Spring 2019 *Issue 5*

Why & How?

The Primary Science Teaching Trust Newsletter

Supporting excellent teaching and learning in primary science

Free to access for all

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Welcome

Welcome to Why & How? - the Primary Science Teaching Trust's termly newsletter. Why and How? is for anyone who has an interest in primary science. Our newsletter offers practical support, news and updates about PSTT and our projects and research.

We have lots of news to share with you in this issue. The PSTT Trustees are very pleased to be welcoming two new Trustees to the board - Ian Dormer and Michael Reiss - and you can read about them both on our news pages. We are delighted to share details of a new primary science capital project which we will be jointly supporting with The Ogden Trust. We also draw your attention to two new primary science reports from the Wellcome Trust. This term PSTT has added two new resources to its collection; details of these are included in the news pages. Finally, as we rapidly approach our international Primary Science Education Conference (PSEC), we highlight the incredible value our teacher tickets and encourage you all to visit our new look conference website.

PSTT Fellows Jenni Monach and Bryony Turford explore children's common misconceptions about levers, gears and pulleys. They offer a wealth of practical advice for teachers about how to support children to develop a deeper understanding that they can apply in the real world.

This issue's picture as a stimulus for talk encourages children to think about the evidence for evolution and to identify and compare features of animals now extinct to animals they see today. Please do share this (and all our free resources) with your colleagues.

Why & How? is the brand name of the Primary Science Teaching Trust
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DOWNLOAD ALL ISSUES FOR FREE AT: www.pstt.org.uk/what-we-do/why-how-newsletter

The Why and How Challenge in this issue encourages children to look at their surroundings with more purpose and accuracy as they try to identify where in the school (inside or outside) they can find the greatest number of particular categories of things. You could add extra excitement to this by running it as a whole school competition.

New section in this issue: Collaborator Update

In 'I bet you didn't know' PSTT's CEO Dudley Shallcross outlines how the real scientific research by a group of scientists at the University of Bristol can provide a helpful stimulus to practical investigation in the classroom. Based on ideas about why animals have stripes, the research presented in the paper can be linked to concepts encountered in primary science about animal survival and adaptations to environment.

In the project update pages PSTT Fellow Carol Sampey tells us about her current project, 'Bringing the Jurassic Coast to your classroom'. The project resources support teachers to inspire children to look more closely at their local rocks, fossils and landscape wherever they might live. More useful ideas come from six of our Primary Science Teacher College Fellows from across the UK who share thoughts and suggestions for teaching and learning in the College Snapshot section.

A new section in this issue, collaborator update, includes information and resources from two of our close collaborators.

The Primary Science Quality Mark (PSQM) has over 80 active hubs across the UK and beyond, and over 3000 schools have now achieved a Primary Science Quality Mark. We encourage you to read more in the PSQM special issue of Primary Science.

The Scottish Schools Education Research Centre (SSERC) is a Local Authority shared service that provides support for primary science across all 32 Scottish Local Education. Their free termly primary bulletin is full of ideas and advice that you might find useful.

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The winter 2019 issue (16) of the Journal of Emergent Science is now available to download. In our research update we highlight two papers: the first looks at the value of using free exploration with wooden models to develop understanding of how machines work, and the second explores the benefits of outdoor learning for science teaching. This section also includes a reflective article written by Professor Deb McGregor from Oxford Brookes University. The creator of 'Dramatic Science' and project lead on the PSTT funded 'Exploring and exemplifying creativity', Deb shares some insights into how teachers can use drama effectively to teach science and the rationale for these. She outlines a series of strategies for teachers to try in their own classroom, with practical examples of each.

Please have a look at our key dates page for reminders of what is on the horizon for primary science – in particular our Primary Science Education Conference (PSEC) in Edinburgh from 6-8 June and the Great Science Share for Schools on 18th June 2019.

We invite you to share this newsletter with anyone you know who has an interest in primary science, and please do get in touch with us about what you like about our newsletter and what you would like to see in it. Please send your feedback and suggestions to us at newsletter@pstt.org.uk

Prof. Dudley Shallcross
CEO

Ali Eley
Academic Director

Dr. Sophie Franklin
Cluster Director

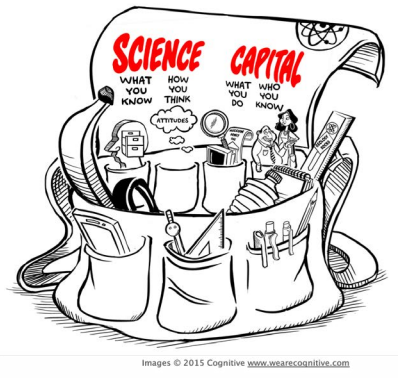
Sue Martin
Programme Director

News

Primary science capital: a whole school teaching approach

The Primary Science Teaching Trust and The Ogden Trust are jointly supporting a new research and development project with University College London and King's College London.

The project, 'Primary science capital: a whole school teaching approach' aims to meet the already strong and rapidly growing demand among practitioners for the secondary-developed Science Capital Teaching Approach (SCTA) to be further developed within and for the primary sector. The project will start in September 2019 and run for two years.



We welcome two new members to our board of trustees

Ian Dormer CBE, CDIR, HonFIoD, BA (hons)

Ian Dormer has been Managing Director of Rosh Engineering Ltd for nearly thirty years. Ian is a member of the Institute of Directors, and was appointed national Chairman in 2012 for a 3 year term. In 2013, Ian qualified as a Chartered Director, and he regularly contributes to the Institute of Directors professional development courses. Ian has held a number of Non-Executive Director roles ranging from the Board of Regional Development Agency, ONE North East, through to Chairing Business Link Tyne & Wear. His passion for education has led him to become a Trustee for the comprehensive school (now Academy) that he once attended, and to becoming the Chairman of Newcastle College. He was awarded a CBE in Her Majesty the Queen's 2016 New Year Honours list.

Professor Michael Reiss

Michael Reiss is Professor of Science Education at UCL Institute of Education, Visiting Professor at the Universities of Kiel and York and the Royal Veterinary College, Honorary Fellow of the British Science Association and of the College of Teachers, Docent at the University of Helsinki and a Fellow of the Academy of Social Sciences. A former Director of Education at the Royal Society, he is also a Priest in the Church of England and President of the International Society for Science and Religion. His research and consultancy interests are in science education, bioethics and sex education.

INTERNATIONAL PSEC Primary Science Education Conference

Outstanding Professional Development for all Primary Science Educators

PSTT's Primary Science Education Conference

6 – 8 June 2019, Edinburgh International Conference Centre

At £240 our three day teacher tickets offer incredible value – they include:

- Entry to the whole conference, with refreshments and lunch provided on all three days.
- Three keynote talks.
- Seven sessions offering a choice of talks, seminars and practical workshops.
- A science show finale.
- A packed and lively exhibition hall offering support and resources specially for primary education.
- A follow up CPD day in your area*.
- Entry to the PSTT Children's Conference at PSEC.
- An invitation to a drinks reception on Friday, sponsored by the Wellcome Trust.
- A social and networking event on Thursday, hosted by PSTT.

* Ts and Cs apply

Click here to buy your ticket today!

Visit the new look **conference website** for the latest conference news and delegate information and to download the programme preview.

Science on Stage 2019

We are delighted that four PSTT College Fellows, Sarah Eames, Kathryn Horan, Robin James and Paul Tyler, have been selected to present projects at Science on Stage in Cascais, Portugal in October 2019.

