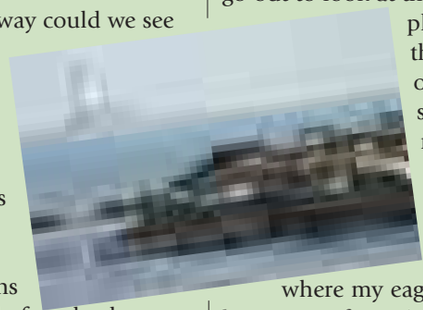
Members of PSR Editorial Board explain what drew them to science

Alan Peacock is Editor of *Primary Science Review* – and a keen fisherman!

Alan Peacock, *PSR* Editor, emphasises the need to preserve children's sense of wonderment about the world

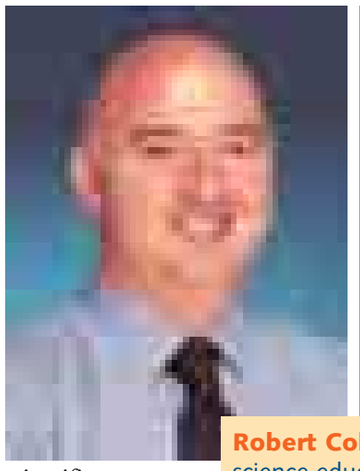
A couple of summers ago, I took the small boat from Seahouses in Northumberland to the Farne Islands, to watch the seals. The water was still and glassy, and the sea fog so thick that only when we were 25 metres or so away could we see the rocks with dozens of seals lounging on them. Everything was quiet. And yet one after another, puffins with beaks full of sand-eels came in off the sea like bullets, straight to their burrows. How do they do it? That same summer, I was walking around Trevose Head in Cornwall with friends. On the cliff beyond the lighthouse is a tall pole with foot holes cut along each side, probably an old navigation aid for passing ships. Every time I pass it – and we go there frequently – I have to climb it. It has a special view from the top. My friend, in amused exasperation, says, *'Will you ever grow up?!'*



I hope not, in some ways, because it is this kind of wonderment about the world that I value as the basis of all science. Life will not be any easier for knowing how puffins navigate in fog; yet I still have an urge to understand. In primary school, our class went on a 'nature walk' most weeks. At weekends, my father took me along the river, the canal or on the moors, finding birds' nests, identifying flowers, climbing trees or going fishing. Sometimes at night, we would go out to look at the stars and planets. I never thought of any of this as science – I'd never heard the word. But I loved every minute of it, and this is where my eagerness to learn came from; it opened the doors of perception. Most people, when asked about their earliest memory, describe some event in the natural world that made an impression on them.

In grammar school though, we sure did science: memorising lots of laws and equations, being tested, or doing the kinds of tedious experiment where you know what the result should be before you start. (How many times did we watch a test-tube of oxygen re-light a glowing splint?) Much of it left me cold. Did this make me anti-science? Not a bit. I held on to the value of those early experiences: the joy and satisfaction of careful observation; the surprises, like green shooting stars; a huge pike in the reeds chasing fry; the beautiful symmetry of four eggs in a tewit's nest on an open field; catching a trout on a fly I had designed and tied myself, to imitate one I had observed on the river. And asking questions, learning to test out my ideas for myself, not to prove something to someone else. Preserving this curiosity and enthusiasm, the habit of noticing, looking closely at things, asking questions and seeking patterns, is the vital job of primary schooling; it is the foundation of all science, but there's no real need to call it science. As long as children want to explore the world around them, do all you can to encourage and foster their curiosity. They will always be grateful to you, as adults, for lighting these fires in their hearts and minds.

Robert Collins thinks we are all *'secret science superstars'* and reminds us to celebrate the teachers who quietly sustain children's motivation to learn science



Robert Collins is a science educator in the Faculty of Education, University of Strathclyde.

