Primary Science

SPECIAL ISSUE: PSEC 2019

January 2020

The ASE’s journal for primary science
Primary science assessment (PLAN)

PLAN is a set of resources produced to enable teachers to have a clearer understanding of National Curriculum (England) expectations for meeting the standard in science. See www.ase.org.uk/plan for more details.

The PLAN is evolving

We know from Understanding the ‘state of the nation’ report of UK primary science education, published by Welcome in January, that only 22% of teachers surveyed ‘strongly agreed’ that they were confident in undertaking summative assessment and only 21% ‘strongly agreed’ that they were confident in undertaking formative assessment. We also know from Intention and substance: further findings on primary school science from phase 3 of Ofsted’s curriculum research, that science assessment is absent or not well embedded in curriculum design in more schools than for English and maths.

PLAN was developed to support teachers with precisely this challenge. To date, the planning matrices are helping teachers ensure that their plans cover all the required knowledge, and the examples of secure work are enabling teachers to confidently judge the knowledge of their pupils. But we haven’t stopped there. We have almost completed the publication of the comparative examples that enable teachers to develop their moderation skills, building their confidence in individual assessment as well as greater consistency across year groups.

We are now turning our attention to supporting the assessment of ‘working scientifically’ skills. In the near future, we aim to publish new versions of the planning matrices that will include explanations of what the relevant working scientifically statements for each phase mean and, over the next year, we intend to publish examples of what this might look like in practice. If you are interested in working with us to gather these examples, we’d love to hear from you. You can contact us via www.primary-science.co.uk

We are currently trying to capture evidence of how the PLAN resources are being used and their impact. We will be creating an online survey for this purpose and would be very grateful if you would share your views with us to inform our plans for the future. Look out on www.ase.org.uk for news of the survey in future months.

For more information, please visit www.ase.org.uk/join

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Focus on... PSEC special issue

On June 6th 2019, I caught a train from my local station to head to Edinburgh to the PSEC Conference. 11 hours after leaving Leeds, I stepped back on the platform of my local station, both extremely disappointed and really motivated.

I was disappointed because I had travelled for approximately 8 hours of the day, walked across a sunny Edinburgh and spent a mere hour and a half at what was obviously a very exciting, engaging and vibrant conference. I was disappointed to leave, not to have had more time to share the wealth of primary science experience that was there, and not to have had more of the good things that were on offer. However, my motivation was piqued from a personal perspective, as this snippet of conference attendance resulted in my doctoral work being shared by more people in a few days than since its completion.

The Primary Science Education Conference (PSEC), held every two years and run by the Primary Science Teaching Trust (PSTT), is a wonderful event, offering an inspirational and hugely worthwhile experience to hundreds of primary science practitioners.

This special issue of Primary Science allows those of you who couldn’t make it, and those who missed sessions to attend an alternative one, to read about the work that teachers have been doing. Their conference proceedings are shared here and cover a range of topics and ideas – all easily accessible and doable for you in the classroom. A lesson learned for all of us in this... get to the next conference for as long as possible!

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From 6-8 June 2019, the Primary Science Teaching Trust (PSTT) welcomed well over 400 delegates to its second international Primary Science Education Conference (PSEC)

Delegates came from across the UK and around the globe, including New Zealand, Australia, Brazil, South Africa, Nigeria, USA and many European countries. Over 100 workshops, seminars and presentations were led by world-class teachers, academics and educationalists, alongside three outstanding keynote speakers: Jim Al-Khalili, Laura Schulz and Kate Bellingham.

Over three packed and exciting days at the Edinburgh International Conference Centre, PSEC 2019 offered a varied and carefully chosen programme of the very best in professional development for primary science. Organised around a range of themes, our programme enabled every delegate to select sessions particular to their areas of interest and curriculum needs. The dynamic exhibition hall hosted a range of exhibitors as well as lunchtime practical Pick and Mix sessions, which, alongside some lively social events, were integral to the PSEC 2019 delegate experience.

All PSEC 2019 programme presenters were invited to share their contributions more widely by writing for this PSEC special issue of Primary Science. This excellent collection of articles is a great window onto what was a superb conference, giving just a flavour of the different opportunities that were presented to delegates.

Contributors come from countries ranging from Scotland to Australia, and each article is a presentation of tried and tested methods that we hope can be replicated in your schools and settings.

The articles cover a variety of themes, including:

- pedagogical approaches and strategies: Moore outlines dialogic approaches; James explains how using video playback can support peer assessment; Trew et al consider the value of using real science research; and Farrer and Tyler explore the use of images to develop scientific understanding;
- teaching science in exciting contexts: Turford et al outline their development and use of the Polar Explorer Cookbook; Eames links science with Premier League Football; Barrow and Bishop bring together Aboriginal and modern scientific knowledge;
- ideas for teaching particular concepts: Deller offers ideas on teaching evolution; Riggs shares her work on ocean literacy; and
- practical suggestions for developing working scientifically skills: Trew and Skerry discuss the use of floorbooks; Foney shares her “What’s in My Tray” activities. Many of these highlight new PSTT resources, exploring the background of how they were created and developed for best impact, as well as top tips on how to use them. There is also an ideas to share in the staffroom section based around the Practical Pick & Mix sessions at PSEC.

Guest editors: Kate Redhead and Alison Eley

Disclaimer

PSTT is not liable for the actions or activities of any reader or anyone else who uses the information in this journal. PSTT assumes no liability with regard to injuries or damage to property that may occur as a result of using the information contained in this issue.

Safety

Reasonable care has been taken to ensure that articles in the journal do not suggest practices that might be dangerous, and safety warnings are given where appropriate. However, the Association for Science Education 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 5-12 year-olds (4th edn, ASE, 2011).

The PSTT Children’s Conference at PSEC

During the Friday of the Conference, we were delighted to welcome children from 15 primary schools to the first PSTT Children’s Conference.

The focus of the conference was Climate Change and, as well as attending a keynote speech, children shared their own climate change projects with each other over the course of the day. All children talked confidently and enthusiastically to each other, and to PSEC delegates who took a wealth of ideas back to their own settings.

In preparation for this event, schools were able to access a climate change pack to support work in school. This could be used by all schools that registered, not only those who attended on the day. During the last year, over 200 schools across the UK and beyond carried out a climate change project using ideas presented in PSTT’s climate change pack (see pstt.org.uk/resources/curriculum-materials/childrens-conference).

The children loved the inflatable whale from Incredible Oceans

The children’s conference ended with a fantastic science show provided by Tim Harrison from Bristol Chemlabs
Primary Science Education Conference – Edinburgh 2019

These pictures give a flavour of the variety and quality of everything on offer at PSEC. For more details please visit our conference website or download the conference handbook.

If you would like to be kept informed about plans for any future PSECs or to join our mailing list, please visit the Primary Science Teaching Trust website.

I didn’t realise how much was out there to help and support science teachers. I have come away with so much to share and build on back at school, with teachers and TAs, as well as with teaching friends further afield and within my local cluster group. An amazing three days – full of positivity and opportunity. The whole conference was outstanding – probably the best CPD I have ever had.
Cutting-edge science in primary schools: Support for classroom practitioners and the development of teacher guides

PSTT Fellows with backgrounds in science research describe a new PSTT project: introducing resources to support primary teachers and children to engage with cutting-edge science research

The Cutting-edge Science Webpage: I bet you didn’t know...

PSTT has launched a new page on their website (pstt.org.uk/resources/curriculum-materials/cutting-edge-science-primary-schools) where new articles will be published, at least once a month, along with a Teacher Guide to support primary practitioners using the suggested investigations and sharing the cutting-edge science research with primary children. One of the articles will also be included in each of PSTT’s termly newsletters. On the webpage you will find:

- The rationale for using the cutting-edge research approach (why and how);
- The articles about the cutting-edge research;
- Teacher guides in the form of PowerPoints – one to go with each article; and
- Biographies of the authors of the articles.

The articles are not grouped according to any curriculum theme, to make them accessible to an international audience and because, due to the interdisciplinary nature of science research, some articles include aspects of biology, chemistry and physics. This is worth pointing out to the children and it might also be interesting to share with them that the scientific research was carried out by both female and male researchers, sometimes working in groups drawn from across a range of different countries.

Teacher guides: Providing support for primary teachers

The primary school teachers attending our PSEC 2019 seminar were very enthusiastic about the project, recognising that teaching children about cutting-edge science research provides opportunities for children to make connections with real scientists and deepen their understanding of the nature of science research and its relevance to everyday life (Trew et al., 2019).

 Acting upon feedback from primary teachers at the PSEC 2019 seminar, we have produced a Teacher Guide as a PowerPoint, structured as follows:

- We start with a list of the authors of each paper and their locations.
- We think that it is interesting for children to see that papers can be written by one or two scientists or by large teams of people who sometimes work in different countries, as revealed in “I bet you didn’t know… How to calculate the age of a shark?” (Shallcross, 2017) (see Figure 1).

The next slides introduce and describe the recent science research:

- What did the scientists know? What did the scientists do? What did the scientists find out? The PowerPoint is intended to be a guide for teachers for their reference, but we have included images to illustrate the main points on these slides because teachers may wish to show certain slides in the classroom. For example, to describe what scientists already know in the Teacher Guide that accompanies I bet you didn’t know… How to clean water using a molecular sieve! (Shallcross, 2018), we included images of graphene and of people collecting water at a pipe in a developing country (see Figure 2).

After describing what the scientists found out, a ‘Quick Activity’ and a ‘Longer Investigation’ are suggested (sometimes two) that children could do in the classroom to mirror the research and investigate as the scientists did. For example, in I bet you didn’t know… How to grow a new skin (Trew, 2018), we suggest that children could investigate how much skin they would need to cover their bodies using large rolls of new skin paper, and this is illustrated on a slide in the Teacher Guide (see Figure 3). The investigations vary in complexity and are suitable for different ages, but all pose a question for the children to investigate and list the resources that will be needed to carry out the investigation.

The final Teacher Guide slides give some key questions to prompt discussion about what the children have found out from their investigations, and we have also included slides suggesting ‘Questions for further learning’, maths links and writing links. We do not intend that teachers follow these ideas as a lesson plan or a sequence of work. We hope that teachers will adapt what we have provided to suit their pupils’ interests and questions, and we would welcome any feedback from teachers who use these Teacher Guides.
**Enquiry approaches and skills**

The activity slides also include symbols that refer to the different types of enquiry approaches (see Figure 4a) and the enquiry skills that pupils will use (Figure 4b). These enquiry symbols could be useful for teachers and pupils to refer to when talking about different investigations and the nature of science research. The symbols can be downloaded from the PSTT website (pstt.org.uk/resources/curriculum-materials/enquiry-approaches and pstt.org.uk/resources/curriculum-materials/enquiry-skills).