Sarah will be sharing her PSTT/Premier League Primary Star's-funded collaboration with Leicester City Football Club Community Trust to bring together football and space to inspire children in science. Kathryn looks at creative ways that children can share their ideas in science through drama, English and ICT. Robin's project, The Hula-hoop Hundreds-and-Thousands Hadron Collider is based on materials developed following his visit to CERN. Paul will talk about the ways in which Mearns Primary School has adapted the Science Capital Teaching Approach for a primary setting through developing partnerships and careers resources for their pupils. We will look forward to hearing more about their experiences in a later edition of Why&How.

Special Offers on PSTT Resources - up to 25% off!

2019 is the PSTT's 21st birthday and to celebrate, we are offering special prices on some of our popular resources, including Let's Go! Science Trails and Titanic Science. We are also extending this offer to include discounted launch prices on our latest publications: Tracy Tyrrell's new book to support assessment for learning in science 'Explore, Engage, Extend' and the soon to be released follow up to Science Trails from Jeannette Morgan: Let's Go! STEM Trails.

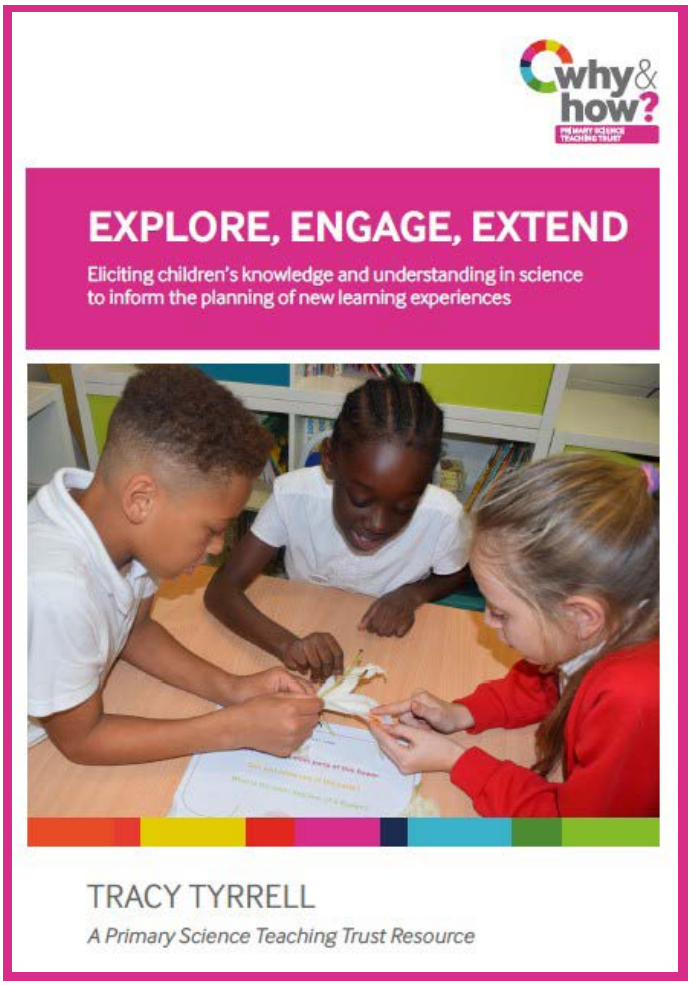
These books will all be available to purchase from our website shop at the discounted price of £15 per copy. Visit our website for full details of these and other great primary science resources, and pick up a bargain!

Please visit us online at https://shop.pstt.org.uk/collections/all

Explore, Engage, Extend
A new resource from PSTT to support assessment

Written by PSTT Fellow Tracy Tyrrell, this fantastic new book supports teachers to elicit children's knowledge and understanding in science and use this to inform the planning of new learning experiences.

Explore, Engage, Extend includes twenty sets of highly engaging practical activities to support teachers with assessment for learning in science. The activities generate rich assessment data, enabling the teacher to plan the topic in response to the children's specific needs. The topics presented cover the upper primary age range, are transferable across year groups and can be easily adapted for the particular curriculum being followed by the school. The activities are intended to be used at the start of a topic, but are equally valuable for providing a practical approach to learning at any stage of a topic.



For more information please visit:
https://pstt.org.uk/resources

RRP £20 - special introductory offer £15 - click here to buy

Teachers from the trial project say:

"Explore, Engage, Extend is excellent assessment for learning."

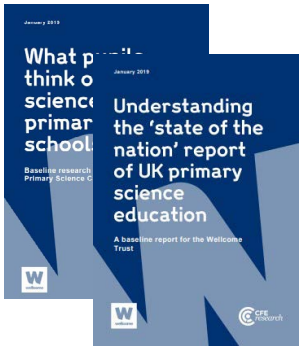
"The children are more engaged and motivated and make good progress."

"Science in my classroom is now much more child-led."

Special Service Award for PSTT College Fellow

Congratulations to PSTT College Fellow and newly-appointed part time PSTT Regional Mentor Claire Seeley, who was recently presented with a special service award by the Association for Science Education in recognition for 6 years of service on the primary committee.

The Wellcome Trust's Primary Science Campaign



Following the publication of their 'State of the Nation' report of UK primary science education (2017), Wellcome has released two further reports.

The first, Understanding the 'state of the nation' report of UK Primary Science Education, presents qualitative findings from the original baseline research and draws on these to explore the factors that affect the decisions schools make about their science provision.

The second, What pupils think of science in primary schools, examines pupils' perceptions and views of science, linking these to the surveys completed by science subject leaders in their schools.

Science in My Pocket

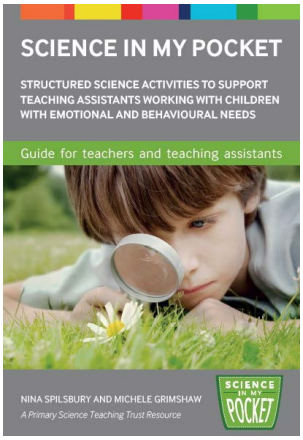
In our autumn 2018 newsletter we featured our new resource Science In My Pocket, and we are delighted that this is now available to buy!

Science In My Pocket is an exciting box of structured science activities for teaching assistants to use with children who need emotional and behavioural support. Schools have a critical role to play in supporting children's mental health and emotional wellbeing. Currently, an average of three children in every primary school classroom in the UK have diagnosable mental health conditions. The classroom can be a challenging place for these children and it often falls to a teaching assistant to supervise them and support their learning on a one-to-one or small group basis.

Science In My Pocket offers is an invaluable addition to a teaching assistant's toolkit. The benefits of using the resource include:

- children become better at self-regulating their behaviour, enabling them to return to a whole class setting more ready to learn and participate.
- children's social skills improve as the resource provides a context for the child to communicate positively with their peers.
- teaching assistants' confidence with engaging children in scientific discussion increases.

What is in the box?



- 10 numbered drawstring cloth pockets, each containing instruction cards for a series of investigative science activities based around a particular theme. (NB the rest of the equipment that needs to be added to the bag is listed but not supplied.)
- A guidebook for teachers and teaching assistants, including additional photocopiable resources
- An A3 poster to support schools with how to organise using the resources

For more information please visit:
https://pstt.org.uk/resources

Click here to buy!

