Effective Practice in Early Years: Focus on Learning Science

In this guide, we have suggested a range of strategies that you could use with children aged 3 to 5 years to encourage them to explore the world around them with a focus on learning science.

Strategies:

Acknowledgements

This resource was created in 2021 by PSTT Fellows who have extensive experience teaching in the Early Years Foundation Stage: Jane Catto, Chris Lawson (in England), Elaine Stockdale (in Wales), Liz Branniff (In Northern Ireland) and Nicola Connor (in Scotland). The work was made possible through PSTT Small College Project funding.

Play, Observe and Ask

We have called this resource **Play, Observe and Ask** because we believe this describes succinctly how practitioners in Early Years can effectively support and nurture young children learning about the world around them (that's science!).

Evidence to support this approach

The Effective Pre-School, Primary and Secondary Education (EPPSE) project (1997-2003) was the UK's first major study into the effectiveness of early years education.

The project demonstrated the positive effects of high-quality pre-school provision on children's intellectual and social behavioural development and it changed thinking and practice in pre-school entitlement, pedagogy, curriculum and teacher education in the UK.

Findings from the Effective Provision of Pre-School Education (EPPE) project (2004) suggest that children made the most progress when:

- there was more 'sustained shared thinking' – that is when two or more individuals work together in an intellectual way to solve a problem, clarify a concept, evaluate an activity, or extend a narrative. This could be a 1:1 interaction between children or a child and a supporting adult.

- there was an equal balance between child-initiated activities and staff-initiated activities. The report states: Almost half the child-initiated episodes that contained intellectual challenge included interventions from a staff member to extend the child's thinking. Freely chosen play activities often provided the best opportunities for adults to extend children's thinking.

You can download the full EPPSE report here.

To enhance young children's learning, we suggest the following approach:

Play

Provide opportunities for the children to play and explore new concepts, sometimes independently and sometimes with a supporting adult.

Observe

Take time to observe children playing independently and listen to their conversations. Decide whether the children understand what they are doing and whether they can they explain what they are noticing. Consider whether there is an opportunity to get involved in the play to clarify the learning, extend the narrative or to introduce new vocabulary. To extend the learning, you might want to introduce a problem and work together to solve it.

Ask

Consider the type of questions that a supporting adult might ask to develop children's thinking whilst playing alongside the children. The EPPE project found that in the settings where children made most progress, staff engaged in open-ended questioning and provided formative feedback to children during the activities. Before providing the activity, plan the questions that could be asked, the specific vocabulary that could be introduced and any challenges that might extend the learning. If you are a teacher, remember to share these questions and vocabulary with your teaching assistants!

A well-planned environment will enhance the learning experiences of the children. We suggest how to provide engaging opportunities for Early Years children to learn about science in PSTT's **Early Years Science Provision Maps**.

These Provision Maps are freely downloadable from the PSTT website and include:

- lists of equipment,
- questions to ask children to encourage exploration and to develop their knowledge and understanding in science,
- science vocabulary related to each activity,
- further science investigations.

I see, I notice, I wonder…

This is an effective, and very easy strategy to develop young children's observation and questioning skills. It can be done with any object and provides a simple format to enhance science talk. You can learn so much from observing what children say and do in response.

'I see…' is the beginning. Children look at the object, maybe draw it, and say what they see (an adult may need to prompt by saying, 'I see...'). If the object is an unfamiliar one this is a good place to spot misconceptions that may need to be addressed.

'I notice…' adds more detail and encourages children to put their ideas into words and select appropriate vocabulary. At this point they need to handle the object so that they can describe what they feel, hear and maybe even smell. If children struggle, adults can support and model vocabulary (very useful for children with English as an additional language or SEND).

'I wonder…' is the beginning of formulating questions and understanding different enquiry types. Children can then be supported to find out the answer.

For example, these children were shown a pumpkin.

I see… a pumpkin.

I notice… it's smooth and it has bumpy edges. The bit on the top looks like a nose.

I wonder… if we put it in water, will it float?

I see… a pumpkin.

I notice… it's hard. It looks a bit like a tomato. It's bumpy.

I wonder… has it got seeds in like my pumpkin? I think every pumpkin's got seeds.

Encouraging independent exploration

Children are naturally curious and keen to explore the world around them with awe and wonder. We can make the most of their desire to learn in a hands-on way by making sure our provision is accessible and engaging. Valuing child-led learning in all areas and encouraging children to plan and take ownership of what they want to discover next, sets them up for success. One way to do this is to set up a mini science lab in your provision where children can make predictions, test out their science ideas and explore independently. These work well both inside and outside and it is useful to get children involved in designing and creating them with you. Activities can be changed weekly – or as often as you decide – and encourage children to see themselves as super scientists both now and in the future.

