WORKING WONDERS

Figure 1 Listening to poetry and Frank Sinatra to stimulate scientific wonderings

LET THEM GO

What do children really wonder about? What encourages children to wonder? Where do we find space for children to share their wonderings in school? What, if any, is the role of the teacher in a child's wondering? And what is the value of wondering in our primary science classrooms today? ***Lynne Bianchi*** *shares the answers she and others have found in a recent project.*

Key words:
Creativity
Children's ideas

Over the summer term last year, the Centre for Science Education at Sheffield Hallam University and teachers representing three schools in Sheffield and Stockport considered how children's wonderings could be explored and potentially used as authentic starting points for curriculum design for science and, indeed, other subject areas. They worked with children aged from 6 to 11 years old and, with the help of AstraZeneca Science Teaching Trust (AZSTT) funding, held three focused meetings to explore this area further:

- Stimulated by research undertaken at the Centre for Science Education and that of others, in particular Goodwin (2001), initial discussions explored what wonder is and reflected on the outcomes from other projects (see end), which taught us more about the relevance of context-rich, activity-rich and response-rich approaches to curriculum design in primary science. Invigorated by the prospect of encouraging wonder in their classrooms, the teachers went back to their classes to ask their children what they wondered about and to encourage this in ways that they saw fit with their year groups.
- Support and critique was given in the second meeting, which was filled with talk about a whole host of questions that the children had shared (Box 1).
- The final session focused on summarising what had been learnt. They looked more closely at how the wondering activities had been sequenced, from encouraging and leading children in sharing their wonders, through to looking for those that could be explored through scientific enquiry. With so many different types of questions we also considered our role as teachers in this process. Should we tell them the answer or encourage them to find it out

Box 1 Some of the children's wonderings

6 year-olds were asked to post their wonders in a 'wonder box':

- How hot is a star?
- What will I look like when I am 16?
- Is the Sun bigger than the Earth?
- When I get older will I have glasses?
- How old does a human get to?
- How big will my feet grow?

7–9 year-olds were asked to write down what puzzled them, taken on a 'wondering walk' and shown photographs as stimulus:

- Why are there wars and tsunamis in countries that don't have enough food or drink?
- How does a rubber makes things vanish?
- Why did they invent hat stands?
- How do birds make nests?
- How does gravity works?
- Why are bananas yellow?

Stimulated by music and poetry, 11 year-olds asked:

- How does the Moon make waves?
- If you could walk on water, would you come to the end of the world and fall off?
- Why does the Moon orbit the Earth?
- What created the big bang?
- How come we can't teach domestic pets to speak, when we developed from animals?
- Can you dispose of nuclear materials?
- How did people discover the centre of the Earth?
- If the Earth span faster would humans live longer, shorter or the same amount of time?

Box 2 Factors affecting children's wonderings

Factors in order of influence (highest first)	Thoughts
School culture	Schools are heavily driven by pressures to achieve standards as defined by Ofsted, which can lead to somewhat formulaic lesson structures. The value of identifying spaces within the curriculum for this type of work becomes compromised.
Classroom culture	In order for children to share their wonders there needs to be opportunity (space and time in lessons and all valuing each other's ideas) and appreciation (a safe atmosphere with no 'rights or wrongs').
Real-life experiences	Children who had a wide variety of experiences during their home life seemed better able to share more unusual or 'deeper' wonderings, e.g. different types of hobbies, holidays, visits, travel, animals/pets, books read, talk engaged in with parents.
Academic ability	The more academically able children had better language and communication skills during discussion about their wonders.
Behaviour and demeanour	Children's general behaviour and demeanour did not prove particularly significant, as long as they were effectively stimulated and/or engaged in the wondering. This type of work did not pose more behavioural challenges than any other lesson.
Age	Age was not viewed as a factor influencing children's ability or willingness to wonder.

themselves? How would this link to the curriculum? How do we address questions that we feel are sensitive? The group considered ways to help children think more about the questions they asked, and how to move the wonderings from questions into areas for enquiry.

The emerging model

While this process was being carried out in the classroom, each teacher considered not only the questions the children produced but also the factors that influenced their wonderings (Box 2). Each teacher's reflections also provided evidence and ideas to begin to develop a six-step 'model' (Figure 2).

