Spring 2020 *Issue 8*

Why & How?

The Primary Science Teaching Trust Newsletter

Supporting excellent teaching and learning in primary science

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Free to access for all

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Why & How? is the brand name of the Primary Science Teaching Trust
Tel 0117 325 0499 · **Email** info@pstt.org.uk ·
Web www.pstt.org.uk
Primary Science Teaching Trust ·
12 Whiteladies Road · Clifton · Bristol · BS8 1PD

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Welcome

Welcome to Why and 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.

In **News** we share the achievements of several of our Fellows, including the winners of the ASE Book of the Year 2019, and we also announce the **winners of Primary Science Teacher Awards for 2019**. We introduce you to the authors of our popular 'I bet you didn't know' articles that have appeared in each issue of Why & How and monthly on our website. We also announce our recent new partnership with TTS Group.

In the **Climate Science** section of our newsletter, PSTT Fellow Dr Paul Tyler outlines the importance of outlines climate change in the primary classroom. Paul uses his 'Topical Science Update' resource to arm teachers with relevant background science and materials to help children to develop their understanding of the effects of climate change, using recent news and research articles to support their discussions and their own research into the issues.

This issue's **Picture as a stimulus** for talk relates to floating and sinking. The picture provides opportunities for the children to use evidence from what they can see to justify their ideas. The picture will undoubtedly encourage discussion about the reasons why some objects are able to float and it will provide an impetus to investigate this further . Please do share this (and all our free resources) with your colleagues.

Our **Why and How Challenge** in this issue asks children to investigate various ways of achieving balanced forces by creating a mobile, supporting their understanding of levers. The challenge can be for an individual, groups, classes or even a whole school competition to create the biggest mobile.

DOWNLOAD ALL ISSUES FOR FREE AT:
www.pstt.org.uk/what-we-do/why-how-newsletter

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Other free resources that we highlight in this edition relate to **Enquiry Approaches and Enquiry Skills**, using the icons and explanations developed as part of the '**Standing on the Shoulders of Giants**' resource that was published last year. In this newsletter, we also provide a **full unit from this book, completely free** for our newsletter readers. Standing on the Shoulders of Giants is a popular resource with teachers who want their children to see themselves as scientists. Children are introduced to the work of historic figures and then carry out their own similar investigations to develop understanding of the science behind the discovery. They are also able to consider the work of contemporary scientists in the same fields, appreciating how science advances over time.

In '**I bet you didn't know**' PSTT Fellow Dr Alison Trew shares recent research on the changing pitch of whale song. Whilst scientists have known for years that the frequency (pitch) of their calls has been decreasing, recent evidence has uncovered reasons for this change. Alison's article, based on the original research paper, introduces the science in a format that can be shared with primary school children and, along with the accompanying Teacher Guide that can be downloaded from our website, suggests ways that children can undertake their own investigations in the classroom.

Our College **Snapshot** features six of our Primary Science Teacher College Fellows from across the UK. We hope you find their quick thoughts and suggestions useful for your own teaching of primary science.

This issue's **Research Update** has links to two recent publications that focused on last summer's PSTT conference, PSEC 2019. A special issue of the Association for Science Education's Primary Science journal features numerous practical ideas and strategies based around workshops delivered at PSEC, many written by PSTT College Fellows. The Journal of Emergent Science contains papers with a more theoretical perspective on the outcomes of PSEC. Both these journals are open access and completely free to download from the ASE website.

In our **Collaborator Update**, John McCullagh describes a model for excellence that has been adopted at Stranmillis University , Belfast, through the creation of a Primary Science Accreditation programme. The approach recognises and rewards the work of student teachers who demonstrate innovative practice. Dr Lynne Bianchi discusses the work of the Science and Engineering Education Research and Innovation Hub (SEERIH) at Manchester University and in particular QuSmart, a two year project that is considering how children can develop to ask and build scientific questions.

Finally, we include some **Key Dates** for your diary. There is still a short window of opportunity to submit an application for a Royal Society Partnership Grant or an entry to the Rolls Royce Schools Prize for Science and Technology. The Primary Science Teacher Awards for 2020 are now open and we look forward to receiving nominations for more outstanding teachers.

We value feedback from our readers so please do continue to keep us posted about what you find most useful and interesting in our newsletter, and please do keep sharing it with anyone else who would like to receive practical classroom support, news and PSTT updates.

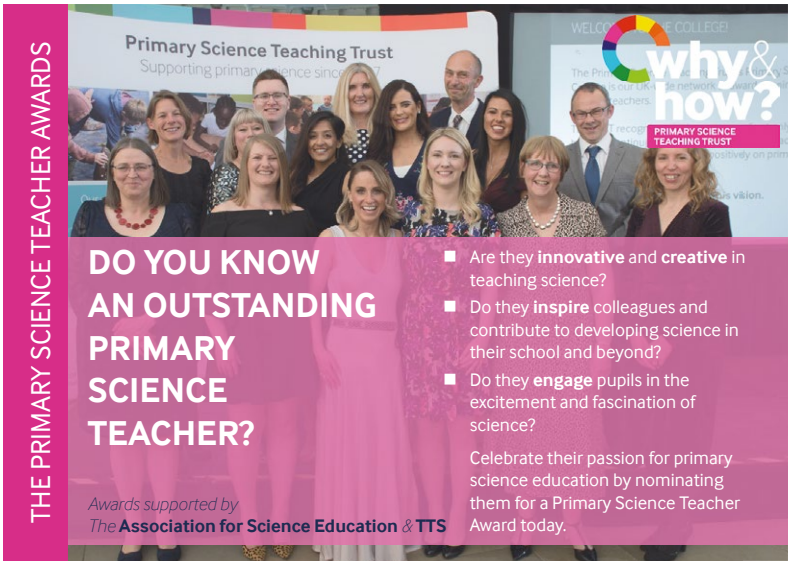
Prof. Dudley Shallcross
CEO

Ali Eley
Academic Director

Dr. Sophie Franklin
Cluster Director

Sue Martin
Programme Director

News



Molliebird wins ASE Book of the Year 2019

PSTT were delighted to hear that **The Molliebird** was selected for the Association for Science Education's **Book of the Year 2019** award.

Beautifully written as a narrative poem by PSTT Fellow Jules Pottle, and exquisitely illustrated by PSTT Fellow Rufus Cooper, The Molliebird tells the story of natural selection.

The Molliebird provides a highly engaging fictional context for discussion about evolution. The story skilfully supports teachers with how to identify and address children's misconceptions about inheritance and changes within species. A free to download teacher's handbook (available on the PSTT website) includes background information, additional supporting ideas and cross-curricular activities.

Many congratulations to Jules and Rufus on this success!

Primary Science Teacher Awards 2019

We are delighted to announce the winners of the Primary Science Teacher Award 2019 and send them our warmest congratulations:

Alex Farrer
Wimbledon High School, London

Carl Luke
Hotspur Primary School, Newcastle

Emily White
St Gregory's RC Primary School, Stoke

Emma Crisell
Richard Taylor CE Primary School, Harrogate

Haf Hayes
Ysgol Pencae, Cardiff

Ian Griffiths
Timberley Academy, Birmingham

Liz Southwell
Raysfield Schools, Federation, Chipping Sodbury

Molly Fletcher
Hilderthorpe Primary School, Bridlington

Nathan Williams
St Peter-in-Thanet CE Junior School, Broadstairs

Nicola Connor
Peel Primary School, Livingston

These outstanding teachers will join the PSTT College as Fellows from September 2020 and we look forward to celebrating their achievements at an Awards Dinner planned for October 2020.

