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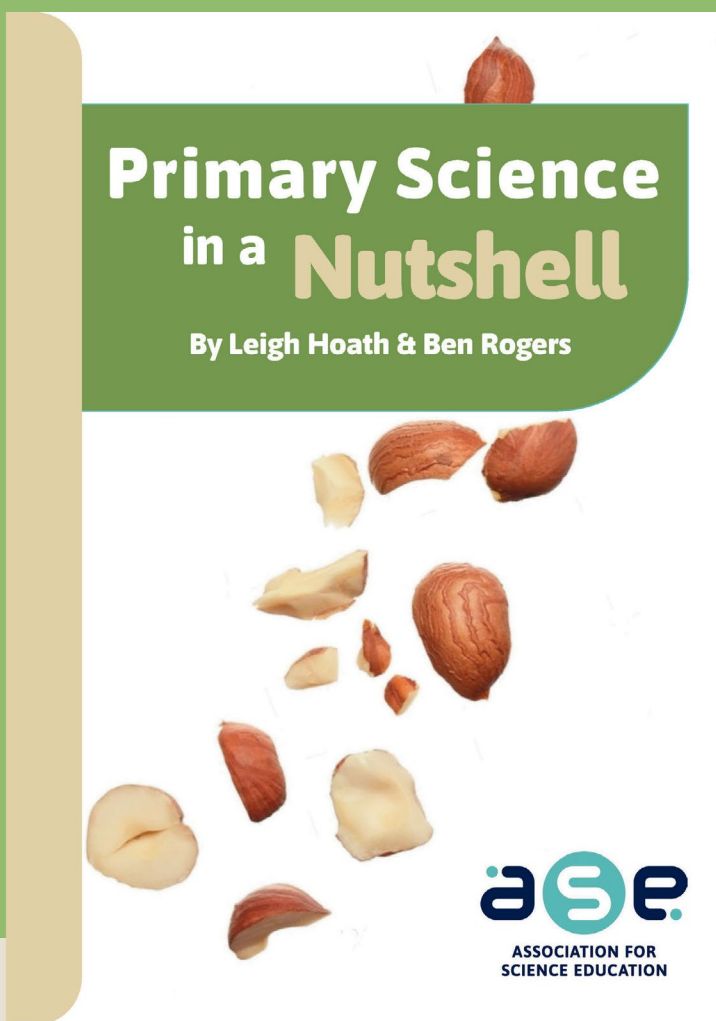
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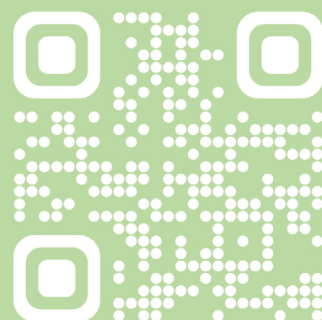
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Future themes

Generally each issue of *Primary Science* focuses on a theme, but also includes other articles on a range of topics, so if you have something to write about that is not on a theme or responds to a theme already covered, don't be deterred. All contributions are very welcome. Shorter articles are particularly welcome.

Issue 185 (May 2025) AI and computing in science

(deadline for submissions 7 February 2025)

Issue 186 (September 2025) Education for sustainable development

(deadline for submissions 6 June 2025)

Writing for *Primary Science*

Primary Science publishes articles on all aspects of primary science education, including early years, and we welcome articles that:

- support effective classroom practice in teaching, learning and assessing science;
- give practical classroom ideas;
- interpret (rather than simply present) research;
- address issues relating to primary science education;
- comment on controversial articles, issues and debates;
- challenge teachers' thinking about important changes.

Short contributions are very welcome, including notices, letters and short responses to other articles. It may help you if you read one or two articles in *Primary Science* before beginning your own.

The Editor is very happy to advise and support new authors. Contact: editor.primaryscience@gmail.com

Detailed guidelines for writing for the journal are available on the ASE website:

www.ase.org.uk/write-for-us

Contributions and comments:

Please send as an email attachment to:

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Safety: Reasonable care has been taken to ensure that articles in this journal do not suggest practices that might be dangerous, and safety warnings are given where appropriate. However, the ASE has not tested the activities suggested and can therefore give no guarantee of safety. For further advice on health and safety matters in primary science education see *Be safe! Health and safety in school science and technology for teachers of 3- to 12-year-olds* (4th edition, ASE, 2011).

The ideas and opinions expressed in this journal are not necessarily those of the Association for Science Education.

Focus on...

Science in the early years

It was real pleasure to edit this issue of *Primary Science*, especially with its theme affording insight into 'Science in the early years'. It has been a while since investigating science with our younger learners has been given such prominence and so it was great to curate articles providing update into current approaches in early-years teaching.

The issue starts with an article from one of our newest Editorial Board members, Kalpa Ghelani. Here Kalpa provides insight into contemporary teaching in the early years with particular emphasis on the use of play within STEM. Her article provides a really good rendition of current policy and practice, and very much fulfils the brief of setting the scene of good practice in the early years. Ideas from Andy Markwick, also a new recruit to the Editorial Board, follow in the form of two excellent examples of practical activities carried out in separate investigative forums with early-years practitioners. Andy's work here offers some really useful insight into why and how science can be carried out with very young learners. All of this is then rounded off with an insight into modern approaches to playful science in early-years settings north of the border in Scotland, where both I and my good colleague Kirsty Aitchison outline the benefit of policy encouraging teachers to adopt a playful approach in their teaching with very young learners.

It is always a pleasure to receive articles from new writers to *Primary Science*. Our next two articles come from new authors and both place focus on holistic approaches to developing unique and bespoke opportunities for all children when it come to engaging in science learning. The first of these comes from Emma Smith, who offers an informal take on her own experience of leading whole-school science assemblies and innovative ideas such as the 'curiosity box', all of which place responsiveness and engagement at the

heart of a good teaching approach. We then hear from Joanna Farbon, who provides really useful insight from a head teacher's perspective on developing a science curriculum across an entire school. I am confident that both authors' advice and experience will be of great benefit to anyone developing science provision from early years to later stages in the primary setting.

As regular readers of our journal will have realised, *Primary Science* is committed to bringing exciting resources, equality, diversity and inclusion and updating of international perspectives to the fore. This issue is no different in this aspiration and so the focus of our final three articles will come as no big surprise. We are first treated to some upbeat inspirational comment as Verity Jones speaks to Clare Lawrence and Naomi Bowen, participants at the launch of the Sustainable Power, Renewables, and Construction (SPARC) Alliance on International Women's Day 2024. Next, we hear from Kulvinder Johal from PSTT as she recounts the many successes of UK schools at the annual 'Science on Stage' event, hosted in 2024 in Finland, and invites you to consider taking part in 2025! Finally, Alex Harris from the BBC supplies both his enthusiasm and really useful links to astronomy resources and details of a space event in British Science Week in March 2025. I think readers will find this material provides some exciting ways to engage and motivate children to learn about space and the planets.

So, issue 184 starts out with looking at the early years, takes us through studies and practice conducted throughout this year, and ends with some inspirational events in 2025! Quite apt, some might say, for a December edition of your favourite *Primary Science* journal.

I hope that you enjoy issue 184!

Robert Collins

The science of play: exploring STEM learning through play-based approaches

Kalpa Ghelani explores the role of play in early-years STEM education and its effect on shaping children's thinking



Play can be challenging to define and people will conjure up various images and definitions. Regardless of your definition, decades of research provide evidence of the benefits of play on children's development and learning (Schlesinger et al., 2020). In early-years education, play is central and is a focus of the Early Years Foundation Stage (EYFS, ages 0–5) framework in English schools, as well as Scotland's Curriculum for Excellence and the Curriculum for Wales. Play-based learning opportunities enable children to develop social skills, creativity and problem-solving abilities. When this intersects with STEM (science, technology, engineering and mathematics) learning, we open up a world of enquiry, exploration, problem-solving and curiosity. In STEM learning, the focus is on what we can do with what we know.

Children and educators are facing a new reality, with life-changing technologies and career opportunities that we cannot yet foresee creating their own challenges (Zosh et al., 2017). Thus, learning about STEM through play-based activities becomes even more important. Early-years educators are at the forefront of facilitating learning in playful environments that will build the foundation for children understanding how to navigate these unknowns. This is powerful for STEM subjects because we have an opportunity to create and construct environments where

children are so involved and immersed in what they are doing, and 'playing' with, that learning occurs naturally.

While substantive knowledge (content-focused or the 'what' of learning) is valuable, particularly in STEM subjects for EYFS children, disciplinary knowledge (the behaviours or the 'how') serves as an effective means of acquiring that substantive knowledge – a concept further explored in the Ofsted (2021) *Research review*. Early-years settings are indeed hubs of creativity when designing learning through play-based opportunities. Box 1 gives some suggestions for how play can be integrated more specifically with STEM learning and around disciplinary approaches supporting children to navigate uncertainty.

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Play-based learning opportunities enable children to develop social skills, creativity and problem-solving abilities. When this intersects with STEM learning, we open up a world of enquiry, exploration, problem-solving and curiosity.

Box 1 Opportunities for STEM learning through play

Science through exploration

- **Nature walks.** Familiarise children with the natural world, as they observe plants, insects and weather, and learn scientific concepts such as ecosystems, life cycles and weather. Suprabha (2024) shares examples that go beyond this, considering unusual or blended opportunities for learning, such as combining nature walks with storytelling, weaving in tales of local flora and fauna, ecosystems or creating 'nature discovery bins'. Here, children create themed bins that they can fill with natural items as they explore, which encourages 'hands-on exploration and sensory learning' (Suprabha, 2024).
- **Experiments.** Simple experiments such as mixing baking soda and vinegar introduce chemical reactions. Using sensory tables with a variety of materials, such as sand, water, ice, etc., allows children to explore properties and changes in matter.
- **Time-lapse photography.** Use this to observe moving shadows, sprouting seeds, flower buds opening and closing, snow and ice melting, or puddles evaporating.
- **Variability.** Where different amounts of materials can lead to different outcomes, supporting children's growing understanding of variability and that outcomes are not always predictable.