### Access to cutting-edge science research in primary schools

Teachers can access the Royal Society partnership grants, which enable students, including primary-aged children, to carry out science, technology, engineering or mathematics (STEM) projects with scientists and engineers (Royal Society, 2019). At PSEC 2019, Paul Tyler and Dudley Shallcross described how children can access cutting-edge science research.

**Why**

... articles provide a window into the world of primary science teaching.

**How**

1. The Teacher Guides are intended to support teachers who are planning to use cutting-edge science articles in the classroom; they are mainly for teacher reference, although teachers may wish to show particular slides to the children.

### Summary

Our articles explain cutting-edge science research and suggest science-related activities for primary children to investigate in the classroom. We believe there is value in producing these resources, because it is important that children recognise the same processes followed by real scientists, and that children see that there is a purpose to studying science: to help to understand the world around them and see the potential for a future career. Teachers may not have the confidence, or time, to apply for funding to take part in science research projects, so these resources help with this.

**Why**

1. Research scientists have expressed interest in working with us to write some materials for the webpage and we look forward to working with them to do this. Indeed, the next stage of the project is to have schools interacting with the actual scientists and being able to pose questions. We would welcome your comments on this paper, the *I bet you didn’t know… articles* and the Teacher Guides being produced. If you have subject areas about which you would like to have a cutting-edge science research article, please e-mail PSTT at info@pstt.org.uk.

**How**

1. The Teacher Guides are intended to support teachers who are planning to use cutting-edge science articles in the classroom; they are mainly for teacher reference, although teachers may wish to show particular slides to the children.

### References


NCCPE (2019) [www.publicengagement.ac.uk](http://www.publicengagement.ac.uk) Accessed August 2019


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Developing talk in the primary science classroom

Jo Moore writes about how talk is encouraged and used to support learning and teaching

Keywords Talk, Dialogic, Oracy

Our starting point

Encouraging children to explain their science learning in writing is never an easy task.

It was discussing how we tackle this that led our group of North London schools to develop a range of strategies and resources to promote science talk in our classrooms. We concluded that, before we could expect children to write, they needed to be able to explain their understanding verbally and this should be our focus.

Research conducted by Mercer et al (2009) looked at dialogic teaching in the primary science classroom and concluded that ‘children are rarely offered guidance or training in how to communicate effectively in groups…Many children may rarely encounter examples of such discussion in their lives out of school – and teachers rarely make their own expectations or criteria for effective discussion explicit to children’. This was certainly true of my school and, as a result, we began by using their research findings to develop rules for talk in all our classrooms (see Dawes & Sams, 2017).

Once we had achieved this, we focused on different techniques to develop talk and higher order thinking within science lessons. Some come from the Thinking, Doing, Talking Science project developed by Oxford Brookes and Science Oxford, and others are techniques found regularly in literacy lessons.

This article aims to outline these techniques, which work well with children across the primary age phase (age 4-11) and could also be used in the secondary setting (age 11-18).

Odd One Out

Show the children three carefully chosen images that fit with your science topic and ask them to decide which is the odd one out. Importantly, there is no right or wrong answer, so children soon become confident in expressing their opinions without fear of making a mistake. The key is that children give reasons for their answers and listen to the variety of opinions within the classroom, understanding that there are many different answers. This is also a very useful assessment tool for teachers – for example, at the beginning of a unit it can indicate what children already know and the vocabulary they can use. Similarly, later in a unit, teachers can assess what the children have learned.

The Wellcome Trust’s excellent Explorify website (explorify.wellcome.ac.uk/) has some great examples.

What if…/Always, sometimes, never

Teacher: ‘Who can think what would be positive about not having a digestive system?’
Child 1: ‘I wouldn’t have to spend time eating. Perhaps we could be like plants and just use oxygen, water and sunlight to make our food’
Child 2: ‘We wouldn’t need to go to the toilet’
Teacher: ‘Can anyone think why the whale might be the odd one?’
Child 3: ‘It doesn’t have any legs and it is the only one that lives in water’

Child 3: ‘We would not have the energy to do anything if we didn’t eat’
Child 4: ‘We would only be able to eat soups, or other foods that don’t need breaking up by our body’
Child 5: ‘It would be boring if we never needed to eat – what would happen to all our favourite food?’

These are techniques for developing higher order thinking skills in the science classroom and can take place during a science lesson, or in a spare ten minutes during the day.

What if… can be used with any topic and children need to come up with positives, negatives and anything that might be interesting. I always really enjoy the children’s comments and they never fail to surprise me with their ideas. For example, a discussion about ‘What if there was no electricity?’ developed into a discussion about mobile phones and how children thought not having a mobile could be a positive, as their parents would not be on the phone all the time and would have more time for their children.

TOP TIP

Expect any discussion to take 10 to 15 minutes, giving children individual thinking time at the beginning and then a chance to talk to a partner before opening it up to the class.

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TOP TIP

Expect any discussion to take 10 to 15 minutes, giving children individual thinking time at the beginning and then a chance to talk to a partner before opening it up to the class.
**True or false**

This is a great technique for teasing out misconceptions in science and promoting talk.

Give the children a set of statements on cards to sort into true and false – I have a set of photocopied boards on card for the children to sort onto. It takes a bit of time initially to make, but they then last for years. Never expect children to do this on their own: the key is the discussion while they are doing it and when you go through it. Try to include many common misconceptions to ensure lots of discussion. This is another great assessment tool, which can be used throughout a science topic (although not at the end, because time is needed to deal with any misconceptions that still exist).

**Top tip**

I would never expect this to go in books; it is a formative assessment tool and it needs to be low stakes for it to be effective.

**Ordering a text**

This is something that we use regularly in English, so why not in science?

It works best with topics where events can be sequenced, for example, the circulatory or digestive system, or a life cycle. It is also a great technique in preparation for science writing, as you can introduce the language structures that you would want to see in a piece of writing. I always chop up the sentences in advance, as just the physical process of moving the sentences around seems to help the level of discussion within the group.

**Top tip**

I wouldn’t expect children to stick the sentences down, so I can use the same chopped up sentences again the following year – ordered sentences can be photographed if evidence is needed.

**Cloze text**

This is a very good technique when children are just beginning to learn new concepts or vocabulary, as it gives them a chance to practice without having to develop full sentences. It is particularly effective with children who are new to English, or less confident. Often cloze text is used as an individual writing activity but, in this context, it is a talk activity. Mercer et al (2009) state that discussion is better in threes rather than twos once children are in Year 2 (age 7), because one child is less likely to dominate and discussion is more likely.

**Top tip**

I use this to consolidate new learning within a lesson or at the beginning of the next one.
Meet the expert

If a written outcome is needed, or you simply want to assess what the children have learnt, this is a great technique; it could be your final outcome, particularly if you record it.

In groups of three, the children share the roles of expert, interviewer and observer, taking it in turns to do all three. Prepare a tick sheet of key vocabulary and phrases for children to use in their explanations. The expert’s role is to answer questions about the topic posed by the interviewer, whilst the observer uses the checklist to tick off what is used. They then give feedback before swapping roles and repeating the process.

TOP TIP

Many children find it difficult to think of what questions to ask and, as a result, I often model the activity with another adult or confident child.

References and further reading


The Premier League Primary Stars Primary Science Project

The Premier League Primary Stars Project is a collaboration between Leicester City Football Club’s (LCFC) Community Trust, the National Space Centre (NSC) and the Primary Science Teaching Trust (PSTT). The project produced a series of lessons that link space, football and working scientifically.

The lessons

Our first lesson was a trip to the stadium (this is a visit that schools can arrange by contacting their local football, cricket, rugby, hockey or other sports club). At the stadium, we looked at the materials that make up the stadium and asked questions such as: Why are these materials used? Could other materials be used? Following this initial discussion, the children were challenged to design a comfortable chair to sit on. The children recorded their ideas by annotating plans, and they were encouraged to justify their decisions.

One of the highlights of the visit to the football stadium was meeting the head groundsman, who explained how the pitch is grown and how they arrange by contacting their local football, cricket, rugby, hockey or other sports club). At the stadium, we looked at the materials that make up the stadium and asked questions such as: Why are these materials used? Could other materials be used? Following this initial discussion, the children were challenged to design a comfortable chair to sit on. The children recorded their ideas by annotating plans, and they were encouraged to justify their decisions.

One of the highlights of the visit to the football stadium was meeting the head groundsman, who explained how the pitch is grown and how they would be possible to grow a pitch on Mars. In the lesson Pitch Perfect, the children were given this very challenge. They were asked to research the conditions on Mars and to plan their own investigations based on what they had found out. We also developed a lesson where variables are controlled, data are recorded for several weeks, and comparisons are made about how plants grow. The children worked in small groups to investigate growing seeds in different conditions. Their questions included: Why are these materials used? Could other materials be used? Following this initial discussion, the children were challenged to design a comfortable chair to sit on. The children recorded their ideas by annotating plans, and they were encouraged to justify their decisions.

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References and further reading


The Premier League Primary Stars Project

Linking football, space and working scientifically… Sarah Eames shows you how!

Keywords Space, Materials, Sport

These resources were presented at PSEC 2019 and are freely available to download and use in the classroom; they can be found on the PSTT website: pttt.org.uk/resources/curriculum-materials/city-science-stars.

The project created a series of lessons using football and space as a context to encourage children to be curious about the world around them. The lessons were designed so that they could be delivered by teachers or sports coaches to 9-11-year-old children. The project was also an opportunity to increase the confidence of class teachers and promote practical and active science lessons. Over 300 children from nine schools took part in the trial lessons; after each lesson, the children took part in surveys and interviews to help make improvements to the content.

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Our first lesson was a trip to the stadium (this is a visit that schools can arrange by contacting their local football, cricket, rugby, hockey or other sports club). At the stadium, we looked at the materials that make up the stadium and asked questions such as: Why are these materials used? Could other materials be used? Following this initial discussion, the children were challenged to design a comfortable chair to sit on. The children recorded their ideas by annotating plans, and they were encouraged to justify their decisions.