COMMON MISCONCEPTIONS

Levers, gears and pullys

Jenni Monach

Bryony Turford

For more about Bryony and Jenni see College Snapshots in the autumn 2018 issue of the Why and How newsletter

What children need to know

English National Curriculum statutory statement: To recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

- Mechanisms are designed to make 'work' easier because less force may be required to make an object move
- Levers, gears and pulleys are different mechanisms and can be used for specific purposes
- How to use mechanical systems in products they design and make (English Design Technology curriculum)

Common misconceptions – often children may think:

- The term 'force' means someone makes you do something you do not want to do. It is also associated with the Armed Forces by some children in schools.
- Movement stops when things 'run out of push' rather than because there are other forces acting on them. They may think that to keep an object moving you need to keep giving the object a force (push). This common misconception is because of the invisibility of the other forces at work. To help overcome this idea, the use of arrows to define size and direction of forces is needed in diagrams. This is particularly important as force is a 'vector quantity' and therefore should have both its size and its direction identified.
- A stationary object has no forces acting on it. The reason the object is stationary is because the forces acting on it are balanced.
- The best place to put the fulcrum is in the centre of the lever. The mechanism will in fact have a bigger effect when it is closer to the object being moved.
- A greater force on a mechanism always has a greater effect on the object. In fact, a mechanism can allow a smaller force to have a greater effect.
- Mass and weight are the same thing. Mass is a measure of the amount of matter in an object; weight is a measure of the force exerted by the object due to gravity. It is important to define these measurements and the difference must be clear when introducing pulleys.

Introduction

When looking at this area of the curriculum to support teachers with whom we work, our local PSTT Fellows found it to be poorly covered and Year 5 teachers reported they found this a difficult objective to teach and assess. Cited barriers included lack of resources and weak subject knowledge. As a team, we have tried to put together some ideas and resources to help Year 5 teachers successfully teach this objective, making links to the Design Technology curriculum and real life contexts.

Our experience tells us that attempting to teach about all three mechanisms in one lesson is unrealistic, may lead to shallow learning and feed misconceptions.

We recommend splitting the objective and considering the three mechanisms separately in order to cover the objective effectively. We drew on our knowledge of lessons and research of resources we have tried or found and provide a range of useful starting points. Providing opportunities for children with opportunities to explore mechanisms practically will help them develop a deeper understanding of mechanisms and their associated forces.

Levers teaching ideas

Set up a carousel of self-discovery activities for the children to develop an understanding of how levers work. Children initially investigate how each 'thing' works.

Figure 1. With load near the fulcrum, it is easier to move the nail.

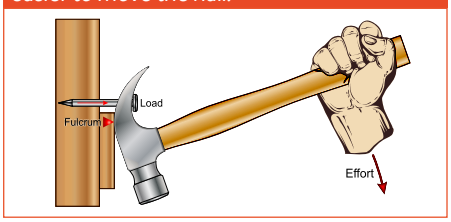


Figure 2. Nutcrackers combine 2 levers. Load and effort are on one side of the fulcrum.

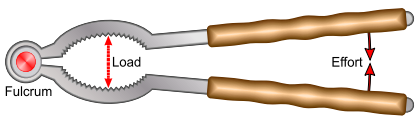
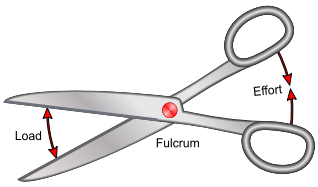


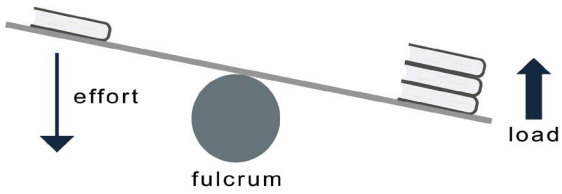
Figure 3. Scissors combine 2 levers. Load and effort are opposite sides of the fulcrum.



For example:

- *syrup tin, 1 p, 10 p, teaspoon, longer spoon, screwdriver – children try to open the tin with each device (top tip: wash out the tin before use)*
- *claw hammer and plank of wood with nails in*
- *pliers, scissors, or wire cutters and wire*
- *can with ring pull (fizzy drink or e.g. beans)*
- *bottle and bottle opener*
- *stapler*
- *tweezers*

Figure 4. Create a simple lever to lift a large pile of books with a smaller one



Encourage the children to focus on what the 'load' is in each case, where there is a fulcrum (pivot point) and where effort must be applied (Figures 1–3). This will help them see that often they apply a small force to move a bigger load whilst at other times, a large force is applied but only a small load is created (e.g. when using tweezers). Children could then go on to build their own levers (Figure 4). Try setting a challenge such as moving a bigger pile of books with a smaller pile of books. Explore moving the pivot point using:

- *Wood (shelf or board for the beam)*
- *Rolling pins (to act as the fulcrum, providing the pivot point)*
- *A set of books that are the same size e.g. dictionaries (you will need lots!)*

Gears teaching ideas

Children should spend time observing gears working including:

- *looking at a bicycle (turned upside down)*
- *whisking eggs in different ways*
- *looking inside a clock, watch or wind-up toy*

and where possible, explore commercially produced plastic gears set (your EYFS may well have a set already!).

Children could then explore the most effective way to whisk egg whites to peaks stiff enough to hold over their heads! They could use a range of tools such as:

- *Balloon, rotary whisk or fork*

Pulleys teaching ideas

Children need to experience making and testing mechanisms using different numbers of pulleys (2, 3 and 4 pulley systems) to evaluate their effectiveness, using readily available resources. Teachers have reported a lack of quality pulleys and the cost of purchasing these as their biggest barriers. Should you wish to invest, we recommend metal pulleys (not plastic) and perhaps making some links with your local secondary school science department, who may be able to loan some to you for a lesson or two. However, an effective pulley system can be easily created from the following resources:

- *Wire coat hangers*
- *Curtain rings*
- *String*
- *Weights*
- *Broom handles*

PSTT has a great resource: Titanic Science which sets practical investigations in a historic context, a number of which are ideal when exploring mechanisms. Our free resources, Chain Reaction and Wooden Models, provide extensive support on teaching about mechanisms.

Story links

Finally, we are huge advocates of using stories to give our science more context. For this topic, we would suggest:

- *The Minpins by Roald Dahl*
- *The Lighthouse Keeper's Lunch by Rhona and David Armitage*
- *The Tin Snail – Teaching Science Through Stories*

Support for teachers

Many of our partner organisations provide free resources to help teachers with these topics, including:

STEM Learning hold a huge collection of resources; Royal Society of Chemistry (Ancient Egypt topic plans link in well); The Institute of Physics (Marvin and Milo activities); The Wellcome Trust's Explorify materials (gears).

PSTT's 'Wow Science' website provides links to these and many other completely free resources for teachers, including: The Institute of Engineering and Technology, ReachOut CPD and Practical Action. Wow Science has also reviewed a number of games and activities for children that teachers may find useful.

FREE RESOURCES

Pictures for talk in primary science

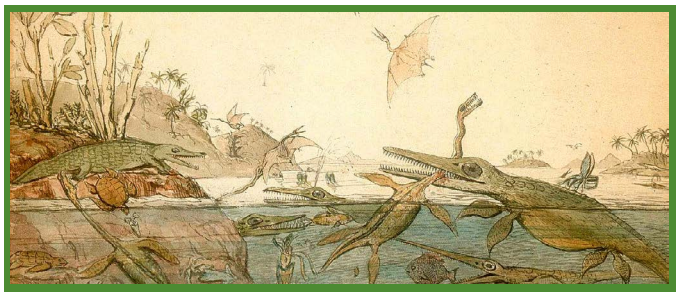
A picture can be a very good stimulus for children to engage in effective talk in science.

Using pictures is an inclusive approach that facilitates high levels of participation. Pictures can also be used as a starting point for inquiry. The discussions the children have will generate questions that they want to investigate.

Asking the children carefully chosen questions about the picture will support them with learning to:

- *construct explanations and link their ideas with evidence*
- *make confident challenges to the ideas of others*
- *explore scientific terminology and use it with genuine understanding*

Pictures for talk in science activities are designed to be very open ended and usable with any age of children. The activities can be done as a quick ten minute starter, or extended into a longer and more in-depth lesson.