Technology through interactive tools

- **Robotics, computing and coding.** Robotics kits can introduce children to basic engineering and programming concepts. They learn about design, structure and the basics of coding through play. Research conducted by Dangwal *et al.* (2005) demonstrates the impact of minimally invasive learning models, specifically focused on computing. Hatzigianni (2017) further stimulates discussion beyond simply using technology, discussing the potential it has to significantly change everyday

practice in the early-years experience, and commenting on the enjoyment of unrestricted freedom and open-ended play.

Engineering through building and designing

- **Block play and construction sets.** Building structures using blocks, magnetic tiles or other construction sets helps children understand principles of balance, stability and geometry.
- **Problem-solving challenges.** Set up challenges where children have to design and build solutions, such as creating a bridge from various materials. This fosters creativity, critical thinking, problem-solving and collaboration.

Mathematics

- **Counting and sorting games.** Use everyday objects for counting, sorting and pattern recognition. Games such as matching shapes or colours can introduce basic mathematical concepts and develop mathematical vocabulary.

Integrated STEM activities

- **Themed play areas.** Create role-play corners, such as a mini science lab or a construction zone, where children can engage in various STEM activities. This integrated approach helps them see the connections between various STEM fields.
- **Storytelling and role play.** Use stories and role-play scenarios that involve STEM concepts. For example, children can pretend to be engineers fixing a broken bridge or scientists discovering new plants, identifying characteristics of a new species, categorising and sorting. *Balancing act* by Ellen Stoll Walsh, *At the same moment, around the world* by Clotilde Perrin, *Construction* by Sally Sutton and *The dreamer* by Il Sung Na are just some of the excellent books on offer to support STEM learning.

Cognitive, social and emotional benefits

The literature review and discussion of case studies by Schlesinger *et al.* (2020) outlines the benefits of play and the positive outcomes related to social-emotional development. This is highly relevant in an age when educators need to develop children's ability to navigate the unknown and apply their knowledge in new and developing fields that are rapidly changing and evolving. The study also discusses how some types of play (specifically guided play in science and mathematics) can support children's executive functions, also known as 'ready to learn' skills. Diamond and Lee (2011) explore these as impulse control, attention, memory and flexibility. They suggest that focusing on these skills in isolation may

not be as effective as also addressing social-emotional development. This is where play can support the development of these 'ready-to-learn' skills.

Overcoming challenges

Resources and materials

With tight school budgets and differing opinions on setting priorities, it can be a challenge to source the necessary materials to effectively implement STEM activities. Some of the examples in Box 1 use readily available resources or require no budget at all. If finance is a challenge, consider seeking grants, donations or partnering with local businesses or organisations to acquire the resources you may need (see *Weblink*).

Training and CPD

Movahedazarhouli, Kermani and Aldemir (2023) identify that educators may not have adequate training in STEM subjects or in how to integrate these subjects into play-based learning. While it is important for schools to ensure that staff feel confident in all subject areas, early-career teachers and initial teacher education (ITE) students are also great people to learn from, as ITE providers set up opportunities for students to develop their understanding of STEM. An example is the engineering project, led by Juliet Edmonds and Fay Lewis at UWE Bristol, in which ITE students are partnered with engineering students to develop a sequence of learning for primary-aged children (Lewis and Edmonds, 2024).

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We have an opportunity to create and construct environments where children are so involved and immersed in what they are doing that learning occurs naturally

Balancing curriculum requirements

We all know about the difficulties of trying to balance the demands of the curriculum. Consider how you can be creative in your approach to play-based learning and continuous provision in your setting.

Varying levels of pupil engagement

Not all children will be equally engaged in STEM-based activities and some may need more encouragement to participate fully. Offering a variety of activities that cater to various interests can help to engage children. A variety of independent, less-structured and guided play activities, where practitioners can facilitate engagement, will support this.

Conclusion

The uncertainty of what STEM will look like 20 years from now, means that we need to enable young children to explore the world around them in a way that is safe and scaffolded. As they develop, we enable them to build on their curiosity, use their skills and develop a mindset that allows them to continue to explore, collaborate and create with enquiring minds.

For more information on engineering in primary settings please see Edmonds, Lewis and Fogg-Rogers (2023) or Lewis and Edmonds (2024).

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Weblink

Free resources: www.braintasticscience.com/free-science-resources/schools-stem-grants

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Bouncing balls: a simple and fun activity to introduce scientific ideas and to practise mathematical skills in the early years

Andy Markwick and Jenny Hayward report on how using children's natural urges to play offered opportunities for them to think scientifically and mathematically



Figure 1 The range of balls used in the activity

Thinking about learning in EYFS

Early Years Foundation Stage (EYFS, ages 0–5) education is arguably the most critical stage in a child's emotional, social and cognitive development, and, as such, the learning must provide children with a range of opportunities to make sense of their world (Larimore, 2020). A learning environment that allows creativity, critical thinking and empathy through collaboration to flourish is one of the hallmarks of effective provision (Beghetto, 2013).

In English schools, effective provision is guided by the EYFS framework (DfE, 2024), which is divided into the prime 'areas of learning', *Personal, social and emotional development*, *Communication and language* and *Physical development*, and the specific areas of *Literacy*, *Mathematics*, *Understanding the world* and *Expressive arts and design*. This complex network of learning exemplifies the cross-curricular identity of EYFS learning. This complexity is deepened by the presence of the 'characteristics of effective learning' (COE), *Playing and exploring*, *Active learning* and *Creating and thinking critically* (DfE, 2024), which define the learning behaviours that shape the pedagogical approaches to early-years teaching.

The prime areas are important as they form the foundations for further learning. *Self-regulation* is a developmental thread in the *Personal, social and emotional development* strand and it is an early learning goal. It can be understood as the ability of children to manage their behaviour and learning. Opportunities for children to explore and develop these skills must begin in the early years. When effectively encouraged, they can positively impact problem-solving skills, pre-reading skills and early maths skills (Muijs and Bokhove, 2020).

In the EYFS framework, science falls under the banner of *Understanding the world*. Analysing COE reveals a close connection with 'working scientifically' skills, the key stage 1 and 2 strands of the national curriculum in England that define scientific process and enquiry skills through which science knowledge is learned. Therefore, science permeates every area of learning in the early years (Earle, 2022), and it follows that there is an assortment of potential opportunities to develop scientific thinking in younger children.

EYFS and pedagogies for learning

Research on early-years science identifies various routes to promoting enquiry through play. For example, the

European project, *Creative Little Scientists* (Cremin et al., 2015: 415), established that 'playful experiences' and 'hands-on, minds-on exploratory engagement' were critical for scientific development. Pyle and Danniels (2017) urge teachers to move away from seeing 'play' and 'learning' as unrelated constructs and to take on the idea of a continuum of child-directed to adult-directed play, with openings for learning at each stage, whether child-led or adult-initiated. Fleer (2022) discusses the idea of starting with the scientific concept rather than using children's play as a learning entry point. An interesting Scottish study is presented by Conor (2022), who looked at the potential for using stories as an impetus to engage children with enquiry in science. This is also supported by Markwick (2021), who developed a series of exemplar story-led enquiry activities for ages 3–7. However, while guidance exists on developing communication and language through science, there is a paucity of research on the potential that scientific enquiry offers to develop collaboration and self-regulation across the early-years foundation stage.

An activity developed from play

Below, we report on how a learning activity for children develops from play. Children enjoy playing with balls, and such play can encourage collaboration through sharing. However, as with all activities, it is important to consider what might be learned through such play and whether guidance might enhance learning. We wanted to determine whether children could understand comparative thinking and develop their numeracy skills through an enquiry-led pedagogy. We also wanted to see how children's metacognition and self-regulation developed from nursery to reception-aged children.

Introductory demonstration

The activity was introduced separately to a nursery group (ages 3–4) and to a reception group (ages 4–5). We wanted to see whether one year in the development of children, that is, from nursery to reception, influenced how they conceptualised the problems presented to them.

Children were shown several different balls (Figure 1). The teacher picked up one ball and asked, 'What will happen if I drop this ball?' Responses from nursery children included 'It will hit the ground', whereas reception children were able to provide more detail. For example, one child stated 'It will bounce'.

The children were then asked 'Which ball do you think is the bounciest?' followed by 'Why do you think that?' Nursery children quickly decided that the largest ball would be the bounciest, but they could not provide a reason apart from 'It's the biggest'. Reception children also confidently chose one of balls as the bounciest ball; when asked why they had decided on this ball, one child stated 'It is firmer and so will bounce more'. Others generally acknowledged that this was a sensible response.

The next problem for children to consider was whether a large or small ball would bounce higher. In this demonstration, the teacher held two balls at the same height above the ground and asked 'Which ball do you think will bounce higher?' Both nursery and reception

children thought it would be the larger ball. In this case, it was. However, the teacher then held up another two balls, one larger than the other but very soft. The same question was asked. Nursery children were split in their decision: some thought it would be the larger ball again, and others thought it would be the smaller one. However, they could not give a reason for their decisions. This was quite different for the reception children: almost immediately there was a consensus that the small ball would be the bounciest because the larger ball was soft. One child summarised this as 'The large ball will not bounce; it's too soft'.

Hands-on investigations

Children were asked to choose two of the balls and find out which one was the bounciest. The nursery child in Figure 2 concentrated while she dropped the balls simultaneously and then attempted to count the bounces. Another child threw the balls out in front of him and attempted to count the bounces but found this too challenging because he threw the balls in different directions. The reception group adopted a more systematic approach, with each child taking one ball, dropping it and counting the bounces and then swapping. One child was excited to report that they had counted different numbers of bounces for their two different balls (Figure 3).

A critical difference between the two groups was the range of self-regulation capabilities. With the younger group, there was some tension around the choice of balls to test, and, for a few moments, this took over their thinking. For example, one child had to manage their disappointment in not getting the blue plastic football. Children found it difficult to focus on more than one request at a time and, indeed, were far more focused on rolling, throwing and kicking the balls than comparing them. The reception children were 'matter of fact' in their attitudes to the question presented to them and showed considerably more ability to collaborate with each other. The older children were also able to conceptualise the idea of comparing and found unique ways of doing this. They either counted bounces or compared the height of the bounces, from the same drop height.

