




Why&How?

Autumn 2022: Issue 16

Magazine



Sustainability and climate:
FREE resources
Helping under-represented
groups into physics

Spot the difference:
Thinking and talking
about animal embryos

Supporting excellent teaching and learning in primary science
Why & How? is the magazine of the Primary Science Teaching Trust

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PSTT recommends that a full risk assessment is carried out before undertaking in the classroom any of the practical investigations and activities contained in this publication.

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

Connect with us:



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Welcome

Welcome to this bumper issue of the Primary Science Teaching Trust's termly magazine, Why and How? In this issue we have our regular features, including a **picture for talk**, new ideas and support for **climate science**, and an update on the latest developments in **Explorify**. We have also recently launched **Eco Science** - a new set of Science and STEM Club resources which are free to download.

In **news** we are delighted to welcome the latest group of award-winning teachers to the PSTT College. If you know an outstanding teacher of science, why not nominate them for one of next year's awards?

In the latest **I bet you didn't know** article, PSTT Fellow Julia Nash looks at the science behind the role of soil in reducing global warming. Other articles from College Fellows include Rebekah May's project to develop **science vocabulary**, Byrony Turford's cluster project to find

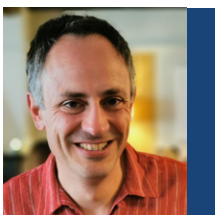
the **'Most important animal of all'**, and Carol Sampey's work to bring more **rocks and fossils** into primary classrooms.

In our new section for Initial Teacher Education, we share updates about our **Primary Science Enhancement Award** scheme (PSEA). In wider collaborations, we welcome articles from the Institute of Physics in which they outline Limit Less: their campaign to support under-represented groups in physics, and the latest news from **SEERIH (University of Manchester)** in their 'Autumn Splash'.

In our Collaborator updates, **PSQM** explains how the outcomes of a PSTT funded PhD have informed new developments to the quality mark. We alert you to the latest issue of the **Journal of Emergent Science** which has a focus on sustainability, and we also bring to your attention a new publication by Bath Spa University: **Cognitive Science and TAPS**.

This is the 16th issue of our magazine. We hope that it continues to be a source of practical classroom support, along with news and updates from PSTT and from other organisations across the primary science education sector. We value feedback from our readers so please do 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 free resources, classroom guidance, and updates from PSTT and other organisations who support primary science.

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Martin Pollard
Chief Executive Officer



Dr. Sophie Franklin
Research Director



Peter Sainsbury
Cluster Director



Ali Eley
Outreach Director



Sue Martin
Programme Director

News

PSTT welcomes new Fellows

We are delighted to recognise the most recent recipients of the Primary Science Teacher Awards (PSTA), nominated in 2021 and awarded as winners in 2022.

These outstanding primary school teachers are now Fellows of the PSTT College, joining our network of over 200 colleagues across the UK. We would like to welcome them warmly to the PSTT and we will look forward to working with them in the future. We will be holding our celebration event for these winners in June 2023.

Do you know an outstanding teacher? We're currently accepting **nominations** for our 2022 awards.

Primary Science Teacher Awards 2021

- Cat Boaz**
Charlton Primary School, Wantage
- Chloe Lister**
Newington Green Primary School, London
- Dawn McCann**
Hillside Primary School, Stoke-on-Trent
- Elaine Arbuckle**
Mearns Primary School, Newton Mearns
- Ellie Hunter**
Ashurst Primary School, St Helens
- Jodie Lea**
Fairford CE Primary School, Fairford
- Melanie Boyeson**
Newport Primary School, Brough
- Rebecca Lamb**
Stalham Infant and Junior Schools, Norfolk
- Stuart Naismith**
Gartcosh Primary School, North Lanarkshire

Do you know an outstanding Primary Science Teacher?



NOMINATIONS FOR THE PRIMARY SCIENCE TEACHER AWARDS 2022 ARE OPEN

Each winner receives:

- £1,000 personal prize money
- Fellowship of the Primary Science Teacher College
- A set of science resources from TTS for their school
- A year's membership of the ASE

Awards supported by
The Royal Society, Association for Science Education & TTS





Fellowship leads to partnership

Winners of PSTT's Primary Science Teacher Awards each year automatically become Fellows of the PSTT College, which presents numerous opportunities to network with other Fellows throughout the UK. From local 'area meetings' to our annual College Conference and other events, PSTT recognises the importance of fellowship, bringing teachers together to share their own good practice, to reflect on recognised and emerging evidence of good practice, and to develop ideas that improve science teaching and learning in primary schools.

The collegiate nature of these fellowships has led to collaborative projects and CPD events, and the creation of many resources that PSTT has been able to disseminate to other teachers. We are always pleased to hear about ways that our Fellows have worked together to benefit the wider primary science teaching community. Bryony Turford and Paul Tyler exemplify this; although based in different parts of the UK, they have come together to write materials for teachers and have recently launched a new commercial enterprise, 'My Science Club'. We wish them every success in this venture.



Bryony Turford



Paul Tyler

National prize awarded to the Primary Science Capital team

PSTT congratulates UCL's STEM Participation and Social Justice research group for being awarded the Royal Society's Athena Prize for their work in transforming young people's participation in science, technology, engineering and maths (STEM). Their research aims to make STEM fields and subjects more inclusive, accessible and equitable for all young people. The group's activity encompasses four current projects that all seek to understand and challenge injustices in STEM engagement and participation: ASPIRES, Making Spaces, Youth Equity + STEM and Primary Science Capital.

Jointly funded by PSTT and The Ogden Trust, and with PSTT Fellows as participants in the research, the UCL team developed the Primary Science Capital Teaching Approach to help children find more meaning and relevance in science subjects. The approach is currently being embedded through a national network of regional primary coordinators.

Professor Louise Archer, who leads the group, said, 'It is wonderful to have the STEM Participation & Social Justice group's work recognised by the Royal Society and the scientific community. We hope that winning this award can further our messages of social justice within science education and help us to continue to improve equitable STEM participation for young people.'



UCL's STEM Participation and Social Justice research group



Promoting Sustainability in Education – FREE webinar



Sustainability education is the key to a better future. Whether children are learning about ways of protecting our ecosystems, or the importance of preserving natural resources, primary school is the ideal starting point for turning ideas into actions.

PSTT invites teachers of all primary ages to join our webinar and discover opportunities to promote learning through the Sustainable Development Goals throughout your school. If you're just getting started and need some ideas or want to take your sustainability education further, join us to learn more about:

- Food for the 21st Century – a prize-winning sustainability project from Science on Stage
- Related science projects from previous Science on Stage participants
- Free resources for sustainability



Sarah Eames



Emma Crisell

Delivering this event will be PSTT Fellows, Sarah Eames and Emma Crisell. Sarah is PSTT Regional Mentor for the East Midlands. Emma won the Sustainable Goals in Education prize for her project "Food for the 21st Century - Making a Difference" during this year's Science on Stage festival.

Wednesday 2nd November 2022

16:00-16:45

Register [HERE](#)

Climate science

WWF – support for primary science, including the new sustainability guide



WWF's new schools' sustainability guide, made in partnership with PSTT, Eco-Schools, Learning through Landscapes and Let's Go Zero. Image credit © WWF-UK

PSTT is delighted to be working closely with the WWF. Amy Ball, Primary Education Officer, shares details of the sustainability and climate science resources and support that WWF provides for primary schools.

At our climate symposium last November, WWF delivered 'Threats to Nature: Climate Crisis' - a live workshop for children that explored the impact of climate change on different habitats and nature and encouraged children to think about realistic changes they could make to their own lifestyles. WWF also took part in the event's panel

discussion, 'Greening your curriculum and school systems'. Recorded versions of both these sessions are available for download [here](#).

Last year, WWF worked in collaboration with PSTT, Eco-Schools Let's Go Zero and Learning through Landscapes to produce a **Schools' Sustainability Guide**. PSTT has also facilitated joint webinars with WWF, offering teachers CPD based on the latest thinking in climate education.

The Earth's atmosphere is warming, probably at a faster rate than ever before. Our ice sheets are melting, sea levels are rising and in many cases weather patterns, climates and natural environments are changing too quickly for some wildlife and people to adapt. Climate change is harming our planet's rich variety of life – its biodiversity – which is essential for our survival.

You might be surprised to hear that the UK has an average of only 53% of its biodiversity left compared to 1970, putting us in the bottom 10% of the world's countries. Many of our unique habitats from wetlands to heathlands are under tremendous strain from intensive farming, urbanisation, deforestation and pollution, and this is all exacerbated by the impacts of climate change. We have lost 97% of our wildflower meadows since 1970, one in seven of our native species are facing extinction, and more than 40% are in decline, including some of our most iconic species, like hedgehogs and bumblebees.