Why science? That's an easy one. It's got to be because scientists are the secret superstars of history. From the very first guy that rubbed two sticks together and sparked off civilisation, to the one who conceptualised the electronic information superhighway – and everyone in between. Sure, we've all got our theories on how it all came about, and so we should, because the human is a natural scientific being. That means you and I must be superstars too!

I say 'secret' superstars, because I feel they have always been a silent cultural impetus. As a Scot, I'm all too familiar with the renowned contributions of the likes of John Logie Baird to modern society. But I wonder how many of the millions of football fans who watched the recent world cup on television across the world were aware of the importance of the scientifically inquisitive mind underpinning the origins of their enjoyment and memorable moments? And there are many thousands of smaller examples like this in everyday life aren't there? Like morning toast, or the drive home from work. From electricity to petroleum, modifications around discoveries made possible through enquiring minds, schooled in the field of scientific investigation.

But what feeds a hungry mind? What drives us humans to discover these essentials we now consider commonplace? As an educationist, I am certain that the scientific process goes a long way to satisfying many of the mind's cognitive appetites. I've always felt that a good science lesson is capable of grabbing the attention, holding it, engaging and engrossing the learner in a creative, thinking dynamic. It is the teacher, that self-effacing educational celebrity of the primary classroom, who is quietly sustaining and motivating children's natural curiosity and ability to learn. Like all good and familiar things, I suppose, we all take it for granted sometimes. I like to deliberately focus in on it, once in a while, just to let it know how much teaching is appreciated. It is a practice I'd recommend.

Recognising good science, I feel, is to highlight it as a journey in which wonder, questioning and practical involvement can fuel almost endless nurturing of an inquisitive mind. It is an open-ended, all-inclusive process, whereby creativity and personal logic combine with the true prospect of gaining a better understanding of our lot as human beings. It is also good fun. Without science and scientists of all ages, life would be less than ordinary. It is much better being a superstar, don't you think?

Ian Milne is a senior lecturer in primary science education at the University of Auckland, New Zealand.

Ian Milne talks to children themselves in order to explain why science should still be part of the primary school curriculum

My belief is that the overall goal of school science education programmes is that young people leaving the school system will have developed the knowledge, skills, attitudes and values that will allow them to take an informed position on scientific issues and tensions that may be facing them and the society they live in. School leavers should be aware of and have an understanding of the scientific process and its values. They should have developed an enquiring attitude and the knowledge and skills that will allow them to find the answers to their questions. Recognition of the natural curiosity and wonder that young children bring to the process of exploring and explaining their

experiences of the natural world must be a key consideration for primary science educators when planning learning activities for primary-aged children.

All those involved with primary science education have a responsibility to ensure that these attitudes are valued and enhanced, ensuring that when children transfer to secondary school they retain these natural creative dispositions. Primary school science is about children's science, that is, the personal explanations children have created to explain their experiences of the phenomena they have encountered whilst exploring their world. The evidence children have collected, and the thinking behind how they have used it to inform the creation of their explanations, become building blocks for their further learning in science. It is important that children's existing explanations and their evidence are viewed as personal and tentative in nature; they need to be tested and shared with others. Children's science must be valued and be an integral part of science learning programmes in schools.

Asking children what they think science is, may provide an insight into the role science should play in the primary school curriculum. Whilst working in an intermediate school (years 7 and 8) recently, we asked the children involved to respond to the statement, '*What I think science is all about*'. The most common response was '*Science is about doing experiments*' (74 per cent). '*Chemicals and explosions*' or '*Blowing things up*' were referred to by 79 per cent. A significant proportion (37 per cent), however, indicated that they hadn't done science at primary school. That children expect science to be doing experiments and making explosions is not new; but for science educators, the fact that nearly 40 per cent of the children shared the belief that they had not done any science at primary school is significant. I believe primary science educators need to provide a learning culture that allows the children to appreciate that their explanations, and the evidence they used when creating them, is their science and when they share this with others they are participating in scientific activity.