Structuring the activity

Following the initial activity with the nursery children, we decided to include the bouncy ball investigation as



Figure 2 Dropping balls from the same height and counting bounces



Figure 3 This very engaged nursery child reported: 'I got 3 and 7, the one that got to 7 is the bounciest'

part of our weekly physical education lesson and to provide greater structure to the activity. This time, in pairs, the children were given a hoop in which they placed two different-sized balls (Figure 4). The hoop provided a base for the children to work from and, on a practical level, prevented the balls from rolling around the hall. The activity aimed to determine through child observation which of the two balls was the 'bounciest'. The teacher then demonstrated how to carry out the activity, and each pair had to take turns dropping the ball and counting the bounces. The other child had to retrieve the ball. These roles were interchangeable and presented to the children as 'bouncer' and 'fetcher'.



Figure 4 The structured activity with hoops in a PE lesson

We noticed that structuring this investigation with a step-by-step set of instructions enabled the children to communicate their results and findings more effectively than in the first investigation. This enabled the younger children to build up a conceptual model of the activity and so better understand its purpose. This was not required for reception children, who appeared to already have the cognitive and linguistic agility to make sense of the activity and even create their own methods for measuring comparative bounciness.

Conclusions

- Although it is difficult to generalise with such small numbers of children, for this study there was a distinct

difference in the way children were able to draw on their experiences to explain their answers.

- The activity provided a great opportunity for children to practise and demonstrate their counting skills and begin to develop a conceptual understanding of measurement.
- Both nursery and reception children were able to confidently count bounces.
- Nursery children were unable to make sense of comparative measurements without additional scaffolding and practice, whereas reception children were confident in comparative measurement.
- Very significant improvement was seen in children's language acquisition, cognitive abilities and self-regulation (social and emotional) in just one year.
- The activities supported children's scientific and mathematical understanding in a fun way.

All the evidence regarding maths mastery points to looking for meaningful contexts in which to foster mathematical understanding and this simple activity seems to be very effective in achieving this. It is important, however, to recognise that effective learning does need careful planning, especially in the EYFS where children's experiences are embryonic. Teachers must make choices about what approaches work best for their cohort and context.

We need to build on children's natural urges to play, and offer opportunities for them to think scientifically (and mathematically) through collaborative play, without destroying the play itself.

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Play-based pedagogy in science: realising ambitions from a Scottish perspective

Kirsty Aitchison and Robert Collins from the University of Strathclyde discuss play-based pedagogy in Scottish early years



Developing meaningful contexts for learning: promoting confidence, creativity and curiosity through a Forest School approach

It is difficult to believe that the 'new' Curriculum for Excellence (CfE) for schools in Scotland is nearing its 20th birthday in terms of operation. Since its inception all those years ago, it has been steadfast in its support of active learning in the classroom for learners aged 3–18 years. In this time, several pedagogical support documents have been published to put flesh on the bones of the CfE vision, through from *Building the Curriculum* (2006) to the more recent support for early-years pedagogy and practice, *Realising the Ambition* (RtA), in 2020.

This latter document is now ubiquitous in Scottish early-years establishments and constitutes the most up-to-date national practice guidance. As such, it underlines the importance of play in the learning experiences of younger children. Although CfE had long promoted a playful approach to teaching science through exploration, investigation and collaboration, RtA advice specifically places enhanced focus on harnessing aspects of children's

confidence, creativity and curiosity. It is envisaged that this should shape a lifelong love of learning as children begin to discover and understand the world around them. Chief among these aspects is creativity, as this focuses on the child's ability to wonder, to see and use things differently, all in the realm of exploratory and investigative play. This play is deemed as vital for all learning, to help children deal with the pace of change in the modern world around them and build competencies and transferable skills for the future. Although more traditionally utilised to support language and literacy development, the same approach should also be viewed as fundamental to building attainment and engagement in STEM in the early years.

Child-centred approach

Fundamental to success in all of these endeavours is a commitment to developing a child-centred approach to pedagogy and practice. Importantly, the play-based



Embedding STEM across the environment: encouraging children to see themselves as scientists, inventors, creators and innovators at the mud kitchen

learning of RtA places value not only on children leading their own learning, but on a holistic and asset-based approach. This means that learning is founded on children's own interests and motivations – a controversial idea for some – and certainly relies on their teachers developing sophistication in terms of responsiveness and flexibility in their teaching. Success relies heavily on commitment to noting children's choices and providing time and space to develop their interests and adapt learning experiences as these interests grow and develop. In short, in focusing on children's voice and recognising that authentic learning must – and should only – start with the child.

In concert with these are also the dispositions of inclusion to support social wellbeing, opportunities for collaboration and conversation and celebration of children's achievements. These require teaching that recognises the interconnectedness of the adult, child and environment, co-constructing meaning with them, tapping into the rich experiences of knowledge in family and community, and a willingness to try new ideas. In terms of science teaching, such an approach will resonate well with those teachers well versed in constructivist or social constructivist approaches, with focus on the 'lone scientist' and vicarious learning through collaborative dialogue. In short, RtA's approach would seem to be ideally suited to the teaching of STEM to young learners.



A provocation to play and learn: building on children's interests to develop a meaningful context for learning

The role of the 'playful adult'

As with all things, ambiguity in this field is the proverbial 'fly in the ointment' of successful operation. Many similar-sounding terms abound, playful pedagogy, play pedagogy, play-based learning, or just plain 'play', all appearing in the writing about the subject. Each of course has its own take and definition of play and how this translates into practice, which can be exceptionally confusing, especially when trying to establish the grounding for a new pedagogical approach. What is distinctive about RtA's interpretation, however, is its focus on the attributes of the teacher. As with constructivism and social constructivism, the boundaries of authority are blurred; RtA's interpretation goes one step further – it asks teachers to consider the role of the 'playful adult' in supporting early learning and engagement.

Key here is knowledge of early learning and development, curriculum and pedagogy. It relies on teachers developing skilful interactions and conversations to help scaffold children's thinking. It needs a frame of mind that allows for the construction of open-ended experiences to encourage exploration, investigation, provocation and stimulation. It requires space in teaching to embrace opportunities across the learning environment and beyond into family and community. It also requires faith in the iterative process; this is a skillset that can only be mastered through practice. In essence, it requires a good



Nurturing children's identities as learners: providing opportunities for collaboration, conversation and problem-solving through exploratory water play

deal of commitment and the courage to be authentically socio-scientific in learning and teaching.

Implications for practice

All of this sounds fine, but a tad theoretical. However, as many early-years establishments in Scotland have proved, it is entirely possible in practice. As with many new ideas, establishing the fundamentals is key; these are identified in Box 1 in a broad sense for anyone brave enough to respond to RtA's call.

Conclusion

When done well, commitment to these simple steps generates huge amounts of learning in science and, importantly, genuine engagement in children. This approach can be used across a whole range of concepts and lends itself well to the responsiveness needed to meet

Box 1 Establishing the fundamentals

- Develop meaningful contexts for learning to support and challenge children's thinking, embedding STEM across the environment through authentic learning experiences.
- Arrange informal professional collaboration events to build practitioners' confidence in promoting play-based approaches and building motivation in STEM. Share good practice and establish a local network to support professional learning and practice.
- Actively nurture children's identities as learners and creators in STEM – look for opportunities for collaboration, problem-solving and investigative exploratory play.
- Regularly encourage children to see themselves as scientists, inventors, creators and innovators through open-ended resources and provocations.
- Build connections with families and communities and tap into local expertise to support pedagogy and practice.

the idiosyncratic needs of young learners of science. The pictures in this article evidence this really well. We can fully recommend giving this type of science learning a go with your early-years class!

Photos courtesy of Michaela McCune, Early Stages Teacher, West Dunbartonshire Council.

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Dissecting fish in year 2: applying elements of the Science Capital Teaching approach

Andy Markwick, Junior Walker and **Oomar Dhuru** illustrate how learning through contextualised enquiry in year 2 (ages 6–7) increases engagement, promotes deeper understanding and enhances children’s science capital



The excitement was palpable as children began their dissection

Children are wonderfully curious about their world and we must help them to explore and enhance this throughout their lives. They need to develop their environmental consciousness (Markwick, 2023) and understand how they are part of an amazingly complex natural world that needs to be respected.

In the lesson described here, year 2 children (ages 6–7) were provided with the opportunity to look inside a fish and compare its internal organs to those found in a mammal (themselves). Before the session, permission was gained from parents for their child to take part, and we told the children what the session would entail so that they could opt out if they wanted to (none did). As with all practical activities, it is important to consult CLEAPSS, SSERC and ASE *Be safe!* for health and safety guidance.

The potential for this activity to explore many key ideas in the national curriculum in England across key stage 1 (ages 5–7) is demonstrated in Table 1.

Suggested lesson structure

Stations were set up before the children entered the room and the children were asked not to touch anything.