'Duria Antiquior – A more ancient Dorset' is a watercolour painted in 1830 by the geologist Henry De la Beche based on fossils found by Mary Anning, and was the first pictorial representation of a scene from deep time based on fossil evidence.

WHAT TO DO

Download the image overleaf by following the link, and either display on a whiteboard or give children printed copies. Ask the children to work in groups of three to discuss the following questions:

The picture was painted in 1830, but what time in history do you think it represents?

Why do you think this?

The animals drawn here would have been alive hundreds of millions of years ago. What evidence do you think the artist must have seen to be able to draw them?

Where might the evidence have been found?

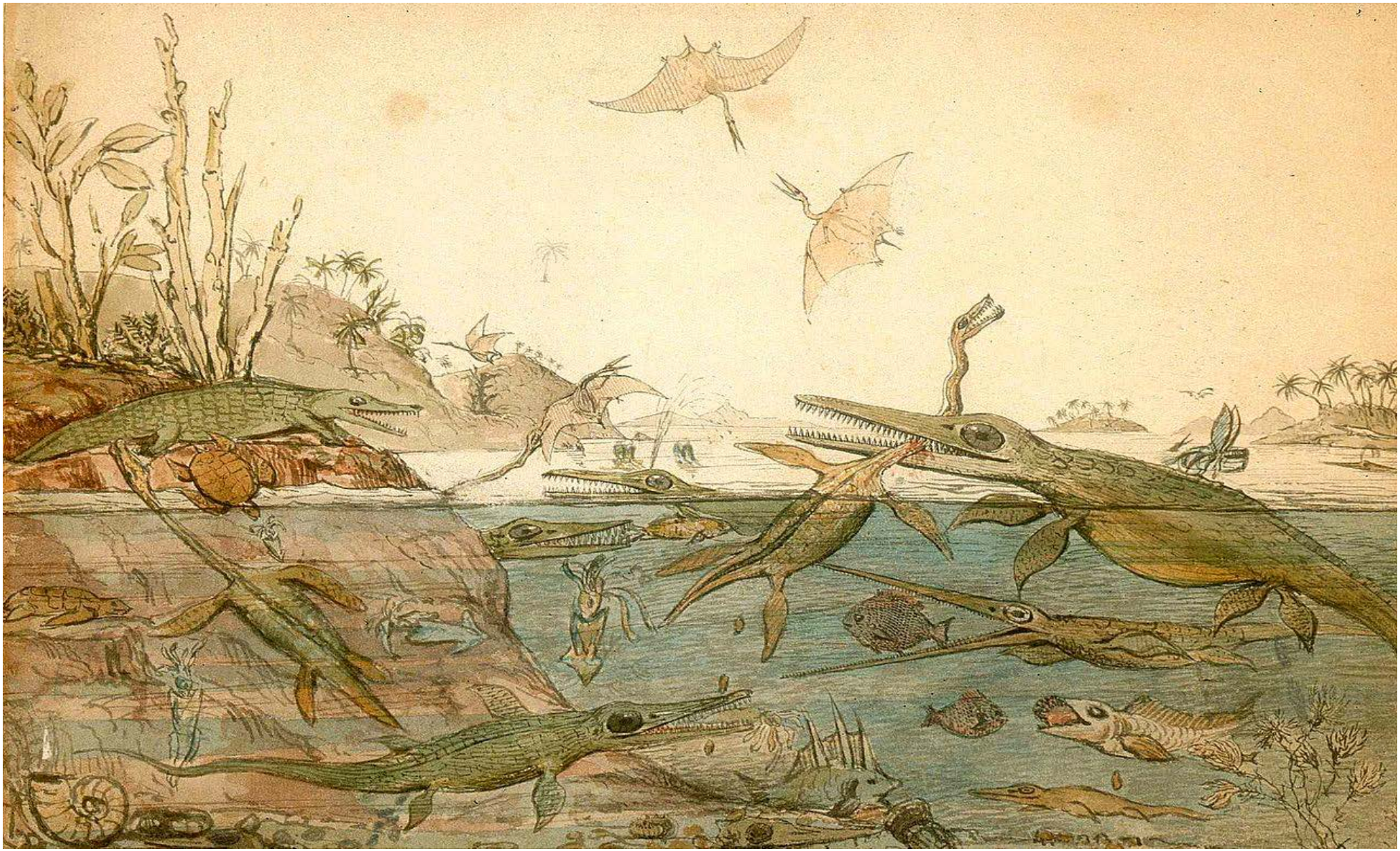
Other questions to generate and promote thinking and explaining

- Ask the children to look closely at the animals.
- What similarities are there to animals you might see today? Are there any differences?
- How many different animals can you see? Can you sort them into groups?
- What other living things are in the picture?
- Can you create a possible food chain from animals in the picture?
- What do the animals need to stay alive?

Follow-on discussion ideas

- Why might these animals (or their descendants) no longer be seen today?
- The artist used fossil evidence discovered by Mary Anning. What type of scientist was Mary Anning?
- Ask the children to find out more about her life and work.
- Why might her life be considered unusual at that time?

For more information and ideas for teaching about fossils and geology, visit The Big Jurassic Classroom, or come to PSTT Fellow Carol Sampey's workshop on Friday 7th June at PSEC 2019.



CLICK TO DOWNLOAD IMAGE

FREE RESOURCES

The Why and How Challenge

The 'Why and How' Challenge is intended to be something for the staffroom table that lots of teachers will try.

This issue's Why and How Challenge is a version of the one we suggested in the summer 2018 newsletter. It will encourage the children to look at their surroundings with more purpose and accuracy. It can be run with small groups, a class or as a whole school competition.

How many different ... can you find?

There are many different categories you could choose to challenge the children to find. For example:

- *types of material, metals, textures, coloured objects*
- *living things (see newsletter from summer 2018)*

Resources

- *30 cm rulers – 4 per group of children*
- *elastic bands – 4 per group of children*
- *clipboards, paper and pencils*

Optional extra resources

- *hand lenses, metre rulers (or other longer sticks) for making larger frames*

Using rulers means that large numbers of children/ groups can have the same sized and shaped frame which then means they can compare what they find in a fair way. Hoops or other types of rigid frame could also be used. String or rope loops are less good as it is hard to ensure they always outline the same sized area.

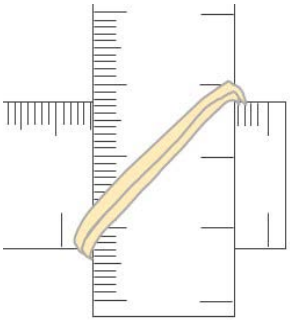
WHAT TO DO

Each child or group of children needs to make a frame out of four 30 cm rulers. The corners should be held together with elastic bands.

Give the children the challenge "How many different [INSERT YOUR CHOSEN CATEGORY] can you find?"

Tell the children to:

- *choose a place around the school – inside or out - and put down their frame*
- *identify how many different things in the given category they can find inside the frame*
- *record what they have found*
- *choose another place to put the frame and repeat*



e.g. putting the frame down on a desk – the materials that can be seen inside it are: wood, plastic, metal, fabric, rubber, paper. Older children might also say graphite (or pencil lead), paint (on the outside of the pencils), ink (squares on the paper) and they might want to give specific names to the metal of the scissors, the wood of the desk and the fabrics in the pencil case.