Teachers have a responsibility to recognise and value the creative explanations that children construct and share and they must provide an engaging learning environment where the children's tentative ideas and evidence can be challenged. Children who recognise the need to test and evaluate their evidence and explanations will be on a pathway leading them to develop the knowledge, skills and attitudes they will need when making informed decisions about the many issues that will confront them throughout their lives.

Keira Sewell stresses the part played by science in children's critical thinking and their ability to engage in debates about what will be possible in future

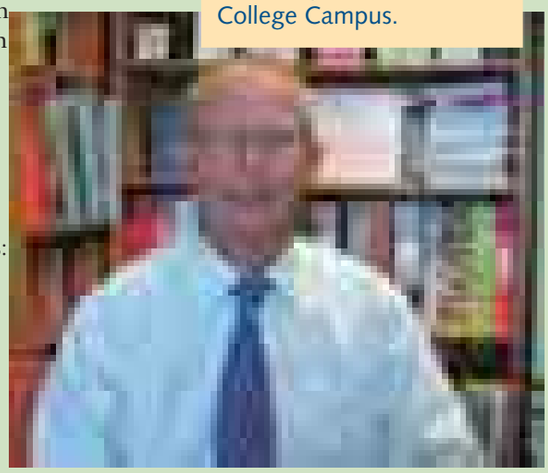
Whilst I could write for hours about the value of science education, there are three things that immediately spring to mind when considering '*Why science?*' First, is the role science plays in promoting critical thinking, the ability to 'think outside the box'. Enabling learners to accept challenge, to debate, discuss and even argue their ideas and to accept that others can have equally valid arguments can only enhance the future lives of all our children. Second, is the way an understanding of scientific processes alongside an understanding of scientific concepts enables us to contribute to our democratic society. We cannot begin to anticipate the future technological and scientific world of our children but we can prepare them to engage in debates about both what is possible and what is desirable. Third, but by no means least, is the way science enables us to appreciate the 'awe and wonder' of the world around us. The world is an amazing place, which should be celebrated, respected and enjoyed. All of these make a contribution that goes way beyond our school days and really does lead to a lifelong love of learning.

Keira Sewell is programme director for the primary PGCE at Southampton University and teaches science education.

Mick Dunne

emphasises the significance of asking '*Why?*', even before children recognise it as science, and that every good question leads to two more

Mick Dunne is head of science education at the University Centre, Bradford College Campus.



I've always been a scientist even when I was too young to realise it. From the earliest of ages I've always wanted to find out about things: how they work; why it sinks; how different colours mix to make a new colour; why some wild birds lay one or two eggs and yet others lay over a dozen; why the newt dried up under the carpet (don't ask!). I hate the taste of cheese; yet why, if I suck a Polo Mint at the same time, is it OK to eat? How on earth can cabbage be good for you?! These and many, many more questions occurred to me in a very natural way long before I even met the word 'science'. Questioning, wanting to find out, is a centrally important part of being human and it is science that often helps resolve such enquiry. When the nature of science is better understood we don't have to be too concerned about right and wrong answers: there is space for the views of others, and often there are no 'right' answers.

Science is often uncertain and provisional but always dynamic. Science provides us with a means of finding out, of satisfying our desire to know more. But it has a perverse quality of which we only become aware later on in life: for every question we might answer, at least two more emerge and so we're hooked. I relish the idea of learning more; and science, very often creatively and imaginatively applied, is hugely significant in enabling this to happen. Science is in us, on us and all around us – you bet it's important.

Peter McAlister

wonders about the limitations of seeing science as a subject in the primary school, and prefers involving children in a 'venture' that involves thought-provoking enquiry

Peter McAlister is science adviser (formerly a primary teacher) to the South East Education and Library Board, Northern Ireland

Maybe science should not be taught to primary school children; maybe it simply needs to be experienced by youngsters. The words 'subject' and 'taught' conjure up formal connotations that distract us from the essence of good primary science. Fun, awe, curiosity and excitement better describe the kind of primary science development that is preferable. Teachers have the opportunity to tap into an almost inexhaustible reservoir of stimuli to promote investigations and 'hands-on' classroom activities. Children will almost always respond with interest and enthusiasm when learning becomes challenging, practical, meaningful at an individual level and enjoyable.

