Figure 1
Finding out about the solar system

STELLAR WORK:

helping pupils reach the stars in their understanding through use of models

Martin Wesley describes a workshop for supporting the teaching and learning of Earth and Space

'Space – the final frontier', *'In space, no one can hear you scream'* and *'In a galaxy far, far away'* were just some of the titles we rejected for our new primary workshop. We wanted to be totally original. One of our company's services is to deliver practical science workshops in schools. We see pupils from a very wide range of schools across the whole country and, since 2000, we have worked with over 700,000 pupils and their teachers. On our recent travels we identified three needs:

- **teachers requiring support to teach 'Earth and Space' concepts;**
- **pupils struggling with scientific modelling;**
- **pupils assuming that scientists are long-dead people, and that scientific research was only done many years ago.**

We decided to design a workshop to support the teaching of 'Earth and Space' that would also introduce current space research in a practical way to primary pupils. We contacted Mat Smith, a professional astronomer from Southampton, who was only too willing to talk to us about his research into type 1A supernovas. These supernovas are a type of star explosion that always has the same brightness: if they look faint they must be far away and if they are brighter they are closer; the human eye cannot make that distinction. This part of his research became the focus for the workshop, with other activities to put the pupils' understanding into context.

Another consideration was the aspect of scientific modelling – something that a lot of people (both adults and children) find difficult. Models are very useful for teaching many concepts (especially space) and, to avoid creating misconceptions, a discussion around each model's limitations is very helpful.

After several discussions and trial runs in some local primary schools, we developed the 'Stellar' workshop.

The Stellar workshop

The workshop starts with a general discussion about what is meant by a scientific model and explaining that the workshop activities would all make use of models. In doing the activities the children practise, and so get better at, understanding and using them. Helped by the notes that accompany each activity, the children are encouraged to think about the limitations of each model they use.

In small groups they circulate around the room visiting each of the activities in turn.

Key words: Space CPD

Figure 2 Seeing stars – creating their own constellations

Planetarium

Children find it fascinating to watch this in action. It is made and calibrated so that the relative speed of each planet is accurate, which enables the children to count how many times, for example, the Moon orbits the Earth while the Earth orbits the Sun (Figure 1).

This model shows the relative speeds the planets move round the Sun. It does not show relative distance or accurate relative sizes, or that the planets are not all moving in the same plane. It does not show that the orbits are elliptical.

Constellations

The children role-play the ancient astronomers, looking at a model of the night sky to see if they see any patterns. They draw and name any they perceive – just as their forebears did (Figure 2).

This model shows that the patterns of the constellations were defined by the cultures of the people who first studied them and also that constellations are three-dimensional. It does not show where the stars we can see really are in relation to each other.

Moon box

A polystyrene ball represents the Moon and a torch represents the Sun. By looking through each slit in the box in turn, the children see different phases of the Moon (Figure 3). They copy these by shading in circles (as appropriate) on a pre-printed template.

This model shows the shape of the lit area of the Moon at different times in the Moon cycle. It does not show that the Moon moves once around the Earth during this cycle. It does not show that the Moon is also rotating and at a speed that means we always see the same face of the Moon.

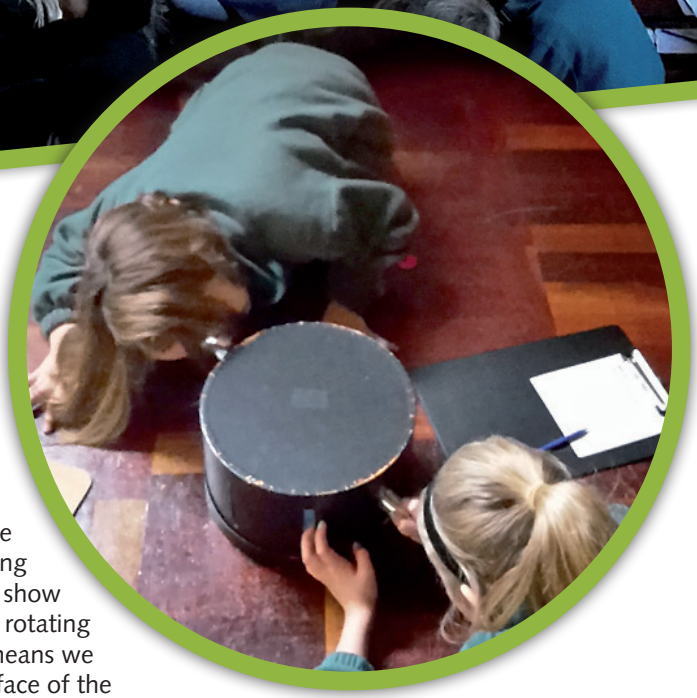

Figure 3 Observing the phases of the Moon

Umbragraphs

Most teachers help children to realise how shadows change during the day by taking them to stand outside at different times and look at their own shadows. This model works indoors. The children shine a torch from different points on the hoop and draw round the shadows created (Figure 4).