Climate change and nature loss are two sides of the same coin – we can't tackle one without the other, and we need to do so in a sustainable way: by meeting the needs of the present without compromising the needs of future generations. Primary schools across the UK have the power to take action on climate change and nature loss today, whether it's through connecting with local nature, making physical changes around



Primary school children campaigning for environmental change in Westminster with WWF Ambassador Cel Spellman. Image credit: © Chris Ratcliffe / WWF-UK



After taking part in a WWF live lesson for International Polar Bear Day, children at Woodfield Primary School in Wigan used recycled bottle caps to make this beautiful polar bear mural. Image credit: Woodfield Primary School

school grounds, transforming school values and championing sustainable behaviours, or by putting pressure on local businesses and governments to deliver on climate promises.

Connecting with nature

At WWF we believe that it's vital for all primary school children to feel personally connected to the nature around them. This could be through learning different bird names, using spotter guides to identify different trees and minibeasts, growing their own fruits, vegetables and flowers, making bee hotels and hedgehog homes, or simply spending more time outdoors in nature. This early connection with nature encourages children to care about the planet they live on, and empowers them to take action to protect it.



Children from St Andrew's Primary School in Horsell using spotter guides and the Seek app to identify wildlife around their school. Image credit: © Greg Armfield / WWF-UK

One way that children can connect with nature is by surveying the wildlife around their school or local green space. To help with this, you can download the free **'Seek'** app by **iNaturalist** on your school tablets to unlock a whole world of nature on your doorstep. Seek's smart image recognition technology identifies a huge range of wildlife, encouraging children to discover the hidden natural treasures in their local area. The WWF **'Our Planet LAB'** gives teachers instructions on how to use the Seek app with their classes as well as on how to conduct a whole school nature survey, test different hypotheses and monitor whether any changes made around school (e.g. installing bug hotels and bird feeders, or planting trees and flowers) are improving the biodiversity in the school grounds.

Building knowledge

As well as connecting with nature, learning more about the environmental issues that affect our world can help primary aged children to understand what needs to be done, recognise what matters most to them, and take action to help protect people, places, wildlife, and things they love. WWF have a range of classroom resources on the topics of climate change, plastic pollution, wildlife conservation and habitats, with printable worksheets, classroom presentations, activity guides and links to high quality video content. Our resources aim to help children build their knowledge and understanding of environmental and sustainability issues and to explore their own values and attitudes. They emphasise the natural wonders we risk losing, but all carry a message of hope that we can still save our planet if we act now. Our classroom resources all have clear curriculum links (and where relevant, links to the UN Sustainable Development Goals), and are all **free to download from our website**.



Children from St John's C of E School planting a herb garden. Image credit: © Richard Stonehouse / WWF-UK

Our resources created with other organisations include **Green Planet**. Featuring Sir David Attenborough, these resources are ideal for teaching children about the wild and wonderful animals we have on Earth, and the challenges that they face.



Children from Langdale Primary School taking part in a WWF live lesson. Image credit: Langdale Primary School.

Another option for building primary children's knowledge and awareness of climate, nature loss and sustainability is through booking a free WWF online live lesson, run by a WWF educator. They are just for an individual class, year group or school, which means we can interact with your children, ask questions, show video footage and challenge them in our weird and wonderful quizzes. Book the FREE SESSSION with us **here**.

We also have a series of online webinars in collaboration with STEM Learning, where children can watch footage from the 'Our Planet' and 'David Attenborough: A Life on Our Planet' documentary series, and hear from STEM Ambassadors about their careers in UK ecology, rainforest biology, arctic oceanography and more! You can watch recordings of our previous webinars **here**.

Taking action

If combined, school buildings and grounds in the UK would cover a huge area of land, so every school has a part to play in reducing schools' overall 'environmental footprint': a measure of our impact on the natural world. Environmental footprints take into account not just energy and carbon, but how much farmland, forest area, soil and freshwater it takes to provide everything that people use. By making some quick and some longer-term changes around the school, senior leadership, teachers and children can help to drastically lower their school's environmental footprint.



Children from Wicor Primary School in Fareham making their own mini bug homes. Image credit: © Richard Stonehouse / WWF-UK

This means less carbon being released into the atmosphere, less waste going to landfill, fewer single-use plastics making their way into ocean ecosystems, lower building running costs, and more nature thriving around the school grounds!

WWF's new **Schools Sustainability Guide**, developed in partnership with the Primary Science Teaching Trust, Eco-Schools, Learning through Landscapes and Let's Go Zero, highlights a variety of different actions that you and your children can take to tackle the issues of climate change and nature loss. You can pick and choose the actions that work for you; whether you're already eco heroes or just at the beginning of your sustainability journey, there is always something you can do to help. Separated into seven key areas for action, the guide gives tips on how to increase your school grounds' biodiversity, improve energy efficiency, reduce plastic and other waste, promote sustainability in school meals and loads more, all under the goal

of empowering and motivating children to drive the change they want to see. Each sustainability tip has guidance on the time it might take, the potential cost and any links to support curriculum, with useful programmes and resources and some really inspirational school stories throughout.

Each individual school has a huge potential for mobilising society-wide change. It might seem as though your one school or class can't make that much of a difference to climate change or nature loss as a whole, but individual children and teachers taking small actions can be the seeds of change. Taking small steps, one at a time, can end up transforming your whole school culture so that sustainability is always at the heart of all choices made. Whole school culture change can inspire children's families, other schools and businesses in your local community to change their ways to make sure they are operating sustainably and improving their own environmental footprints. Community-wide changes

can then influence big organisations, policymakers and governments across the UK and the rest of the world.

It all starts with your schools and your children. You have the power to be a force for good in the fight against nature loss and climate change. By letting your children lead environmental projects and including them in decisions about how the school is run, you can empower and motivate them to drive change and improve environmental awareness for everyone in your school, community and beyond. Children who are enabled to take action on climate change and nature loss are much less likely to feel helpless or overwhelmed by eco-anxiety, while gaining the vital skills and knowledge they need to face the challenges of the 21st century. Together we can encourage nature to thrive in and around our UK schools and help to safeguard our climate for future generations.

Climate science

Get inspired for COP27



Part of a 'tree of promises' pupils produced by children at St. Margaret's C of E Junior School during a COP26 day



Rebecca Ellis
PSTT Fellow and Explorify
Engagement Leader



From 6th –18th November 2022, Egypt will host the 27th Conference of the Parties (COP27) the UN's annual summit to tackle climate change. What will your school be doing?

These annual meetings of world leaders are important because mitigating global warming and supporting the countries worst affected by extreme weather requires collaboration, co-operation and commitment. The publicity surrounding the conference makes learning about climate change even more relevant to children. How can we harness this opportunity to focus on environmental

education in schools? Dr Rebecca Ellis found that COP26 provided a valuable stimulus for enhancing her school's provision of sustainability and climate science education. Here, she describes how a cross-curricular approach to a 'COP26 day' engaged the children in Year 5, allowing them to make links, reflect on their own ideas, and feel as though they had an important role to play.



St. Margaret's C of E Junior School had an immersive COP26 day, using a **cross-curricular** approach. Why not try this in your own school for COP27?

What was the idea?

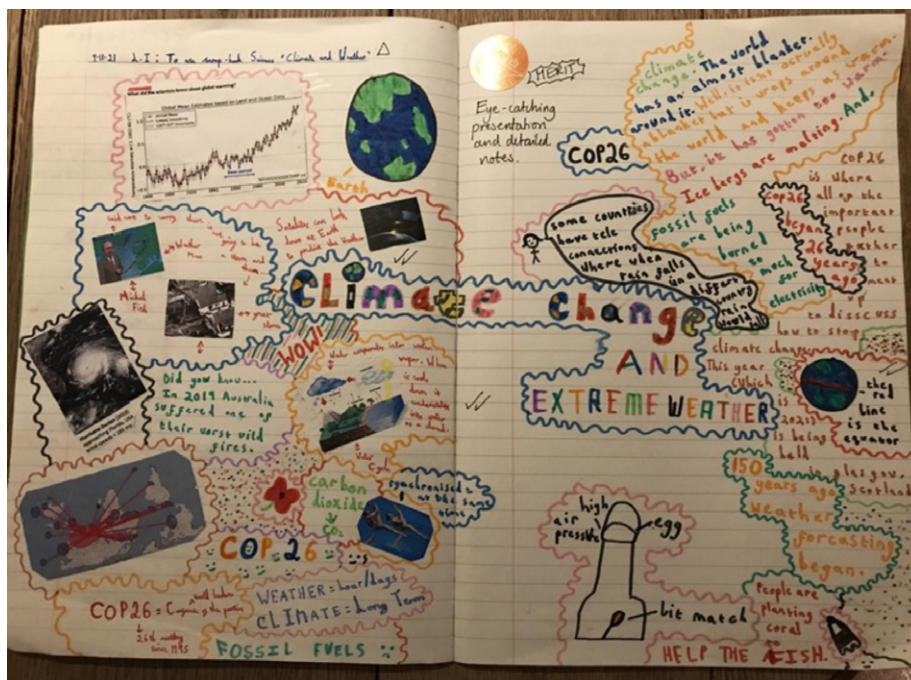
We wanted children to have the opportunity to engage with current affairs in a deep way, rather than just providing a single lesson or assembly. However, at the beginning of our COVID recovery, we knew that daily reading, writing and maths were more vital than ever. We decided that if we ensured that we contributed to these skills, we could justify going 'off timetable' for the day.