Points to note:

- *The children should be encouraged to observe inside the whole frame and to use hand lenses*
- *Children should look for how many different things they can find – they can only count each type once*
- *The children could take photographs of their frames in different places and annotate these with what they found when they are back in the classroom*
- *This challenge is particularly suited to younger children. To make it more challenging for older children, try introducing additional elements, e.g. if the category is materials, for each material they find, ask them to list three other objects that are made of the same material, and say why they think it is used/ describe its properties.*
- *The children might like to know that a frame like this with sides of 1 m is used by scientists to mark out random areas to be surveyed. Its scientific name is a quadrat.*

Making it into a whole school competition

Decide on a category for the whole school (or key stage, or year group). Each class carries out the challenge and then submits a photo of their frame in the place where their class found the greatest number of things in the given category. Each photo should have a list of all things they found in the frame. Compile the pictures as a slide show for the whole school to watch ... and the winning class/ key stage/year group is revealed.

I BET YOU DID'T KNOW...

Stripes and concealment

Prof. Dudley Shallcross, PSTT CEO, links **cutting edge research** with the **principles of primary science**

dudley.shallcross@pstt.org.uk

"BETWEEN THE LINES - WHEN STRIPES HELP US AND WHEN THEY WARN US"

Many animals use stripes to warn that they may be dangerous or to help conceal them from predators and prey. We learn from an early age to be wary of wasps and we may have seen more exotic animals such as tigers on the television or other digital platforms, or may have seen a real one.

With our primary school children, we can discuss how animals hide themselves, which animals use stripes and ask whether they use other patterns. Why do animals need to be camouflaged? It might be useful for children to have an opportunity to look at and discuss the purpose of different examples of camouflage: concealing with colouration similar to the surroundings (Can they also think of examples where animals' coats change seasonally?); disguise through having similar shape and texture to surroundings (e.g. stick insects); mimicry of other animals (Why might an animal want to resemble another?); and disruptive colouration such as stripes or spots to help them blend with the surroundings (e.g. tigers etc). Depending on the age/abilities of the children, they could undertake image grouping/sorting activities, or research into animal camouflage.

What do the children think is the best type of stripe for a particular environment? There has been a lot of research on camouflage (we may want to ask the children why humans might be interested in this) but a recent study specifically looked at different striped patterns to see which of these were easier for birds to see and for humans to see. The researchers made some artificial moths that were patterned, attached them to trees and observed whether a particular patterned moth was taken by a bird more often compared with other types of pattern. They also asked human volunteers to report at what distance they could see these artificial moths.

We can ask the children to imagine doing this experiment. What would they need to think about to make sure it was a fair test? What striped patterns would they think were more effective at concealing the moth and what striped patterns were less effective (What is their hypothesis?). Ask the children to consider how the thickness of the stripes, the angle of the stripes and whether the stripes are straight or wavy lines might have an effect. What colours are the best to use to conceal a moth? Children could be encouraged to plan and carry out simple investigations of their own based on humans' ability to see sample moths. They could try to replicate the researchers' tests or create similar ones based on their own questions about types of camouflage patterns.

The researchers cut triangular pieces of water-proof paper (25 x 50 mm) and used both vertical or horizontal patterns that were either olive-and-black or yellow-and-black. A total of 18 combinations were used and some examples are given in figure 1.

The artificial moths were attached to the tree (experiments were carried out in winter) and each moth was baited with a dead mealworm larva. A variety of birds such as blue tits, European robins and chaffinches that were present in the wood were then able to remove the mealworm . The number of larvae removed in a given time was recorded. In addition, 9 women and 9 men were asked to walk a set path and note when they could see the moth targets and to record the distance from the target when they first saw the artificial moth.

The researchers found that when the olive-and-black stripes matched the background best, in terms of stripe width and orientation, the moths were well hidden from both the birds and humans. However, for the yellow-and-black stripes, the best survival rates (with respect to the birds) didn't match what would be assumed to be the best matched pattern. In fact, the best camouflaged striped patterns were at a higher frequency (closer together). The orientation of the stripe made no difference to the results and the distance they were detected by humans was not affected. Why did the birds not take the yellow-and-black moths, even though they were 'more visible'? (Maybe the children can suggest some answers?) Perhaps the bird's sight is such that the frequency of stripes with that colour combination cannot be detected easily, or maybe the combination reminds the bird of an animal that it does not like (e.g. a wasp). It would be good to discuss: Would the results be different in another season? The scientists only carried out their investigation in winter and suggest that other important factors should be investigated in the future (e.g. amount of foliage, weather conditions, light). It is important to remind children that scientists continue to increase their understanding by refining their ideas and considering more possible variables over time. What might the children consider next in their own investigations?

Figure 1. Schematic examples of triangular targets used; thicker, thinner and wavy lines were all used.

Discuss this question with the children:

What do you think experimental psychology is?

The research paper that generated this work was:

Stripes for warning and stripes for hiding: spatial frequency and detection distance

By James B. Barnett,1 Annabelle S. Redfern,2 Robin Bhattacharyya-Dickson,1 Olivia Clifton,1 Thomas Courty,1 Thien Ho,1 Annabel Hopes,1 Thomas McPhee,1 Kaitlin Merrison,1 Robert Owen,1 Nicholas E. Scott-Samuel,2 and Innes C. Cuthill.1

Behavioural Ecology, vol. 28, pp. 373-381 (2017)

1. School of Biological Sciences, University of Bristol, Bristol BS8 1TQ, UK.

2. School of Experimental Psychology, University of Bristol, Bristol BS8 1TU, UK.

All the researchers are from the University of Bristol.

PSTT COLLEGE SNAPSHOT

Meet six of our **College Fellows** who share some quick thoughts and suggestions for teaching primary science.

Amy Woolgar

East Sussex

Current year group: Y4 and Y5

Year of award: 2016

Best strategy for helping children develop independence in their science learning?

My 'Wonder Wall' which contains all the children's wonderings about the world. Many of these 'wonders' are based on interesting objects I have provided for exploration to help develop their scientific questions. The most important thing then is actually giving time for the children to answer their wonderings.

Most recommended book/website for supporting teaching in science?

The STEM Learning resources, available online. Their CREST Award programme is excellent and has been invaluable for running an after school science club. I like how the activities are real life based and require little preparation or planning. The children enjoy exploring real life problems; they can be very imaginative with their solutions!

Lucy Blackmore

Birmingham

Head Teacher

Year of award: 2016

Most recommended book/website for supporting teaching in science?

The first science book I bought, and would still recommend to anyone within Primary Science, was Teaching, Learning and Assessing Science 5-12 by Wynne Harlen. It was my bible when I started my specialism in Science at university.

Funniest thing that has happened in a science lesson?

A student-teacher and I had to pretend to the children that the butterflies they had looked after as larvae and pupae for a long time were still living when we let them go on the playground. It was an Oscar winning performance, helped somewhat by a blustery morning.

Eli Atkinson

The North West

Current role: Primary science consultant and PSQM Hub Leader

Year of award: 2014

Most recommended book/website for supporting teaching in science?

Getting to grips with graphs by Anne Goldsworthy, Rod Watson and Valerie Wood-Robinson. It's packed full of ideas and very supportive for any teacher who lacks confidence in maths.

Funniest thing you have heard a child say in a science lesson?

Using Flanimals to discuss adaptations I asked my class where these fictional creatures could live based on their features. One child suggested his dad's belly button! He had excellent reasons for this: the flanimal was the right shape and the same colour as the fluff in there...

Jeannette Morgan

West Sussex

Current year group: Y5

Year of award: 2011

Favourite topic to teach in science?

I love teaching reversible and irreversible changes. There are so many investigations that are really hands-on, fun and deliver a wow factor for the children.

Best strategy for helping children to identify and learn the names of a variety of plants?