Nominations are now open for the 2020 Primary Science Teacher Awards. Submissions should be made via the **PSTT website**.

PSEC special issues

Following the huge success of PSEC 2019, we are delighted that two special journal issues are now available to download from the ASE website. **Primary Science** is a bumper issue – full of practical ideas and strategies based on workshops delivered at PSEC. The **Journal of Emergent Science** includes articles based on a wide range of conference presentations and workshops. Organised in three sections: professional learning, pedagogy and STEM, the articles bring a theoretical perspective to the ideas presented. See the **research update** pages for more information

INTERNATIONAL PSEC Primary Science Education Conference

Outstanding Professional Development for all Primary Science Educators

Linking cutting-edge real science research to the primary science curriculum

Fellows of the PSTT's Primary Science Teacher College, who have backgrounds in science research and experience teaching in primary classrooms, are using their expertise to gather recent research papers (published within the last two years in peer-reviewed journals) and to write articles which explain cutting-edge science research in language that primary children can understand. These '**I bet you didn't know...**' articles explain what scientists have done and what they have discovered, suggest questions for children and teachers to consider in the classroom and describe activities that children can do to mirror the research.

We include an '**I bet you didn't know...** 'article in each of our newsletters. These and **the whole collection** can be downloaded from our website. New articles will be added to the collection approximately once a month so do keep checking to see what is new.

PSTT Authors of 'I bet you didn't know....' articles are:

Professor Dudley E. Shallcross
Dr Alison Trew
Dr Craig Early
Dr Julia Nash
Dr Katharine Pemberton
Dr Rebecca Ellis
Dr Paul Tyler

Find out more about these authors and their scientific research here

Science on Stage 2019

The PSTT was proud to support **College Fellows Sarah Eames, Paul Tyler, Robin James** and **Kathryn Horan** at Science on Stage 2019 as part of the UK delegation. Their projects were selected for this international celebration of science education in Cascais, Portugal and it was a wonderful opportunity for them to share their ideas with primary school teachers from across Europe. Paul's project considered developing children's Science Capital; Sarah promoted our City Science Stars resources; Kathryn presented ideas for low-cost and recycled science and Robin shared a 'hula hoop hundreds and thousands Hadron collider'.




Additionally, we congratulate **Emma Crisell**, who has recently been selected for a Primary Science Teacher Award 2019, and was awarded 'Highly Commended' in the joint projects category for a collaborative project with Italian teacher Frederico Andreoletti. We look forward to welcoming Emma to the PSTT College in September this year.

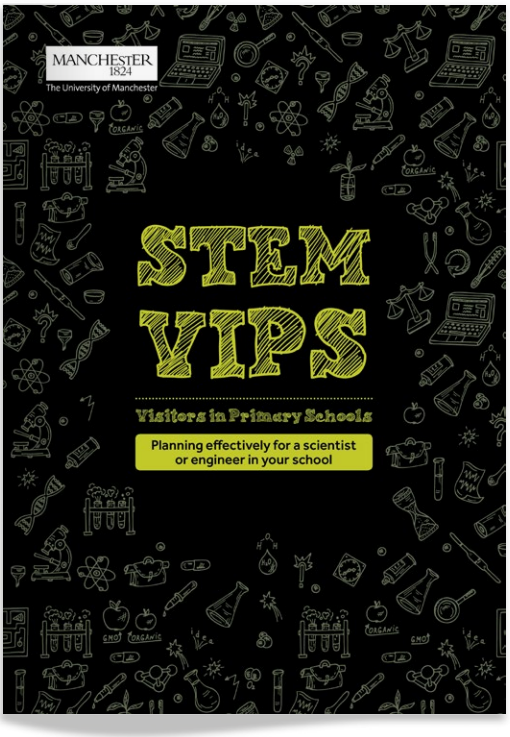
Appointment of new PSTT Trustee

The PSTT Trustees are delighted to welcome Judith Wright to the board. Judith Wright is a Chartered Accountant and currently leads the AstraZeneca Global R&D BioPharmaceuticals Finance team.

Judith has close to 20 years' experience with AstraZeneca working across Commercial, Supply Chain, Business Development and Research & Development. From 2015 and 2018 Judith lived and worked in Japan as the CFO for AstraZeneca KK; this also included a period as the interim General Manager. Judith graduated from Loughborough University and started her career in public practice working in Corporate Finance and Corporate Recovery.

STEM Volunteers in Primary Schools (STEM VIPS)

Dr Lynne Bianchi and colleagues at the Science and Engineering Education Research and Innovation Hub (SEERIH) at the University of Manchester have worked with PSTT Fellow Eleanor Atkinson to produce a fantastic booklet to support schools with making the most of STEM visitors in school. The booklet includes advice and templates to help teachers: find appropriate visitors, plan the visit, prepare the children to be ready to engage fully with the experience, and extend the impact the visit with follow-up work. STEM VIPS is free to download from the Great Science Share website - you can access it here by clicking on the cover image.



PSTT Resources now available from TTS Group

PSTT is pleased to announce that our commercial resources are now available to buy through from TTS.

PSTT and TTS share an ethos to put teachers at the centre of everything we do, with the aim of inspiring the children we teach. With the demand for PSTT products growing significantly over the last year, it was important to find a partner to ensure we can both meet demand and retain competitive pricing, enabling as many teachers as possible to access our resources.

Full details of all our products remain on the PSTT website, with direct links to the TTS website for purchase and your school will have received a copy of the latest TTS catalogue, where you can browse them along with excellent TTS resources created specifically for the primary science classroom.

Click the logos for PSTT resources and the TTS website:

why & how?
PRIMARY SCIENCE TEACHING TRUST

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Royal Society working with the PSTT

The PSTT has a strong relationship with the Royal Society and encourages all schools to join the Royal Society Schools Network. Numerous PSTT College Fellows have successfully applied for Royal Society Partnership Grants in the past to enable them to undertake innovative, investigative projects linking their pupils to someone working in a STEM related profession, such as a researcher or analyst.

PSTT College Fellow Robin James shares his experience of the Royal Society Partnership Grant

Maybe you're in the position I was this time last year? You have an idea; you'd like to get it off the ground; but...

Whatever the obstacles standing in your way, the Royal Society Partnership Grant is sure to help in overcoming them. It's available for STEM-based projects for 5–18 year-olds and about £1.3 million has been awarded to more than 800 schools since the scheme started in November 2000. A grant of up to £3,000 could be on the cards and make all the difference in getting your project off up and running.

The key word is 'partnership'. The Royal Society want to support projects that bring children, young people and their teachers together with experts from the worlds of industry and academia. And who wouldn't welcome a helping hand from an expert partner such as a university researcher or, in the case of my own project, civil, automotive and naval engineers? Bringing such brilliant individuals into school and seeing them work through challenges with groups of children benefits everyone. You may already do this. If so, all you need is an idea for a project. If not, shout out to your local community or contact the STEM Ambassadors Hub for your region through the National STEM Centre.

My project, to give an example of a successful application, was called The Mars Rover Challenge. It involved teams of children in four schools designing, testing and building vehicles that could cross simulated Martian terrain: rocky, dusty and stony. Each school held its own heats to determine its most successful rover as well as a second chosen for the quality of teamwork. These were taken to our local observatory (Norman Lockyer in Sidmouth) for a special day-long event which ended with a surprise extra challenge: making a parachute to land the rover. We scaled down, of course, substituting eggs for rovers and testing the chutes for accuracy and softness of landing (i.e. unbroken eggs!) in the largest and oldest of the telescope domes.