What did we do?

We adopted a 'Scrapbook Science' approach giving children the freedom to record their learning creatively, and decided to use PSTT's *'I bet you didn't know (IBYDK)... It's raining all over the world - extreme weather connections'* resources so that the children learnt about what scientists were doing to try to understand climate change. Armed with a page of snipped images, gel pens, scissors and a dose of creativity, the children began the day learning about what COP26 is with **Newsround**. It was important that the children began to understand that weather is 'what we get': the conditions over a short period of time that can change in hours or minutes. Whereas climate is 'what we expect': how the atmosphere behaves over a long period, based on average weather patterns over decades.

Exploring the concept of weather

As a class, we **read** parts of the *I bet you didn't know* article and completed the quick activity in the teacher's guide, identifying the meanings of weather symbols. Watching **Explorify's** 'What's Going On? **Egg in a bottle**' video prompted some key thinking and talking about



An example of a child's 'Scrapbook Science' work.

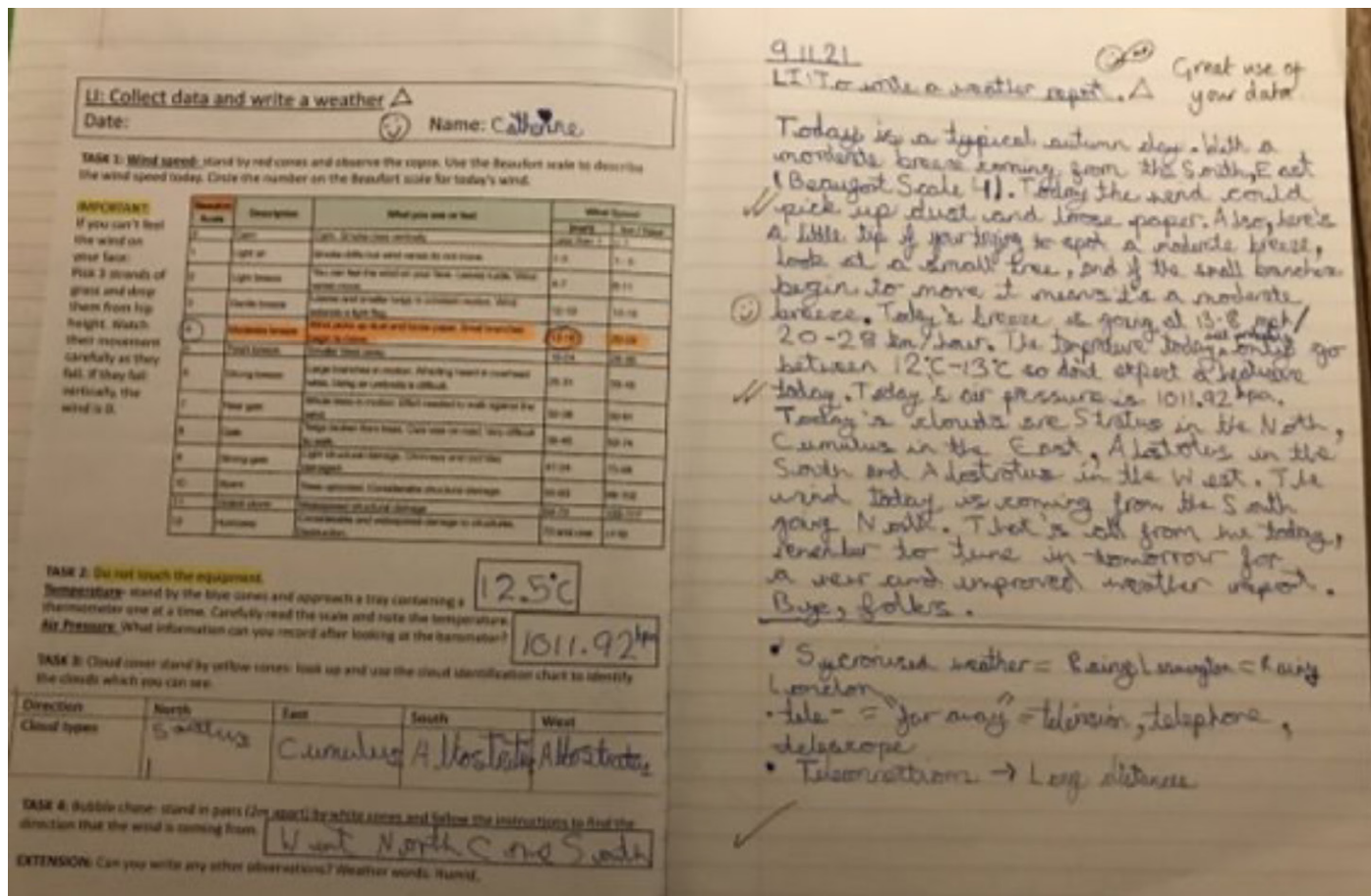
air pressure. We took our time. There was modelling on the board, but children could write, stick and draw to record the information and their own ideas as they liked.

Our next lesson focused on the fieldwork objective in **geography** and the children went on a weather walk. Using their observations and

the Beaufort scale, they identified the wind speed. They recorded the outside temperature with thermometers and identified the types of cloud they could see with the **Met Office's cloud spotting guide**. Using the **Arduino Science Journal app**, they measured air pressure and compass direction.



Children outside recording their observations of clouds and their measurements of windspeed and temperature.



9.11.21 LI: To write a weather report. **Great!**

Today is a classic autumn's day in Whitnash. With the sun down, it's the clouds' time to shine. (Mind you, clouds don't shine.) In Whitnash today, we have a slight breeze as some of you guys and girls have probably experienced. Don't worry, at 1012 hPa air pressure is at its normal state. You still might want to bring some hair gel! Thanks for listening to, "What clothes will you wear today!"

Today will be a typical autumn day in Whitnash. With medium air pressures we are having changeable weather and temperatures may reach 16°C. There is a total cloud coverage with all Nimbostratus. The Beaufort scale is 4 so there will be a moderate breeze of between 13-18 MPH coming from the North West. So don't forget your umbrellas for the occasional shower and go outside and enjoy the warm weather.

Examples of children's weather reports.

They then identified the wind direction using the **Royal Meteorological Society's 'Bubble chase' method**.

In our **writing** lesson, the children watched weather forecasts and learnt how to use the data they had collected to write a weather report. Meanwhile, in **maths** we revised how to collect data and present it as a pictograph and bar chart by asking the class, 'What is your favourite type of weather?'

Exploring the concept of climate

Using the *I bet you didn't know* resources, the children discussed recent examples of extreme weather and examined the evidence for global warming. NASA's **climate kids video** is a great way of explaining the greenhouse effect. It was also useful to use Professor Dudley Shallcross' analogy of 'Granny sitting by the fire' (his PowerPoint and recorded CPD session 'Can we stop Climate Change?' is available in **PSTT's Climate Symposium Resources**).

The children continued to add to their scrapbook science pages as they learnt that scientists are using satellite data to understand links between extreme weather events across the globe. The video in the *I bet you didn't know* teacher guide helped them understand that long-distance teleconnections could mean that extreme rainfall events become more common throughout the world.