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In the lesson Feel the Pressure, footballs are blown up to a range of different pressures. We discussed the term ‘psi’ (pounds per square inch), created a question to be answered and made a prediction. Then, in groups, children were tasked with collecting data that were accurate and reliable about how changing the pressure of the ball affected the ball’s performance. Most groups chose to drop the ball and observe and measure the bounce; a few groups rolled the ball, and this made for interesting discussions about controlling variables.

The Get a Grip lesson explores friction, which the children measure using force meters. Children had to decide on one of two investigations: comparing the friction of different types of shoes on the same surface, or comparing the friction of the same shoe on different surfaces around the school. As with the Feel the Pressure lesson, children worked in small groups and were given time to prepare their conclusions for the lesson plenary. This generated a lot of discussion and debate about why different groups had come to different conclusions, and highlighted that, when groups agreed with each other, this improved the reliability of the results. The history of football boots provided another extremely interesting discussion point, not to mention the branding. This lesson provided a fascinating link to Space, as astronauts walking on the Moon need weights in their boots – not to mention the branding. This lesson provided a fascinating link to Space, as astronauts walking on the Moon need weights in their boots, something that can be likened to football boots provided another extremely interesting discussion point, not to mention the branding. This lesson provided a fascinating link to Space, as astronauts walking on the Moon need weights in their boots.

A large majority of children said the final lesson, Kick Off, Lift Off, was their favourite one. Making the wooden rocket launchers is well worth it; they are easy to construct, are cost-effective and last for years. The children explore how changing the rocket’s launch angle affects how far and how high the rocket flies, something that can be likened to the trajectory of a kicked ball. This lends itself to a great deal of data collection (once the excitement of simply firing the rocket wears off!).

The lesson supports the teaching of forces, and an added bonus is being able to make use of waste plastic bottles, at least until they crack and then they can be placed in the recycling bin! A short video was produced by LCFC to illustrate this lesson: www.youtube.com/watch?v=f2KGE4eQW8.

A STEM coach in Leicester (funded by PSTT) is continuing to develop the resource and to work with schools and teachers in the East Midlands area. Interestingly, they have also been able to work with small groups of children with additional needs to increase confidence and to develop a more positive attitude to science. The lessons have also been used in an after-school club.

### Project evaluation

We asked the children about their attitudes toward the lessons by rating each session out of 10. The scores that the children gave were all 8 and over. Interestingly, those that were more practical and outside (Feel the Pressure, Kick Off, Lift Off and the newest lesson, On the Wing) rated slightly higher than the indoor investigations.

This might be useful to bear in mind if you are a science lead trying to encourage teachers to take science outside.

After carrying out the series of lessons, the children also reported an increased enjoyment and engagement with science. Particularly notable was that the biggest change after the lessons was in the children’s knowledge about science-related jobs.

Teachers are welcome to download the resources and use them with their classes. Science leads are encouraged to share them with other teachers, particularly those teaching 9-11 year-olds. The lessons ensure good coverage of working scientifically skills; they have been structured to support newly qualified teachers and teachers who are less confident with science; and they can also be adapted to suit the needs of the class or group. They work well as a series of after-school sessions or for small group interventions. The contexts of Space and football clearly have a very wide appeal; the practical elements encourage development of skills, record-keeping and analysis, as well as working together as a team. All ESA and NASA videos are copyright-free and available to use in the classroom, and there are some great videos of Tim Peake running a marathon in Space, and other astronauts on the International Space Station trying to play football.

### Sarah Eames

Sarah Eames is a part-time teacher at Sandfield Close Primary School, Leicestershire.

Each winner receives:
- £1,000 personal prize money
- A set of science resources from PSTT
- £1,000 personal prize money
- A year’s membership of the ASE
- A year’s membership of the ASE
- Fellowships of the Primary Science Teacher College

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Developing scientific skills

Why observation?

Human beings have an innate curiosity and an ability to communicate and discuss complex ideas. Through our evolution, we have tried to make sense of the world around us, explain its past and predict its possible futures. We observe things happening around us, often in complete awe, and ask questions... Why does the moon look different every night? How do flowers know when to grow? Where do stars come from? What happens to the water in a puddle?

We find ways to answer our questions, and then ask more questions with increasing complexity to build our knowledge of the world around us. We call this process ‘science’ and, without it, we wouldn’t be where we are today. In simple terms, without observation and questions there is no science, and without science there is no progression in our understanding of how everything around us works, and how it interacts with everything else.

The skills of scientific observation, scientific questioning, discussion and debate need to be taught explicitly. Children then need lots of opportunities to practice their skills and realise that the same process can be applied to just about anything. See Through Science brings scientific observation, questioning, discussion and debate together through the use of carefully selected, inspirational images and prompts to support teachers in class.

Why questions?

Questions are the starting points and foundations of science and, if we are going to continue to develop our understanding of pretty much everything, we need more people asking more questions (Chin & Long, 1981). What is it like in your classroom? How can you encourage your children to ask more questions?

The starting point for improving questioning in class is developing a safe environment and classroom ethos where children are happy to ask questions without fear. Some direct instruction and good modelling of asking good questions is needed, as well as repeated opportunities for the children to formulate their own questions in different contexts.

Modelling how to rephrase questions so that there is a measurable aspect to them will help children to generate investigable questions themselves. From these, they can then make hypotheses and predictions based on their observations and prior knowledge.

Using See Through Science

There are two parts to See Through Science: the Teacher’s Pack and the Image Pack. The Teacher’s Pack contains a detailed guide to using the resource, as well as the rationale for the design and all the research behind it. There are examples of how teachers have used it in practice and additional activities for building pupils’ observation and questioning skills.

The downloadable Image Pack contains fifteen high-resolution images that cover a wide range of areas of science. They are only loosely curriculum-linked, so teachers have flexibility in how and when to use them and they can also be used in a number of countries.

A copy of each image is provided without a question attached. This might be displayed when children are coming into class so that they can be intrigued and come up with their own questions and ideas. As teachers overhear initial discussions and get an idea of children’s thinking, they may well identify misconceptions and ideas for future lessons.

A copy of each image is also provided with a key question to use in class or in assemblies, so that the teacher can support the children to develop their questioning and discussion skills.

Good scientific questions:

- have real answers. The answer can be as simple as ‘yes’ or ‘no’, or it can be more detailed;
- are testable. You can do an experiment or take measurements to find the answer;
- are linked to a prediction or a hypothesis. This does not have to be correct; sometimes the investigation you carry out will show that your hypothesis is false and
- are interesting!

What is this?

Decide on a yes/no question to ask to help you find out.

Are you sure?

Are you really sure?

Give 3 scientific reasons to convince us that you are right.

Keywords: Image, Observation, Questioning, Discussion

See Through Science is an exciting new research-based resource from the Primary Science Teaching Trust (PSTT), which uses inspiring photographic images to stimulate scientific thinking, questioning and discussion.

It includes a detailed teacher’s guide and a downloadable image pack with inspiring images, key questions, bookmarks, placemats, teacher information and suggestions for follow-on activities.

The original concept for See Through Science came from observing the way that photographic images stimulated scientific curiosity in both children and adults, starting discussion and leading to them asking more questions and engaging with science in a positive way.
Examples of key questions include:

• Which is the odd one out?
• Which 5 scientific words would you choose to go with this photo?
• What are the differences between these two images?

A copy of each image that can be used without teacher support is also included, for example, for use in the lunch queue, in the playground, on the school website, in newsletters or where parents are waiting to collect their children at the end of the day.

There are additional support resources in the Image Pack: printable placemats and science vocabulary bookmarks are designed to support group discussions, either in paper form or by using tablets.

The supplementary questions and follow-on activities are also a key part of See Through Science. Each image links to follow-on practical activities, so that teachers can support children to turn their questions into enquiries. The weblinks also help teachers to ensure that the interesting discussions prompted by the photographs lead to hands-on pupil enquiries.

Many teachers already use a wide range of images to support their teaching and these are easy to find with a simple web search. However, having experienced the frustration of looking for that ‘perfect’ photograph to use, we wanted to give teachers a quick way to find and use inspiring photographs in their science topics.

See Through Science gives answers and ideas, opportunities and suggestions to promote science talk in the whole school community, improves questioning and discussion skills in children, and supports teachers in really thinking about how to develop those questioning and discussion skills.

Reasons to use See Through Science

• Ignites children’s curiosity
• Increases understanding of context-specific scientific vocabulary and broadens scientific understanding
• Promotes debate about scientific issues, encouraging children to collect evidence from observations to justify their opinions
• Explores exciting worlds, from the microscopic to inaccessible places on Earth and the far reaches of the Universe
• Encourages precise observation of scientific detail
• Provides opportunities for children to develop their thinking skills
• Grows science capital by developing positive attitudes to science
• Introduces lessons in an intriguing and engaging way, where answers are not immediately obvious
• Assesses prior knowledge and addresses misconceptions that children have about many scientific phenomena
• Develops teachers’ confidence to facilitate discussions in science

As an example of an image and text that can support learning in and around the school:

Some See Through Science users have encouraged the use of post-it notes or whiteboard pens to gather children’s ideas.

Teacher feedback stated that teachers might be concerned about not ‘knowing the answer’ and might feel vulnerable about their own scientific knowledge when asked to explain some of the images. Each image is therefore accompanied by a scientific explanation and a weblink for teachers or children to use to find out more. This is designed to give teachers the confidence to explore the images in a more creative way with the children.

There is more

The image with a key question for discussion

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Old Ways, New Ways: an outreach initiative based at Edith Cowan University (ECU) in Perth, Western Australia.

The programme looks to bring together Traditional Australian Aboriginal knowledge and contemporary science expertise and perspectives. It has been developed to encourage, support and engage Aboriginal and Torres Strait Islander children from Western Australia’s low socio-economic communities.

ECU has three main campuses, all of which are situated on Noongar boodjar (country). Two are situated on Whadjuk boodjar and the third on Wardandi boodjar. Noongar boodjar is situated in the southwest corner of Western Australia and comprises 14 groups.

The programme enhances confidence in science-based learning, cultural identity and builds leadership and communication skills through peer-supported learning. The programme encourages the participation of Aboriginal and Torres Strait children in science subjects, with a view to increasing educational and employment outcomes in science and technology. Currently, Aboriginal and Torres Strait children from three ECU campuses, all of which are situated on Noongar boodjar (country), are participating in the programme to test their own cultural backgrounds reflected in what they are doing.