Our STEM Ambassadors were invaluable both on the day of the event and in the run-up to it. Especially motivational was a visit to all four schools by engineer Kathryn Waring. For girls particularly, it was inspiring to have a woman engineer talk through the construction challenges involved in building bridges, tunnels and railway stations. This visit set us off on our own space-based construction challenge.

Our partnership will last way beyond the Mars Rover Challenge. As a new term comes into view, we're already planning a stargazing camp using the telescopes we received from charity Scopes4SEN (another recommendation!). We've set up a WhatsApp group to make it simpler for teachers across the four schools to seek the support of our ambassadors. We want children to benefit from a range of skill sets. The Royal Society's support through the Partnership Grant has enabled this to happen and I thoroughly recommend it.

Be part of the Royal Society Schools Network and

Help research come alive in your classroom

By signing up to the Royal Society Schools Network you will have first-hand access to the latest opportunities and resources available for use in the classroom. Whether it is accessing funding opportunities via our Partnership Grants Scheme, accessing funded CPD, or using the Brian Cox School Experiments, the Royal Society Education Outreach team are committed to supporting teachers to undertake experimental work and problem solving activities across the STEM subjects.

Brian Cox School Experiments

A series of six simple experiments covering subjects from clean water to melting chocolate. Each experiment comes with resources and four short videos to support the teacher through set-up, the scientific method and health and safety. One of the videos shows the real world context of the science being investigated – a great way to get your pupils enthused.

To obtain a free copy of all 24 videos and related resources, please email your contact details to **education@royalsociety.org**

Partnership Grants Scheme

Funding of up to £3,000 is available to enable pupils across all Key Stages to carry out investigative projects in all STEM subjects. The funding, which is used to purchase equipment not normally found in UK schools, must be applied for in partnership with a STEM professional (from research or industry).

To find more information about the scheme, visit: **royalsociety.org/partnership**

Applications for 2020 open on Monday 3 February.

THE ROYAL SOCIETY

For more information about the Royal Society Schools Network, please visit: **royalsociety.org/schools-network** or email the team at **education@royalsociety.org**

CLIMATE SCIENCE

Supporting Resources for the Primary Classroom

PSTT Fellow Paul Tyler shares his Topical Science Update about Climate Change

topicalscienceupdates@gmail.com

PSTT is working hard to support climate science education for primary children. In this Climate Science section, we share the outputs, updates and ideas from some of the initiatives we are developing.

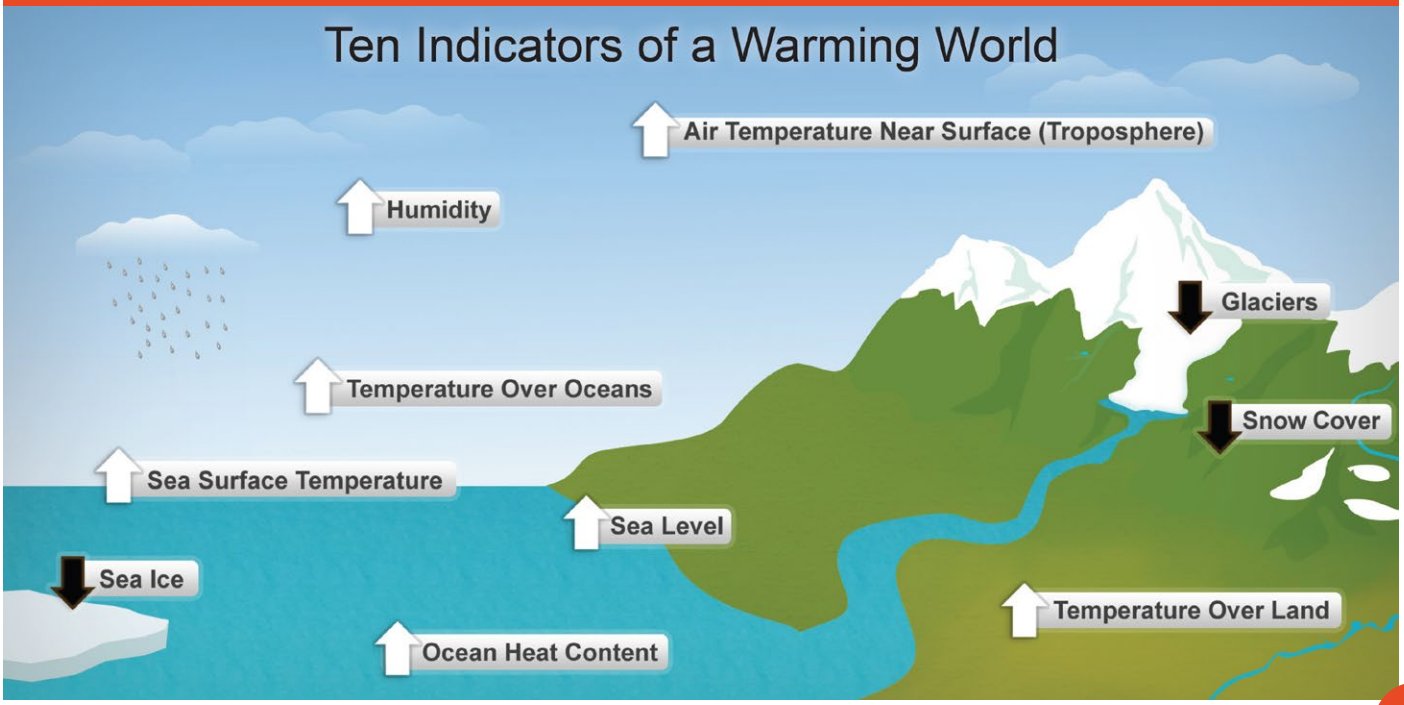
What is Climate Change?

Climate is an average measure of the weather conditions for an area over a long period of time, typically 30 years. Scientists have been closely monitoring the Earth's climate for the last 150 years and in that time they have observed significant changes in the global climate. As well as immediate measurements, scientists are able to study Earth's climate changes over 1000s of years using ice core samples, ocean sediment analysis and fossil records. They have measured that global temperatures are increasing faster than at any other time in Earth's history and they conclude that the increases are directly linked to a variety of human activities.

Why does Climate Change Matter?

But why does climate change matter? Surely if the Earth is getting a bit warmer, we can just enjoy nicer summers and more ice cream? Unfortunately changes in global climate don't just mean it's going to be a bit warmer. Melting ice caps, rising sea temperatures, ocean acidification and increased natural disasters are just some of the effects of long term climate change. The global population continues to rise - 7.6 billion on 16th July 2018 – and all these people need food, water, accommodation, transport and energy, all of which draw on the Earth's natural resources and affect climate change.

Ten indicators of global warming



Why do people talk about it as the Climate Change Debate?

Science tells us we have a problem that affects all of us, so surely we can all pull together to solve it? That'd be great, wouldn't it? Unfortunately it's not quite that simple. Science is often influenced by politics and economics; global leaders hold the power to make real change - most of them agree, but not all of them, hence the word debate which is unhelpful.

The Energy Issue

Seven and a half billion people use a lot of energy! In the last 50 years, global energy consumption has more than tripled and shows no signs of slowing down. More concerning is the fact that, even with advances in renewable technology, we still get about 75% of our energy from non-renewable fossil fuel sources: gas, coal and oil. Energy scientists and engineers are constantly working on new solutions and improving current technologies to meet the growing needs of an energy-hungry global population.