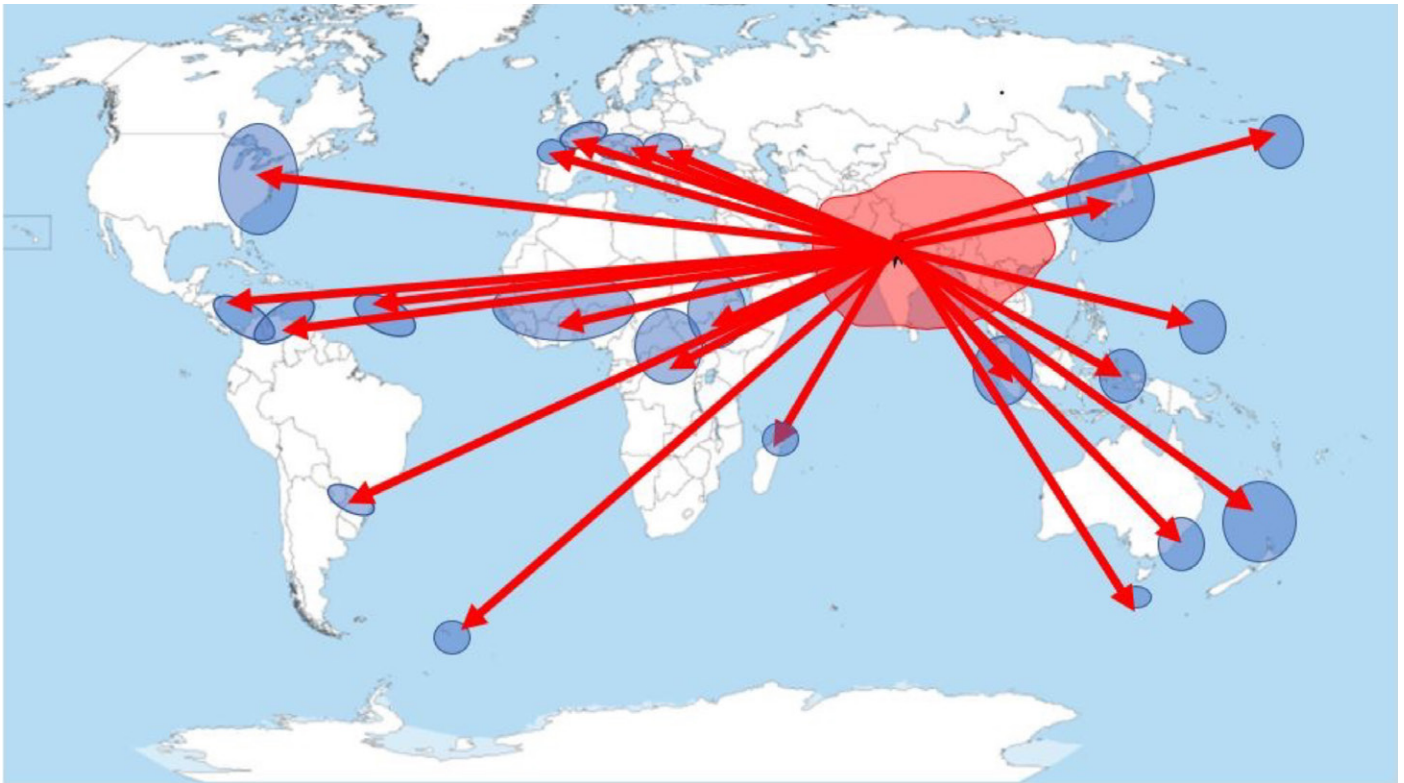


Fig. 1 [Image credit] © Petr Dlouhý licenced through Creative Commons. Arrows and red and dark blue shading added by Dr Rebecca Ellis (PSTT Fellow).

Fig. 1 represents synchronised extreme rainfall events revealed by satellite data. The red area represents the regional weather system of South-Central Asia, while the blue areas represent the teleconnections connecting this region to remote regions on the planet.

Time for reflection

It was noticeable that all the children were very focused throughout this busy day. One of the learning support assistants, summed this up with this reflection:

“The children were really engaged on COP26 day, giving more of themselves during the lessons. They took in the information well and were asking questions, using their knowledge and participating. For some children, the active learning and creative scrapbook science approach allowed them to thrive. Their pride and enjoyment were obvious.”

We moved the ‘normal’ whole school recorded assembly to later in the week and used the last part of the afternoon to allow children some **PSHE** time to reflect on what they could do as individuals to slow down climate change. Inspired by the WWF campaign, they then had the opportunity to make a personal pledge and create a leaf for the class’s tree of promises.

Making an impact

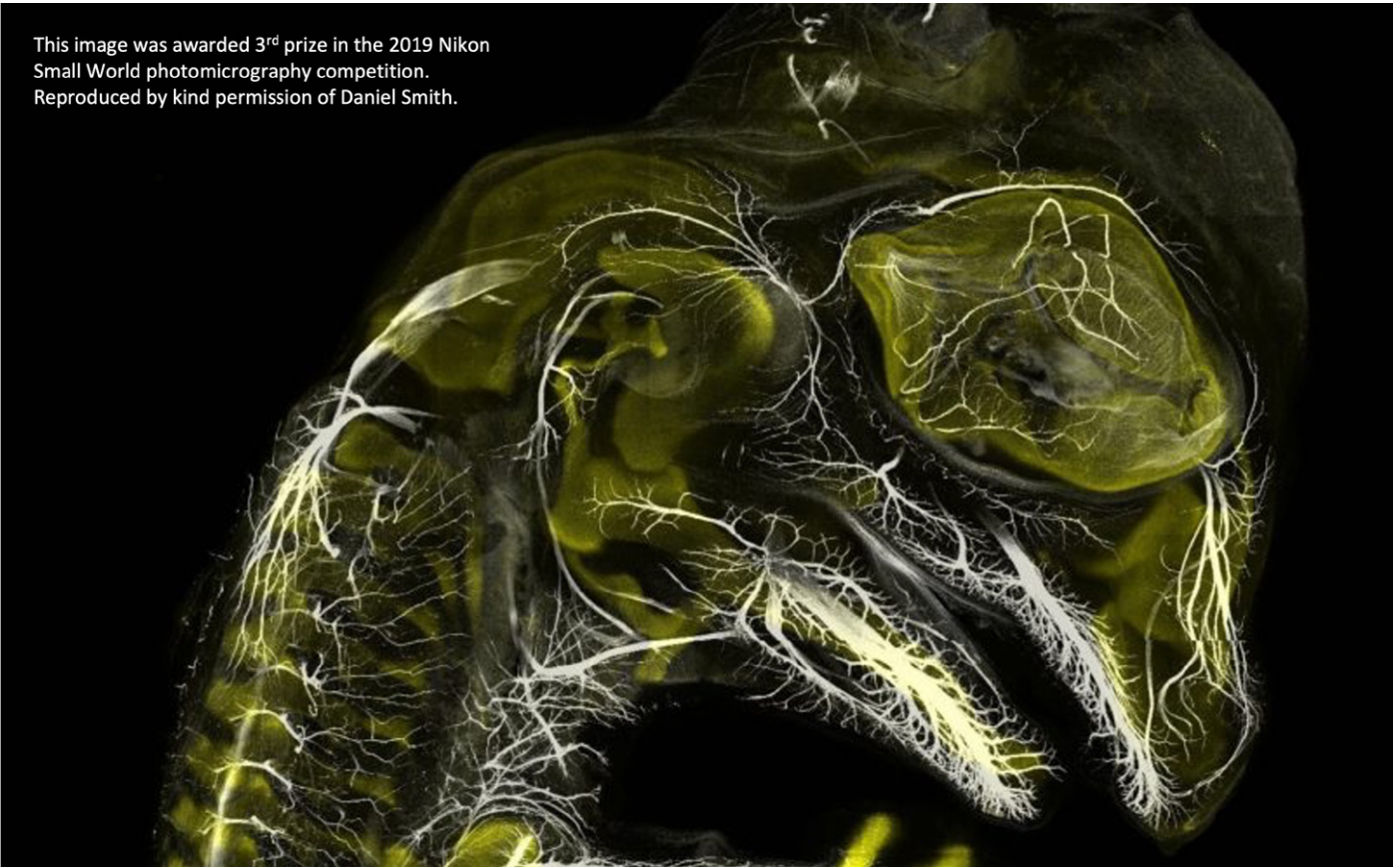
The conversation continued throughout the following days and weeks. Parents and families reported that their children were more motivated to turn off lights and keep the thermostat down for example. When I asked the children what they had specifically enjoyed, lots were in favour of the creative approach. Some showed metacognitive abilities, explaining that they had been able to make links with previous learning, particularly to the states of matter and water cycle topic. However, the child’s comment which really stuck was this:

‘I enjoyed learning about how to help the planet by changing how we act. It is really important to know as we will have to do this in our future’.

Free resources

Picture for talk

This image was awarded 3rd prize in the 2019 Nikon Small World photomicrography competition. Reproduced by kind permission of Daniel Smith.



[Click to download image](#)

Fig. 1

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

Using pictures is an inclusive approach which 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 children of any age. 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 in fig.1 by following the link and either display on a whiteboard or give out printed copies. Ask the children to discuss, in groups of three, the following questions:

What can you see in this picture?

What animal do you think it is?

Why do you think this?

What do you think the yellowy/green parts are?


What do you think the white parts are?

After the children have shared their ideas, explain that this is a picture of an embryo of an American alligator at around 20 days of development. It has been specially stained to show the development of its nerves (these appear white) and its skeleton (this appears yellow/green). The skeleton is currently cartilage, but by the time the alligator hatches, it will mostly have become bone. You might want to show the children a picture of an adult alligator at an appropriate point in their discussions.