Old Ways, New Ways' interactive workshops look to embed Traditional Aboriginal knowledge systems into contemporary sciences, thus increasing the relevance and depth of understanding for participants, while increasing a deeper connection with their cultural background. We act as a vehicle for children to connect with the programme to test their own cultural backgrounds reflected in what they are doing.

We work with a number of focus schools each year across metropolitan, rural, regional and remote areas of Australia. The same cohort of children attend the programme twice a term for the duration of the school year. Each term, the children participate in an Old Ways’ session held at one of our three ECU campuses. Through this approach, we are able to build a rapport with the children and take them on a journey of ongoing narrative, while breaking down some of the barriers and preconceptions they may have around higher education institutions.

How? Old Ways, New Ways: a unique approach

Old Ways, New Ways’ interactive workshops link Aboriginal cultural competency and the Traditional ‘Old Ways’ of Aboriginal science with contemporary or ‘New Ways’ of scientific knowledge. Participants learn through hands-on activities and peer-supported learning. Old Ways, New Ways’ primary objective is to improve the participation of Australian Aboriginal and Torres Strait children in science subjects, with a view to increasing educational and employment outcomes in science and technology. Currently, Aboriginal and Torres Strait Islander people are hugely under-represented in science fields. Old Ways, New Ways seeks to address this imbalance and educational disparity.

The programme enhances confidence in science-based learning, cultural identity and builds leadership and communication skills through peer-supported learning. This is achieved through intergenerational knowledge exchange and demonstrator training, while promoting positive role models who inspire the children to improved education pathways and science career opportunities.

International Piece

Old Ways, New Ways: Coming together to learn

Jason Barrow and Caroline Bishop describe an approach that was designed to bring together traditional and contemporary science expertise and approaches in Western Australia.

What? Our workshops

Creative, non-literacy-based, hands-on science activities create the foundation of the programme. Children are taken on a journey of scientific exploration, where Traditional methods of Australian Aboriginal bushland survival and environmental sustainability methodologies are celebrated, shared and linked to contemporary scientific practice. These workshops are complemented by and connected to practical contemporary science workshops that include: plant and human biology, chemistry, engineering, and computer and security science – all within the context of rigorous scientific knowledge and inquiry. The workshops are adapted based on the literacy, cognition and experience of each participatory group. Older children are trained as demonstrators and provide technical and theoretical expertise in running workshops for younger children. This approach aims to build confidence, communication skills and a greater depth of understanding of the presented subject areas.

Some examples of programme delivery

**Ages 4–5**

Adaptation of Traditional Aboriginal games modified to incorporate fine motor play while exploring concepts of aim, flight trajectories, arcs, ricochet and angles.

**Years 1 and 2 (ages 5 and 6)**

The interactive workshops for Years 1 and 2 explore the concepts of aim, flight trajectories and arcs. These concepts are expanded to explore lever and their impact on achieving increased flight velocity and distance of the thrown item. Participants are introduced to Miro, also known as woomeras (spear throwers). The components of the Miro are broken down: a shaft with a cup or spur at the end that supports and propels a projectile. The Miro is a low-mass, fast-moving extension of the throwing arm, increasing the length of the lever (arm). The extra length allows the thrower to impart force over a longer distance, imparting more energy and higher speeds. Children are encouraged to think about contemporary adaptations of these concepts, i.e. dog ball throwers.

The workshop is structured to test out concepts of velocity and distance. Inflatable kangaroos are placed as targets. Participants initially try hitting the kangaroo while throwing with just their arm, then dog ball throwers are introduced and observations are made regarding the increased distance, speed and accuracy that too utilisation can produce.

**Download full resource at:**


**Yangamini** is an object-throwing game. In this case, we started with hacky sacks being thrown into a small bucket. Participants experiment with different throwing styles (underarm, overarm) and predict outcomes and trajectories of the thrown item. Observations are encouraged around outcomes, and discussions are facilitated regarding where and how these acquired skill sets and outcomes may benefit them. The game is upskilled by using different parameters and materials: changing throwing distance, size of thrown object (changing to tennis ball), size, angle and shape of target. Participants further predict difficulty and alter their throwing style to accommodate these shifting parameters.

**(R)** Jason explains the use of spears and spear throwers

**(L)** Kangaroos inflated and ready for target practice

**Years 1 and 2 (ages 5 and 6)**

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Years 3 and 4 (ages 7 and 8)
The concepts explored in the first two sessions are further expanded upon with the introduction of throwing Kylies (boomerangs). The two boomerang types are introduced: returning and non-returning; and the principles of balanced and non-balanced aerodynamics are explored. The physics of flight is broken down and gyroscopic precession is explained, while exploring and expanding upon the combination of spin, forward motion and lift.

Years 5 and 6 (ages 9 and 10)
Children are introduced to the Balga (also known as a Grass tree, Xanthorrhoea preissii): its classification, historical naming conventions, medicinal and practical uses, the Noongar significance of the plant and the concept of ‘caring for country’ through Noongar environmental knowledge and links with the 6 seasons. By analysing Traditional Noongar tools, children are able to discuss Aboriginal social and gender systems and the importance of caring for the environment in a sustainable way. Additionally, the significance of interconnected observation and connection to country is explored in order to source the natural materials required to make Noongar tools. Children grind the raw ingredients required to make Traditional glue for tool making, and experiment with different heat sources and the results obtained from these approaches.

Children’s feedback
In order for us to gauge the efficacy of the programme, children are asked to complete a feedback form at their first and last sessions of the school year. We aim to capture attitudinal shifts around children’s connection to science, Aboriginal culture and their cultural background, relationship with their schooling, confidence and plans for the future. We use emojis to assist children who may have challenges with literacy.

Quotes from 2018
• Did you like science before this workshop?
   ‘No I didn’t really like science before but now it is amazing that you learn more about your culture’ (Aboriginal girl, Year 5 – age 9)
   ‘No, because the resources didn’t tell us about old science, Aboriginal science’ (Boy, Year 5)
• What did you most enjoy?
   ‘I enjoyed the whole thing. The people talking to us were kind, clear, respectful and answered all my questions and I loved the experiments we did. They were awesome!’ (Girl, Year 6 – age 10)
• Other comments:
   ‘I wish that I could enjoy that amazing experience everyday :) If I could rate it out of 10, I would definitely give it 20!!!’ (Girl, Year 5)

Who? Importance of partnerships
The Old Ways, New Ways programme’s success is attributed to the strong partnerships between our Australian Aboriginal communities and its host university, ECU. The programme is co-ordinated through ECU’s centre for Aboriginal and Torres Strait Islander education and research, Kurongkurl Katitjin. Kurongkurl Katitjin is a Noongar phrase meaning ‘coming together to learn’. The centre’s purpose is to provide excellence in teaching, learning and research in a culturally inclusive environment that values the diversity of Indigenous Australian history and cultural heritage – the guiding principle for Old Ways, New Ways.

ECU academics and students, from a range of disciplines, provide workshops on our three campuses. This links seamlessly with the utilisation of our Australian Aboriginal Elders and knowledge keepers, who deliver their expertise in a variety of outdoor settings. We recognise equal parity between cultural knowledge held by our Elders and the knowledge of our academics.

We acknowledge the Traditional Custodians of the land on which we live, work and play: the Whadjuk Noongar people. We pay our respects to Aboriginal and Torres Strait Islander cultures and to Elders past, present and emerging.

For further information, please contact the authors at the addresses below.

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In order for us to gauge the efficacy of the programme, children are asked to complete a feedback form at their first and last sessions of the school year. We aim to capture attitudinal shifts around children’s connection to science, Aboriginal culture and their cultural background, relationship with their schooling, confidence and plans for the future. We use emojis to assist children who may have challenges with literacy.

Quotes from 2018
• Did you like science before this workshop?
   ‘No I didn’t really like science before but now it is amazing that you learn more about your culture’ (Aboriginal girl, Year 5 – age 9)
   ‘No, because the resources didn’t tell us about old science, Aboriginal science’ (Boy, Year 5)
• What did you most enjoy?
   ‘I enjoyed the whole thing. The people talking to us were kind, clear, respectful and answered all my questions and I loved the experiments we did. They were awesome!’ (Girl, Year 6 – age 10)
• Other comments:
   ‘I wish that I could enjoy that amazing experience everyday :) If I could rate it out of 10, I would definitely give it 20!!!’ (Girl, Year 5)

Who? Importance of partnerships
The Old Ways, New Ways programme’s success is attributed to the strong partnerships between our Australian Aboriginal communities and its host university, ECU. The programme is co-ordinated through ECU’s centre for Aboriginal and Torres Strait Islander education and research, Kurongkurl Katitjin. Kurongkurl Katitjin is a Noongar phrase meaning ‘coming together to learn’. The centre’s purpose is to provide excellence in teaching, learning and research in a culturally inclusive environment that values the diversity of Indigenous Australian history and cultural heritage – the guiding principle for Old Ways, New Ways.

ECU academics and students, from a range of disciplines, provide workshops on our three campuses. This links seamlessly with the utilisation of our Australian Aboriginal Elders and knowledge keepers, who deliver their expertise in a variety of outdoor settings. We recognise equal parity between cultural knowledge held by our Elders and the knowledge of our academics.

We acknowledge the Traditional Custodians of the land on which we live, work and play: the Whadjuk Noongar people. We pay our respects to Aboriginal and Torres Strait Islander cultures and to Elders past, present and emerging.

For further information, please contact the authors at the addresses below.

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Ocean literacy: Using the context of the ocean to teach science

Many children are already passionate about environmental issues surrounding the ocean, so Caroline Riggs describes how this makes it the perfect context to teach other science and maths topics in the curriculum.

Keywords: Literacy, Oceans

Ocean literacy

Over the last few years, I have been lucky enough to talk to many children about the oceans through my work with Incredible Oceans – an organisation that tells critical ocean-saving stories using art and science.

It is rare to meet a child who does not have a favourite ocean creature, and most children will astound their parents with the detailed facts that they can recall. Often, that same child can also talk (to some extent) about an environmental threat to the ocean, whether it be plastics in the ocean or over-fishing. This is what we mean by ‘ocean literacy’.

To be ocean-literate, a person (of any age) will understand how we use the ocean as a resource, how we protect it and how we empower people to contribute towards making vital decisions about how we use the ocean as a resource, how we protect it and how we explore it.

There are still many children in the UK who have never seen the ocean, yet they can still have the opportunity to develop that personal connection with it through stories or classroom activities. There is some truly wonderful work going on in schools up and down the country to engage learners with the seas surrounding our island: through work on ecosystems and food chains, joint projects in science and geography, and recycling projects in eco-schools clubs.