Read more about:
Non-Renewable Energy
Renewable Energy
Energy Sources

Wind and solar power – examples of renewable energy

Power from burning fossil fuels – an example of non-renewable energy

Pollution Problems

Pollution is closely linked to society's increasing demands for energy. Burning fossil fuels produces carbon dioxide which is a greenhouse gas. The build up of CO_2 in the atmosphere traps more heat from the Earth that is trying to escape to space, with some of that trapped heat being redirected to the Earth's surface, causing warming. Other significant contributors to the global pollution crisis are deforestation, concrete production and agriculture. Pollution is also linked to a number of serious health issues, such as asthma, which are on the rise globally.

Other large scale agricultural pollutants are fertilisers and pesticides, which are sprayed on crops and often run off into streams and rivers polluting water supplies.

Read more about:
The Greenhouse Effect
Carbon

Australian Bushfires

Bushfires are common throughout Australia, but since September 2019 they have been raging out of control across South Eastern regions of the country, leading to thousands of people having to abandon their homes to escape not just the fire itself, but the polluted air caused by the fires. Bushfires are most likely to start when the weather is very dry and very hot. The hotter it is, the more likely a fire will start, or carry on burning and if it is windy, this can spread the fire very quickly. Sometimes they are started by human activity which may be deliberate or accidental, but they can also start naturally, e.g. because of lightning.

How did the fires start in Australia?
What is it like in Australia for kids right now?

Please note that PSTT assumes no responsibility for any advertising or other content that readers may encounter when following the links suggested in this article.

Trophic Cascades

Until the 1960s it was thought that ecosystems were always controlled by the primary producers: green plants. It was then discovered that top predators can also play a significant role in determining the success of ecosystems. These predators not only affect their own specific ecosystems, they can have a significant effect on keeping the global ecosystem balanced.

Read more about:
How Wolves Change Rivers
How Whales Change Climate

Questions to support children's discussions and research

- *What can we do in our school to reduce the amount of energy we use?*
- *What can we do as individuals or families to reduce the amount of energy we use?*
- *Can we find out which human activities contribute most to climate change?*
- *Why might some countries and companies not want us to worry about climate change?*
- *Can we find out how climate change could affect our lives in the future?*

Useful websites
Climate change guide
World Population Counter
The 2° Problem
Effects of Climate Change
The Paris Agreement

We are grateful to Paul Tyler for sharing this resource on which this article is based. To subscribe to the mailing list for Paul's FREE Topical Science Updates, please e-mail him on **topicalscienceupdates@gmail.com**

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 enquiry. 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.

WHAT TO DO

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

Why do you think the lemons are floating and the limes are sinking?

Other questions to generate and promote thinking and explaining

What similarities do lemons and limes have?

What might be different about them that means the lemons are floating and the limes are sinking?

What other fruits are similar to lemons and limes? What do you think would happen to slices of other similar fruits?

The children may suggest reasons such as:

- *The slices of lemon are bigger/thicker than the slices of lime*
- *The skin and/or pith on the lemons is thicker/ thinner than the skin on the limes*
- *The thickness of the skin relative to the size of the whole fruit is different*
- *The composition of the skin/pith/fruit centre is different*
- *The lemons/limes have been in the water longer*
- *One of the fruits was older than the others*

The children could carry out an enquiry to test some of their explanations. They could include other oranges or other citrus fruits in their tests.

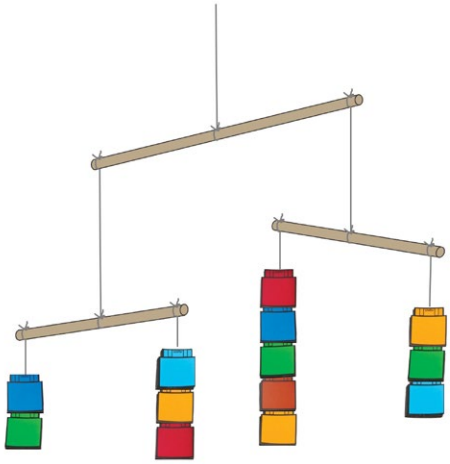
CLICK TO DOWNLOAD IMAGE

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. It is specifically designed to encourage the children to work scientifically to design and make something or to solve a problem.

This issue's Why and How Challenge is to make a mobile. There are lots of different ways to make decorative mobiles, e.g. hanging things from a wooden hoop or using coathangers, but making one using separate wooden sticks and thread provides a great opportunity for children to explore concepts relating to balance and centre of mass.



Making a mobile – can you make it balance?

The challenge for the children is to adjust the position of the strings so that with different numbers of objects hanging off each end of the sticks, the wooden sticks still remain horizontal.

This activity also supports learning about levers – for more about levers please see the misconceptions section of the spring 2019 issue of Why and How?

RESOURCES

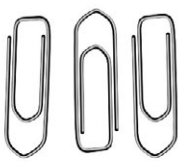
Thin wooden sticks (dowel or similar)

Thread or thin string

Sticky moulding material to stop the threads from slipping on the wood

Selection of objects to hang from the mobile, e.g.

Unifix cubes



Paper clips

Wrapped sweets

WHAT TO DO

1. Start by making a simple mobile just using one stick.
2. Get the children to attach a thread to the middle and at each end of the string. The middle thread will be from them to hold the mobile.
3. Ask the children to take 2 identical objects that they can hang on each end of their mobile, e.g. paper clips or unifix cubes.
4. When they have attached the objects to the string, ask them to make sure it balances when they hold it up.
5. When they have mastered this, challenge them to add a second object to one of the strings and adjust the central string so that their mobile is still balanced.
6. Once they have got the hang of things, challenge them to add more objects and also more wooden sticks.
7. Can they use three sticks with different numbers of identical objects hanging on each string?
8. What about five sticks?

Hint: If the children find the thread slips on the wooden sticks, they could use small amounts (as small as possible, as it will change the mass of the stick) of moulding putty to anchor the thread in place.

INCREASE THE CHALLENGE

- *How big a mobile can the children make?*
- *If they are using paperclip chains, each one paper clip longer than the previous, what is the longest chain they can add to their mobile?*
- *Which class in the school can make the biggest mobile?*

Why not use one of our Why and How? Challenges as a whole school science day or competition?

If you haven't already, you might like to try our other Why and How? Whole school science challenges. Most can be run as a whole school science day or competition.

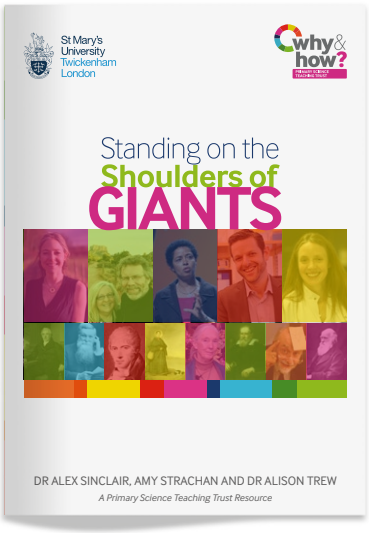
WHAT ABOUT .....

- *How can we make the slowest paper spinner?*
- *Whose rubber band car can go the furthest?*
- *Who can find the greatest number of living things?*
- *How can we make the longest mechanical chain reaction?*
- *How many different ideas can we have for doing science with everyday objects?*
- *Whose O ring glider will travel the furthest?*

See **Why and How** Challenges for further details.