In my own exploration of science with my primary pupils, I have always endeavoured to approach learning by probing and personalising the problem. Encouraging questioning and emotionally involving the children in the venture guarantees commitment and cognitive progress. A study of the Sun, for example, can lead to topics from skin protection to fading furniture, all relevant and accessible issues for this age range.

The process of exercising the children's powers of thought-provoking enquiry will extend their reasoning powers and enable them to find and think things out for themselves. Science might not be the only area of study by which these outcomes may be achieved, but it has the potential to create the practical, enjoyable contexts for children to develop as interested and engaged independent learners.

Natasha Serret explains how wanting to be an astronaut at the age of 10 led to a passion for science

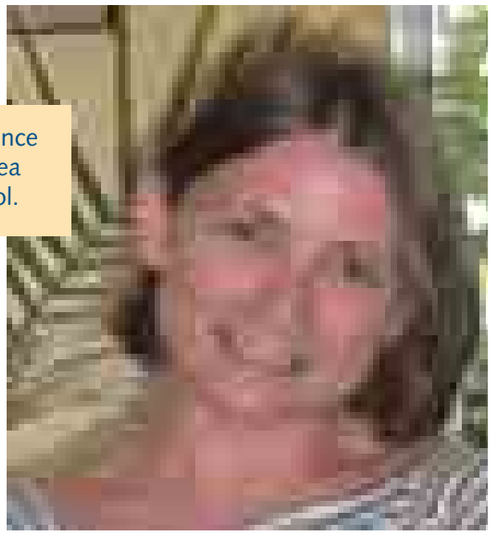
Natasha Serret is a research consultant in science education at King's College London.

Amongst a pile of treasured things in a dusty box in my parents' house is a letter from the European Space Agency, sent to me when I was 10 years old. The only real guidance they could offer to a 10-year-old girl who had set her heart on becoming an astronaut was to keep studying science. Which is exactly what I did: and it must explain why 10 years later, in the final year of my physics degree, I opted for the advanced astrophysics module and why I still relish every opportunity I get to teach primary science. My passion for science started around the age of 6, when I became obsessed with wondering how the Moon managed to follow me on family night drives. The reason why I believe that talking, doing and thinking about science with primary children is so necessary is because, like that budding young astronaut, it stimulates and satisfies an early fascination with everyday phenomena, sowing the seeds for a potential life-long interest in science.

Sarah Earle stresses that to teach science to young children is about helping them to use their natural curiosity in an increasingly systematic way

Young children have a natural curiosity about the world around them. They constantly ask what things are and why things happen. They want to make sense of the world and explain it. Science is an extension of this natural curiosity, a grown up version of the toddler's never ending '*Why?*' It is a way of exploring and investigating the world, asking and answering questions about the meaning of events. Science is a way of problem solving, a way of thinking. To teach science is to teach children how to use their natural curiosity in a more formal and systematic way.

Sarah Earle is science subject leader, Elmlea Junior School, Bristol.



My class of 10- and 11-year-olds think science is important for a number of reasons:

- to help you think: *'it's good to ask questions'*, *'to improve our brain and solve problems'*;
- to understand your own situation: *'helps you learn about things in your life and your life cycle'*, *'it helps you understand everyday life more'*;
- to understand the world: *'helps you learn about how everything in the world works'*, *'it explains things'*, *'makes you realise about the world around you'*;
- to prepare for secondary school: *'so that we can do experiments sensibly'*, *'to learn ready for secondary school'*;
- for future careers/society: *'we need scientists to create new ideas'*, *'if they didn't teach it in school then you wouldn't know about it and you wouldn't be able to be one'*.

I am glad that none of them mentioned SATs and that, despite the over-emphasis on revision, they have not lost sight of the fundamental importance of science as a way of investigating and questioning the world. To explore the world in such a way keeps us interested in life, looking at the world through the wide eyes of a toddler. Science keeps us young!