Go outside and see them in their natural environment. Practise learning their names over and over, but make it fun to do – use matching games, snap games, plant dominoes, treasure hunts, anything that helps them identify them in a memorable way.

Mary Haughey

Co. Antrim, Northern Ireland

Principal

Year of award: 2010

Most used piece of equipment:

Batteries, bulbs and buzzers! The children always love getting a battery and making a bulb light, or preferably a buzzer buzz.

Most recommend book website for supporting teaching in Science:

The new CCEA Science and Technology Progression Guidance. Although written for teachers in Northern Ireland it may be something all teachers find helpful for thinking about progression in concepts and skills and the assessment of these. (NB This document was complied with significant input from PSTT fellows)

Chris Lawson

Durham

EYFS

Year of award: 2016

Most recommended book/website for supporting teaching in science?

I love www.explorify.wellcome.ac.uk as it has something for every topic. It inspires questioning and scientific thinking. For Early Years I especially love the odd one out activities as there is no wrong answer as long as you can explain your thinking.

Funniest thing you have heard a child say in a science lesson?

There have been so many! In a Y1/2 lesson on the needs of humans I asked children to choose four items they would need to stay in a field overnight. One child chose "2 axes and some grappling hooks" because "There might be werewolves in that field."

RESEARCH UPDATE

The Journal of Emergent Science

The Journal of Emergent Science is an open access e-journal published by the Primary Science Teaching Trust (PSTT). It presents current research and provides reviews of research in science education from early years up to age 11. Its focus is on the implications of research on practice and provision and submissions of papers from practitioners as well as researchers are welcome. For further information about writing for JES please refer to the ASE submission guidelines.

Issue 16 Winter 2019 is now available.

Click here to download.

Exploring some simple machines and their applications

PSTT CEO Dudley E. Shallcross, Cluster Director Sophie D. Franklin, and Fellows Paul Tyler, Peter Sainsbury and Michele Grimshaw, with Robert M. Ritchie and Tim G. Harrison describe how open-ended investigations, supported by class discussion, can lead to a deep exploration of a topic. The paper outlines how purposeful engagement with a set of wooden models that demonstrate particular mechanisms can enable children to make significant progress with their understanding of how some machines work. The children compared, grouped and classified the machines, and matched them to real life equivalents. The authors discuss how this type of appropriate stimulus, coupled with plenty of time for free exploration, can result in the children carrying out relatively sophisticated investigations with minimal teacher input.

Download this paper here.

Read 'How things move' to find out more about the wooden models used in this study.

This guide also contains practical ideas for using the models in the classroom.

For more about common misconceptions about levers, gears and pulleys, with practical suggestions for how these might be addressed, go to page 8.

The benefits of outdoor learning on science teaching

PSTT CEO Dudley E. Shallcross, Cluster Director Sophie D. Franklin, and Fellows Jeannette Morgan, Michele Grimshaw and Linda Curwen with Naomi K.R. Shallcross provide a succinct review of the current literature relating to learning outside. This is followed by three case studies that examine the benefits of outdoor learning in particular contexts. The first explores the impact – both planned and unplanned – of using a garden area for development of spoken language in a school with very high percentage of families with English as an additional language. The second case study illustrates how, with careful planning, a school's 'Secret Garden' can provide an all year round stimulus for learning in science for all ages of children. Opportunities for outdoor learning off-site are described in the third case study, including an outline of a 'Science Trail' based on a multi-sensory approach to learning about sound.

Download this paper here.

Our teaching resources to support outdoor learning include 'Let's Go! Science Trails' and our brand new 'Let's Go! STEM Trails'.

RESEARCH UPDATE

Creativity in Science: some suggestions about using drama from Deb McGregor

I passionately believe that if students in classrooms are not engaged in meaningful activities requiring both cognitive and actional participation, learning is less likely to be effective.

I recognise that capturing what learners 'know' in some kind of textual form (written by hand or electronically processed) has become a school and national requirement so that progress in learning can be assessed and measured. However, I strongly believe that in the current political climate, too often, we 'value what we measure' rather than attempt to 'measure what we value'. Having worked with 5-year olds to 50-year olds, it seems to me that that this simple Chinese proverb still holds true for most people, whatever you are trying to teach:

"Tell me and I forget

Show me and I remember

Involve me and I understand"

This has underpinned my practice for years. Introducing new ideas or concepts for learners is much more exciting, fun and meaningful if there is interactional activity involved. However, not just any practical work will do, as research has shown. Activity needs to be focused, relevant for the learners and provide opportunities for them to succeed at a variety of levels. This is exactly what my research in using creative approaches like drama and stories illustrates. Since my responsibility for the MA History of Science module over 10 years ago, my interest in the lives of Leonardo deVinci, Edward Jenner, Marie Curie, Florence Nightingale, Isaac Newton, Robert Boyle, Dmitri Mendeleev, Rachel Carson, Marianne North etc. have re-ignited my enthusiasm for, and fascination with, the ingenious ways they used materials that were available to them, solved problems of their era and developed methods that 'pushed the envelope' during their life-time. My research into the ways that the design of learning tasks (McGregor 2008) also provides a context and purpose for learners is key. From the outcomes of my studies and reflections on practice, it became explicit that the challenges learners are invited to consider influence the kinds of dialogue and action they engage in. Combining the evidence from these studies suggests how the use of drama could be used to 'transport' children back in time, or to a different place, and enable them to consider what it was like to live in a different country at a different time. An example provided below is that of Joseph Shivers (the creator of Lycra). Children can be invited to listen to him (as read out by a teacher or child in-role) talking about his interests in football and his role as an important senior scientist who experimented for years (for the company DuPont) before he found the correct formula for the elasticised material. Listening with eyes closed and then discussing what they deduce about the scientist from the mini speech, imagining his everyday life as well as his work, provides context and background for an enquiry here the children work in-role. In the case of Shivers, they are asked which material is the best for an athlete to wear (in wet, dry, cool or warm weather). Carrying out a dramatic enquiry (as indicated on page 19) can take up to a couple of hours.

However, you don't need hours to use the other basic drama techniques. If you have fifteen minutes, an hour or half a day you could try the following suggestions.

If you have fifteen minutes, you could try...

1. Teaching a new topic

Ask the children to create a statue or group picture of something you haven't yet taught them (this can provide insights into what they know before you teach them).

- All the class can do it around the room.
- 'Tap the shoulder' of groups in turn, for them to explain what their statue or group picture (tableau) represents.
- You can ask 'others' in the class to interpret what they think the statue/tableau represents.
- You can ask them to produce the statue or group picture again after you have taught the topic to compare how their understanding has developed.

2. Teaching how something works

Miming movement and freeze frame are very simple techniques (see page 20) to use and at varying levels.

- Ask the children to work in groups to move and show how something works or changes (this could be to demonstrate different forces or illustrate seed gemination).
- This is adaptable for virtually any science topic or concept.
- Interestingly once the children have grasped the strategy, when you then teach them something tricky, they may request 'acting it out' to help them make sense of it.

If you have an hour, you could try...

Hot seating which takes longer than miming movement or freeze frame because it works best after the children have engaged in an experience they all have some familiarity with.

- It can improve the quality of questioning and developing explanations (answers).
- Within the topic of materials and their properties, invite children in small groups to choose a sport that they mimic (or mime) playing (this approach can work well if connected to an Olympics theme or big sporting event).
- Each group rehearses their mimes.
- Invite them to choose a card (each one with the name of a material written on it, e.g. paper, wood, metal, ice, foil).
- The children then practise miming playing in clothes made of that material.
- Make sure they do not say out loud what they are doing (some team huddling may be required).
- Once each group feels confident, in turn they can each perform their sport wearing normal clothes and then the clothes made of a different material.
- The rest of the class observe carefully how their actions change and what does that mean about the features (or properties) of that material.
- This can be huge fun.... working out what sport is being played and then interpreting how the material affects movement can engage the children in thinking both critically and creatively.
- If you have a little more time, you can ask them to mime how playing their sport is affected if the world is made of sponge or stone or everything becomes magnetic. This elicits some really interesting scientific understandings about properties of materials.