FREE RESOURCES
from PSTT's own collection

Standing on the Shoulders of GIANTS

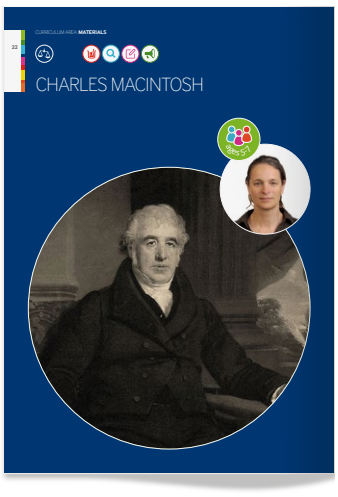


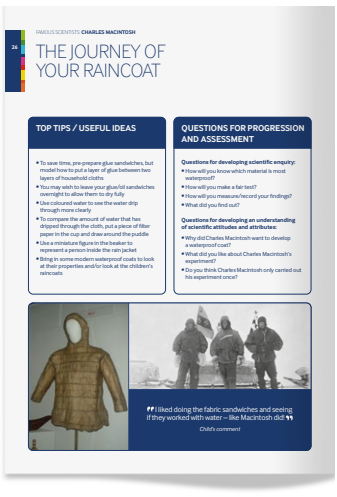
This new and popular resource makes meaningful cross-curricular links between history and science through a focus on developing scientific understanding and the skills of working scientifically.

Written by Dr Alex Sinclair and Amy Strachan (St Mary's University) and PSTT Fellow Dr. Alison Trew, *Standing on the Shoulders of Giants* offers a series of engaging practical investigations based on the scientific work of a historic figure that encourage children to generate their own questions to explore and develop their understanding further. The resource links the work of 10 famous historic scientists to the work of contemporary scientists, giving children an appreciation of how wider scientific understanding develops over time.

In this issue we are including a whole unit based on the work of Charles MacIntosh. The following pages show some of what is included in the unit and you can download the full unit completely FREE. There are two documents to download: the "**SOTSOG MacIntosh book pages**" and the "**SOTSOG MacIntosh teacher resources**"

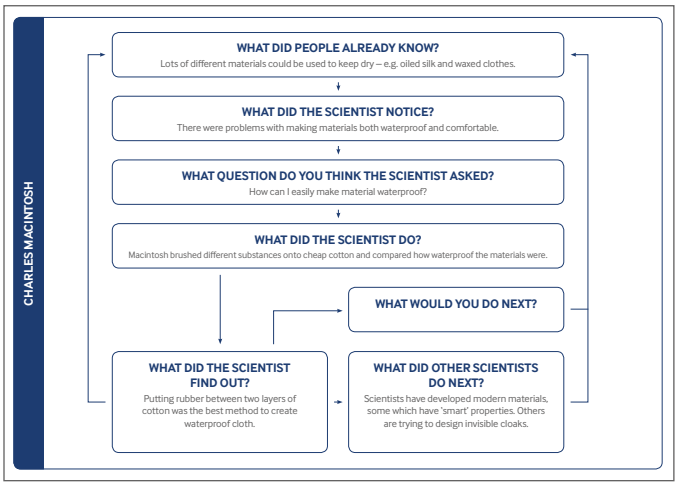
Please visit ***Standing on the Shoulders of Giants*** for further information about the full resource.



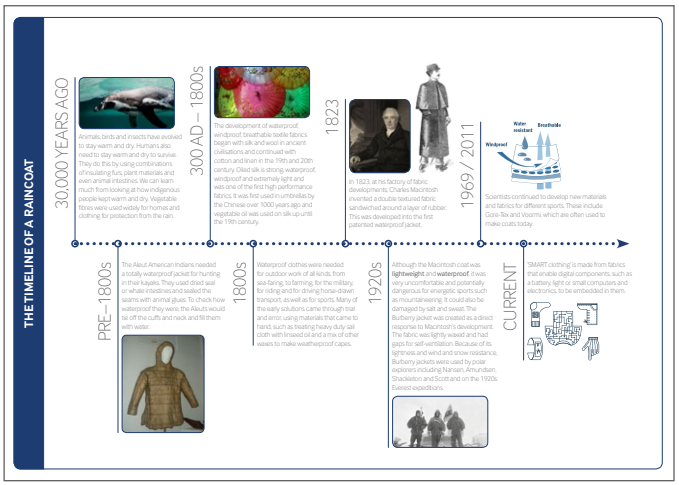


In the book, teachers are provided with a detailed and resources for each scientist.

A template provides a useful structure for the lesson, helping children to appreciate how ideas have changed over time and to consider what the scientist noticed and the questions they asked. Giving consideration to the various methods of scientific enquiry, details are provided to help children carry out a similar practical investigation and compare their results. They are then given an opportunity to consider what they would do next and the teacher is provided with examples of ways that contemporary scientists have worked in the same field. A timeline puts the work of the scientist into context.