Everything you ever wanted for primary science!


On-screen worksheet


How long is it dark?

EASYSENSE Q DATALOGGER


How cold?


Which is the fastest car down the ramp?


Is the cover keeping the water hot?

Datalogging in the bag!

With built-in sound, light and temperature sensors and a simple screen menu, **EASY**SENSEQ lets you see sensor values wherever you are. Inside the soft storage bag you will find everything you need for datalogging in the primary curriculum - the essential extra 2 plug-in temperature sensors, connection leads, Primary Activities book (with teachers' notes) and a multi-user copy of **EASY**SENSE software – complete with 25 on-screen worksheets.

You can extend the range of science activities further by using sensors from the Data Harvest SmartQ range – Heart rate/pulse and Light Gates or Timing mats.

Training workshops are available.

EasySense Q Primary Pack
includes 2 plug-in temperature sensors, software and Primary Activities Book
£189.00 *(plus carriage and VAT)*

DATA HARVEST
Data Harvest Group Ltd
1 Eden Court, Leighton
Buzzard, Beds, LU7 4FY, UK
Tel: 01525 373666
Fax: 01525 851638
sales@data-harvest.co.uk
www.data-harvest.co.uk

Designed and manufactured in the UK by Data Harvest

We subscribe to BESA Code of Practice

Tara Lievesley sees that working in science with children helps her remain a '37-year-old child'

How does that work?
What's this do?
What happens when I move this?

I took it apart and put it together to see how it worked, but have all these bits left over ...

Always questioning about the world around me is part of what makes science important to me. It's the magic of what makes things happen, from the magician in a show to the wonder I still have every year when I plant a runner bean seed and see how big the plant gets and the volume of vegetables it produces. It makes life that big adventure of continual exploration and without it, for me, life would be too dull. Imparting that emotion to others is why I work with children, fostering their natural curiosity. Does that make me a 37-year-old child?

Tara Lievesley is a science consultant in Warwickshire.

Richard Watkins stresses the importance for children of an emphasis on the big ideas and big names of science

Noah, Three Wise Men, Doctor Barnardo, Guy Fawkes. Spot the pattern yet? All these historical characters will probably appear, in some form or another, in school services or as part of topics during the school year. These characters have a monopoly in many primary schools. They are usually afforded pride of place in a morning service or have units of work devoted to them. But how many schools celebrate famous scientists, or their ideas, with such devotion and detail?

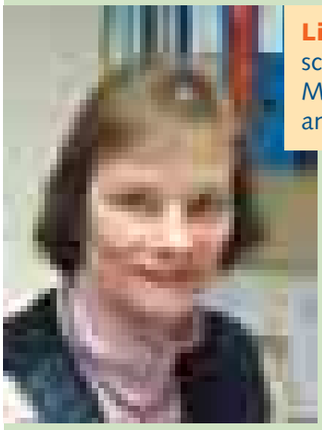
Nearly all primary-age children can tell you something about Florence Nightingale, but how many will know anything about the scientist who first suggested that continents may have moved over geological time (Alfred Wegener)? How many will know about Copernicus or Galileo and their revolutionary ideas about our solar system? Or about the ideas of George Gamow, the scientist who developed the 'Big Bang' theory which helps man explain the most fundamental of questions: How did *it* all begin?

Richard Watkins is science coordinator at Ysgol Llywelyn, Rhyl, North Wales. Before moving into teaching he worked in industry as a research geologist.

Currently, there is too little emphasis on such 'big ideas' in science education, particularly in primary science. Until we embrace and celebrate the ideas of famous scientists, such as Gamow or Wegener, in the way in which we celebrate figures such as Doctor Barnardo or Moses, we are denying children the opportunity to explore the developments that explain some of the most fundamental questions they ask. We must celebrate the way in which science has gained status in the primary curriculum over the past two decades, but we must question whether the curriculum provides children with appropriate opportunities to learn about key ideas and historical figures from the history of science.