In this article, I suggest some ideas for using the ocean as a context for teaching topics outside the traditional biology curriculum, in the hope that we can continue to share ideas and inspiration with the next generations about our blue planet in as many different ways as they need. The following ideas have been trialled in both primary and secondary schools, in curriculum time and through extra-curricular clubs.

Over the last few years, I have been lucky enough to talk to many children about the oceans through my work with Incredible Oceans – an organisation that tells critical ocean-saving stories using art and science.

Exploring the sea floor in a shoebox

When teaching the topic of waves and exploring new habitats, children at St Andrew’s C. of E. High School for Boys and Worthing High School mapped their own section of the sea floor right at their desks. The children were presented with mystery shoeboxes, which they were not allowed to open.

Keywords: Primary Science, Secondary School

Evaluation and next steps

Using the context of sea floor exploration was good for assessing and developing numeracy skills. To challenge students aged 10-11, we talked about the concept of a wave travelling to the sea floor and back to the boat, meaning that the values would have to be halved before using the speed = distance/time equation. This extra numeracy extension allowed the children to experiment with the meaning behind the equation, by thinking about how the wave was travelling and reflecting back. Some children found that comparing their graph and marked sticks directly with the inside of the box helped them to visualise how errors could have been caused in the task. These children were then able to use their equipment to support their contribution to class discussions, in some cases using the box to demonstrate what they were saying.

All children were able to give an opinion on the future of ocean exploration: we used their results and the research they completed on the computers to debate whether humans should explore the oceans, or Space. Next time we teach this project, we hope to link it to historic tales of deep-sea missions, as well as spending some more time linking in career opportunities in oceanography.

In this article, I suggest some ideas for using the ocean as a context for teaching topics outside the traditional biology curriculum, in the hope that we can continue to share ideas and inspiration with the next generations about our blue planet in as many different ways as they need. The following ideas have been trialled in both primary and secondary schools, in curriculum time and through extra-curricular clubs and enrichment days.

Using a ruler to see how far the stick had been pushed in, they were able to record these measurements on a piece of graph paper. Repeating this step for all the holes in the line, and plotting each on the chart, allowed the data to reveal the inverted shape of the sea floor. For children who need extra support, the sticks could be marked with a felt-tip pen and lined up to show the same shape without drawing a graph.

The class were then able to open their shoeboxes and discuss if they thought that this was an accurate method. In the real ocean setting, could the ‘wave’ have been stopped or distorted by anything other than the rock structure? What information could they not find from their exploring? The children were allowed to hide plastic shipwrecks under the card structures, or draw on fossils or plant formations, for future classes to miss in their sampling. The children then enjoyed using Google Earth to start computer-based research into how much of our oceans had been explored and what had been found.

The hidden structure within the mystery shoebox

Along the middle of the box was a line of holes. The challenge was to produce an accurate map of the structure at the bottom of the box, without looking inside. The purpose of this was to model the use of sonar mapping from boats, so pupils had to carefully push a wooden skewer through a hole and mark how deep it had gone before it hit the hidden cardboard structure.

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Science and PE: Making the statistics real

The size of the ocean is incredible: it covers 71% of the surface of the Earth. However, we rarely talk about the size of the creatures living in it. At the Siren Festival in Aldeburgh this summer, David Atkins ran traditional PE games with an ocean education twist:

Families of all ages were invited to take part in a tug-of-war that set teams of the biggest ocean predators against each other in a competition for the most powerful attack.

PE games with an ocean focus

Predator-prey relationships were made visual and interactive for children, as the numbers on each side of the rope changed to reflect population changes in habitats.

One of the most successful activities involved a long jump competition, but instead of measuring the distance in centimetres, ocean athletes could jump the length of starfish, turtles, sharks and even a whale (in multiple attempts!). One of the most notable things out about this exercise was that children were more likely to have a discussion about their jump distance with their group afterwards. In most cases, at least one person from the group then went to look up pictures of the creatures over which they had jumped. From these discussions, David was able to amaze the crowds with facts about the creatures and encourage people to have more attempts at jumping further.

Evaluation and next steps

This activity was beautifully engaging, not only through getting people talking about the ocean, but also by enabling children to take part in an athletic challenge. In some cases, the young person didn’t try very hard on the first attempt but, regardless of the distance jumped, there was always a fact to give as feedback: it didn’t matter if the jump was successful or not, and this hooked them in for another go.

The preparation for the resource was mainly completed by students at The Angmering School and, during a numeracy-based task, they researched and calculated sizes of creatures in the ocean that they found interesting. We hope to continue to use this approach in future, and perhaps extend it to other activities: for example, trying to hit a target in the way that an Archer fish does, or computing the mass or speed of different animals. We would also hope to include more questioning in discussions to see how this task helps to improve estimation of distances.

The future of ocean literacy tasks

These are just two tasks that we have used to link learning to the ocean. As part of the Siren Festival, we ran a circus of other activities, which looked at ocean acidification, pressure, how sound travels across the seas, streamlined shapes of plankton, and STEM team-building tasks that linked to how to pilot a deep sea ROV.

Our aim for the future is to evaluate and share these ideas with as many colleagues as possible, and to continue to hear about the wonderful work that is already happening in so many schools to bring the incredible oceans to every child.

Further reading and resources

Incredible Oceans: Twitter: @incredoceans www.incredibleoceans.org
Ocean Literacy: Russell Arnott: www.ase.org.uk/resources/school-education-reviews/issue-364/ocean-literacy

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Upcycled science – ideas for recycling single use plastics in science lessons

One of the many highlights of PSEC 2019 was the introduction of Practical Pick and Mix sessions. During this ‘lunchtime bonus in the exhibition hall’, delegates were able to browse through a range of excellent suggestions and resources for delivering exciting practical science.

Debbie Jones, PSTT Fellow and Area Mentor, shares some tried and tested practical approaches to recycling single use plastics from her Up-Cycled Science Pick and Mix session. Up-Cycled Science brings a recycling dimension to practical science activities – for example, you’ve probably grown bulbs in class before, but have you thought about using recycled plastic bottles for this?

Bubble snakes

Children love bubbles! Many questions can be raised by making this simple bubble blower.

**YOU WILL NEED:**
- Water
- Washing up liquid
- Bowl
- Small plastic bottle
- Socks
- Rubber bands
- Scissors

**INSTRUCTIONS**
1. In a bowl, create bubble mixture with 1-part washing up liquid and 2-parts water.
2. Cut off the top third of a bottle.
3. Cover the now open end of the bottle tautly with a sock.
4. Secure the sock with a rubber band.
5. Dip the sock end of the bottle into the mixture and ‘blow into the neck of the bottle to create a bubble snake.

**LEARNING OUTCOMES**
- Exploring different variables and observing outcomes.

**EXTENSION IDEAS**
- Explore different types of washing up liquids.
- Try different ratios of washing up liquid to water.
- Set the challenge of creating the longest bubble snake.
- Observe the types of bubble created by different sock materials.

In schools, it is essential to avoid nuts in case of allergies.

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Bird feeders

Bird feeders are simple to make and provide a valuable opportunity for bringing more wildlife onto school grounds. As time passes, children will gain more experience in identifying different species.

**YOU WILL NEED:**
- Small plastic bottle
- Pencil or dowel
- Wire or thread
- Food: *seeds/dried mealworms
- Scissors

**INSTRUCTIONS**
1. Cut a small hole on each side of the plastic bottle.
2. Push a pencil or piece of dowel through the holes to form a perch.
3. Pierce a hole on each side of the neck of the bottle to hang it up with wire or thread.
4. Above each side of the perch, pierce a larger hole for the birds to access the food.
5. Fill the bottle 2/3 full with seeds or mealworms.
6. Hang the feeder out of reach of children.

**LEARNING OUTCOMES**
- Observe and identify different types of birds in the local environment.
- Describe the appearance and habits of different types of birds.

**EXTENSION IDEAS**
- Explore different types of food to see which birds prefer which food.
- Encourage children to spot different types of birds using identifiers, such as those freely available from the Woodland Trust. (see naturedetectives.woodlandtrust.org.uk/naturedetectives/activities/2015/06/garden-birds-id)

In schools, it is essential to avoid nuts in case of allergies.
Growing walls

Bring part of your school grounds to life by creating a living wall. This is most easily done along a wire fence, but plants could also be hung from fixings along a brick wall.

YOU WILL NEED:
• Small plastic bottles
• Soil
• Water
• Young plants: trailing flowers, vegetables, herbs
• Scissors
• Wire

INSTRUCTIONS
1. On the upper section of the bottle, cut away a rectangular piece that is around 2/3 of the bottle’s circumference.
2. Pierce the bottom of the bottle 3 or 4 times for drainage.
3. Pierce a hole on each side of the neck of the bottle to hang it up with wire or thread.
4. Add soil to the bottom of the bottle.
5. Place the plant in the soil and water it well.
6. *Hang the bottle on the wall.

EXTENSION IDEAS
• Explore how plants respond to more/less water/sunlight.

LEARNING OUTCOMES
• Observe different plants and how they change over time.
• Know what plants need to grow.

Bulb growing

A great way to explore the question ‘Do plants need soil to grow?’

YOU WILL NEED:
• 300ml/500ml plastic bottle
• Hyacinth or daffodil bulbs
• Water
• Scissors

INSTRUCTIONS
1. Remove the lid and cut off the top third of the bottle.
2. Invert the drinking end of the bottle and push it onto the cylindrical part.
3. Fill with water to where the base of the bulb will be.
4. Place the bulb into the inverted drinking end of the bottle.

EXTENSION IDEAS
• Explore the rate of growth of different types of bulbs.
• Place bulbs in different places around the classroom to see which grows best.
• To avoid puddles in the classroom, make milk bottle watering cans – punch several holes in the lid and pierce a small hole just above the neck to facilitate airflow and minimise the mess!

LEARNING OUTCOMES
• Observe how bulbs grow.
• Know what bulbs need to grow.