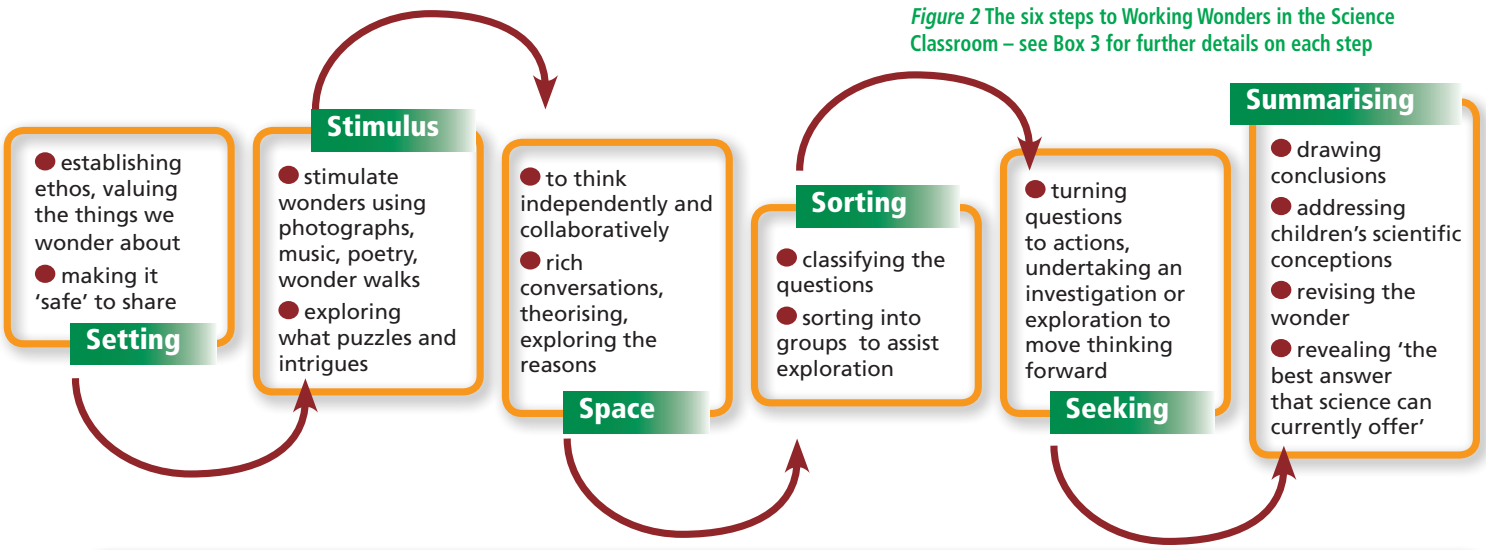
Reflections

The relevance of wondering to the primary science curriculum truly emerges on exploring how scientists work and how scientific endeavours have played out. There is a place for encouraging children to wonder; however, the link to core curriculum objectives may result in tenuous links or a shoe-horning of questions to fit UK National Curriculum objectives.

The innovative use of music, poetry, film, photos, wonder boxes and walks allowed for the introduction of more scientifically related stimuli, enabling the children's wonderings to link to aspects of the curriculum. Describing the qualities of outstanding scientists and the role of science in the wider world also led to children being more aware of their role as scientists and what it meant to work scientifically. The role of wonder and the awe it can inspire was relevant to learning in primary science, albeit perhaps not directly dovetailing into current National Curriculum objectives.

A teacher's (or any adult's) role in wonder, was a very useful one to debate. Does one ruin a wonder if one provides a 'right' answer to a child? The model that has emerged allowed us to promote shared talk about what children were thinking. This also fits with school and classroom cultures that promote thinking skills and personal capability development. It is a teacher's role

Figure 2 The six steps to Working Wonders in the Science Classroom – see Box 3 for further details on each step



Box 3 How the teachers in the project addressed each step in the Working Wonders model (Figure 2)

The approaches are reflective of what the teachers did in their classrooms and are presented here as examples. Putting your own take on these steps is the key to making this a success in your contexts.

1 Setting (10 and 11 year-olds)

At the start of the project, children were given the opportunity to reflect on the qualities of outstanding scientists through quotes and looking at specific developments and the role of science within the wider world. This helped establish certain key scientific principles, and set the learning in a wider context:

- Science is a growing body of knowledge that is always open to questioning and new ideas.
- Scientists learn from mistakes.
- Asking questions and finding ways to investigate them is a fundamental scientific skill.
- Thinking about big scientific questions is exciting and complicated.
- There are not always right and wrong answers to scientific questions.
- Science has developed to provide solutions to real-life problems and has improved our existence.
- Scientists learn from each other.

This gave children the confidence and freedom to ask scientific questions and a sense of how scientific endeavours start.

2 Stimulus (5 and 6 year-olds)

A 'wonder box' was used, where children put their general wonders. Many of them related to themselves, such as '*What will I look like when I am older?*' Some were wonders that we could research, such as '*I wonder if a snail has blood?*' We discussed which wonders we could find an answer to and which we couldn't (at least not for many years).