Resources to make accessible to the children:

- Magnifying glasses
- Plastic pipettes, pots, beakers, jugs, spoons
- Clipboards, paper, pencils
- Magnets, torches, cubes to measure with
- Aprons or lab coats

Ideas for exploration that could be introduced:

Light & Colour

- Light filters, prisms, water bottles with added glitter, torches
- Variety of bottles filled with layers of coloured water / oil / sparkles
- Coloured liquids, pipettes and test tubes / plastic shot glasses for colour mixing
- Filter paper, felt tip pens, water, pipettes – for chromatography (splitting the ink colours)

Nature

- Bugs in resin / toy minibeasts / fact cards / sorting hoops
- Nature items from different seasons with magnifying glasses and non-fiction books
- Seeds - bean / sunflower / pea / cress / pumpkin etc and sorting trays

Construction

- Variety of pegs / lolly sticks / elastic bands for tower building STEM fun

Materials

- Water tray, sorting hoops and items to test for floating and sinking
- Pots containing different items – shake, listen and match the sounds to photo cards
- A variety of different magnets, paper clips – to investigate magnet strength
- 2l plastic bottles with pipe cleaner pieces / paper clips / non-magnetic items inside, and magnets to slide over the bottle to try and move the contents

The possibilities are endless!

Developing talk in Early Years Science

From an early age, children seek to explore and understand the world around them. Doing, thinking and talking about science is a key part of the Early Years framework. Talk in early science introduces and consolidates new vocabulary and provides opportunities for children to share ideas and build understanding. Early science talk is a key window into children's early scientific thinking that can help us with assessment, identifying misconceptions, challenging thinking, and encouraging children to justify their reasoning.

Creating an environment for talk begins with the establishment of some basic rules for speaking and listening. A culture should be created where all ideas are valued, and where children are confident to share their ideas. The practitioner has a key role in this, modelling effective speaking and listening, introducing key vocabulary, and responding respectfully to all contributions.

There are many tried and tested strategies for encouraging scientific talk in young children, for example using a picture or video stimulus and asking, "I wonder what is happening/going to happen?" or using an 'Odd One Out' activity to draw out children's thinking. In Early Years, rich stimuli that invite curiosity and allow time and space for hands-on exploration are key. Investigating sinking and floating in the water tray, playing with ramps and cars, or exploring torches and shadows, when combined with effective questioning are just some of the ways children can be supported to develop their early scientific talk and answer their own scientific questions.

Examples of effective question prompts:

What can you see?

What does it remind you of?

What do you think will happen next?

How can we change this?

What do you already know about...?

What is the same/different?

I wonder why...

I wonder when...

I wonder how...

I wonder what...

What would happen if...?

Developing observational skills

Throughout their time learning science at school, children will be expected to make careful observations, observe changes over time and notice patterns and changes. There are lots of fun ways to help young children develop their observation skills and these will help them, not only in future science lessons, but potentially throughout their lives as well. Supporting adults could model observing alongside the children and ask questions that encourage children to observe more closely (and develop talk):

- What can you see? / What do you notice?
- What does that remind you of?
- What do you think will happen next?
- What do you think might happen if...?

Here are some useful activities to get you started:

Teach children how to use simple equipment like magnifying glasses – start with simple items like leaves, so children are ready to observe those moving minibeasts from the bug hotel.

Enjoy observing activities that change over time – a melting snowman, dissolving vitamin C tablet, seeds grown in transparent cups so the roots can be observed. Use time lapse videos to speed things up (e.g. changes over the seasons) and slow things down (e.g. a bubble popping).

Use Explorify Zoom In Zoom Out activities and **digital microscopes** to look closely at items that the children are interested in. Talk in detail about what you notice and encourage children to do the same.

Try some of PSTT's Early Years Wildlife resources, such as Wildlife Dominoes, Wildlife Faces, Paired Pictures, Odd One Out and Who am I? Please click on 'The Natural World' tab on this page to find these.

Play the cookie observation game – this is a real motivator for observing closely! In groups of 6-10 children, write their names on the bottom of paper plates and give each child a chocolate chip cookie to observe, draw and label on their plate. Mix up the plates and tell the children that they can eat their cookie – but first they must prove it is theirs.

Outdoor learning

The benefits of outdoor learning are very well established and documented:

- Spending time outside has been shown to improve general health and well-being
- Children can be more engaged with their learning
- A positive effect on teacher-child relationships when learning is taken outside
- The development of life skills such as self-confidence, risk-taking, risk-management and resilience
- Outdoor learning is an important was of contextualising science
- Learning about the natural world helps to develop responsible attitudes to the environment and makes it more likely that the world will be cared for
- Learning about the natural world or our engineered environment will be deeper and more lasting if children experience it first hand

A short review of the literature concerning outdoor learning in primary schools is available in the Association of Science Education's (ASE) *Journal of Emergent Science* (2019) Issue 16, pages 40-45: The benefits of outdoor learning on science teaching.

If you are a member of the ASE, you may also be interested in an article by PSTT Fellow, Nicky Bolton, that describes 'Bucket School' as an approach for exciting outdoor learning. This is available in *Primary Science* (2020) Issue 161, pages 33-35.

We hope that you are persuaded that outdoor learning is worth pursuing and that it is never too early to start!

How to get started

You might start by taking children outside in the school grounds to observe what is around them:

Visit the same natural area at different times of day, in different weathers, in different seasons. You might be interested in PSTT's **Early Years Science Provision Maps** for **Spring, Summer, Autumn** and **Winter**.