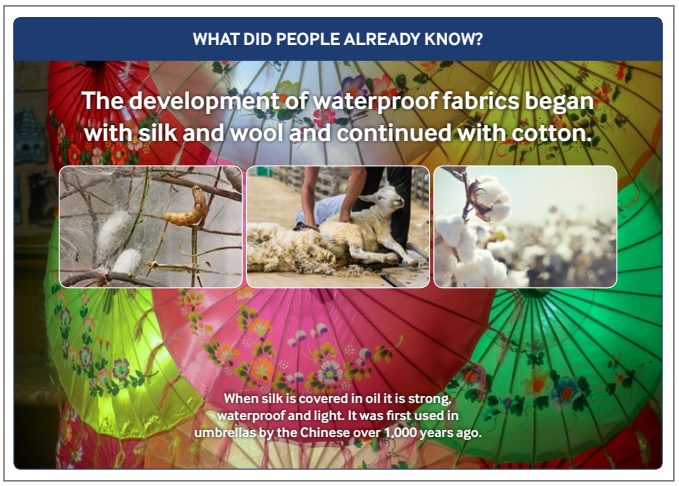


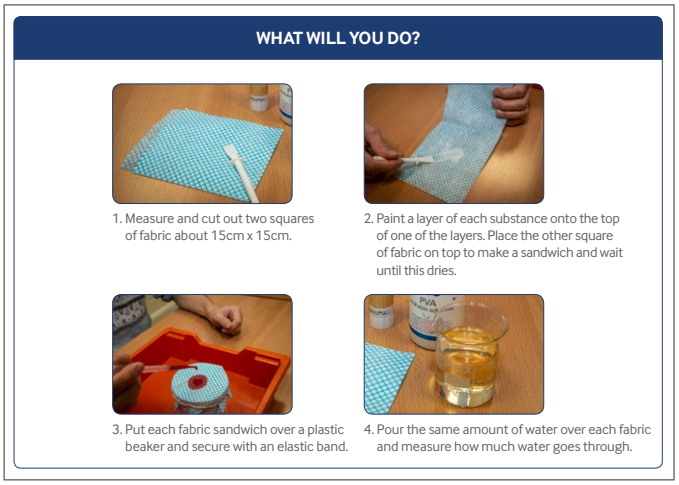
Template

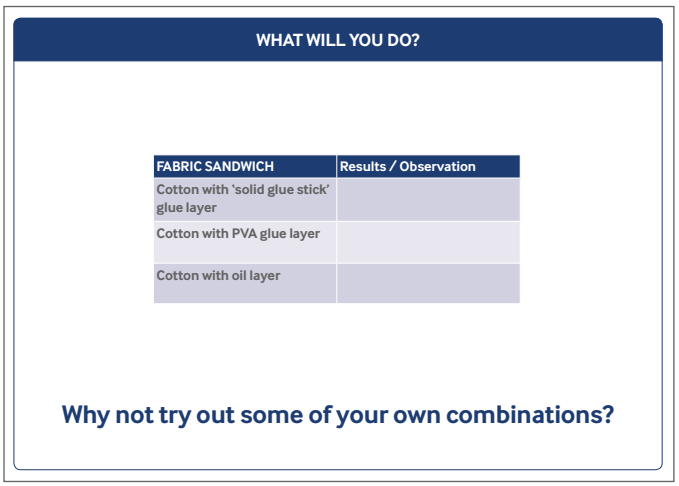


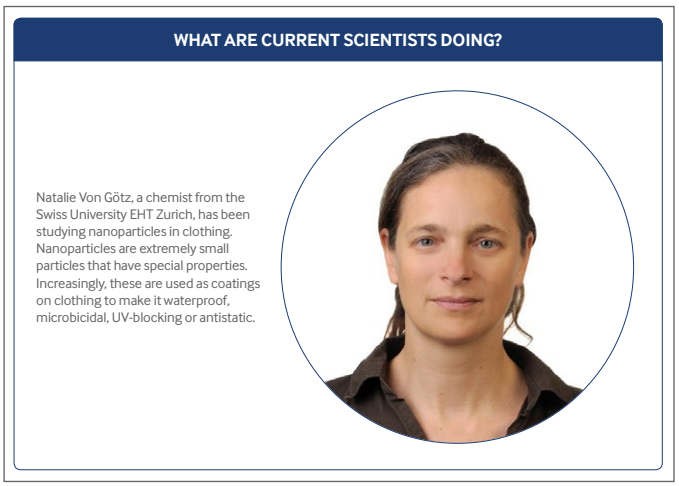
Timeline

Further detailed support for the lesson is provided in a digital classroom presentation to support teachers in guiding children to understand the historic context, ask meaningful questions and undertake their own practical investigations, enabling them to see themselves as scientists.









A selection of screens from the Classroom Presentation

FREE RESOURCES
from PSTT's own collection

In this issue, in addition to the sample unit from one of our best selling resources, Standing on the Shoulders of Giants, we also bring you two further resources: our brand new Enquiry Approaches and Enquiry Skills

Enquiry Approaches and Enquiry Skills

The resources define six different types of enquiry, and also seven core enquiry skills. Each enquiry type and each enquiry skill has a particular symbol linked to it; these symbols are free to download and use. You might find them helpful for ensuring that children make progress with science enquiry, and they also provide useful guidance and support for other teachers.

ENQUIRY APPROACHES

Comparative / fair testing
Changing one variable to see its effect on another, whilst keeping all others the same.

Research
Using secondary sources of information to answer scientific questions.

Observation over time
Observing changes that occur over a period of time ranging from minutes to months.

Pattern-seeking
Identifying patterns and looking for relationships in enquiries where variables are difficult to control.

Identifying, grouping and classifying
Making observations to name, sort and organise items.

Problem-solving
Applying prior scientific knowledge to find answers to problems.

ENQUIRY SKILLS

Asking questions
Asking questions that can be answered using a scientific enquiry.

Making predictions
Using prior knowledge to suggest what will happen in an enquiry.

Setting up tests
Deciding on the method and equipment to use to carry out an enquiry.

Observing and measuring
Using senses and measuring equipment to make observations about the enquiry.

Recording data
Using tables, drawings and other means to note observations and measurements.

Interpreting and communicating results
Using information from the data to say what you found out.

Evaluating
Reflecting on the success of the enquiry approach and identifying further questions for enquiry.

I BET YOU DIDN'T KNOW...

Whale song is changing

Dr. Alison Trew, PSTT Area Mentor and Website Resources Developer, links cutting edge research with the principles of primary science

alison.trew@pstt.org.uk

Have you ever wondered what sounds there might be deep in the oceans?

Nature films are often soundtracked with meditative music so you may not have thought about this. Scientists have been monitoring the oceanic acoustic environment for many years and have shown that abiotic processes (earthquakes and volcanic activities), human activities (shipping, seismic exploration of subsurface deposits of crude oil, natural gas and minerals) and biotic sources (animal sounds) all contribute to this. Whales dominate the low-frequency range (low pitch) of many recordings.

Scientists know that whales use a variety of sounds to communicate verbally: clicks, whistles and pulses (which sound like squeaks to the human ear). Whales also use their tails and fins to make loud slapping noises on the surface of the water to communicate nonverbally. Discussing types of whale communication with children could be an interesting way to explore and learn about sound and environmental change.

Figure 1. An adult blue whale (Balaenoptera musculus), up to 29.9 m in length and a maximum recorded weight of 173 tonnes, it is the largest animal known to have ever existed.

Figure 2: A pygmy blue whale. Calls from Antarctic and pygmy blue whales, and fin whales were analysed at sites across the Indian Ocean

Questions children might like to consider:

How do whales communicate?

How is this different from how humans communicate?

Consider both verbal and body languages.

What about other animals?

What is happening when we make sound?

Children could explore many types of sound to develop an understanding that sound originates with a vibration.

Do you know what is meant by high and low pitch (the frequency of sound)?

Children could be asked to demonstrate their understanding by making appropriate sounds!

A 'sound' background

Sound is a pressure wave vibration of molecules. Whenever molecules vibrate, they will lose some energy to heat. Because of this, sound is lost to heating of the molecules in the medium it is propagating through. Consequently, a sound wave can only propagate through a limited distance. The attenuation of sound waves is frequency dependent in most materials. In general, low frequency waves travel further than high frequency waves because there is less energy transferred to the medium.

Sound research

Scientists have known for some years that whales emit low frequency calls (<100 Hz) which travel up to several hundreds of kilometres. They have also known that the frequency (pitch) of blue whale calls is decreasing worldwide but the reasons are unknown.

Recently, researchers have analysed acoustic data from six sites in the Indian Ocean over 7 years. They have shown a long-term frequency decrease (reduced pitch) for the call of the Antarctic blue whale, pygmy blue whales and the fin whale. To help children understand what this means, they could investigate how the pitch of a sound can be changed by tapping or blowing over bottles containing different amounts of water, or twanging rulers (details of investigations can be found in the Teacher Guide).

The researchers suggest that the long-term decrease in call frequency must have a long-term cause and describe two possibilities. The population density of the whales may have increased since the International Whaling Commission (IWC) banned commercial whaling because of the extreme depletion of most of the whale stocks. If whale numbers have increased, the interindividual distance is reduced and the need for whales to raise their call intensity (loudness) is reduced. Scientists believe that the intensity of the whale's call and its frequency are linked: low-level (quieter) calls have lower peak frequencies (lower pitch) than high-level (louder) calls. Thus, the lower frequencies of calls observed might be a result of an increase in the whale population. Alternatively, the acidification of the oceans since the industrial age has resulted in decreased sound absorption and therefore an increase in the distance the sound can travel. This means that for a given distance, the whales could lower their intensity of call and this might facilitate the lower-frequency calls.

In addition, the researchers have shown short-term cyclical call-frequency changes in Antarctic blue whales, fin whales and the Madagascan pygmy blue whales which follow the seasonal changes in ambient noise levels at similar frequencies. For example, the Antarctic blue whale low-frequency noise level increased during the austral summer (January to February) which is when most iceberg cracking noises are heard and decreased in the autumn (April to May) and winter. Because ship traffic (another potential source of noise) is limited in the southern Indian Ocean, the scientists suggest that the seasonal changes in whale calls could be due to the whales adapting to the seasonal changes in the ambient noise level. This adaptation to maintain the signal-to-noise ratio of vocalizations is known as the Lombard effect and has been demonstrated for birds, primates and for other species of whales.