If you have half a day, you could try...

A dramatic enquiry (McGregor and Precious 2015: 103 – 125).

- Explain the children will listen to a mystery scientist talking (they can later guess who they think it might be).

Have the children close their eyes and listen to a monologue (through a teacher or child in-role reading the script from McGregor and Precious 2015 p. 207).

- In this monologue the mystery scientist is musing over the football scores and muttering about about the wealthy or well-known having access to a 'new' stretchy material, Lycra, that he has developed.

Reflective discussion, 'What do you know about the scientist?'; 'What do you imagine about the scientist?' enables the children to develop a 'feel' for the scientist as a real person.

- Explain the scientist is Joseph Shivers who experimented with materials to create Lycra.

Give them cotton, rubber, bubble wrap, space blanket, foil (plastic bowl, spoon, jug of water, pegs, string).

- Ask them to solve, as Shivers might, two questions,

    1. What can you tell me about the material?

    2. How could you find out which material is best for an athlete to wear in the Olympics?

- Remind them that field and track events will continue no matter what the weather.
- Invite them to work in-role as Shivers to answer the open enquiry questions.
- Invite them to work collaboratively in groups to extend the likelihood of success.
- Celebrate the wide variety of solutions to the two questions.

Key References

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Ten practical suggestions for using drama in science

1. Spontaneous Role Play

In small groups children develop arguments about science in everyday life. By working 'in role' they can explore views and ideas which may be different from their own.

In-role as Montgolfier brothers who invented hot-air balloon.

2. Hot Seating

Where teachers or children are placed 'in role' as experts to answer questions from their peers.

Hot seating used to question others' experiences of wearing 'paper', 'foil', 'stone' and 'rubber' clothing.

3. Miming Movement

Pairs/groups/individuals mime movement allowing them to explore different types/ways of moving and how this might be affected by different circumstances.

Miming movement to illustrate 'forces' applied to a toy (jack-in-the-box) and 'rubber' clothing.

4. Freeze Frames

A freeze-frame is a frozen moment. Group act out a phenomena, on hearing a cue e.g. freeze, clap the group/ individual stops and holds their position. This allows the group to examine and reflect on what is happening at that moment.

The teacher may well ask 'why have you done it this way? What are you trying to show?

Freezing a moment in germination.

5. Modelling

Modelling is a way of physically creating a mimic or illustration of an object or organism and exploring how it works/ acts.

Modelling changes in movement as ground becomes frozen.

6. Mind Movies

Using audio and/or visual stimuli to support the children to imagine themselves in different places/situations. Group/s listen to a description/ sounds (and may have images too) of a location. Whilst their eyes are shut the group/s can be asked questions about what they can hear/see so they can build up their own picture in their mind.

The magic carpet can also be used for this – to add to the imaginative picture of a different location or time.

Preparing to travel to another place on the 'magic carpet'.

7. Mini-historical Plays (MHP)

The teacher tells the group a story – which could be scripted. During the story members of the group become the characters in the story – they could be given a prop/costume item to signify who they are or a simple line to say. There might be moments in the story when whole groups are engaged or moments when they could offer their thoughts on the events of the story e.g. a meeting. Through this enactment the narrative of a scientist's work is brought to life.

Engaging in an historical play as Mary Anning and Edwardian visitors to Lyme Regis.

8. On the Table

Examining objects (often unfamiliar or to be used in an unusual way). The objects to be studied can be related to the topic being taught or the scientists' work or inquiry to be engaged in.

On-the-table examples of equipment George Washington Carver might have used to investigate plant part uses.

9. Monologue

Learners listen to a teacher (or child) speaking in-role as a scientist.

The 24 monologues produced so far provide an initial focus on a scientist's life and a particular aspect of their work. They can be used to introduce an enquiry.

Introducing a mystery scientists (like Joseph Shivers who created lycra) through reading a monologue (McGregor and Precious 2015 : 207).

10. Dramatised Inquiry

This builds on Mini Historical Plays or a Monologue (see 7 above) to introduce a scientist and then engage the children in a related investigation. Developing an enquiry from the Joseph Shivers story might include: soaking different material squares for different times, timing how long they take to dry when hung out (with pegs) on a string, and even comparing different places where the material square might be dried.

Professor Deb McGregor taught in schools in the Midlands, held posts of responsibility in Biology, Science and ICT. She worked as an advisory teacher for Staffordshire and the Stoke-on-Trent area before moving to Keele University where she led the Science PGCE program and studied for her doctorate.

After 10 years at Keele, an opportunity arose to work in the USA providing in-service training for would-be primary and secondary science teachers. Returning for family reasons she took up a post at Wolverhampton University as Assistant Head of the Research Centre before moving to Oxford Brookes University to lead research and teach on the Masters and Doctoral-level programmes. Her research interests focus on teaching and learning processes, particularly those that involve creativity, stir the imagination of learners and inspire them to want to become scientists!

Deb has written books and articles related to thinking skills, creativity, metacognition, reflective practice, science teaching, learning and leadership.

COLLABORATOR UPDATE

PRIMARY SCIENCE QUALITY MARK

PSTT has supported the Primary Science Quality Mark (PSQM) since 2013. In September 2018, to ensure its continued delivery and development, PSTT increased its support for PSQM through a five year collaboration with the University of Hertfordshire.

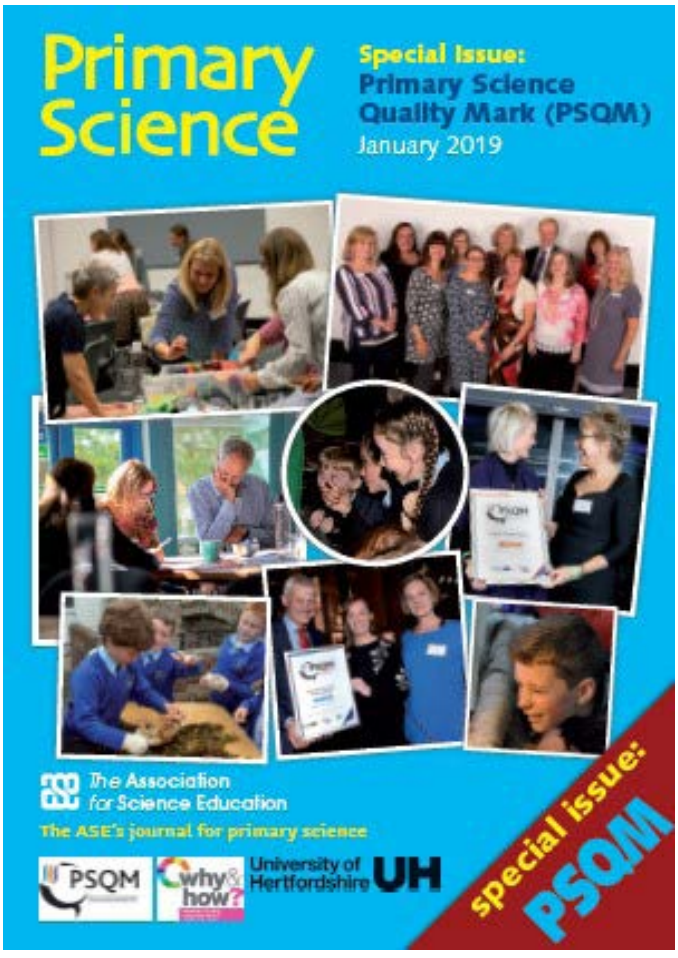
The Primary Science Quality Mark is a developmental accreditation programme enabling primary schools in the UK to improve science education through effective science leadership and school self-evaluation. It began in 2009 and involved 12 schools, with the aim of raising the profile of science in primary schools by developing, sharing and celebrating good practice.