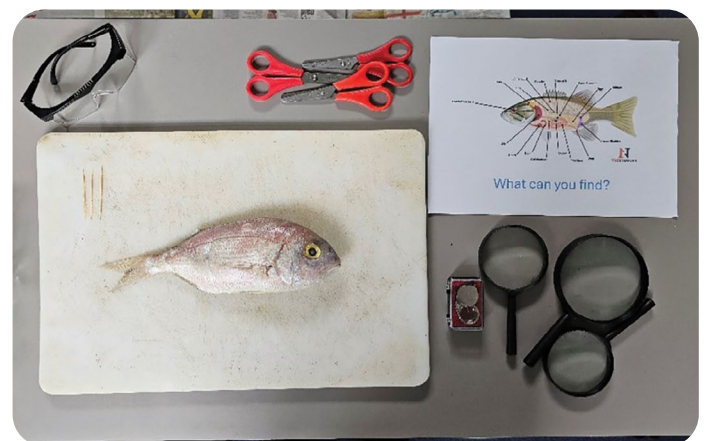


Figure 1 A work station set up for dissection

Table 1 Key ideas that might be explored in this activity

Statement (key stage 1)	Comments
Working scientifically	
Asking simple questions and recognising that they can be answered in different ways.	Children wanted to know why fish and mammals swam differently. They asked questions such as 'I wonder what's inside the eyeball [a lens]?' And 'Where are the fishes' gills?'
Observing closely, using simple equipment.	Children were keen to find the different organs and structures of the fish and were able to describe these and suggest their function; e.g. gills for breathing underwater, fins and flexible tail for swimming.
Identifying and classifying.	Children were able to state the differences and similarities between the fish and mammals (themselves).
Using their observations and ideas to suggest answers to questions.	Children were able to explain why the fish was streamlined (moving through water) and why it had fins rather than limbs like a mammal.
Animals, including humans (year 1)	
Identify and name a variety of common animals including fish, amphibians, reptiles, birds and mammals.	The activity provided children with an opportunity to describe the similarities and differences between a fish and a mammal (themselves) and so introduce the beginnings of classification.
Identify and name a variety of common animals that are carnivores, herbivores and omnivore.	One of the fish had a crustacean in its mouth. This showed children what the snapper had been eating and indicated it was a carnivore.
Describe and compare the structure of a variety of common animals (fish, amphibians, reptiles, birds and mammals, including pets)	The shape of the fish and structures inside it were explored in comparison with those of mammals. Children discussed possible functions for each structure.
Identify, name, draw and label the basic parts of the human body and say which part of the body is associated with each sense.	Children were able to discuss the purpose of eyes, ears, nose and mouth in relation to differences and similarities between fish and mammals.
Living things and their habitats (year 2)	
Identify that most living things live in habitats to which they are suited and describe how different habitats provide for the basic needs of different kinds of animals, and how they depend on each other.	Children understood how the shape of a fish, its gills and swim bladder were all good adaptations for living in the sea. The fact that fish had gills and that mammals like dolphins have lungs showed that even mammals that live in the sea cannot breathe underwater.
Describe how animals obtain their food from plants and other animals, using the idea of a simple food chain, and identify and name different sources of food.	Finding the crustacean in the fish gullet enabled the class to discuss its possible food source.
Possible extensions	
Explore the food chains associated with fish and mammals. Begin to use classification keys to distinguish between the different animal groups (using knowledge of fish and mammals as a guide). Identify types of teeth and relate to purpose in carnivores, herbivores and omnivores. Check retention by providing an illustration without annotations and ask children, in groups, to label what they see.	

1 Looking at the way fish and mammals swim

[Prior learning included a session on the basic structure and function of the heart, and another on the lungs and why these are important to us.]

The session started with a simple video showing goldfish swimming. Children were asked to show how the fish swam using their hands (side to side movement).

They then watched a video showing a pod of dolphins swimming and were asked again to show this movement with their hands (up and down motion). This demonstrated that mammals and fish swim in fundamentally different ways because of their different skeletal structures. Children then watched a video showing a 'mermaid' and 'merman' swimming and asked 'Are they mammals or fish?'



Figure 2 Indonesia, where the snapper fish come from (AI generated by J. Walker)

Children were able to see that the way the mermaids and mermen swam suggested they were mammals.

2 Introducing the fish

Children were asked if they had seen a red snapper fish before and several had (this is a familiar fish in the food markets in their school area and often a popular choice for families). There are alternative fish that can be used for the dissection, such as mackerel, but children in this area would be more familiar with red snapper fish.

A possible structure for the session might be to present children with a world map (this could be projected or from a traditional atlas) and ask them to first find where they

live (London) and then find Indonesia. The sea around Indonesia is where the fish live (Figure 2).

When using the maps, the children can be asked, for example:

- What can anyone tell me about the country of Indonesia?
- How far do you think London is from Indonesia in a straight line? (Provide a map with a scale for children to use.)
- How big is Indonesia compared to the UK (see also Table 2)? Which is larger?

Table 2 Comparative facts about Indonesia and the UK

National flag		
Population (millions)	270.2	67.8
Capital city (population/millions)	Currently Jakarta (11.2) but is changing to Nusantara	London (8.9)
Languages	Indonesian, Javanese, Sundanese, Madurese	English (+ Gaelic, Welsh and Cornish) + 300 other languages
Main crops grown	Rice, corn, soya beans with cash crops such as palm oil, rubber, and cocoa	Wheat, barley, oats and potatoes
Size of country (km²)	1,904,569	243,610
Climate	Tropical (hot and humid) (av. 26 °C)	Temperate (av. 9 °C)
Types of wild animal	Komodo dragon, Borneo elephant, macaque, java rhinoceros. red snapper	Rabbit, fox, badger, squirrel, rat, rainbow trout, pike
Highest point (metres)	Puncak Jaya (4884 m)	Ben Nevis (1345 m)

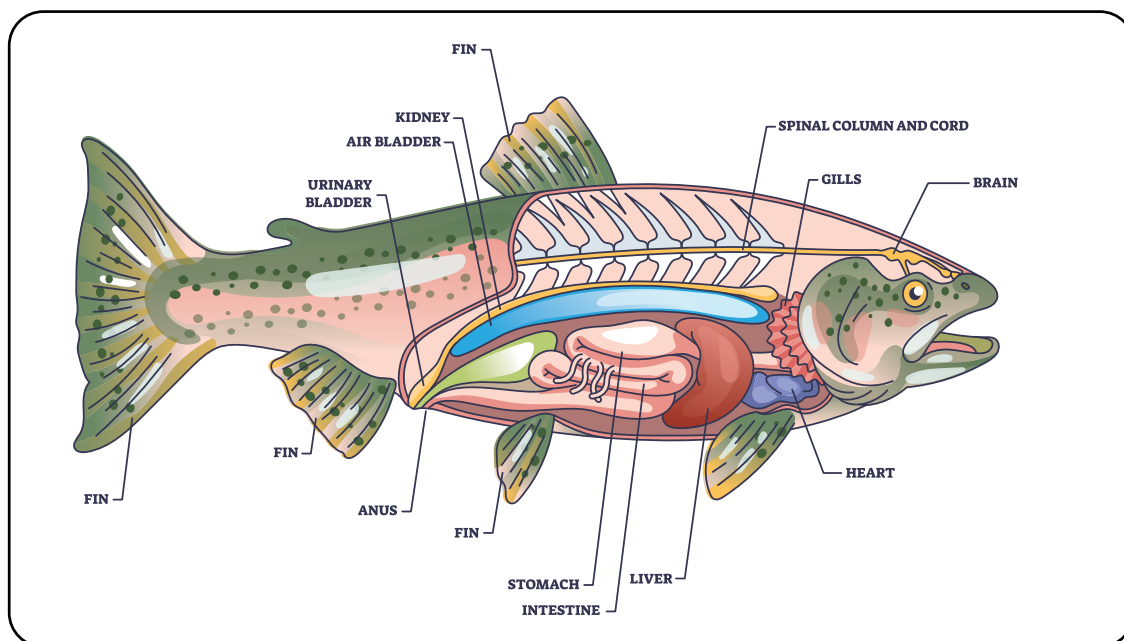


Figure 3 The guide to the fish's internal organs (© VectorMine/Shutterstock [labels adapted])

Another interesting way to engage children with maps is to present them with an A3 map that has been cut into eight equal (or less) strips and ask them to put it back together.

Many activities can be created from the information in Table 2. For example, can children calculate the difference in population between Indonesia and the UK? How many degrees hotter is Indonesia compared with the UK (on average)? This could be made more realistic by having two beakers, one with water at 26 °C and the other at 9 °C. Children can then experience the different temperatures for themselves. The different wildlife in each country offers potential for research and cross-curricular activities, for instance with art and computing.

3 Dissection – protocol

Children were introduced to the equipment (scissors, cocktail stick, magnifying glass) and the potential hazards were explained.

Children were provided with a labelled illustration of a fish's internal organs (Figure 3) and asked:

- Can you describe the shape of the fish and suggest why this is a good shape for it to have?
- Can you find anything (else) that helps the fish to swim?
- How many of the internal organs of the fish can you find (use the diagram to help you)?
- Which organs are the same in a fish and a mammal and which are different? Can you explain why?

It was important to stop the session occasionally for mini plenaries. These were designed to check whether children were grasping the concepts presented in the activity and to answer any questions they might have.

Highlights from the session

It was interesting to see how excited children were when they saw the fish and, as expected, many commented on

the smell! However, after a short time every child was busy dissecting the fish (Figure 4). Several children said that they had seen this fish at home. The children were able to locate many external features of their fish, such as fins, scaly skin, eyes and tail. They were also confident in identifying internal organs, such as the liver, swim bladder, skeleton, gills, heart, stomach and muscles (Figure 5). Most were fascinated to be able to pop open an eyeball to reveal the lens: lenses that were not opaque could be used to magnify print on a newspaper!

Inside one fish, children found a crustacean, which was shown to the group (Figure 6). Finding evidence of what the fish had eaten began a discussion about whether the fish was a carnivore or herbivore. Once the group had decided the fish was a carnivore, one child noted that this was supported by the teeth: 'It has sharp teeth for eating a crustacean'.

It was notable that children with SEND were absorbed in the activity. For example, a child with profound autism, who rarely fully engages in activities, became fascinated by what he found inside the fish and was able to identify most of the organs and discuss how these were often



Figure 4 Children beginning their dissection



Figure 5 Locating the gills

different to his. He was clear that fish had gills to breathe under water and humans had lungs to breathe in air.

Some interesting comments were exchanged during the practical:

Child A (cutting open the fish): *Make sure you look for this [referring to the fish swim bladder in the diagram].*

Child B: *There it is! This keeps the fish floating, doesn't it sir?*

Child C: *The fish doesn't have the same colour eyes as us. Look, the lens is round, weird!*

Child D (as she cuts into the fish): *Oh my days, this is weird. Like we need to tell someone what is happening here, this is us being like real scientists!*

Child E: *We need to describe this bit, don't just mash it!*

Child F: *It's the gills, this is what it needs to breathe.*

Child G: *Sir, can we have another science lesson like this, we are going to be the best scientists ever!*

There is no doubt that this activity engaged all the children, helped to develop their understanding of the similarities and differences between fish and themselves (mammals) and introduced the importance of why we put animals into different groups. It also helped children to link structure to function, for example gills for breathing under water, a swim bladder to help maintain the buoyancy of a fish, and fins to help streamline the fish so that it can swim in water.



Figure 6 Crustacean found in the mouth of the snapper fish

By choosing the snapper fish, our children's cultural knowledge was recognised and integrated into the activity. This prior experience helped to 'personalise and localise' the activity and in doing so create a strong foundation for developing children's science capital (Godec, King and Archer, 2017; Nag Chowdhuri et al., 2023).

The activity illustrates how learning through enquiry that is contextualised for children increases engagement and promotes deeper understanding. In doing so, children's science capital is enhanced.