Safety notes

*PSTT recommends a full risk assessment of the activities described above in line with your school policy. In particular, care should be taken when using bottles with cut edges. If in doubt, please refer to ASE’s Be Safe! document and the CLEAPSS website (www.cleapss.org.uk), or consider the approach shared here for further advice: www.gardengatemagazine.com/articles/how-to/plant/how-to-make-a-soda-bottle-cloche

These ideas were brought to you by Debbie Jones, PSTT Fellow and Area Mentor for the West Midlands. She also works as an Edina Trust Science Grant Scheme Consultant for Wolverhampton.
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*PSTT Pick and Mix Ideas to share in the staffroom

More upcycled science ideas
The Polar Explorer Cookbook
– bringing real-world science into the classroom

Bryony Turford, Helen Spring and Beckie King show how The Polar Explorer Cookbook can support teaching and learning in primary science

Keywords: Polar Explorer, Case study, Real-world science

Introduction

Being Polar Ambassadors for the past 3 years as part of the Polar Explorer Programme (PEP), we have had the privilege of working directly with teachers and children in their classrooms, inspiring them with the fantastic range of resources curated by STEM Learning.

The original resource included personal stories of exploration that really captured the interest of the schools and children involved.

When the opportunity arose to write a Polar cookbook to complement the original materials, we knew that this personal angle was key to making this a real and relevant resource. Eight STEM professionals shared their educational and professional journeys to explain how they came to be in their current roles. From pilots to a conqueror of Mount Everest, from food chemists to station leaders, they are all hugely inspiring and motivating to read about.

What is The Polar Explorer Cookbook?

The Polar Explorer Cookbook is split into five mini-projects that can either be taught as stand-alone lessons or as part of a sequence, taking children on a journey of planning menus for scientists who work in the Polar regions, but have very different jobs.

These projects include:

- menu planning;
- making and testing the food;
- preserving and storing the food;
- packaging the food appropriately; and
- transporting the food across their very own Polar assault course.

Each activity is linked to at least one STEM Professional Profile and therefore sets the activity in a real-world context. Many of the STEM professionals also gave permission for their contact details to be included in the resource, so children have a genuine audience to whom to send their findings after their investigations. The activities are relevant to all primary science curricula and include links to the English National Curriculum. Working scientifically is woven into each activity, along with cross-curricular links to many other subjects, including English and maths.

CASE STUDY 1:

Working with Kirby Hill Primary School in North Yorkshire

Helen worked with Kirby Hill Primary School’s Year 6 (age 11) class. The children engaged with a range of activities, including:

- using dataloggers to research what colour of material would be the best for a Polar Explorer’s goggles;
- finding out about ice in the Arctic and Antarctic and learning about salty seas;
- cooking ‘bannocks’ from Ernest Shackleton’s original recipe. After the Endurance sank amongst the ice floes of the Weddell Sea, this simple flatbread sustained the crew, as it could be made easily with minimal equipment on a blubber stove made of scavenged metal from the shipwreck;
- building shelters intended to protect them from the harsh Antarctic conditions;
- training like explorers by taking part in a gruelling obstacle course; and
- investigating the best way of transporting a food parcel (in this case, bread rolls) over an obstacle course representing the Antarctic.

It was great to see the Polar Explorer displays that the children had been busy creating, and to hear the amazing facts that they had researched in their own time. Although work was carried out primarily with the Year 6 pupils, to finish off the Polar Explorer Programme the school held a whole-school Polar Explorer Day using many resources from The Polar Explorer Cookbook. The bannocks were eaten during the end-of-the-day assembly, when the Year 6 class also shared the fantastic work that they had been producing.
CASE STUDY 2:

Working with Parkstone Primary School in Hull

Bryony worked with Beckie and her Year 2 (teaching children aged 6-7) colleagues. Following a Polar Explorer CPD day, they decided to adapt the resources from The Polar Explorer Cookbook to make an exploration-themed day as part of their wider Polar topic. Having already baked sledge biscuits from the book, which whipped up their excitement, Polar Day began with an assembly from Bryony who introduced the children to the new Royal Research Ship (RRS), the Sir David Attenborough, and the work of the British Antarctic Survey in the Arctic and Antarctic regions. The activities that followed included:

- testing a selection of rehydrated foods such as couscous, porridge and dried fruit;
- designing an appropriate way to protect the food during transportation – in this case, the food was a raw egg! Children packaged the egg in all sorts of edible materials, from Rice Krispies to flour, thus reducing waste when it arrives in the Polar region!
- testing their packaging – out in the playground, the much-anticipated ‘long drop’ test awaited, where almost all the packages survived being dropped from a height; and
- designing and making sledges for transporting food packages. In the afternoon, the food packages met their final fate where they were dragged around three laps of the sledging assault course in carefully-designed sledges. Much to everyone’s relief and excitement, the food parcels arrived at their destination intact!

Beckie’s story

When we got involved in the Polar Explorer Programme (PEP), we decided to go all out! We linked it to a whole term of work and called our brand-new topic ‘We are Polar Explorers’. The main aim was to improve gender attitudes towards STEM subjects, as the PEP questionnaire showed that attitudes of all children towards females in STEM subjects and careers were not all as positive as we would like.

We linked many areas of the curriculum to our topic, such as:

<table>
<thead>
<tr>
<th>Subject</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>Writing information texts</td>
</tr>
<tr>
<td>Art</td>
<td>Creating polar fish</td>
</tr>
<tr>
<td>DT</td>
<td>Making fishing rod winding mechanisms</td>
</tr>
<tr>
<td>Geography</td>
<td>Locating the Polar regions and looking at the changing ice caps over time</td>
</tr>
<tr>
<td>Computing</td>
<td>Using algorithms to get ‘Boaty McBoatface’ back to the ship</td>
</tr>
<tr>
<td>Links to other areas of science</td>
<td>Researching living things and food chains in the Polar regions and looking at how living things have adapted to this habitat</td>
</tr>
</tbody>
</table>

We also compared a famous local fishing trawler (the Arctic Corsair) to the new RRS Sir David Attenborough. Other enhancement opportunities included a Polar movie night and a ‘penguin waddle’ around the school field to raise funds for our school trip to see real penguins! When Bryony joined us, she brought some ski clothes for the children to try on. They enjoyed comparing the features of their own gloves to the gloves needed for Polar conditions. The real Polar Explorer character profiles brought the activities to life and, after carrying them out, the children wrote letters to the STEM professionals to tell them about their findings.

The whole of Key Stage 1 (ages 5-7) took part in the programme and the children got so much out of it that we have made it a permanent annual topic. The practical activities from the PEP resources are easily adapted to make them appropriate for the needs and interests of younger children.

The outcomes for our school included:

- Children were immersed in their learning and there was a buzz of excitement at home as well as at school;
- The real Polar Explorer character profiles brought the activities to life and the activities enabled the children to imagine being an explorer and to engage with the challenges that they face; and
- Attitudes towards females in STEM careers improved.

Accessing the resource

We hope that you are inspired to try The Polar Explorer Cookbook. The resource is free to download here:

www.stem.org.uk/resources/elibrary/resource/445111/polar-explorer-cookbook

You can find out more about the Polar Explorer Programme here:

www.stem.org.uk/welcome-polar-explorer-programme

ACKNOWLEDGEMENTS

We are hugely grateful to the staff at British Antarctic Survey (BAS) and others who freely gave their time and thoughts to complete one of our STEM Professional Profiles, which is our personal highlight of the resource.

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Helen Spring is a freelance primary science consultant based in Yorkshire and the Humber.

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Beckie King is a Year 2 teacher and science leader at Parkstone Primary School in Hull, a PSQM School in Round 16.
For some years, I have been involved in a Dramatic Science project at Oxford Brookes University with Professor Deb McGregor and Dr. Wendy Precious. The project developed dramatic techniques to facilitate children’s learning (McGregor & Precious, 2015), including the creation of a new dramatic monologue as an introduction to a lesson to support the development of understanding of evolution and inheritance.

New perceptions, so facilitating a change of ideas and growing a new understanding of alien or difficult concepts (Daud et al., 2012). In this article, I will describe a lesson idea to support teachers in delivering an engaging lesson to illustrate the process of natural selection. The activities support the children in recognising that living things have changed over time and encourages them to identify ways in which animals and plants are adapted to suit their environment. The lesson also gives children creative but concrete models to support the acquisition of abstract ideas. I used this lesson with some children in a Staffordshire primary school prior to running a workshop at PSEC 2019.

Creative ideas inspired by Darwin’s observations of the differing proboscis lengths in butterflies and moths formed the basis of the lesson/workshop to support the teaching of concepts such as change over time, variation and natural selection. I formulated the idea of using Darwin and his research into moths and orchids while reading an article on the subject. It cited a letter that Darwin wrote to his friend Joseph Hooker in 1862, in which he exclaimed over an orchid specimen received from Mr. Bateman: ‘Good Heavens, what insect could suck it?’ (Beccaloni, 2017). Darwin went on to predict that a moth specimen received from Mr. Bateman: ‘Good Heavens, what insect could suck it?’ (Beccaloni, 2017). Darwin went on to predict that a moth would be discovered with a 30cm-long proboscis that could reach the nectar at the base of an orchid with such a long nectary. This idea supported the development of Darwin’s theory of evolution by natural selection. The moth itself was only discovered many years after Darwin’s death.

The lesson highlighted for children how changes in environment that cause habitat loss affect the populations of insects that rely on particular food sources. By ‘becoming’ the insects, they could find out how easily they could get nectar from flowers with nectar tubes of differing lengths. Through modelling in this way, the children experienced one of the effects of habitat change on a population of insects. These activities supported a growth in children’s understanding. An understanding of how scientists worked in the past, and the challenges they faced, also grew from the immersive activities.

The lesson

Materials needed:

- Short party blowers (cut to the length of the short ‘orchid’ plastic bottles)
- Long party blowers
- ‘Orchids’ made from plastic bottles, with varying nectar tubes (cut the bottom off a 2L plastic bottle, add petals around the cut end made from cardboard. Create some that are around 15cm long and some around 20-26cm long)
- Disaster card – tropical cyclone/deforestation
- Nectar points (counters)

Lesson hook:

The lesson begins with a dramatic monologue, setting the scene and transporting pupils back in time (with the help of a few props) to Darwin’s house.

The children then begin to take on board some of the skills and attitudes held by Darwin. They discuss what qualities he needed and perform a tableau to demonstrate these, so putting some of their new ideas into practice.

On the table

The children then begin to take on board some of the skills and attitudes held by Darwin. They discuss what qualities he needed and perform a tableau to demonstrate these, so putting some of their new ideas into practice.

Summary:

Explain that the different lengths of party blowers mimic the variation of proboscis length within a population of moths. These specific proboscises allow moths to reach the base of flowers with differing nectaries.