The class of 10–11 year-olds I was teaching gravity to recently were fascinated with ideas about time, space and the origin of the universe. The challenge of primary science is to find appropriate opportunities to integrate such 'big ideas' into the primary curriculum in a meaningful context. Young children need explanations for key questions they ask about Earth and the universe. It is possible to explain difficult or abstract ideas to children and, using a combination of models and analogies, primary science can open young minds. Of course, some may not understand, but not to share these ideas at all with children denies those capable of understanding access to powerful new ideas and explanations about their world.

Liz Lakin wonders about that bumble bee on the ceiling, and how it helps children ask and explore difficult questions for which there are no immediate answers



Liz Lakin is senior lecturer in science education at St Martin's College, Cumbria, and reviews editor for *PSR*.

When you look out of the window and watch the birds nimbly searching the undergrowth for food, see an aeroplane gracefully climb into the sky above you, or notice a giant bumble bee also defy gravity by flying to the ceiling and hanging effortlessly from the lamp shade, do you wonder how, or why or even what if ... ?

That is why science is important – it allows us to answer some of those questions and explore those that we can't immediately answer. By creating opportunities for our children to learn about science we allow them to develop those natural enquiry skills, whilst nurturing and refining the other science process skills. That way children will be encouraged to ask questions and seek answers whilst developing their own attitudes and priorities based on sound foundations and frameworks. Promoting this experiential science at the foundation stage, supported with progressive conceptual development at primary level, is fundamental to our children's future scientific development.

Interest and enthusiasm for science so often wanes after transition to secondary education; as teachers we have a role to play in ensuring that this interest and enthusiasm gets off to the best possible start, with the hope of maintaining it. That is why primary science is important.

Finally, **Carolyn Lindsay** asks '*Why not?*'

Carolyn Lindsay is a class teacher in Tower Hamlets, with responsibility for science, design technology and assessment

Attending a small primary/secondary school meant that from the first year I was fortunate enough to experience science with Mr MacDonald every week. Mr McDonald was the secondary department's science teacher, so I was not exposed to the then customary 'nature study', which for most of my generation was the only nod in the general direction of science. I quickly discovered that science legitimised every human being's right to ask questions. At least so it appeared to a 5-year-old in the north of Scotland. For two precious hours every week I was full of wonder and confusion – actively encouraged to ask questions, to observe and hypothesise – I was in child-centred heaven!

Science in the primary school gave me the opportunity to be in control of my own learning, with no ceilings. Now, as a teacher I can see that, in science, children do not have preconceptions of what they should be doing at a particular stage in their learning. They do not put up barriers to their development: they flourish through the process of asking questions and finding answers, and the primary science curriculum offers a unique opportunity for children to extend this stage in their development. Primary science offers children a unique kind of control over their learning, an opportunity to explore and make sense of their world. They are able to pose questions that arise from their own interests, and then to set up the process by which they can answer their questions. They can learn that not all investigations are going to give them a clear-cut answer and that probing questions about their world can influence their whole lives, enriching and deepening their understanding of their world. Primary science necessitates children being active in their learning. They acquire a range of investigative skills that are transferable to other areas of learning. Children who have experienced investigative science, who have posed a question for investigation and followed the scientific process of investigating the question, are prepared to use reason and logic in all aspects of their learning.

The role of the primary science teacher is to facilitate this style of learning. We can help children to look at the world with enquiring eyes. We can structure their learning environment so that they can explore phenomena or simply investigate through play how materials behave or 'what happens if ...'. The knowledge of scientific investigation and exploration helps children to formulate hypotheses based on what they observe in informal play. These skills and experiences establish for children a way of thinking that will colour their whole future.

Science, the exploration of our world, begins at birth and continues forever. Primary teachers support this developmental process when children are given opportunities to question, investigate and explore, becoming increasingly more independent learners. Primary science makes them increasingly more confident about playing a crucial role in fostering a society whose members are empowered to continually question and evaluate their world.