Ask the children:

- What is the same?
- What is different?
- What lives here?
- What changes over time?

Explore your outside environment with **data loggers**. (Yes, even very young children can use dataloggers or apps on tablets or mobile phones to measure sound, light and temperature. They are not afraid of technology!)

Some possible questions that children could investigate are:

- Where is the quietest/loudest place in your school grounds?
- Where is the sunniest/shadiest place?
- Where is the warmest/coldest place?
- Does this change during the day/week/year? Why?

If you have enough adult support, you may decide to explore the local environment outside the school grounds, e.g., a weekly nature walk**, a 'welly walk'**, a visit to the market or a playground. Remember that science is all around us and that it is not just the natural world that we should be sharing with young children.

Children are also learning about the **engineered world** around them. For example:

- **At a market**, children could look at different types of foods, fabrics and clothes. What foods keep us healthy? What do these foods feel/smell/taste like? What do these fabrics feel like? How are they similar/different? Which fabrics keep us warm? Which fabric is suitable for a winter coat?

- **At a playground,** children could find out what their bodies can do. What happens when you sit at the top of the slide? What happens to your breathing/skin/arms/legs when you run around? They could investigate push/pull forces on different equipment. How do you make this move?

What challenges are there?

Taking children outside might require more adult support than when you are in the classroom, particularly if you take the children away from the school grounds. You should check on your school policy for this.

When there no are physical boundaries to the learning space outside, you need to give very clear instructions to the children (before you go outside) so that they know what is acceptable behaviour and what is not.

Useful resources for outdoor science learning

The following PSTT resources may help your school to make the most of its outdoor areas:

Let's Go! Science Trails - the book, developed by a group of teachers in the London borough of Haringey and led by PSTT Fellow Jeannette Morgan, offers support and ideas for 29 science Trails covering all aspects of the primary science curriculum to promote outdoor learning from ages 4-11.

Let's Go! STEM Trails - a book describing another 29 Trails to explore science concepts in the outdoor environment of the school grounds and locality, which focus on and link this to technology, engineering and maths in thought-provoking ways. Suitable from ages 4-11.

Playground Science - is a set of fun and informal science activities that children can carry out in their playtimes. The activities use simple instructions and a small amount of equipment to encourage the children to explore the world around them and to develop scientific skills.

Using stories

Science communicators for years have used stories as a meaningful context and effective way to communicate with an audience as stories are integral to all cultures. Studies indicate that stories help audiences to process and recall new information. Studies also show that messages delivered as stories can be 22 times more memorable than just facts. Stories tease the imagination and science feeds off our curiosity about the world. Stories can spark that imagination and curiosity, being the hook with which learners engage.

Young children love stories! When you put a story together with playful, scientific enquiry, the result can be a really good combination of high interest, enjoyable, creative and engaging science. Using children's interest in picture books and stories not only helps develop their literacy skills but allows children to see the purpose and relevance to the science learning and put it into a meaningful context.

Have a look at PSTT's **Early Years Science Provision Maps** for ideas for scientific learning linked to popular storybooks. Children develop an immediate sense of empathy as they try to solve a scientific mystery or help a character from a story. They quickly become motivated within the story context and develop many scientific skills such as prediction, observation and communication.

Adapting whole school science events

Early Years Foundation Stage is a vital part of a school, so there should be no reason for it to be left out of whole school science events. Of course, this does not mean that EYFS children should do activities that are inappropriate for their needs because the rest of school is doing them. With a little planning, meaningful activities can be designed to fit the learning needs of young children, ensuring that their experiences of whole school events are every bit as valuable as those of the older pupils.

This type of event may be planned by the science lead (who might not have EYFS experience) or may come from published resources, which are often Key Stage 1 or Key Stage 2 based. To ensure it is accessible and relevant for EYFS children, it is probably down to EYFS staff to do a bit of tweaking! To make your event successful:

- Know what you want the children to get out of the experience. It could be particular science knowledge, or equally, it could be to get children talking, questioning, investigating and thinking scientifically.
- As well as adult-led activities, give children plenty of opportunities to play, observe and investigate independently, and have adults on hand to extend their talk and thinking.
- Celebrate your pupil's achievements. Join in assemblies, create displays, contribute to newsletters, send photographs to parents. Basically, make sure everyone knows that small children are amazing scientists!

An example (Teacher in Durham, England):

My school held a whole school **'Science meets History' week**, based on the PSTT's **Standing on the Shoulders of Giants** resource (you can find out about this on the PSTT website). This is a wonderful resource for KS1 and KS2, and was easily adapted for EYFS. We concentrated on the science (in terms of history it was enough to say that a scientist who lived long ago found a way to solve a problem). We chose to adapt a unit on John McAdam to provide meaningful investigations for very young children. In adult-led sessions, the children explored and described various surfaces and the way cars moved when they pushed on them. In free-play they continued to investigate independently, especially outdoors where they rode trikes and pushed trolleys on grass, pavement, gravel, etc. Nursery and Reception pupils were talking, investigating and explaining using appropriate scientific vocabulary, which was exactly the outcome we wanted.