLAN Primary Science Assessment Resources – *Y3 Light Max*: **www.ase.org.uk/resources/y3-light-max**

STEM Learning – *Six great activities for teaching primary students about light*: **www.stem.org.uk/blog/six-great-activities-teaching-primary-students-about-light**

Science Kids – *Light for Kids*: **www.sciencekids.co.nz/light.html**

Kids Academy – *Light sources*: **www.youtube.com/watch?v=d65mdTJaJTI**

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