Since then, over 3000 schools have achieved a Primary Science Quality Mark and there are now over 80 hub leaders delivering PSQM across all parts of the UK and beyond. PSQM training is focused on developing science subject leadership capacity, confidence and skills with the intention that all teachers and pupils benefit through raised standards.

We encourage you to read the PSQM special issue of Primary Science, published by the Association for Science Education (ASE).

New PSQM rounds begin in the Spring and Autumn terms each year – click here to register your interest.

Edited by Jane Turner, the director of PSQM, this collection of articles explores the wide benefits of being involved with PSQM. Articles are written by subject leaders from schools working towards a first award and from schools aiming for PSQM gilt or outreach, and by hub leaders who describe the process from their perspective.



The issue is available to all on the ASE website – you can also access it by clicking here.

COLLABORATOR UPDATE

SCOTTISH SCHOOLS EDUCATION CENTRE (SSERC)

PSTT has a long-standing relationship with SSERC and we are delighted to be working in partnership with them to deliver our international Primary Science Education Conference (PSEC) in June this year.

SSERC is a Local Authority shared service that provides support across all 32 Scottish Local Education Authorities. Its support for primary science is delivered through three core strands:

- *The provision of career-long professional learning (CLPL) opportunities for teachers across Scotland.*
- *As an advisory service providing health and safety advice and guidance.*
- *As lead coordinator for the STEM Ambassador hubs in Scotland, giving schools opportunities for wider STEM engagement*

SSERC provides two distinct types of career-long professional learning programmes: systematic and open. The systematic programmes include the Primary Cluster Programme (supported by PSTT funding) and the Sustain and Extend Programme (funded by PSTT). The open programmes are courses available to any teacher who wants to participate.

The Primary Cluster Programme

This is a national programme that aims to improve the confidence and expertise of all primary teachers in a participating cluster in their teaching of science and technology. The programme begins by training teachers nominated by their Local Authorities or School Clusters to become science and technology mentors. They then design and implement a bespoke CLPL programme to meet the needs of the colleagues in their clusters. This systematic two-level approach involves every teacher in the cluster in professional learning over time. The Primary Cluster Programme was externally evaluated during its pilot phase (2012-2018) by the Robert Owen Centre for Educational Change at the University of Glasgow. The evaluation found that the programme was highly successful in raising levels of confidence and expertise regarding teaching of science and technology and was also associated with an increase in pupil confidence. For more information please see the Primary Cluster Programme leaflet.

The PSTT Sustain and Extend Programme

One of the key recommendations from the evaluation of the Primary Cluster Programme was that it would benefit from being sustained and extended so that mentors completing the programme would be able to access continued support. The Sustain and Extend Programme has been in place since 2016 to strengthen and develop the existing mentor networks. Mentors are given flexibility to use some of the funding to address particular needs of their clusters. The programme supports the development of new mentors, develops new professional learning programmes and provides experiential workshops for all teachers in the LA.

The open programmes are primary science professional learning courses. These range from twilight sessions after school to two day residential experiences. They cover early years up to and including primary-secondary transition, and they can be delivered as traditional face-to-face workshops or online interactive electronic workshops called SSERC_Meets.

Research at SSERC

SSERC collects a wealth of evaluation data from their various Career Long Professional Learning programmes. Emma Bissett, a PSTT funded researcher at SSERC is working with these data to determine the ways in which the various programmes are having an impact and the factors which bring this about. Future research will explore in more detail the impact that the programmes have on pupil learning.

SSERC's termly primary bulletin – free to download

For more information about SSERC's support for primary science and technology, or to sign up to receive the bulletin, please click here.

PROJECT UPDATE

The Jurassic Coast

Bringing the wonder of The Jurassic Coast to the classroom

If you are teaching about Rocks and Fossils a wonderful place to visit is the Dorset and East Devon Coastline known as The Jurassic Coast, England's first natural World Heritage Site. Not only is the area breathtakingly beautiful but it is also an area rich in educational resources. Displaying 185 million years of the Earth's History in its dramatic cliffs and tumbling landslides, it is both a geologist's and fossil hunter's dream!

PSTT is delighted to be supporting an initiative to enable all schools to benefit from what the Jurassic Coast offers. For most primary schools in the UK, a visit there will not be an option but you can still use the area to inspire children and enrich their learning.

With funding from PSTT in 2014, The Jurassic Coast Trust (JCT) developed an educational outreach programme to engage with schools. This project resulted in the creation of The Big Jurassic Classroom, a set of free educational resources available from PSTT, collections of Rocks and Fossils for schools to borrow, and a team of trained local Volunteer Ambassadors. These resources were used very effectively to support teaching and learning by schools in Dorset and Devon. During the last year, PSTT has developed the project further to enable the resources to have a much wider impact.

PSTT Area Mentor Carol Sampey has now trained as a Jurassic Coast Ambassador. Carol has developed a creative workshop which draws on the Jurassic Coast and the Big Jurassic Classroom resources to support schools with teaching about rocks and fossils – an area which some teachers find difficult to bring alive – and to introduce ideas to inspire children to look more closely at their local rocks, fossils and landscape (wherever they may live) and to engage with the stories rocks can tell and discover "pebble personality!"

Carol will be delivering this workshop at our Primary Science Education Conference (PSEC) in June this year, with a UK wide roll out to follow.

To find out more, visit:

The Big Jurassic Classroom

The Big Jurassic Classroom science resources

or contact Carol Sampey via email:

carol.sampey@pstt.org.uk

Key Dates

PSTT's international Primary Science Education Conference (PSEC)

6th - 8th June 2019

Edinburgh International Conference Centre (EICC)

Save the date and join us in Edinburgh for our international Primary Science Education Conference (PSEC)!

We are determined that there should be no barriers to every child receiving an outstanding education in primary science, and we are committed to our vision that teachers are the key to making this happen. Through crossing boundaries between the classroom and academia, between policy and practice, and between one nation and another, our conference in 2019 will empower educators to develop excellence in primary science.

Primary Science Teacher Award Deadline

12th July 2019

Nominations are open via the PSTT website

Do you know an outstanding primary science teacher?

These awards celebrate amazing primary science teaching across the UK, recognising talented teachers in early years, Key Stage 1 and Key Stage 2. Teachers who win this award are not only judged to be outstanding practitioners in their own classrooms, they also support and develop colleagues in their own schools and others either locally, regionally or nationally. Award-winning teachers are also innovative, creative, enthusiastic and will have significantly raised the profile of science in their own schools and beyond.

Great Science Share for Schools

18th June 2019

#GreatSciShare

Are you registered for the Great Science Share for Schools?

Reaching over 40,500 young people in 2018 it's time to register to take part in the Great Science Share for Schools on the 18th June 2019.

The Great Science Share for Schools is a national campaign to inspire young people into science and engineering by sharing their scientific questions. You'll benefit from taking part by:

- encouraging young people to communicate their scientific questions and investigations with new audiences
- improving teacher confidence in teaching children to think and work scientifically
- raising the profile of school science, improving the science capital of children and families

Register your interest now here.

Download resources and information at www.greatscishare.org.uk

Any questions or ideas email us at greatscishare@manchester.ac.uk and follow us on Twitter.