Although noise levels are rising in other parts of the world ocean, there seems to be no effect on the worldwide frequency decline in whale calls. This presents a paradox: changes in environmental noise correlate with a short-term seasonal effect on the frequency of whale calls, but not a long-term effect. Scientists will need to investigate acoustic behaviour of other whale species in other parts of the world, along with monitoring the pH and acoustic properties of the ocean to find answers to this.

How can children investigate sound in their local environment in a similar way to the scientists who carried out this research?

Using data loggers or sound apps, children could investigate ambient noise levels in different locations, at different times of the day, in different weather conditions, or how sound intensity (loudness) varies with distance from the noise source. They may also consider how different materials might reduce the distance sound travels.

Apps for measuring sound frequency (pitch) are also available. Using an electronic sound source (a keyboard or computer) with fixed volume, children could investigate how far different frequencies of sound can travel and what effect different background noises have on this. Details of these investigations are included in the Teacher Guide (see figure 3).

Figure 3: Example pages from the accompanying Teacher Guide PowerPoint presentation.

GLOSSARY

Sound intensity
relates to the loudness of the sound (measured in decibels) which depends on the energy or power of the sound wave and how far the sound wave travels from its source.

Sound frequency
the number of vibrations per second (measured in Hertz) which determines the pitch ('higher' and 'lower' sounds associated with music)

The research paper that generated this work was:

Long-Term and Seasonal Changes of Large Whale Call Frequency in the Southern Indian Ocean
By Emmanuelle C. Leroy[1], Jean-Yves Royer[1], Julien Bonnel[2], and Flore Samaran[3].
Journal of Geophysical Research: Oceans, ***123****, 8568–8580.*
https://doi.org/10.1029/2018JC014352 Accessed Oct 2019

[1]University of Brest and CNRS Laboratoire Géosciences Océan, IUEM, Plouzané, France.

[2]Woods Hole OceanographicInstitution, Woods Hole, Falmouth, MA, USA.

[3]UMR CNRS 6285 Lab-STICC, ENSTA Bretagne, Brest, France.

PSTT COLLEGE SNAPSHOT

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

Greg Mace

South London

Head of ASD unit at a primary school

Year of award: 2013

Most used piece of equipment in your science cupboard?

I do use the smoke machine a lot! Great for vortex cannons, lasers and light, movement of the air around us, creating a sense of excitement and, of course, the school disco.

Most enriching off-site science trip?

Rolling up my trousers to go into the local river to dip for invertebrates. I love the excitement and surprise when the young people look into their nets and find that as well as old shopping trolleys and shoes there's a whole unseen world full of alien lifeforms teeming in their nets.

Best idea for an observing over time investigation?

I always enjoy our annual micro-organism version of 'Crufts'. Each young person learns about mould and micro-organisms and the conditions that promote their growth and then sets up their own. After a couple of weeks we take our colourful and exotic friends around a course judged by a member of SLT.

Beth Budden

South-East London

Year 3/4 Leader
Pedagogy Development Leader

Year of award: 2014

Most used piece of equipment in your science cupboard?

Timers – quite a few different types of investigations such making observations over time and pattern seeking need these. Plus children love pressing the buttons and it prompts them to start recording their findings.

Most enriching off-site science trip?

Local pond in our park for pond dipping - the amount of life hidden beneath the water amazed the children. Matching their finds to identification sheets is always engaging and using nets never fails to excite. Most local ponds are available to use and the equipment isn't that expensive. It also teaches young children how to be safe near bodies of water. I've never had anyone fall in yet!

Best STEM visitor you have had in your school?

Tim Harrison from the chemistry department at Bristol University – the children were enthralled to see chemistry in action with all the bangs and whizzes, all with comprehensive explanations. It is worth contacting your local university to see if they have any outreach science activities or demonstrations.

Katharine Pemberton

Devon

Teacher and science lead

Year of award: 2019

Most enriching off-site science trip?

Before becoming a teacher, I did some work on reproduction in flies and decided to use this experience during a year 5 topic on life cycles. We visited a local cow field and collected dung flies from the cow poo. Back in the classroom we kept them in mini-tanks, watched the eggs develop and produced our own generation of flies. The health and safety form took a bit of time to complete!

Best STEM visitor you have had in your school?

A few years ago a local beekeeper came to visit us. The children were immediately engaged as they were allowed to try on her protective clothing. More usefully, her presentation, delivered as a non-scientist and someone the children knew from the village, really helped them understand pollination and how humans can exploit it.

Vanessa Seehra

London

Early Years and Y1 Leader, Science Lead

Year of award: 2018

Most used piece of equipment in your science cupboard?

Easi-Scope: I think this is a great tool for generating discussions in class and for creating your own zoom in/zoom out activities, giving the children an opportunity to apply their current learning and to recall previous scientific learning.

Best video for supporting the development of children's scientific understanding?

Emma Watson's video about the Global Goals This video really helps children to understand how important science is in supporting us to resolve real world problems. When linked with the challenges from the Practical Action website, it can help children to see how science can make a huge difference to their lives and others all around the world.

Angharad Pass

Leeds, West Yorkshire

KS2 Teacher and Science Lead

Year of award: 2018

Best video for supporting the development of children's scientific understanding?

I love the Explorify 'What's Going On?' videos. My particular favourite is 'On Thin Ice' – a short David Attenborough clip of three polar bears moving on ice. It promotes discussion about animals and their habitats and forces, and can also lead onto discussions about adaptation and evolution.

Most recommended book for supporting teaching in science?

Explore, Engage, Extend by Tracy Tyrell supports teachers to make accurate assessments about where children are with a science topic, to spot misconceptions and to address them.

Janine Carpenter

Stoke On Trent

Year 2 Teacher and Science Coordinator

Year of award: 2014/15

Most enriching off-site science trip?

Our local wildlife centre. We saw owls and other raptors in flight. At the centre the children observed a variety of animals up close. They were able to handle them and discuss them in detail with the keepers – a very hands-on day.

Best video for supporting the development of children's scientific understanding

The introduction to Science Capital animation made by Louise Archer and her colleagues at King's College, London – this is for teachers rather than children, but is really helpful for teachers to develop understanding of how to build a child's confidence and interest in science.

RESEARCH UPDATE

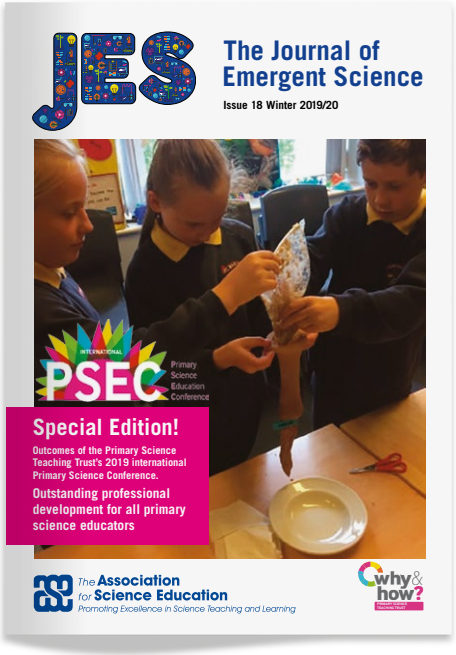
PSEC SPECIAL ISSUES OF PRIMARY SCIENCE AND THE JOURNAL OF EMERGENT SCIENCE

We are delighted that these two special issues are now available to download from the ASE website.