Acknowledgements

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Exploring science: igniting curiosity across the school

Emma Smith shares two initiatives that spark curiosity and excitement about science throughout her school

Since becoming Science Lead at my school 15 years ago, my mission has been to inspire our young pupils to want to explore and engage in science. I firmly believe that science can be accessible to all, and I aim to demonstrate its relevance while also sparking curiosity and a desire to learn more.

To achieve this, I create opportunities for pupils to experience science beyond the standard curriculum. I plan and lead whole-school science assemblies every half term, set home challenges, and run STEM and science clubs. The two key initiatives described here have been especially effective in nurturing curiosity and excitement about science.

Whole-School Investigation

While sitting in a science conference six years ago, I was struck by an inspiring idea: applying the same scientific investigation across all age groups in school. My mind buzzed with possibilities. How could this work in my own school? What would the impact be on both teachers and pupils? I could see the potential benefits, but I knew the key to success was first securing the support of the senior leadership team (SLT).

Once I had the backing from my SLT, I designed a plan to launch what we would call our Whole-School Investigation. To ensure everyone felt prepared, I created



Which liquid keeps apples from turning brown longest?



Which biscuit is best for dunking?



Which material helps water 'walk' best?



Does toast always fall butter-side down?

Figure 1 Examples of Whole-School Investigation topics

Whole-School Investigation • Assemblies • Curiosity Box

detailed documents for staff, including skill progression recaps and examples of how the investigation could look in different year groups. Although all year groups would be tackling the same investigation question, I wanted to ensure the skills applied were progressive, with each year building on the previous one.

We decided we would start the new academic year with our Whole-School Investigation in every class from nursery to year 6 (ages 4–11). I shared my vision during a summer staff meeting, emphasising the advantages of doing a full investigation early in the year. It would allow teachers to assess pupils' scientific abilities and identify areas that might need extra attention. The investigation would also set the stage for the rest of the year, where we would break down specific skills at age-related levels in our regular science lessons.

Initially, the investigation ran on a trial basis; however, the results exceeded our expectations! Teachers discussed science in ways we had not seen before, sharing strategies for teaching enquiry skills, and building excitement across year groups. The pupils, too, were energised and fully engaged in the whole process. They began asking more questions and sharing discoveries with peers. A developing culture of curiosity and collaboration was evident! During subsequent pupil voice meetings, our pupils have consistently highlighted the Whole-School Investigation as one of their favourite science activities of the year.

We have since fine-tuned our approach, conducting these investigations during transition days in the summer term, so ensuring that we can dive straight into the new school year and science curriculum with excitement and enthusiasm. We also spend time discussing careers that our investigation skills might help with.

Our investigations have included everything from finding the best biscuit for dunking to testing which balloon is best for a rocket. See Figure 1 for more ideas. These fun, engaging enquiries have encouraged curiosity and critical thinking but also created a solid foundation for scientific exploration throughout the year.

Curiosity Box

Another idea that has had a significant impact in our school is the Curiosity Box. It is a simple concept: a clear, plastic box filled with intriguing objects placed in a busy school corridor to catch pupils' attention (Figure 2).

The box encourages pupils to ask questions about what's inside. Asking questions is a fundamental part of our school's science curriculum and the Curiosity Box gives pupils a chance to practise this skill often. They write their questions on sticky notes and pop them into the box. Every two or three weeks, we pick out the most thought-provoking questions and display them on a notice board for everyone to see (Figure 3). These questions spark class discussions and help to clear up common misconceptions in half-termly class assemblies led by our pupil science ambassadors.

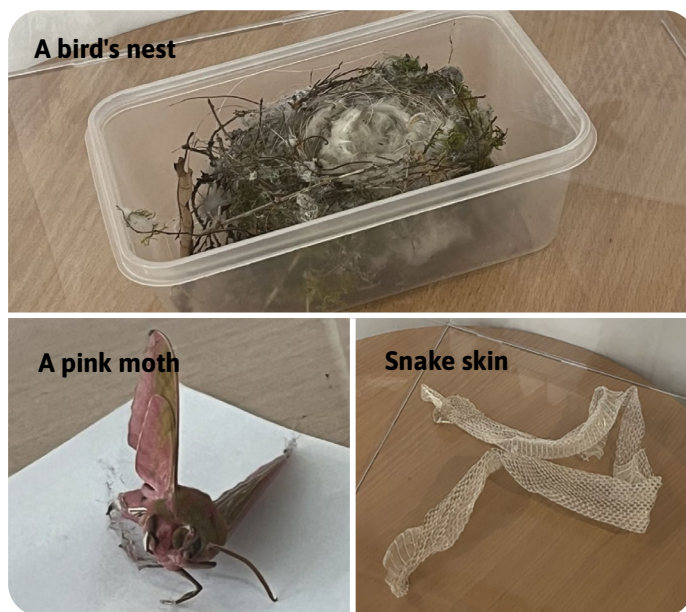


Figure 2 Examples of Curiosity Box objects

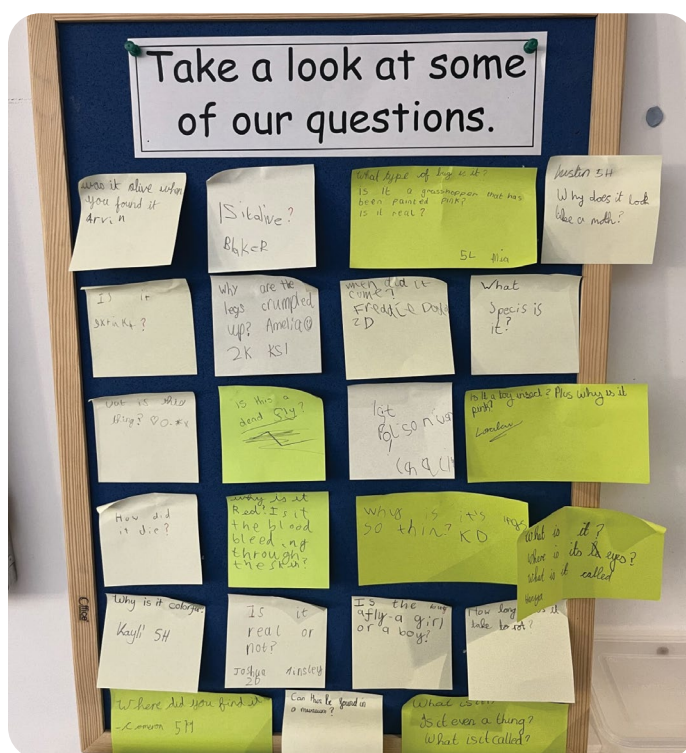


Figure 3 Our overflowing notice board of questions

Conclusion

In today's rapidly evolving world, it's crucial that we equip our children with the skills to question, explore and make sense of the world around them. I hope these two straightforward initiatives spark as much curiosity in other schools as they have in mine. Good luck!

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Choosing a new science curriculum

Joanna Farbon and her team choose a new science curriculum through a planned cycle of audit, enquiry and implementation



Investigating rocks in year 3

Identifying needs through audit

At Icknield Primary School we identified that our science curriculum was next in the subject audit cycle based on our three-year school development plan. The principles for the audit were devised by the deputy head teacher and science subject leader. The audit showed that there was a need for change, as the curriculum lacked coherence when considered as a whole-school curriculum. Our science curriculum was an amalgamation of different schemes and teacher-created materials and lacked the small steps of progression and year-on-year coherence needed in a curriculum for the whole school. We took two critical insights from the audit, which were informed by Ashbee (2021) and the *Great teaching toolkit* (Coe et al., 2020). Ashbee states 'a curriculum must be built for progression' (p.51), which led us to investigate off-the-shelf science curricula that identified steps of progression and would offer deep subject knowledge for primary teachers whose specialism may not be science. In the *Great teaching toolkit* (p.18), the first dimension that underpins the very best teaching is centred around teachers' understanding of the content they are about to teach. As we explored this, we realised we did not have the depth of subject knowledge in school to construct a bespoke curriculum autonomously.

Choices, choices...

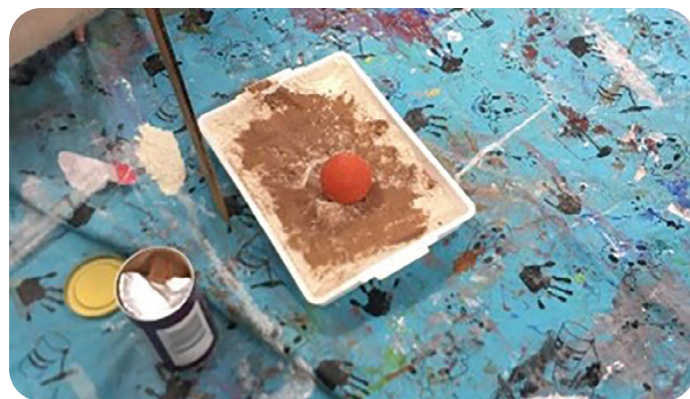
Following the audit we implemented an 'enquiry phase' (Chartered College of Teaching, 2021), where we engaged with a number of pre-written curricula and sought two for teachers to appraise together. The enquiry phase was set for two terms. We were looking for:

- a clear progression of learning across the school;
- high-quality resources;
- key knowledge that would anchor teachers' understanding of what they were teaching and why;
- continuous professional development and learning (CPDL) offered by the company who created the curriculum.

The CPDL offer was vital in ensuring that teachers had a 'deep and fluent knowledge and flexible understanding of the content' (Coe et al., 2020: 6) they would be teaching. This feature was of great importance; as Bubb and Earley (2007: 4) state 'creating opportunities for adult learning, ultimately for the purpose of enhancing the quality of education in the classroom' would be a significant underpinning for the development of Quality First Teaching (Almond, 2024) of science in line with the new curriculum and our school vision and aims.

Following professional discourse based around the attributes of each curriculum, teachers and senior leaders chose Plymouth Science as the curriculum that would support Quality First Teaching in science from early years foundation stage to year 6. This was for a number of reasons (Box 1).

Upon further discussion and exploration within the two terms of enquiry, we believed that the Plymouth Science curriculum supported our vision for pupils to become 'confident, motivated and resilient learners who flourish into well-educated citizens'. These discussions focused on both pupils' education in our school, and how the curriculum would be a springboard for science learning in the next phase of their education.