Reproduction and pollination:

Then, the children have another attempt at feeding and see how many nectar points each moth gets. Are there any patterns? Can they see how moths can both feed and reproduce if healthy enough (enough nectar points), when their proboscis (party blower) reaches right to the bottom of a flower?

Disaster! Tropical storm/deforestation:

Introduce a disaster event where short nectary flowers are destroyed, then repeat the feeding scenario several times. What do the observers see now? Can you start to see changes in the number and variety of different moths?

Discussion:

What have the children noticed about the population of moths? Here, the children start to voice their growing ideas about natural selection, as they see that certain moths cannot get enough food to survive, while others feed well and can reproduce. This causes the population of moths to change over generations, those with long proboscises becoming more common.
Summary:
Certain moths will have proboscises that are more advantageous compared to the others, enabling them to feed sufficiently to thrive and therefore reproduce. Inversely, others will die out, as their proboscis is too short to reach the nectar. Over time, the population of moths will have a higher frequency of these successful moth types. Over generations, the population evolves. The class could be shown a framework for evolution by natural selection, discussing each step in relation to the activity.

Plenary:

Questions can be aired in the plenary and during discussion around this process of change, where children articulated their new learning.

In 1962, Charles Darwin was sent an orchid from Madagascar with a 30cm nectary. What could this mean, do you think? What would you have thought about this as Charles Darwin?

In 1991, a flower with a 40cm nectary was discovered in Madagascar. What can we predict will be found to pollinate this flower?

This activity has been found to facilitate excellent learning when completed with a class of children. Their knowledge of natural selection and the reasons why populations may change was significantly increased. Children were engaged and enthusiastic, generating successful learning and an ability to work like scientists. I hope that you will be inspired to try this out in your school.

Acknowledgements
Thanks are due to Professor Deb McGregor and Dr. Sarah Frodsham from Oxford Brookes University for their ongoing support and encouragement, and for collaborating and participating in the school lesson. The techniques and ideas that we trialled have been collated and published in Dramatic Science by Debra McGregor & Wendy Precious, Routledge (2015).

The online CPD unit Dramatic Science can be freely accessed at:

pstt.org.uk/resources/cpd-units/dramatic-science

References

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Stop Watch
Robin James describes how peer assessment can be promoted with short, self-made films

I’d like to start with a ‘thank you’ to the Swiss delegate who I met at PSEC in Edinburgh. He attended my workshop, Looking For Learning, about the assessment technique that I will describe here. Looking For Learning was the name chosen for my PSTT-funded project from which this technique was developed.

The filming stage
Let’s face it, practical science – indoors or outdoors – can sometimes be messy. It can also be over in a flash, though not literally, we hope! Children are usually excited at the prospect of getting ‘hands on’ and the social challenges that this entails for them shouldn’t be discounted. A lot may happen in a practical: planning, setting up, observing, recording, for example. There are often external distractions too – there always are with children! – to the extent that it may even be possible that an individual just wasn’t looking at the right thing at the right time. They missed it! Wouldn’t it therefore be a good idea to capture the action of a science practical on film? That was the starting hypothesis from which the Looking For Learning project evolved.

In my PSEC 2019 workshop, I explained how the idea for the Stop Watch technique originated from a lesson that I taught with local geography expert, Dr. Margaret Mackintosh. She introduced me to the ‘Passive Observer Technique’, which QCA (2007) describes as ‘clips filmed with sights and sounds but no commentary or as if watching the world go by’. We watched a short film showing a street outside Serekunda Market in The Gambia.

The name described the project well, but in practical terms the technique needed a name of its own – certainly one catchier than ‘CIVFF’ (child-initiated video freeze-frame), which was the name used during my Master’s thesis. My Swiss friend suggested Stop Watch. Yes, I thought, perfect. For, in essence, it is simply that: you stop a film that the children have been watching in order to ask them what they’ve noticed. However, as with most apparently simple things, it will require a little more explanation.

Keywords
Assessment, Technology, Recording
On second viewing, individuals could request that playback was paused or freeze-framed in order to comment on something that they’d noticed: the unexpected parked Mercedes, the little boy selling green oranges on the dirt road – that sort of thing. Plenty of valuable talk was generated, which is why, a few years later, I wondered if the technique could be adapted to a science context. We experimented with a range of models: different group structures; film that had sound and film that didn’t; films made by children compared with those made by adults; different lengths of clips; and different foci for the camera operator, e.g., on faces and hands, or just on hands. In the end, we developed a set of guidelines both for the ‘Filming Stage’ and the ‘Viewing Stage’. At PSCE, delegates made their own short film of a simple practical involving ice, salt and string. The challenge was to lift a block of ice with string using a little salt to melt the ice in contact with the string before it re-freezes. Each group had its own filmmaker, using a mobile phone or an iPad to capture the action. ‘Short’ is the key word here. We found that there’s an optimum film length and it’s not ten or even five minutes; it’s two. Any longer than two minutes is likely to prove tiresome to watch at the Viewing Stage, whereas any shorter is likely to provide insufficient material for comparison and discussion.

### Five things to remember when filming:

1. Try to film hands rather than faces – film as close up to the action as possible.
2. Keep it short. Two minutes of filmed footage is plenty. Use the pause button if you need to.
3. Don’t worry about what’s said: the idea is to watch the film back without sound.
4. A child can do the filming, but we noted a tendency to switch focus if adults come into the vicinity – particularly our STEM Ambassador (regarded as the fount of all knowledge). It tends to work better if an adult films.
5. Aim to film at least two groups carrying out the same practical. This is what provides the impetus for purposeful talk and a good peer assessment opportunity.

### Where next?

- Recording the discussions that result from the use of Stop Watch works well. One misconception, for example, out of 22 potential ‘next step’ investigations revealed in one recording suggested that magnets don’t work in the dark. Although you're unlikely to have time to transcribe the recording, you can at least listen to it again.
- You might select from these ideas to create your own Concept Cartoon.
- Allow groups to choose one of these ideas to investigate next.
- Alexander reminds us that ‘outstanding’ assessment practice allows children time for ‘reflective thinking, especially as they planned their own investigations’ (Ofsted, 2013, p.16).

## The Viewing Stage

Dialogue is really stimulated when one group sees how another approached the same task. It might not have been at the same time, or even on the same day. (In fact, I’m interested in exploring in future research what happens when groups in different schools – in different countries even – compare notes on the same task.) The Viewing Stage takes place in a calmer, cleaner environment (which may, of course, be the same location after a clean-up). Outdoor science can be re-experienced and reflected upon indoors.

Vital to the process is that the groups don’t see (at least not too closely) what the others have done until the Viewing Stage. ‘Oh, they did it that way!’, ‘Why didn’t we use the metal one?’, ‘See, I told you that would happen!’ are the typical responses that you hear when groups watch how others approached the same task. As an example, PSCE delegates were surprised by the ingenuity of one group who chose to sandwich the string and salt between two cubes of ice. The ensuing talk can be insightful, helpful and revealing as to children’s understanding of a scientific concept.

Peer assessment may be further enhanced if the objectives of the lesson are revisited before the Viewing Stage. With a little steering of the talk, a little training in how to phrase feedback in the kindest way and some time spent going over learning objectives, the teacher should find that the children are quick to offer helpful feedback to their peers. Furthermore, if the teacher is strategic with grouping, even more may be revealed. Three different groups (male, female and mixed-gender) took very different approaches in our small sample. We also grouped by ‘utterance’, separating those who are frequent contributors to class dialogue from those who are not. At the Viewing Stage, each group listens to the responses of others to their film before responding themselves.

#### Five things to remember when viewing:

1. Show a two-minute (max) film of one group’s work to others who did the same thing.
2. Show the film without sound. Silent playback focuses eyes and minds on what’s happening.
3. Watch the film through once in its entirety, without pausing, then watch it a second time, freeze-framing whenever a child who wishes to contribute says ‘Stop’.
4. Allow the filmed group and others to respond to feedback; but limit the interaction to three or four exchanges so that the pace of the playback isn’t lost – and, obviously, don’t allow more than one child to speak at the same time.
5. Ideally, if you have time, allow each group to watch their own film back beforehand (without others present) in order to review and discuss their own learning, before they compare their own approach and results with those of another group.

We tried other ways of pausing the playback, including ‘utterance’ games with a ball proved popular. We found that this encouraged children to use recently learned scientific terms more readily. Even Nobel Prize-winning physicist Richard Feynman noted (1983) that ‘the dumber a thing is, the more interesting it is and therefore challenging to explain’. Magnetism was the example he cited. Children (and adults) often substitute gestures for words, we noticed. This struggle to find words is a particular problem for children from socially disadvantaged backgrounds, as James reminds us (2013).

#### Warming-up words

While on the subject of ‘utterances’, we discovered the value of vocabulary warm-ups. Before watching and discussing each other’s films, children played short games to jog their memories about words and meanings. Games such as Kim’s Game (which word is missing from the set?) and Throw, Catch and Say games with a ball proved popular.
Issues around the evolving technology

We’re all filmmakers these days, aren’t we? Hands up anyone who hasn’t used a mobile phone to film something in the last month, if only a 10-second clip of your cat chasing a strand of cold, cooked spaghetti?! Technology has provided us with an abundance of whizzy, pocket-sized multi-tools in the shape of our mobile phones. Who, apart from my mum, uses their phone primarily for making phonecalls these days? They’re calendars, timers, alarm clocks, radios, maps, compasses, barometers, address books, bird and plant species identifiers, constellation spotters and even wallets. They’re useful. They’re personalised – a precursor perhaps of the direction in which the wider field of educational provision may need to develop?

Technology has developed apace. Just 20 years ago, the sort of videocamera, AKA camcorder, (if you were lucky enough to even have one) available in schools could put your shoulder out, or reduce you to tears if someone (no names mentioned, Mrs BI) recorded an episode of Eastenders over several weeks of filming for a school news bulletin. Then, along came the Flip camera in 2006 and, for only £70, every teacher could become a filmmaker. Flip, however, fell victim to sky-rocketing smartphone sales only five years later.

The ethical and safeguarding issues that have arisen around the use of this readily-available new technology are legion. In 2018, for instance, students in France were banned from using phones, tablets or smart watches in school and many English primaries forbid their staff from bringing personal devices into work. My school permits the use of personal mobile technology, providing that teachers agree to occasional monitoring of images. You may be lucky enough to work in a school that provides its own filmmaking devices, such as iPads. Digital learning journals, such as Seesaw, are widely used and facilitate regular sharing of photos, film, text and weblinks with parents. Whatever your personal view may be on these issues, it’s vital that you find out first about your particular school’s policy on the use of film, photography and mobile technology, and that you follow this carefully.