Other questions to generate and promote thinking and explaining


- Where can you see most of the nerves (white) developing? Why do you think this is?
- Which other features of the alligator can you identify?
- What do you know about other animals and their development? How is this the same as the alligator? How is it different?
- Download the image in fig. 2 to compare the embryo of the alligator with the embryos of a turtle, a chicken, a rabbit, and a human.

Prizewinning image in the 2019 Nikon Small World photomicrography competition. Reproduced by kind permission of Daniel Smith.




alligator


What do you notice?
What looks the same?
What looks different?




human



rabbit



chicken



turtle

Let's compare the alligator embryo with the embryos of some other animals at a similar stage of development.

What features can you see in each embryo that help you identify which animal it is?


 [Click to download image](#)

Fig. 2. Comparison of animal embryos

Background information

Alligators are reptiles – after mating in the early summer, the female builds a huge nest and then lays 40-50 eggs and covers them up with vegetation. The alligators take 9 weeks to develop inside the eggs. When they are ready to hatch, they make loud squeaking noises inside the egg and the mother then knows she needs to uncover the nest. When the baby alligators hatch, they are about 15cm long. They stay with their mothers for at least two years, and it takes more than 12 years to become an adult. When they are fully grown, females can be up to 2.6m long, and males up to 3.4m long.

Alligators are carnivores. They have extremely strong jaws – strong enough to crack the shell of a turtle. They usually live in and around rivers, and they catch and eat other animals at the water's edge. These include fish, birds, frogs and mammals. They swallow small prey whole, and if they catch a large mammal they will often drag it under the water to drown it before shaking it apart, or they will bite it into smaller pieces that they can swallow. An alligator's teeth get worn down with use, so they constantly grow new ones. They have up to 80 teeth in their mouth

at any one time, and in its lifetime an alligator might go through up to 3,000 teeth. This explains the huge network of nerves supplying an alligator's mouth, which can be seen in the developing embryo in the picture.

Follow-on discussion ideas

What do other vertebrate animal embryos look like at a similar stage of development?

➡ [Click here to download a slideshow of the development of vertebrate embryos.](#)

These slides are arranged like a quiz, starting with images of early embryos and then images from later stages are added to subsequent slides. At each stage, there are questions to encourage the children to identify similarities and differences between the embryos, and to see if they can work out what animal each embryo will become. The answers are revealed on the last slide.

➡ [How is an alligator different from a crocodile? Find out more here.](#)

➡ [Watch a baby alligator hatch from its egg and call for its mother.](#)



Free resources

NEW Science and STEM Club resources - Eco Science



We have a new set of club resources to add to our collection of ready-to-go packs that will get children engaged in practical investigations.

Eco Science is a series of eight activities related to recent research about the environment and climate. They are ideal for use in a weekly club with children aged 7-11 years. Each activity is based on one of PSTT's 'I bet you didn't know' articles. Teachers and adults interested in introducing primary children to cutting-edge research may be interested in these and other articles, all available [here](#).

The Eco Science pack was created by PSTT College Fellow, Alison Trew, and the *I bet you didn't know* Team.

More about PSTT's Science and STEM Club resources

Each club pack includes:

- an overview of how to run the sessions with a list of simple, everyday materials needed
- an activity sheet giving the club leader guidance on organising the activities; including a practical challenge for the children, key facts, ideas for questions and further activities

- a fact sheet with some club packs for children to take home for further learning with family
- validation by the **Children's University** that count towards accredited learning for any children taking part.

➔ Explore our **Science Clubs CPD Unit** to learn more about the benefits of running a science club.



Sample activity sheets for microplastics in soil, biodiversity and bamboo cricket bats



Sample fact sheets for termite tunnels and water harvesting

Resource Update

Impact of A Scientist Just Like Me, and Science at Work

We are always delighted to hear from schools about how they are using our resources and the impact they are having on children's learning. Here we share recent news from two schools about how they have used PSTT's resources.

Writing letters to scientists

Children in year 5 at Great Meols Primary School in the Wirral used PSTT's **A Scientist Just Like Me**, and **Science at Work** resources to learn more about more about civil engineer, Jyoti Sehdev. They were so inspired by her story and the work she does, that they wrote letters to her. We are grateful to Great Meols for letting us share some extracts of the children's letters.

I am writing to you to tell you how much you have inspired ~~me~~ young people including me. Firstly, I was so surprised and excited when I heard about you doing ~~demolish~~ demolition as I didn't ~~not~~ really know about girls and women being a civil ~~major~~ engineer. I was mainly inspired when I heard about you building London Bridge Station! It has been really fun hearing about how London Bridge Station connects to ~~no~~ eight city's!

Abigail

I found it interesting that you play piano (so do I). It's also cool that you like to play football and play video games to relax. It must also be handy that you enjoyed math, science and geography in school.

I think I would be a good civil engineer because I'm interested with the world around me and I'm quite good with technology. I would also like a job that will allow people to take better care of our planet.

I am aware you are one in only a few ~~us~~ females in your engineering. That must be challenging but it's reassuring that you are ~~reassuring~~ improving now! It's obvious you worked really hard to get where you are today.

Maisy

If I were to become an engineer (civil) then I think certain things could help me get there, such as:

- My dad was a civil engineer so he could help me
- I would like to impact the world
- I am interested in the world around me
- I love making things
- I really enjoy investigating and solving problems
- I can read maps and do grid references

Plus, I would like to be a civil engineer so hopefully, I could motivate myself to keep on going.

Ewan

I have learned that you are a senior civil engineer and just by that I was extremely interested, and most importantly I learned that no matter our gender we can be whatever we want!

You probably have faced many challenges such as being one of only a few women, but you still achieved your goal.

I think I would make a good civil engineer for I enjoy maths, LOVE science, and I am very interested in geography!

Summer



I realise that you have had to face many challenges to get to where you are today. During your career it must have been especially hard being one of only a few females in engineering. Because of this I think you are an inspiration.

Amber

Finally, you have inspired me and my class-mates alot to help the world whenever we can and to give women more respect! You must have ~~worked~~ worked so hard in school!

Rosie

“We really appreciated the resources provided by The Primary Science Teaching Trust. They enabled us to inspire the children and open their minds to new possibilities. Our Year 5 children were so inspired to learn about a career in Science and they thoroughly enjoyed writing letters to Jyoti Sehdev. In what can be wrongly perceived as a male dominated industry, it was lovely to see both girls and boys realise that a career in Science was possible!”

Leah Jennerway, Year 5 teacher at Great Meols

Whole school approach to raise awareness of diversity in scientists

Kelsey Byers, one of the scientists featured in **A Scientist Just Like Me**, got in touch with PSTT to let us know that she had had some exciting news from Carleton Rode Primary School in Norwich. Following their engagement with A Scientist just Like Me, the school decided that this year it would name its houses after diverse scientists, and Kelsey was delighted to learn that her name had been selected for one of the houses.

She has since arranged to have a Zoom call with the school so the children can actually 'meet' her.

Kelsey said in her message to PSTT, 'I really feel so honoured to have been selected for one of the house names and wanted to congratulate you on a great job with the resource which is clearly being well used in UK schools!'

How are you using our resources?

What impact have they had on your children's learning?

If you have any stories to share, we would love to hear so please do let us **know**.





Explorify

What's new?



Black History Month

Explorify is sharing the stories of less well-known individuals and their valuable contributions to science. Celebrating Black Britons is integral to this. Although each October we celebrate Black History Month, we encourage you to share the achievements of Black scientists in your classrooms throughout the year; the related Explorify activities can be used at any point in the school year as well as to complement the teaching of different science topics.

There are four new activities which feature Black scientists and we are very grateful to the **Royal Society** for the use of extracts from their series 'Inspiring Scientists', which records the life stories of ten British scientists with minority ethnic heritage. Three further activities, newly added to Explorify, celebrate the diversity of British culture and the contribution made to it by children and families originating from all parts of the world. To find out more about the collection of activities for Black History Month, have a look at this [five-minute read](#).






Explorify

What's new?

The climate challenge

All the Explorify resources that provide opportunities to discuss issues about climate, biodiversity and sustainability are now marked with a polar bear badge. These activities are tagged with 'Climate Challenge', enabling teachers to search by curriculum science topic or by 'Climate Challenge'. There are three versions of the polar bear badge, each denoting a particular area of climate science.

- 
Indicates activities that support the discussion of global warming
- 
Indicates activities that support the discussion of biodiversity loss
- 
Indicates activities that support the discussion of pollution

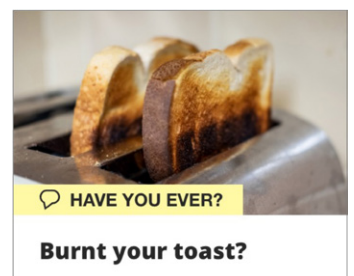
New activity category: Have you ever?