Primary Science is a bumper issue, giving a wealth of practical ideas and strategies based on workshops delivered at PSEC. The articles cover a variety of themes including pedagogical approaches and strategies, teaching science in exciting contexts, ideas for teaching particular concepts and practical suggestions for developing skills of working scientifically. Each article presents tried and tested methods that can be replicated in your own school setting.

Download here

The Journal of Emergent Science includes articles based on a wide range of conference presentations and workshops. Organised in three sections: professional learning, pedagogy and STEM, the papers bring a theoretical perspective to the ideas presented. The professional learning articles include contributions from colleagues at SSERC who draw on extensive experience of developing teachers mentors in clusters of schools, and PSTT Fellow Kathy Schofield presents her research into using co-teaching to raise teacher confidence. The pedagogy section covers a wide range of interest, including creativity, development of children's scientific questions and the development of understanding of science skills. The papers in the STEM section focus on raising career aspirations, family learning and using science demonstrations in assemblies.



Download here

Stranmillis College – A model for excellence in primary science in Initial Teacher Education

Stranmillis College in Belfast developed the Stranmillis Primary Science Accreditation programme to recognise pre-service teachers' innovative practice in primary science. The programme aims to serve as a 'Community of Practice' for student teachers with respect to primary science and to establish mindsets and dispositions to professional development which will be sustained throughout their professional careers. The programme encourages student teachers to develop their science teaching skills and to engage in additional professional development activity in primary science. Successful completion of the programme enhances their professional profile and their future employability.

Colleagues at Stranmillis College have produced a full report to outline the theory and rationale that underpin this accreditation programme. They have also written a guide to support other initial teacher education providers to develop similar initiatives in their own settings. Please click on the images below to download the report and guide.

Stranmillis has carried out significant research into other areas of primary science education. These include playful approaches, use of iPads, co-teaching and micro-teaching. For further details about these developments please see their **website** or contact the above:

Download here

Download here

Dr John McCullagh

Dr John is a Senior Lecturer in Science Education at S tranmillis University College, Belfast and a Fellow of The Royal Society of Chemistry. His research interests include the pedagogy of initial science teacher education.

J.McCullagh@Stran.ac.uk

Dr Andrea Doherty

Andrea is a Senior Lecturer at Stranmillis University College, Belfast. She lectures in Early Years Education with STEM, and has research interests in playful pedagogy, primary science education and the pedagogy of initial teacher education.

A.Doherty@Stran.ac.uk

COLLABORATOR UPDATE

University of Manchester

QuSmart: Children's scientific question-asking

The Science and Engineering Education Research and Innovation Hub (SEERIH) at Manchester University are carrying out a two year study. **QuSmart** focuses specifically on how Key Stage 2 **children can develop routines to ask and build scientific questions**. Targeting a most fundamental habit of mind of scientists, scientific question-asking and development impacts on interest to enhance the child-focused or self-regulated approaches to working scientifically in the primary classroom.

As the interest in child-led learning permeates the sector, it is essential that greater understanding is developed as to how this can be achieved and ensure this without compromise to conceptual development within the framework of the national curriculum.

Project Aims:

1) To develop understanding about the nature of children's scientific questions;
2) To identify routines for children to learn how to ask and build scientific questions;
3) To improve teacher confidence to create learning opportunities and environment where children ask and build their own scientific questions.

What's the problem we want to solve?

Questions and questioning underpin the foundational habits of mind of scientists (Çalik et al., 2012). They are one of the most regularly used forms of communication from the early years. However, 'scientific questions' are specific and have a particular role to play in enquiry. A purposeful literature review was undertaken at the start of the project, which revealed a rich discourse around questioning, and in particular a focus on teacher questioning. Fewer articles looked specifically at children's scientific question-asking.

We continue to see primary school science having a lower profile than that of other core subjects (OFSTED 2013). Together with the impact of low Science Capital, this is limiting children's career aspirations (Kings College, 2013). In spotlighting 'scientific question-asking', we respond to the findings of the State of the Nation Report (Wellcome 2017) which suggested that child-led and child-designed investigations are undertaken 'occasionally' or 'never' in 47% of schools. Although there are initiatives and campaigns focused on addressing this, including the **Great Science Share for Schools**, we believe that there needs to be more focus on how the practice of children's scientific question-asking can be developed so that children can become increasingly self-regulated in the approach.

Children's question-asking and devising investigations to answer them has been the basis of curriculum reform since Science 5/13 (1972). Although an intention in many curricula since that time, evidence suggests that children still have limited opportunity for such activity (OFSTED, 2013).

The SEERIH team has drawn on the systematic evaluation of classroom-based science teaching and learning arising from the University of Manchester's Deep Dives Programme (2013-current) which continues to offer strong evidence of need for a power-shift in primary classrooms. What we notice is that teachers direct the flow of talk in the classroom based on their levels of confidence, their interests, and that which links most directly to pre-prepared resources and worksheets. This project will continue towards shifting the power dynamic, yet fully appreciating and enhancing the role of the teacher in the learning of science.

The QuSmart team at SEERIH includes Christina Whittaker, Amy Bonsall and PSTT Fellow Bryony Turford.

To keep updated on the progress of this project, please visit **www.seerih.manchester.ac.uk** or contact **fascinate@manchester.ac.uk**

The project will follow 3 phases of development involving teachers throughout. Core to understanding the project outcomes will be the clarification of key questions, including:

What is a scientific question?

What are scientific questions for?

When do scientific questions get asked within the enquiry process?

What is the role of the teacher in supporting children to ask scientific questions?

What routines can a child use and develop to ask and build their own scientific questions?

Dr Lynne Bianchi started her career as a primary school teacher in North Manchester. Since that time she has developed expertise in teacher professional development and curriculum innovation and research. She studied for her Masters at Manchester Metropolitan University and then her doctorate at Sheffield Hallam University, where she developed her area as a Principal Research Fellow. She founded the Science & Engineering Education Research and Innovation Hub at the University of Manchester in 2014. Her areas of work focus on improving science and engineering education through practice-led approaches with in-service teachers. Areas of interest include wonder-filled science education, tinkering-for-learning and enabling effective teacher professional development. She is an author and academic writer and has attained CSciTeach and RSA Fellowship. Lynne is also the founder of the Great Science Share for Schools.

fascinate@manchester.ac.uk

KEY DATES

Primary Science Teacher Awards

Nominations opened:
15 January 2020

Deadline for submissions:
12 June 2020

British Science Week

6th -15th March 2020

@ScienceWeekUK
#BSW20

Royal Society Partnership Grants

Submissions opened
3 Feb 2020 and close (for Stage 1) on 3 March 2020

Invited Stage 2 submissions close
31 March 2020

Great Science Share for Schools

16th June 2020

#GreatSciShare

Rolls-Royce Schools Prize for Science and Technology

Submission deadline for entries is
11 April 2020

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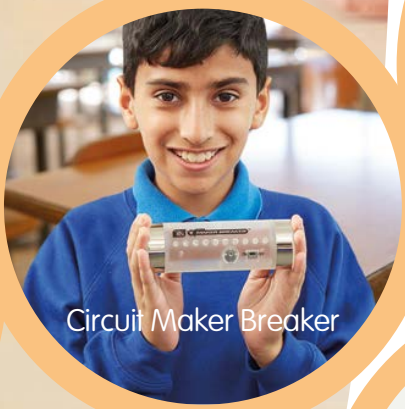

www.tts-group.co.uk

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