I think we can agree that filmmaking technology is far more accessible to teachers than it was just 20 years ago. And I hope that, if you’re able to try the Stop Watch technique, you’ll find it a simple and effective way to encourage peer feedback and discover, as we did, unexpected outcomes that point the way to future investigations.

References and further reading


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The Ofsted report, Maintaining Curiosity in Science (Ofsted, 2013, p11) states that improvements in achievement in science could be traced to six features. One was ‘increasingly accurate assessment’ and another was ‘very good, regular monitoring of achievement in science for individuals and groups of children’.

We believe that a floorbook provides teachers with a manageable and meaningful way to do this in science. In this article, we will outline what floorbooks are and explain why and how they are useful for children and teachers, making links with the recently revised ‘Floorbooks’ resources on the PSTT website (pustt.org.uk/resources/curriculum-materials/floor-books).

Using floorbooks is not a new idea… the PSTT published a CPD unit back in 2002. We have used floorbooks in our science lessons for several years to support the children’s learning and teacher assessment, and we shared some of our floorbooks at a workshop at PSEC 2019.

Science in little books

There may be times when it is appropriate for children to record their science in written form and an exercise book is the best place for this. In this situation, it is important that teachers and children are clear about the focus of the science learning. In the example opposite (see Figures 1a and 1b), children (aged 6 years) looked at leaves and were asked to observe and record what they saw. The example in Figure 1a is very neat, correctly labelled and there is a grammatically correct sentence that describes the leaf below the diagram. The work in this image includes fewer descriptive words. Which is best? This either depends on the learning objective: if the objective was to write a sentence to describe a dandelion, we might consider Figure 1a to be better than 1b, if the objective is to observe and record what you see (it was), then we should regard Figure 1a as having successfully met the criteria (more so than Figure 1b) – a dandelion usually has a curved tip. This illustrates how important it is that teachers assess children’s attainment in science against a scientific objective.
Recording and assessing children’s conceptual understanding in floorbooks

A floorbook provides a place to keep evidence of children’s attainment demonstrated through drama, presentations, PowerPoint, Concept Cartoons®, etc. Often a photograph provides evidence of what a child can do, but, to create a record of children’s conceptual understanding, teachers could ask the children to record their ideas on sticky notes or photograph diagrams or thoughts noted on whiteboards. Examples of how floorbooks have supported teachers’ assessment can be found on the PSTT website (pstt.org.uk/resources/curriculum-materials/assessment). We suggest that teachers could scribe for a poor writer and might prompt children who are struggling (recording “S” on the sticky note when a lot of help is given). It is worth stressing here that, when misconceptions arise (and they will), they should always be addressed. This might be a conversation with a small group of children during the same lesson, or in the subsequent lesson once you have reviewed all the child’s contributions. We offer the children the opportunity to write a new sticky note, which they can place over or next to their initial idea. Scientists can change their minds and we tell the children this.

Advantages and disadvantages of floorbooks

For children:

Floorbooks can be used with any age group, but are especially useful with younger children and for others who have limited writing skills. We have found that children are motivated because they enjoy seeing their photos and their work in the floorbook. Key vocabulary is reinforced when children browse through the floorbook. This rarely happens with children’s individual exercise books. We believe that the main advantage for both children and teachers is that, with less time given to writing, there is more time available for developing and justifying ideas and scientific concepts. Children should still be taught to record data and write scientific methods and conclusions, but this could be done in literacy lessons. We asked children what they thought about using floorbooks. Without exception, the children were enthusiastic about using them (see Figure 4). Some were pleased not to have to write, but it is apparent that children value each other’s opinions, and enjoy asking and answering one another’s questions, particularly when the teacher is involved. Leaving ‘challenge questions’ in the floorbook, which is available to the class during the week, and encouraging children to add their ideas, continues the science conversation beyond the science lesson. We believe that using floorbooks in this way demonstrates that science is a subject that is collaborative, promotes debate and justification of ideas and is utilising the life of the scientific research community.

Disadvantages of floorbooks

The photo of the floorbook is not always to scale. Children need to be shown how to present their ideas accurately. Children need to be shown how to present their ideas accurately. Children need to be shown how to present their ideas accurately. Children need to be shown how to present their ideas accurately.
Floorbooks in the future

Using new technologies, teachers may gather evidence of science learning through film or vocal recording.

Conclusions

Is the floorbook a replacement for little exercise books? We have different ideas about this. Children can use exercise books for drawing diagrams, recording data, graphs and occasional individual writing; these can run alongside the floorbook (though they may not be used in every science lesson) and be marked in the usual way. If children do not have personal exercise books, teachers may decide to include one or two samples of written work in the floorbook.

How to use a floorbook is very much up to the individual teacher, as can be seen in the examples on the PSTT website (pstt.org.uk/resources/curriculum-materials/floor-books). We regard our floorbooks as ‘working’ documents: interactive books that are always available for children and others to read. They clearly demonstrate the collaborative nature of science and they allow children who struggle with writing to shine.

“Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid” (Albert Einstein).

REFERENCES


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What's in My Tray?

Katherine Forsey outlines how simple and effective What's in My Tray activities can engage and enthuse children with primary science

Keywords Practical science, Small science

Would you like to create more practical science opportunities for your students? What’s in My Tray from Gratnells, makers of the iconic classroom tray, is a collection of over 100 free, tray-based practical activities that will enthuse and engage your students. The Gatsby Foundation’s Good Practical Science report (Holman, 2017) reported that many schools are making too little use of their often-excellent practical science facilities. Gratnells are working to support teachers and schools to increase the amount of practical work that they undertake through the publication and sharing of well-planned and purposeful practical activities that require little in the way of specialist equipment. What’s In My Tray activities are straightforward and can be undertaken in your usual classroom or school grounds.

All What’s in My Tray activities are curriculum-based (England’s National Curriculum) and are easily recreated for your learners using your own classroom, commonly available, equipment. They are robust and repeatable, using minimal consumables. The What’s In My Tray activities can be used individually as lesson starters, for STEM Clubs or to support theory work and develop subject knowledge. The full carousel can be recreated for end-of-term round-ups, science week and open days, and the activities are a great way to raise the profile of science in your school and to cascade practical science activities to colleagues via a CPD session.

The benefits of tray-based practical work include:
- easy resource allocation;
- finite equipment access;
- simplified preparation and clearing up;
- a controlled work environment;
- a clear format for collaboration and group work;
- transportability;
- easy differentiation; and
- supporting students to take ownership of the activity.

At PSEC 2019, the What’s In My Tray workshop saw five teams take on a selection of five of our tray-based practical activities. With only five minutes per activity, it was a fast-paced, interdisciplinary whirlwind around five areas of the primary science curriculum. Participants had to work together to complete each task and there were Gratnells Tea Trays available as prizes for each member of the winning team. The competition was fierce, which was evidenced by the high levels of engagement from all participants. I’ll whisk you through all five activities below.

A. BrightSparks – Electricity

What will allow electricity to flow? Construct a simple circuit using ‘plug and play’ BrightSparks modules following the circuit diagrams provided. Test nine different materials to see which are conductors and which are insulators and record your findings. Can you add a parallel circuit with a buzzer to provide an audible signal too?

Full activity details here: learning-rooms.com/brightsparks-electricity

B. Minibeast Key

Preparation: Cut out the free minibeast key download and use it along with a Sharpie to create a giant key in an art tray.

Activity: Use brushes and spoons to hunt through a woodchip-filled tray and uncover an amazing collection of minibeasts from Natural Selection Learning. Follow the key to identify all 10 minibeasts. Use a magnifying glass to see all their interesting features. Place each minibeast onto its own space at the bottom of the key and record your answers.

Full activity details here: learning-rooms.com/minibeast-key

C. Dinosaurs Love Bridges – STEM Challenge

Preparation: Half-fill two dark blue shallow trays with blue rehydrated water beads.

Activity: Dinosaurs migrate too! Help the dinosaurs to escape the long dark winter and get to land with more food and water by building them two bridges over the river (water bead trays). The two bridges must be of differing designs. The bridges must span the longest length of the tray. If any dinosaurs fall in the river, they will be swept away – you cannot pick them up out of the water once they have fallen. When the buzzer goes, note down how many dinosaurs are standing on your bridges and how many are in the river. Take a photograph to evidence your work.

Full activity details here: learning-rooms.com/dinosaurs-love-bridges
D. Digestive System

**Preparation:** Collect an assortment of recycled bottles, tubes and pipes into a jumbo tray. Print out the name and function labels contained in the free download.

**Activity:** Use the items in the jumbo tray to build a model digestive system in the large art tray. Label each part of the model with its name and function. Take a photograph of your completed, labelled digestive system to evidence your work. Record the letters and numbers of the matched parts and functions on the answer sheet.

Full activity details here: learning-rooms.com/digestive-system

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E. Investigate – Properties

**Preparation:** Gather an eclectic collection of objects and a few magnets into a 30-section tray insert. Half fill a deep tray with water.

**Activity:** Investigate the properties of the objects in the shallow tray. Use your hands, the table, water tray and magnets for your investigation. Match each item to the properties listed on the answer sheet. There may be more than one example of each set of properties, for example, magnetic and sinks = paper clip and spring.

Full activity details here: learning-rooms.com/investigate-properties-2

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**Reference**


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**I BET YOU DIDN’T KNOW...**

Introducing cutting-edge real science research projects to primary children provides a rich context for learning.

Written by Fellows of the PSTT’s Primary Science Teacher College who have backgrounds in scientific research, these ‘I bet you didn’t know...’ articles are based on real cutting-edge science research. The articles take recently published papers and explain the science presented in them in language that primary children and teachers can understand.

Each article has an accompanying Teacher Guide that provides details of practical investigations that illustrate different types of scientific enquiry and model the real research that was carried out. The articles and Teacher Guides are freely available to download from the PSTT website.

**PROJECT LEAD: ALISON TREW**

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Wow Science links to the very best primary science materials for children to explore, and for teachers to use in the classroom.

All materials have been quality checked by the Primary Science Teaching Trust to ensure they are high quality, age appropriate and scientifically accurate.

We provide links to web-based resources and apps that engage children in science through games, quizzes, videos and other activities.

Additionally, Wow Science provides links to recommended sites for teachers to access many excellent resources and points to the latest news and developments via social media.