Explorify's brand new set of Have you ever? activities are designed to relate science learning to children's prior experiences by getting them all to think about something they have experienced and using this as the starting point. The scenarios have been chosen to enable most children to relate easily to the questions and images, so that those who would not normally see themselves as 'sciencey' can become the experts. The ideas are based on the **Primary Science Capital Teaching Approach**, which explicitly values children's personal, family and cultural experiences, and links these to the science curriculum.

There are now over 40 (and growing!) Have you ever? activities. They cover all curriculum topics and age groups and can be viewed by clicking [here](#) and selecting 'Have you ever?' from the Activity Type drop-down menu. For a three-minute read on how to get the most out of using these activities, click [here](#).

More information and links to other useful resources can be found in Explorify's two-minute read: **[Are you ready to meet the 'Climate Challenge'? Part 1](#)**

Using these Explorify climate challenge activities will facilitate important classroom conversations, allowing children to express their ideas and feelings. The background science sections in the teacher notes contain up-to-date, reliable information to support these discussions, and every climate challenge activity has an extra section, titled '**positive action**', that signposts to simple ideas for relevant steps that children can take to make a positive contribution to the well-being of the planet. More information and links to other useful resources can be found in Explorify's two-minute read: **[Are you ready to meet the 'Climate Challenge'? Part 2](#)**





Science planning support - FREE online sessions

Our collection of short, friendly sessions to find out how Explorify can support your science topic planning covers all curriculum topics and age groups. Each session has been recorded and the full set is available to view [here](#).

Each session is:

- Suitable for all classroom teachers and ideal for science subject leaders to use to support other teachers in their schools
- Relevant to all four UK curricula
- 30 minutes in length - we know how busy teachers are
- Accompanied by a handy downloadable planning document.

Next term we are planning more support sessions to show you how Explorify can underpin wider curriculum learning and initiatives across the school. Book your FREE place now to join an Explorify Engagement Leader in one or more of the following live sessions.

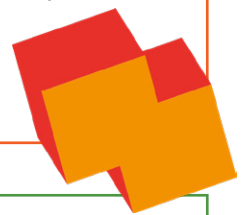


Developing Long Term Memory

Wednesday 1st February 2023, 16:00-16:30

This session will show how you can use Explorify activities successfully to support retrieval practice in schools, strengthen children's understanding and build connections between different scientific concepts.

➔ Register [HERE](#)



Enhancing Whole School Events

Tuesday 7th February 2023, 16:00-16:30

This session shows you how you can use Explorify to add to your whole school event, whether it's a one-off assembly, a science-themed day, or a whole week of science-based curriculum activity.

➔ Register [HERE](#)





Science planning support - FREE online sessions



Building Science Capital

Tues 7th March 2023, 16:00-16:30

This session will look at the Primary Science Capital Teaching Approach (PSCTA) and how you can use Explorify activities to support this. The PSCTA aims to broaden the ways in which science is represented, by valuing what all children bring with them and by connecting science with children's identities, experiences and what matters to them and their communities.

➔ Register [HERE](#)



Developing Thinking, Speaking and Listening Skills

Wednesday 19th April 2023, 16:00-16:30

In this session, we delve into how and why regular use of Explorify activities can develop children's 'higher order' thinking skills and improve their confidence, relationships and vocabulary.

➔ Register [HERE](#)



Joining a live event means you will have opportunities to ask questions, but if you cannot attend live, don't worry, as all the sessions will be recorded and you will be able to access them at a later date.

If you haven't yet registered for Explorify, SIGN UP FOR FREE [HERE!](#)

Keep in Touch!

Let us know what you think about what's new at Explorify as it will help us as we create more great activities and supporting materials for CPD. Contact us using [Twitter](#), [Instagram](#) or our [Facebook](#) staffroom.



College update

Developing science vocabulary



Rebekah May
PSTT Fellow

PSTT Fellow Rebekah May shares the outcomes of her project that explored the development of scientific vocabulary in children in the early years.

The aims of the project were a response to the updated 'Statutory framework for the early years foundation stage' (2021) in England. The Early Learning Goals for Communication and Language (Speaking) state that children at the expected level of development will:

- Participate in small group, class and one-to-one discussions, offering their own ideas, using recently introduced vocabulary;
- Offer explanations for why things might happen, making use of recently introduced vocabulary from stories, non-fiction, rhymes and poems when appropriate.

We based the project on the school's existing practice of weekly 'Book Buddies', with Y6 learners taking up the role of 'the experts to work with children in the early years. We felt that

within a busy early years classroom the 'one-to-one' discussions, although they happen, are difficult to plan for, and that with a focus on science books, our buddy system could provide an excellent context for 'recently introduced vocabulary'. With careful preparation, we felt our Y6 children would be able to offer additional opportunities for our reception children to talk and explain using the new vocabulary that had been introduced in the books that they read together.

Although the impetus for the project was to improve the communication and language skills of our reception children, we felt that another benefit might be an improved scientific vocabulary in our Y6 children. A selection of books was bought, mostly covering a range of areas of science, but with several others that were more general.

These books were stored in the reception classroom and were accessible to the children whenever they wanted.



After reading 'Secret Life of Rocks' by Jo Bourne, the Y6 children encourage their younger buddies to use their new vocabulary in an activity sorting rock samples.

One of the important parts to the project was being clear to our Y6 learners that this was, in itself, a scientific project in which we wanted to establish a current baseline and then look for impact at the end.

We were keen that the Y6 children would feel confident in their roles as 'experts' as well as with their younger reading buddies, so we started with some training from our early years teacher on using 'thin' questions (these require one word or minimal answers and there is usually only one right answer) and 'thick' questions (these require deeper thinking and there may be several possible answers). The Y6 children were encouraged to think about how they phrased their questions to the younger children, what might lead to a more extended response, and what might simply require a single word answer. They then had time to explore the range of books and identify key vocabulary, checking that they themselves understood the meanings.

To encourage high levels of discussion and learning, the children were paired carefully into book buddies. They met on a weekly basis and the project followed the pattern of alternating one-to-one reading sessions with activities linked to the books. The Y6 children took turns to set up and facilitate the activities, and had the books available for reference. They teased out the appropriate vocabulary from the books that linked to their activities and did their very best to use it, and to encourage their younger buddies to do the same.



'The Really Incredible Science Book' by PSTT Fellow, Jules Pottle has a page that explores the reactions of bicarbonate of soda with vinegar. After reading the page, Y6 helped reception children to recreate the investigation.



To support a materials sorting activity, the Y6 children created a vocabulary sheet as a prompt, so reception children had a reminder of the key words they had learned and discussed when they read the book.

The staff in reception were particularly impressed with the impact this book project had on the children's books choices, noticing that they more frequently chose to look at science books. When the children were asked about the experience, they expressed their enthusiasm for their books and activities. Isla and Darcy listed some of the vocabulary they remembered (camouflage, reptiles, mammal, acid, reflection, habitat) whilst others talked about the books they had especially enjoyed. George said that he liked 'The Really Incredible Science Book' because the flaps helped him remember things. Quentin said that he liked the bicarbonate of soda and vinegar activity on reactions because it 'blew my mind' and Imogen liked the treasure hunt that she did with Pete and Charles.

The Y6 group also showed improvements in their vocabulary. They completed a baseline quiz prior to the start of the project and repeated this at the end. They made gains in all areas, but the improved quality of their explaining

was particularly noticeable. One child showed they had developed a deeper level of understanding of day and night when their explanation changed from, 'Day is when the sun is out and night is dark with the moon' to, 'Day is when your country is facing the sun and night is when it isn't.'

With clear engagement and enjoyment from all the staff and children in the project and some strong impact in both Y6 and the early years, we will certainly be running the project again this year. We are keeping most elements exactly the same, but considering introducing the buddies to one another a little earlier in the year.

Rebekah May is currently a Y6 teacher, science leader and the deputy head at Birch C of E Primary School, Colchester. She also runs a PSTT cluster.

College update

Rocks and Fossils for Schools



Carol Sampey

PSTT Fellow and Area Mentor for Wessex and South Wales, and PSTT Jurassic Coast Champion

Not every school is within easy reach of the coast or able to fund field trips, so when trustees from the Tomlinson Brown Trust (TBT) approached PSTT and the Geologists' Association (GA) in 2021 to ask if we could assist them to “get rocks into the hands of primary children and inspire the next generation of earth scientists,” both organisations were keen to help.

TBT was set up in honour of Geoffrey Brown and Dr Mabel Tomlinson, whose work had already inspired many young people to take up careers in geology. TBT has been awarding grants to support secondary schools for a number of years but, aware that primary schools often do not have the resources they need to teach KS2 children about rocks and fossils, the charity wanted to offer funding to provide younger children with real specimens to handle and investigate. PSTT could help find schools in need of resources and the GA were well placed to provide the specimens.