A montage of DVD clips relating to our current science topic (variation) was shown. The children then came up with wonders and questions more specifically about this, such as '*How are boy/girls different?*' and '*What is the biggest animal in the world?*' We could then research some answers.

3 Space (10 and 11 year-olds)

Having given children the opportunity to discuss their ideas, and ask questions they needed space and the opportunity to think. They benefited from rich conversations around their questions. They were challenged to explore their reasoning fully, and engage in high-level conversations. The children should also have the opportunity to ask questions after the lesson, for example through an online forum or at an appropriate moment in class that may lead to further questions.

4 Sorting (7 to 9 year olds)

The next step after generating the questions was to decide with the children upon a suitable method of sorting them; for example:

- **Research** – questions that could be answered using various secondary sources.
- **Calculate** – questions that required the children to define a series of steps they could use to generate an answer.
- **Easy** – questions that could be answered relatively easily by the children.
- **Unanswerable** – generally questions that were religious or philosophical, such as '*Why is the universe here?*'
- **Unsuitable** – questions that were not appropriate or clear etc.

5 Seeking (10 and 11 year-olds)

After categorising, the teacher and the children need to agree on the most appropriate responses. The approaches taken have to be fitting to the type of questions asked; for example, hold an informed philosophical debate, carry out an investigation or interview a scientist over a particular issue. Each question will need specific learning outcomes based on the way the answer is sought.

It was at this stage that the younger children carried out science investigations linked to the termly topic of variation. These included the 'Wonderful Worm' activity where the children were able to ask many questions about things they might like to find out about worms. Some were research or observational questions, such as '*Do worms have hairs?*' and '*Do worms have a heart?*' This was developed further into questions that could be set up as an investigation, such as '*Do worms like different smells?*', '*Do worms like water?*' and '*Do worms like hot or cold places?*'

6 Summarising (7 to 9 year olds)

As children had clearly indicated their desire to have the questions answered, it was our role as teachers to reveal the best answer that science can currently provide to their wonderings. Teachers felt it important to make sure the children felt there could be a line (of sorts) drawn under the explorations, although we needed to ensure they understood the big idea of science being a developing phenomenon.

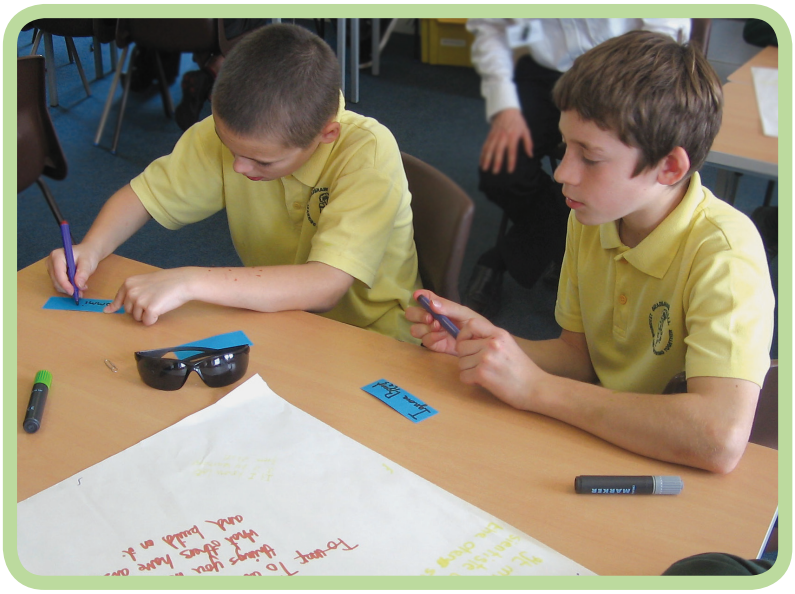


Figure 2 Reflecting on the qualities of outstanding scientists

to find a means by which to exercise the 'wondering muscle', even within a standards-driven culture.

What next?

It would be of interest to take more time to consider how this work fits with educational theories or, indeed, how it links with current educational writing on 'Expansive Education' by, for example, Guy Claxton and Bill Lucas (see *Websites*). Please share your experiences and children's wonderings and how you foster them with us by emailing the author.

Websites

Expansive Education Network: **www.expansiveeducation.net**

Top Marks Project Continued Professional Development Unit, AstraZeneca Science Teaching Trust: **www.azteachscience.co.uk**

Photographs courtesy of Bradshaw Hall Primary School, Cheadle

Reference

Goodwin, A. (2001) Wonder in science teaching and learning: an update. *School Science Review*, **83**(302), 69–73.

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