Investigating craters in year 5

Box 1 Reasons for our choice of the Plymouth Science curriculum

- **The curriculum is evidence-informed** having been written weaving in findings from key reports, including from the The Wellcome Trust, Ofsted substance reports, the Curiosity report, Primary Science Quality Mark research and Education Endowment Foundation documentation (Bennett, 2024). This supported our school-wide work to move towards a 'best bets' (Farbon, 2024) evidence-based approach to curriculum and pedagogical development.
- **Skills for 'working scientifically'** were 'at the forefront of the planning' (Ofsted, 2023; Bennett, 2024). Exploration of the entire scheme also highlighted that these scientific skills were transferable and supported our drive to move to science being a fully practical subject with high-quality investigations to support this.
- **Correct scientific vocabulary** was clearly mapped for progression, thus supporting our school focus on oracy and developing the use of the correct vocabulary in the correct context (Oracy Cambridge, 2018).
- **Consideration for current understanding of cognitive science** was shown in the curriculum. Key knowledge was pared down and focused lessons on the specific knowledge needed without overwhelming pupils with too much information. In the words of Willingham (2021: 1) '*unless the cognitive conditions are right, we will avoid thinking*'. We need children to think about science! The curriculum also guided staff to ensure that pupils had sufficient time to learn and be able to recall this learning to support progression over time. This was a particular recommendation in the Ofsted science subject report (Ofsted, 2023) and also a consideration for our school in developing evidence-based education across all curriculum subjects.
- **High-quality literature and resources underpinned the planning.** Our school had previously engaged with Mary Myatt's *Stories in the curriculum* (Myatt, 2024) project on quality literature and quality resources. As a result, teachers had developed a good understanding of the impact of literature on children's learning and staff enjoyment of what they are teaching.

The pedagogy promoted by the curriculum was based on best practice from CLEAPSS (Consortium of Local Education Authorities for the Provision of Science Services, www.cleapss.org.uk) and the Primary Science Teaching Trust (pstt.org.uk). It also promoted professional autonomy by allowing our teachers to adapt the lessons to the needs of our learners. We believed that this curriculum would ensure that pupils were interacting with high-quality teaching and learning which would, in turn, drive better pupil outcomes in our science assessments.

Next steps

Once the enquiry phase had been completed and a new science curriculum had been chosen collectively, our focus moved to considering the implementation phase for this whole-school development. Being guided by the Education Endowment Foundation's report *A school's guide to implementation* (2024) and our senior leaders' wider knowledge of robust implementation, we began planning stages of implementation for the new science

curriculum. This included trialling individual topics in year groups before full implementation and discussing teacher experiences of this, CPDL opportunities to discuss subject knowledge and lesson sequences in depth as a teaching team, and pre-ordering of resources to ensure full resourcing before the implementation of the curriculum in earnest. Planning for implementation also considered communication with all staff to ensure collective understanding of why the curriculum had changed and how implementation would be planned for, both in the current academic year and beyond. Planning noted an iterative process for ongoing audit of how effective implementation of the new curriculum was throughout the academic year across all year groups, and how the findings from this would be acted upon.

Implementation planning discussions also included how we would de-implement the previous curriculum. De-implementation (DeWitt, 2022) is a consideration that we focused on to ensure that teachers and senior



Making blood in year 6



Investigating pulse rate in year 6

Box 2 Top tips for curriculum auditing

Were we to offer guidance to other schools when auditing their science curriculum, it would include these top tips:

- **Being child focused.** Anchoring the audit in understanding exactly what pupils will experience and learn in science from a new curriculum and how this supports their education in future years was key to building teacher confidence in the new curriculum. Keeping your school vision and ethos in mind clarifies the 'why' (Sinek, 2009) for auditing and potential change.
- **Involving teachers in decision-making.** Truly collective decision-making for the choice of curriculum ensured high levels of enthusiasm and 'buy in' from teachers for the new curriculum.
- **Step-by-step implementation for change.** Clear, focused steps for implementation following an evidence-based framework for implementation ensured change was well led by senior leaders and gave staff confidence that the change would be successful.
- **Communicating during the enquiry phase.** Ensuring that the enquiry phase was shared with all staff, through regular communications in briefings and through training, prepared staff well for the change.
- **De-implementation for fidelity.** Actively attending to removing the previous curriculum is key to fidelity in planning and classroom practice. This included all documents and resources to which staff have access. Ensuring that leadership discussion was focused on an evidence base from current classroom practice and work scrutiny ensured leaders understood whether the new curriculum was being implemented successfully and what the next steps would be to drive high pupil outcomes over time.

leaders consciously considered the new curriculum in practice and that teachers planned with fidelity to this. This de-implementation process eliminated the potential for crossover into the old curriculum and returning to a mixture of curriculum used for planning science. This was one of the negative outcomes found when auditing the original curriculum offer. Steps in the de-implementation process included ensuring the only planning that was accessible by teachers was from the new curriculum,

that senior leaders actively spoke of the new science curriculum in any discussion about science, and the science subject leader used only the new curriculum documents in lesson walks and work scrutiny.

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Women in STEM: how one county is making SPARCs

Verity Jones speaks to **Clare Lawrence** and **Naomi Bowen** about their personal journeys into careers in the sustainable power, renewables and construction sector

On International Women's Day 2024, Pembrokeshire County Council and Pembrokeshire College in Wales jointly launched the Sustainable Power, Renewables, and Construction (SPARC) Alliance. This new alliance promotes gender diversity in these industries, which are key to reaching net zero.

A huge variety of job opportunities are available in the growing field of sustainable power, renewables and construction but, as teachers, we often don't know about them and therefore can't signal them to our pupils as jobs to which they might aspire. Role models have been

identified as a great way of engaging pupils, and SPARC hopes to highlight the work of Pembrokeshire women in STEM, showcasing the varied roles on offer, as well as the various routes people have taken to get there. STEM careers do not have to start with STEM, and they do not necessarily require a university degree.

I met up with two of the women working in the industry, who are part of the SPARC Alliance, to find out more about their work and how they would like to see primary teachers encourage children into the sector.

Clare Lawrence



Clare is a project manager at the port of Milford Haven where she helps to operate the UK's leading energy port safely, responsibly and effectively.

How long have you worked in this role?

I started in the business as an apprentice 12 years ago. I became a project manager two years ago.

What is the journey you have taken to get to your current role?

I joined the port as an apprentice and gained on-the-job experience while studying, completing a degree in construction management and sustainable technology.

What does your job entail?

As a project manager I help the port deliver infrastructure and construction projects. My days are varied and include interaction and planning with

a variety of designers, engineers, clients and contractors, while ensuring we continue to operate a safe and sustainable business. I spend my time between the office and on site with our teams to ensure delivery is on budget and on time. I also assist with any issues that may occur throughout the programme.

What are the best bits of your job?

The sense of achievement when you see a previously disused area completely transform into a functioning asset for our community and stakeholders. As a social person, the opportunity to work with a wide variety of professionals, suppliers, stakeholders and within your own community is hugely rewarding.

What are the biggest challenges?

Our location. Working on the most south-westerly point of Wales we are certainly exposed to the elements and we can be quite some distance from suppliers.

Has there been anything surprising about your job?

The huge opportunities available on my doorstep and the experiences that I have had. For example, I was involved in the successful delivery of a 4* hotel build as well as a £40 million investment in port infrastructure for the renewable industries within the space of four years. This was a great achievement for the port and Pembrokeshire!

What do you hope the SPARC project will accomplish?

I hope it highlights the wide variety of opportunities available to everyone at every level right here in Wales. Sustainability, engineering and construction are industries gaining momentum and SPARC will hopefully show young people of Pembrokeshire that this is a really exciting time and we can make a difference for ourselves and future generations through this industry.

How can a primary teacher support a future career in the sector?

We need people who can problem-solve and work as a team, so developing those skills early on would be great. Social interaction and working together to achieve a result is vital in my role and something that needs to be encouraged from an early age. Take the opportunity to approach industry and ask for support with site visits, classroom engagement and providing resources for tasks.

What would you like to say to your 10-year-old self?

Don't follow the crowd. Find your passion and qualities and a job role that fits in with them. Being chatty is also a good thing!

Naomi Bowen



Naomi is an assistant construction project manager at RWE Renewables UK, a company focused on renewable energy development, construction, operation and generation.

What is the journey you have taken to get to your current role?

After my GCSEs and A-levels I got my first full-time job at 19, on a liquefied natural gas (LNG) terminal construction site, working as an agency admin/finance assistant. I worked my way up to a staff job at the LNG terminal in finance and continuous improvement for 13 years. During that time I gained two NVQ level 4s, in accounting and tax, and then spent 12 months on a secondment in maintenance working on projects. I then decided I wanted to pursue a career in project management so spent two years working in floating offshore wind development projects, and ended up

in onshore wind construction projects. I am currently on a project manager training programme to become a construction project manager.

What does your job entail?

I assist the construction project managers in overseeing the construction of onshore wind farms. As part of my role I also have to provide construction support to the Development Team. My day consists of civil and electrical contract management (including turbine supply agreements), developing and managing the invitation to tender process for large contracts. As well as budget management, I attend regular meetings at the construction site with all contractors, team meetings through Europe, and visit development and construction sites throughout the UK. I also manage the ground investigation works to inform construction decision-making. Taking part in community liaison meetings, and stakeholder management, including dealing with complaints, is an important aspect, and assisting with the off-site road modification contracts, to allow large components to be delivered to site. There are also project administration tasks, recruitment for contract positions, assisting with management of the DNO (distribution network operator) and grid connection management.

What are the best bits about your job?

I get to travel across the UK and Europe, visiting sites and meeting new people.

What are the biggest challenges?

Getting large components to site is a huge challenge, as most of our wind farms are in rural hill/mountain locations and the road networks require upgrading.

Has there been anything surprising about your job?

I have been amazed at how complex building a wind farm is, especially the construction of a turbine foundation; the engineering is fascinating!

What do you hope the SPARC project will accomplish?

I hope that the SPARC project will inform and inspire young people to take up a career in renewable energy. Giving young people knowledge and insight into the technology out there and the vast array of career paths available within the renewable energy sector is key to helping them reach their potential. This will also go some way to sustain the local and UK economy by attracting the young people of Pembrokeshire to stay and work in their local area.