The GA had successfully started their own SchoolRocks! loan scheme 6 years ago (using donated geological collections, plus rock samples previously tested by the Building Research Council, thereby saving these from landfill). Using TBT funding, they agreed to put together 10 new rock boxes (Fig. 1) suitable for teaching a class of 30 children. Each box contains a range of rock and fossil samples and is supported by PSTT's **Big Jurassic Classroom** teaching materials.



Fig. 1. Each box contains 6 samples of 8 types of rock: sandstone, limestone, chalk, granite, basalt, quartz, slate and schist, along with a range of fossils including ammonites, belemnites, echinoids and coral. Each different rock sample is stored in small, labelled drawstring bags and housed in a large sturdy box.



After delivering a series of Big Jurassic Classroom workshops, designed to support and increase teacher knowledge and confidence of science subject leaders across Gloucestershire, PSTT Fellow and Area Mentor, Carol Sampey invited schools lacking resources to apply for a rock box. Schools were selected and rock boxes delivered in September 2021.

Feedback from the recipient schools was very positive. Teachers liked how it was organised and easy to use, with science subject leaders sharing comments such as:

“Having this rock box definitely makes teaching rocks easier. In the past, I’ve used a random selection of rocks that I had scrounged from friends and family, things like a bit of left-over marble worktop, but that really doesn’t compare to having actual samples. The way the samples are stored in their little bags inside the box makes it look really special and the children were hooked from the moment they saw the box and couldn’t wait to see what was inside it!”

“I used the box during our Science Week. We have a 2-year rolling programme for science, so I hadn’t taught rocks this year (it comes in next year). However, our science week focus was on enquiry, especially child led enquiry, and so was a perfect opportunity to use the rock box! We also took part in the Great Science Share as part of science week, which is when all of our KS2 pupils set up enquiries by themselves to answer their own questions and share their science knowledge with our KS1 and EYFS pupils and parents. One group of pupils asked if they could use the fossils for this and they set up an activity using magnifying glasses to get a close look at the fossils and then draw them carefully. The younger children really enjoyed taking part in this.”



Comments from children showed that the rocks had certainly sparked interest:

“I really like that you could feel the different types of rocks and could examine them up close.”

“I liked having the rocks because I think they were interesting and it was better to see them in real life than on a screen.”

Following the success of the scheme, TBT are planning to fund more GA boxes and PSTT is now considering other areas with schools in need of resources and training. If you feel your school would benefit from the resource, watch out for news coming soon!

In the meantime, for a small returnable deposit (£25) the original GA SchoolRocks! loan scheme is available to all through: schoolrocks@geologistsassociation.org.uk

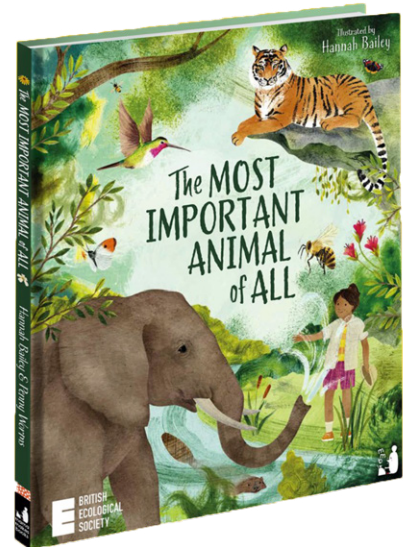
College update

North Yorkshire PSTT Cluster Schools Debate: What is the Most Important Animal of all?



Bryony Turford,
PSTT Fellow and Senior
Regional Hub Leader,
PSQM

PSTT Fellow Bryony Turford describes an exciting project carried out over a whole school year with eight schools in her PSTT-funded cluster.



The project culminated in a lively debate and a vote, all taking place as part of the Great Science Share for Schools (GSSfS) on 14th June 2022.

As a cluster, we had been approached by Penny Worms, the author of a new book 'The Most Important Animal of All', to give her some feedback ahead of the book launch. We were immediately taken by the blend of photographs and illustrations, and the idea of a keystone species (a species on which many other local plants and animals depend) which was a term new to us all.

We planned to recreate the debate and to scale it up from the classroom setting to an inter-school event to coincide with GSSfS. We set about allocating the animals, one to each school and we identified some



Sample pages from 'The Most Important Animal of All', reproduced by kind permission of Penny Worms

common threads that we would be able to present to each other in our debate to answer the question: 'What is the most important animal of all?'

We also applied to the Royal Society for one of their Partnership Grants to support our schools to connect with industry or with academic STEM professionals in order to investigate the material presented in the book at a deeper level. The support we had from the Royal Society was incredible: more of our schools



were encouraged to apply and we eventually had 4 successful grants over the year we were working on the book. This enabled us our children to engage first hand with professionals who work with bats, bees, tigers and dung beetles!

After the children in each school had conducted extensive research, talked to professionals and carried out relevant activities, they came to the final debate armed with a fountain of new knowledge, understanding

and authority. The buzz in the room was electric and the children and their science learning took over! Each school group shared a tabletop display, presented a slideshow to the audience, sang, danced and shared learning with each other. They led the whole day – even the comperes were children from one of the schools, and the children presenting and debating stood out as experts in their field.

Just like in the Earthwatch debate of 2008, when Dr George McGavin successfully argued that bees are the most important animal of all, bees were the winners of our own debate. The voting was extremely close though, with just a few votes in it.



The day of the debate – children from Kellington, Riverside, Monk Fryston, Sherburn Hungate, South Milford, Kirk Fenton, Saxton and Brayton alongside Penny Worms, author and publisher

Impact of this project on the children’s learning in science



“We found out all about the various subspecies of tiger and how scientists have only just identified why they are orange. Remarkably, their prey species see orange as green!”

Kerry Fitzpatrick, science leader and Team Tiger, Kirk Fenton C of E Primary

“It was simply brilliant to see so many young people together in one place, talking with such passion about their research and sharing their knowledge. They were able to present as scientists to their own scientific community!”

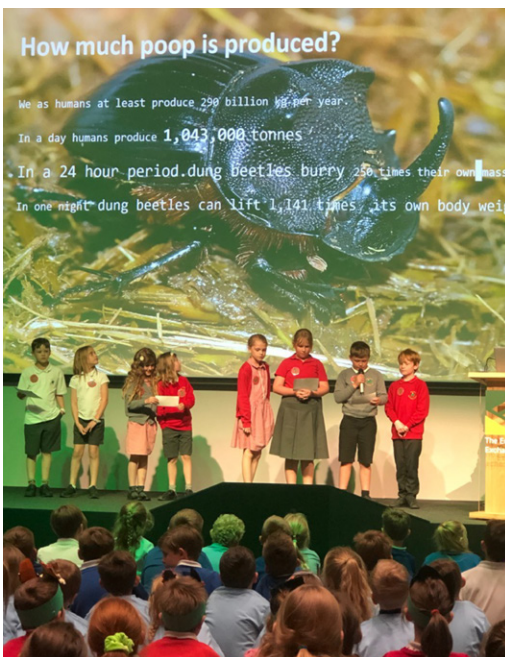
Ian Yapp, CEO, STAR Multi Academy Trust

“The whole project has had a huge impact on the children’s learning, and love of science. They now look at insects in a completely new way and have a better understanding about the work that scientists do.”

Vicky Walsh, leader of Team Dung Beetle, Monk Fryston C of E Primary

“We have loved finding out about Sea Stars. We took part in a Sea Star workshop with The Yorkshire Wildlife Trust, created and have even written and illustrated our own books all about sea stars!”

Sarah Smith, science leader and team Sea Star, South Milford Primary School



“I could not feel prouder of my Year 1 class as they stood on stage and delivered a superb presentation about bats to nearly two hundred other children and their teachers. The children were radiating confidence, enthusiasm and excitement as they independently explored other stalls, handed out fact booklets and debated with other children of all ages.”

Ollie Hine, science leader and Team Bat, Riverside Primary

We even managed to get our inspirational author and publisher, Penny Worms, to join is for the day. She was very impressed with the children and what they had achieved.

She said, 'An unforgettable afternoon. The energy and excitement were palpable. The children were engaged, collaborative and confident to share their knowledge and work. They brought the book to life!'



What next?

The Great Science Share for Schools for next year is on 13th June 2023. All our cluster schools already have this date in their diary and are planning to debate again. This time we will consider the question, 'What is the most important invention of all?' Long lists have been already created by the schools and they are in the process of choosing their invention, and making contact with relevant scientists. They are using the book '**Standing on the Shoulders of Giants**' as a starting point and they are also connecting their learning to the UN Sustainable Development Goals.

These children flipped the narrative of learning - they were the teachers, leaders and educators: the future is so bright with these young people in charge!