This model shows that the position, length and direction of a shadow depends on the position of the Sun in

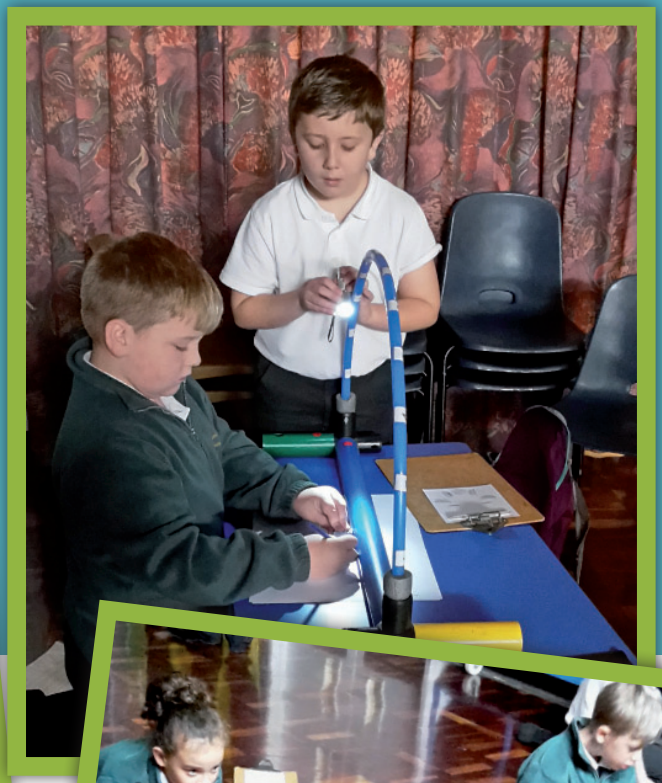

Figure 4 Using the umbragraph to see shadow patterns

Figure 5 Comparing the brightness of supernovas

the sky. It also shows that the position of the Sun at different times of day changes with the seasons. It does not show that the Sun is a vast distance away from the Earth or that it is actually the Earth that goes round the Sun.

Supernovas

The children look at two different light bulbs representing supernovas and compare their brightness. It is only when using a filter, that they can appreciate the bulbs are a different distance away (Figure 5).

This model shows that the human eye is not sensitive enough to detect different astronomical distances. It does not show accurate relative distances, or the actual method used to measure the light intensity.

Closing plenary

We have a general discussion with the children about what they have learned and about the use of scientific models. We are also able to contextualise the activities with regards to Mat Smith and his work, especially with studying supernovas.

Seeing photographs of young Mat standing by a radio telescope in Chile certainly helps to correct the view we found most children held of scientists as long-dead, white (elderly) males in lab coats! Even then, and with the support of their class teacher, it still took a lot of effort to persuade some children that scientists are living people (just like them) carrying out research on a daily basis.

Evaluation

With each class, a simple questionnaire was used to discover what the children and teachers had learned from the workshop and how their attitudes to space science had changed.

Here are some of the children's comments:

[We enjoyed] the opportunity to use some equipment that is kind of realistic.

I did get a bit stuck on the shadow job. We enjoyed all of it. There is not one [activity] we thought it was the best.

[We understood everything] – it was explained very well.

Their teachers commented:

Lots of misconceptions in Space were addressed and came out in the discussions in the workshop.

The workshop contextualised the topics and is so useful for future lessons. It also helps with the new curriculum. This helps with the children's aspirations knowing about scientists in the real world. It's useful and inspirational.

The workshop is useful for our debate that we are going to do in class. I liked the easily produced equipment that they could replicate.

Beforehand, just under half the pupils had no idea what space scientists do at work and 77% had little interest or knowledge about space, but nearly 100% learnt new things and found the workshop interesting and enjoyable. At the beginning of the workshop, many of the pupils enjoyed the aesthetically pleasing planetarium but, by the end of the project, most of the children enjoyed the simple model about Mat's research. All the teachers said they would discuss Mat's research with future classes and use scientific models in their teaching.

Since developing this workshop we have given talks about it at the ASE Annual Conference to great acclaim:

Excellent models! Super.

Lots of really interesting and useful practical ideas. Thank you!

Lovely and practical.

Acknowledgement

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