How can a primary teacher support a future career in the sector?

It would be great if teachers could focus more on engineering disciplines as well as science. Associating different subjects/skills with career paths, so that pupils understand the link between what they are learning and how they can apply that knowledge in whichever career they chose would be great. The UK has a large energy industry and the transition that is happening to renewable energy is massive. I think more career engagement at primary-school age, with talks from renewable industry workers to demonstrate the career paths and roles available, would help pupils think further and dream bigger. Avoiding gender stereotyping of roles is critical.

What would you like to say to your 10-year-old self?

I would like to tell myself that technical careers in engineering, operations and maintenance are not just for boys; you can do it too. However, I would also say that a degree in engineering or science is not necessary for a career in the renewables industry or project management. This is often a misconception and discourages young people from entertaining a career in the sector.

About SPARC

SPARC Alliance members include Blue Gem Wind, Floventis, Ledwood Engineering, Port of Milford Haven, RWE Renewables ERM, Morgan Sindall Construction and Pembrokeshire Coastal Forum, local secondary schools and Pembrokeshire College.

Investment from the Alliance, with additional funding from the Swansea Bay City Deal, supports schools in delivery, engagement and awareness-raising activities.

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By teachers for teachers: that's Science on Stage 2024!

Kulvinder Kaur Johal describes
the inspiring experience of attending
the prestigious international Science
on Stage festival



Vicky Walsh from Monk Fryston C of E Primary School and Nicola Bolton from Tattenhall Park Primary School at the Festival

After two years of preparation, planning and recruiting our UK delegation, it was time to set off to Turku in Finland for the international Science on Stage festival. For those of you who are not familiar with it, Science on Stage is a celebration of science across Europe, culminating in a festival every two years, where delegates from schools across 35 countries gather to share their ideas and resources. In 2024, the festival took place on 12–15 August in Turku, the oldest city in Finland. Over 400 delegates gathered with shared common interests of a love of teaching, science and collaboration.

The preparations

The journey for our delegates had started over a year earlier, when the Association for Science Education opened the application process for UK schools. Participants had to apply by sharing their innovative teaching ideas based around one of these guiding themes:

- STEM for the youngest;
- STEM education for sustainable development;
- Digital technologies in STEM education;
- Diversity in STEM teaching;
- STEAM in education;
- Low-cost experiments in STEM education.

This time around, there were 11 available places for UK delegates, shared out among primary, secondary and higher education colleagues. Of the 11 projects chosen, five were primary, four were secondary biology based, one was secondary physics based and one was based on data science.



Stuart Naismith from Gartcosh Primary School at his stand



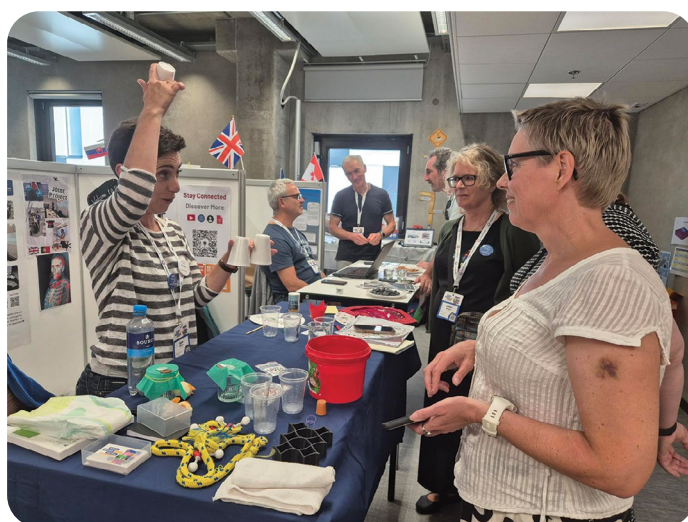
Caroline Cross from St Agnes Academy



Maren Kelly from St Catherine's Prep School



Sophie Brace from Heath Mount School



Rute Olivera and Adrian Allan from Dornoch Academy



Vicky Walsh from Monk Fryston C of E Primary School



Maren Kelly from St Catherine's Prep School

Some of the UK delegates to the Science on Stage 2024 festival enjoying sharing their projects with delegates from across Europe

Some comments from the UK delegation

I have come back to the UK bursting with ideas and knowledge and I know how enriching this will be for my staff, pupils and the wider scientific community. Realising, during the event, the common educational challenges we have across countries has enabled me to have exciting conversations, which have given me lots of new ideas and I can't wait to get started.

(Nicky Bolton, headteacher, Tattenhall Park Primary School)

I left after the three days feeling inspired and with a suitcase full of new engaging ideas and projects to incorporate into my teaching, as well as new friendships with teachers from the UK and beyond.

(Maren Kelly, primary teacher, St Catherine's Prep School)

I think for me it's the networking – I can't think of any other event that gives us the opportunity to network internationally in this way.

(Rose Edmondson, Falinge Park High School)

For me, it was about being gaining the confidence to continue to find new ways of making STEM accessible and interesting, not just for the students, but for teachers too. Like any other profession, every now and again we need a boost to keep us up to date with the latest developments and to stay motivated to do our best. Sharing ideas with teachers from across the continent has given me the confidence to continue with projects and develop new ideas for teaching challenging content to a wide range of students. It has been great to meet teachers in the same boat (some of them literally!) who are so encouraging towards each other and so willing to share ideas that will ultimately filter down to our classrooms and influence more students. Thanks again for the opportunity.

(Alasdair Riddell, Lossiemouth High School)

All delegates created posters sharing their work, to be displayed at their event stand, and prepared practical examples so that visitors to their stand could get a feel for the project and perhaps replicate it in their own countries. The posters can be seen here:
www.sons2024.eu/festival-projects

The great thing about Science on Stage is that it also fosters international collaboration between schools. This year, the UK also took three joint projects to Turku, where a UK teacher had collaborated with a teacher from another country on a project.

The festival

As well as the individual project stands at the festival, there were workshops, highlight sessions and awards. The three days were packed full with opportunities for each participant to show their projects and engage in meaningful conversations with other teachers and participants. All participants are able to take part in interactive hands-on workshops from teachers for teachers. Talking, discussing, networking and highlighting all-things STEM-related is a huge part of the festival, giving you a wealth of new ideas to bring back to your own classroom and to your school community.

How did we do?

Of the 11 individual and three joint projects the UK delegation took to Turku:

- five featured in the highlights sessions;
- one, led by Colleen Reesink-wells from Holy Trinity C of E Primary School, won a European STEM teacher award on polymers;

- three were chosen to present at workshops:

- *How magnificent is moss?* by Rose Edmondson, Falinge Park High School;
- *Replacing plastics: an investigation into creating natural polymers*, Colleen Reesink-wells, Holy Trinity C of E Primary School;
- *The science behind magic*, a joint project with Dr Adrian Allen and Dr Rute Olivera.

Resources

Science on Stage is not just about the festival, there are lots of resources and webinars available for your CPD. The newest resources, *AI in STEM Education* (www.science-on-stage.eu/project/ai-stem-education), include a series of lesson plans introducing AI into the primary classroom, looking at how AI impacts our life and how we can solve problems with it. The secondary lesson plans include looking at careers in AI and focus on machine learning. With a wide range of resources, some based on the Sustainable Development Goals and science in food and technology, they are well worth looking at as they have been written 'by teachers, for teachers' (www.science-on-stage.eu/teachingmaterials).

Science on Stage is clearly well worth applying for so why not watch out for the next round of applications!

Kulvinder Kaur Johal is the PSTT Regional Mentor for London and the South-East. She is part of the Science on Stage steering committee and the UK Science on Stage ambassador.
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Simply out of this world

Alex Harris from BBC Teach shares resources and his enthusiasm for all things astronomical



Before working for the BBC, I spent many years at The Observatory Science Centre in East Sussex. The awe-inspiring former home of the Royal Greenwich Observatory – with its iconic green copper domes and flint-knapped walls – provided the best Saturday job in the world. After I graduated from university I went full time, taking on a role with the Observatory's outreach team. I put on science shows for people of all ages and abilities, and gave tours of the historic telescopes.

In my current role as Executive Producer at *BBC Teach*, I see now what I saw then: space never ceases to captivate children's (and teachers'!) imaginations. Therefore, it is my pleasure to share with you some of my favourite space-themed resources for primary schools from the BBC.

KS1 Topics: Space

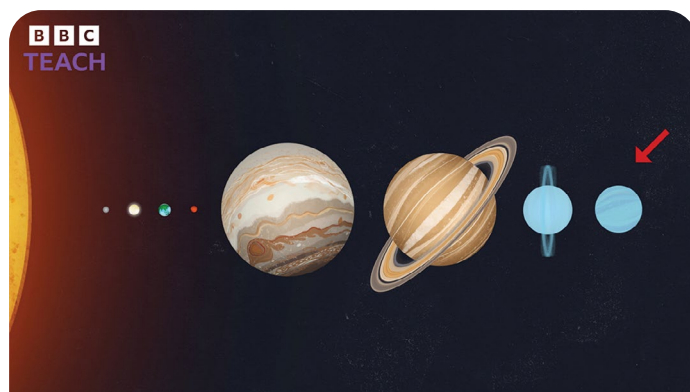
<https://rebrand.ly/a147a3>

This is a great place to start your exploration of all things space with younger learners. In three short films for key stage 1 children (ages 5–7), we explore how the Earth travels around the Sun, what exactly the solar system is, and how humans have explored space. Each film covers key aspects of this popular primary topic, including how long it takes the Earth to spin, the characteristics of each planet within our solar system, and those who have explored space in the past.

KS1 Significant Individuals: Neil Armstrong and Matthew Henson

<https://rebrand.ly/5d1b15>

One of my favourite recent additions to *BBC Teach* is this charming short film charting and contrasting the brilliant achievements of Neil Armstrong and Matthew Henson. It reveals how Armstrong fell in love with flying after taking his first plane ride when he was six years old. Meanwhile, Henson dreamed of travelling from a young



Younger children learn about space and space exploration in three short *BBC Teach* films (copyright BBC)



The achievements of Neil Armstrong (left) and Matthew Henson are compared in this film (copyright BBC)

age too, and landed a job on a ship aged just 13. Children will learn how years of preparation led to their respective remarkable achievements, and how recognition for the two differed.

KS2 Significant Individuals: Neil Armstrong

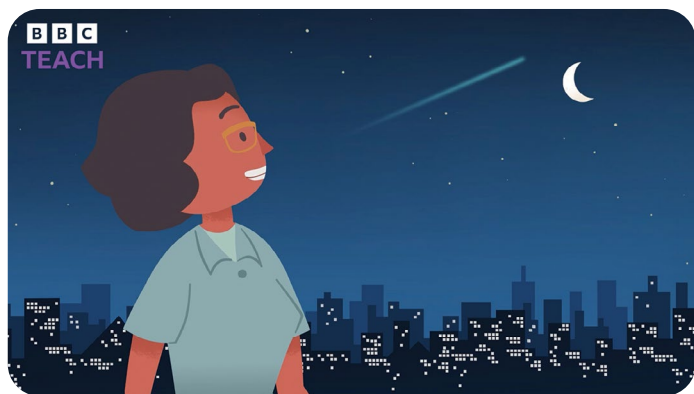
<https://rebrand.ly/e55a50>

Older children (key stage 2, ages 7–11) will enjoy this animation from our popular 'Explorers' series. Here, children can learn all about the Apollo 11 mission on the Saturn V rocket, and the crucial role played by mathematician, Katherine Johnson. The resource has teacher notes with suggestions about how the film can be used beyond science, including starting points for writing.

KS2: Significant Individuals: Katherine Johnson

<https://rebrand.ly/db0277>

This wonderful animated short film tells the story of the NASA mathematician. Katherine Johnson struggled against prejudice in her early life and went on to play a crucial role in NASA's space programme. She contributed significantly to the space program – a fact that was only recognised in later years. Johnson helped to calculate the trajectories for historic space missions, including the first American orbit around the Earth and the Moon landing in 1969.



This animated short film for KS2 tells the story of the NASA mathematician, Katherine Johnson (copyright BBC)

British Science Week 2025: Space Live Lesson – Monday 10 March

<https://rebrand.ly/73e8a8>

One of the best bits of my job is to work with the BBC Teach team to produce Live Lessons. Each 30-minute programme marks a key moment in the school calendar for primary schools.

For British Science Week in March 2025, we have gone – you've guessed it – all out for space! Children will learn how to become astronauts (we will have a downloadable mission patch), looking at how humans adapt and stay healthy on the International Space Station. The lesson will examine the effects of microgravity on our bones and how astronauts manage nutrition and hydration. The broadcast will be a fun and engaging way for your pupils to learn about the challenges of living in space. We may even have a visit from a famous astronaut or two! Teaching guides and activity sheets will be available to download.

Don't forget to get in touch if you'd like a shout-out for your school. Just email live.lessons@bbc.co.uk with British Science Week 2025 in the subject field.



To access further space-themed resources, visit: www.bbc.co.uk/teach

We always welcome feedback from teachers about our resources and what else you would like to see. Please get in touch with me and the BBC Teach team on: teach.bbc@bbc.co.uk

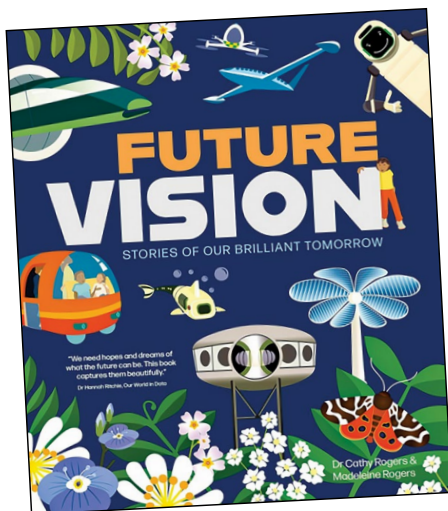
Alex Harris is Executive Producer of BBC Teach.
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REVIEWS

Future vision: stories of our brilliant tomorrow

Cathy Rogers and Madeleine Rogers
53 pp. £12.99
Lewes, East Sussex: Button Books,
2024
ISBN 978 1 787081 50 5

A futuristic look into the bright future of 2070 aimed at ages 8–12



This wonderful 'tomorrow's world' (a reference for older readers) looks at what life could be like for people in 2070. The authors of this futuristic book are clear that all the scenarios are possible: they have spoken to academic experts and have read hundreds of articles and books on the topic.

Ten chapters deliver a fascinating glimpse of what our future could be like. We are treated to a future vision of transport, wildlife, homes, AI, energy, health and wellbeing, oceans, food, space and democracy. We take the tour with Kit, aged 12, and her best friends, Asser, Maryam, Vera and Jonah. We are shown many familiar initiatives, such as 3D printing, hydroponics and AI, and how these develop, as well as new inventions, such as holoscreens, share hoppers, home bots and neuro-prostheses. The addition of timelines for many of the chapters provides insightful

predictions as to the events that may lead to the great changes. There are many hours of reading here and I couldn't put the book down. The illustrations forecast cleaner cities, automated driving, wallpaper that changes its pattern, living furniture that is grown, and nuclear fusion for clean and cheap energy.

In Chapter 5, 'Energy', the children take a visit to the augmented reality zone, in school, and learn about life in the coalmines, visit a 1970s house with a burning fossil-fuel fire, view an oil platform and then a solar power installation. Imagine taking a school trip to so many different places and not having to complete a risk assessment! My favourite chapter is the one on space, which provides the absolutely brilliant news that there has been life on Mars and we now have a city there and we have found tardigrades on Jupiter's moon, Europa!

To sum up, this book is fascinating and children and adults alike will love it. The author states, '*Optimism sometimes seems hard to come by*', but after reading this I cannot but feel optimistic about what might be possible.

Kathryn Jagger

Assistant Headteacher and Chartered Science Teacher, Spotland Primary School, Rochdale

Felix the friendly fox finds a new friend

Caley Russell
Independently published, 2024
41 pp. £8.00
ISBN 979 8 32475149 4

A simple tale of friendship for under-5s that would need supplementing to lead on to discussion of science topics

Felix the friendly fox finds a new friend is a book aimed at younger children. The story tells the tale of a lonely Felix, as he travels through

a dark and scary forest. He finds an equally lonely character, Benny the Bunny, and they travel through meadows and streams in search of their lost families.



The tale is written in rhyming couplets, and features alliteration, which often appeals to younger readers. However, I found the basic tone a little dull. It may have benefited from a repeated word or phrase to allow the reader to engage more. The illustrations are dark and simple: I do not think that they would engage a younger child. It would be possible to elicit talk around science topics, such as animals, habitats and plants, from the book, but this would have to be supplemented by the adult reading the story. With simple language, and not much explicit reference to science topics, I am not sure I could recommend this book to develop a love of science.

If I take this book as a tale of friendship, then it is basic in its form: a character is lost and unhappy; the character finds someone in the same predicament; they work through a problem together and then they are happy. In conclusion, a book with a friendship tale, which to my mind does not fit into a specific science topic and I am left believing that many other stories would be far more engaging for the intended audience.

Kathryn Jagger

Assistant Headteacher and Chartered Science Teacher, Spotland Primary School, Rochdale



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Access a wealth of resources, some member-only, geared towards both teaching and professional development in a primary school context.

Mary Anning: a fossil hunter's story

Targeted at pupils aged 9-11 to help uncover the key themes and ideas associated with fossils and evolution, including the inspiring life of Mary Anning. You can also access our award-winning narrative short film *Sea Dragon* based on the young Mary Anning and her pioneering discoveries.



Primary Science Assessment (PLAN)

These resources have been developed to support the planning and assessment of science for Key Stages 1 and 2. Whilst most content can be accessed on www.planassessment.com, ASE members have exclusive access to 18 additional resources for year groups one to six.

SEE ALL PRIMARY RESOURCES

Scan the QR code to visit our website



Primary Science Skills

This collaboration between ASE and the Primary Science Teaching Trust, has now published all eight units. The digital materials cover the skills required at each stage of scientific enquiry and are mapped to different scientific enquiry types.

Primary Remote Learning Resources

Originally developed during lockdown, this set of over 50 resources are equally usable in the primary classroom or for home learning assignments. There are resources for years one to six, covering plants, everyday materials, light, states of matter, living things and their habitats, properties and changes of materials.

Other resource collections on our hub include:

- **Why you'll never catch smallpox:** Transport your pupils back to a time when smallpox stalked the world and introduce them to Dr Jenner, James Phipps and the experiment that might well have saved their lives.
- **Primary upd8:** A series of science activities for 5-11 year-olds covering a huge range of topics.
- **Primary Science Leaders' Survival Guide**



ase.org.uk/primary-resources

PRIMARY INSIGHTS NETWORK: ONLINE

23
JAN

Working Scientifically

This new ASE Primary Insights Network will provide you with a welcoming space to learn, discuss and share best practice about the key themes in primary science with other primary colleagues. This session focuses on working scientifically.

24
MAR

Relevant and Real World Contexts

This session will focus on relevant and real world contexts.

08
APR

Scientific Literacy

This session will focus on scientific literacy.

17
JUN

Assessment to support learning and responsive teaching

All sessions: 60 minutes with two speakers and time for discussion and Q&A

Delivered online remotely via Zoom at 3pm

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'Being a chartered science teacher (CSciTeach) means so much to me. As a primary teacher with a GCSE in Human Biology, I have often felt a huge sense of imposter syndrome... The charter mark had a huge effect on my self belief that my work is valued and has parity with colleagues in the sector.'

Bryony Turford, CSciTeach



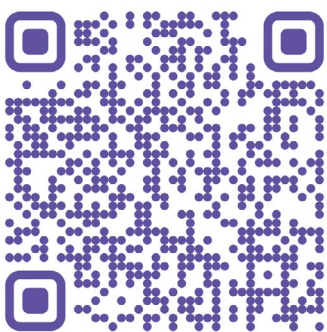
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IT'S NOT FAIR, OR IS IT?

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The popular **It's Not Fair, or Is It?** is back with a brand new second edition! In this new edition we continue to explore science enquiry, looking at five different types of science enquiry carried out in the primary classroom, which enable children to learn and consolidate their science skills.



**Written and edited by
Liz Lawrence,
David Allen, Alex Sinclair,
Helen Sizer, Jane Turner,
and Lucy Wood**

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