How to run the project 'What is the Most Important Animal of all?' in your school

We ran the project across eight schools with our final debating day being held at one of the schools. But it would work equally well as a whole school event. Here are some pointers about how to do this:

1. Get a copy of the book and read it with all the children. It could be introduced to the whole school in an assembly, or by class teachers, or a combination of these.
2. Select an animal for each class in the school. This is best done by letting the teachers read the book first or research keystone species to help them know a little about the species before choosing one. There are seven in the story and another eight listed in the back of the book.
3. Make a shared list of things about the animal that every class will research or find out about. We included: ecosystems they support, habitats they help to thrive, endangered status and why they need protecting (where relevant), food webs that they are part of, and variation within the species (where this is relevant to their importance).
4. Connect to a whole school event such as World Book Day, British Science Week or the Great Science Share for Schools to give a date to work towards.
5. Allow time for the children to get immersed in their research and learning about their animal. The children could record what they are learning in a shared scrapbook, or electronically, so that they gradually build up their 'evidence' for why their animal is so important.
6. Before the debate, the children should agree who will be their speakers. Other children can help write the speech and practise debating with them. It is a good idea to think of all the challenging questions they might get from other groups so they can prepare answers in advance!
7. Prepare a space for the debate, giving each class and their animal a table-top to display their learning. They could even make flyers or other items relating to their animal that they can hand out to other children. Each class made a voting box, decorated like their animal, and they displayed this on their table-top.
8. Set up the timetable for the debate. We gave each class a maximum of five minutes to present their argument for why their animal was the most important of all. Then after everyone has presented, there can be time for further debate and challenge, with children asking each other questions.
9. Voting – each child gets one vote (they cannot vote for their own animal). They go round the room and place their vote into their chosen animal box. Then count up the votes and announce the winner! The children were very thoughtful and considered when they came to vote. They had clearly listened to the presentations and learned from each other when visiting the tabletop displays.



Tabletop display by Team Bee, Saxton Primary School

Useful Links

- www.mamamakesbooks.com/books/p/mostimportant
- royalsociety.org/grants-schemes-awards/grants/partnership-grants
- www.educationexchange.org.uk
- web.starmat.uk
- www.greatscienceshare.org
- pstt.org.uk/what-we-do/cluster-programme

Contact

Bryony Turford

bryony@myscienceclub.com

[@PriSciGeeks](https://twitter.com/PriSciGeeks)

Bryony Turford is a senior regional hub leader for PSQM, a co-author of '100 Ideas for Primary Teachers – Science', and the co-founder and director of the recently launched 'My Science Club'. She is also a chartered science teacher, Explorify Champion and a STEM Learning CPD facilitator.

I bet you didn't know

Soil fungi could reduce global warming



Fig 1. Soil is essential for growing food.



Dr. Julia Nash
PSTT Fellow

The impact of increasing carbon dioxide (CO₂) in the atmosphere, mostly through burning fossil fuels, has and will continue to have a significant impact on all aspects of our lives.

The Earth is warming at much higher rates than at any time in the past, leading to climate change. Could soil and the fungi that live within it be key players in reducing this impact? A team of research scientists, Luiz A. Domeignoz-Horta and co-workers, has recently shown that fungi play an important role in how much carbon (from CO₂ in the atmosphere) is stored in and released from the soil.

Why is soil so important?

Many of us rarely think about the soil that is all around us, do we? What is it made of? What lives in it? Why is it important? What do we use it for (Figure 1), and how does it impact on our lives? However, this body of soil, known as the pedosphere, alongside the organisms that create it and live within it, could be an important factor in reducing climate change.

Soil is extremely complex. It is composed of eroded particles of rock, organic matter, minerals, gases, liquids, and a diversity of organisms. The organic matter is formed from the faeces (poo) of animals and decomposed plant matter. There are many different soil types based on the size of the soil particles, including peat, clay, chalky, loam, sandy, and silty soils. Different soils have different properties; for example, peat is made up of very old, decayed plants and is dark, crumbly and rich in nutrients.



Questions for children to consider:

Which soils have you heard of?

What type of soil can you find near you?

Why do you think soil is important?

Soil is vital in supporting life. It stores water, interacts with and modifies the Earth's atmosphere (see 'carbon cycle' below) and provides a variety of habitats for animals and plants.

Over recent years, the significance and importance of soil with respect to global warming has grown considerably. This is because soil stores carbon, holding three times as much carbon as the Earth's atmosphere. Soil is also responsible for removing 25% of the Earth's fossil fuel emissions each year. It can separate and store carbon for decades or much longer. By storing more carbon in the ground, the amount of CO₂ in the atmosphere can be reduced. Atmospheric CO₂ is important – it acts like a blanket around the Earth and stops heat from the sun escaping (Figure 2) - but the amount needs to be limited to prevent temperatures rising too much. With less CO₂ in the atmosphere, the Earth warms at a slower rate.

How does soil store carbon? The 'carbon cycle'

The carbon cycle is the process through which carbon-based substances are changed in the environment (Figure 3). Plants absorb CO₂ (gas) from the atmosphere and use water and sunlight to turn the

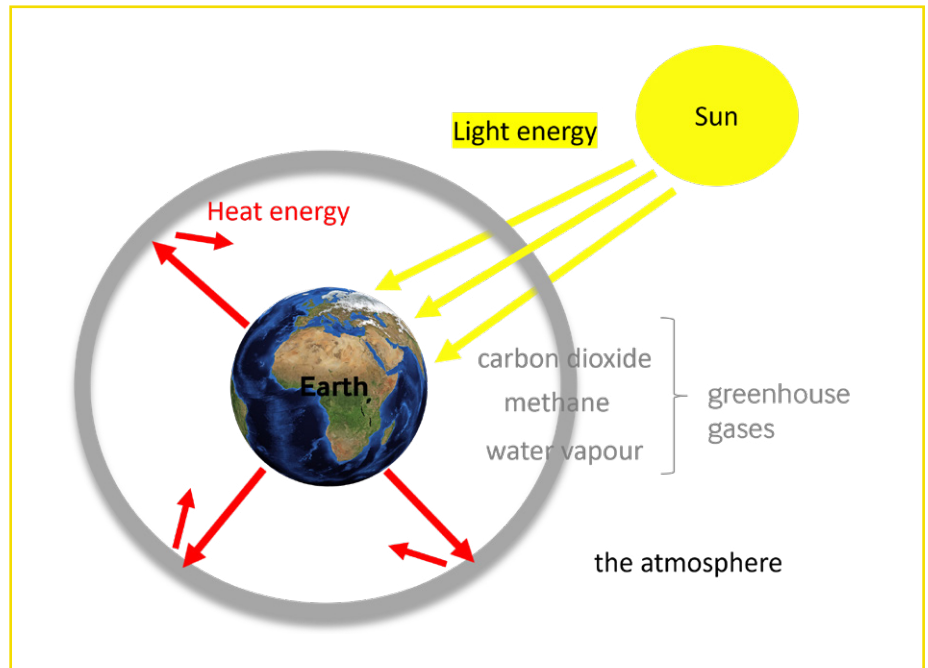


Figure 2. The Earth is getting warmer because gases in the atmosphere act like a blanket and stop heat escaping

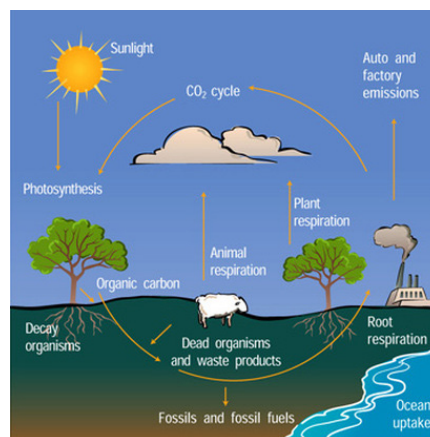


Figure 3. The carbon cycle

carbon into living tissue (leaves, stems, seeds and roots). This process is called photosynthesis and is effectively storing carbon in the plant. Animals eat plants to obtain energy to live. When plants and animals die, the carbon-based organic matter is consumed by decomposers in the soil (such as worms, bacteria and fungi). Some of this carbon is converted into materials in the soil. Over very long periods of time, these materials may become fossil fuels. When burned, the stored carbon is released back into the

atmosphere as CO₂. At each stage of the carbon cycle, living animals and plants respire, releasing CO₂ to the atmosphere.

Plants also release carbon as a sugary substance through their roots to the soil. Microbes (bacteria, fungi, protozoa and nematodes) feed off the sugary substance produced, breaking it down into other carbon-based materials. Certain fungi, known as mycorrhizal fungi, produce special sticky compounds that help soil clump together. This is essential for the formation of humus, which protects the carbon within it for long term storage. The more fungi in the soil, the more clumping occurs, and the more carbon can be stored.

Human activity is disrupting the fragile balance of the carbon cycle. Burning fossil fuels releases more CO₂ into the atmosphere and there are no longer enough trees or plants on Earth to remove the extra amount of CO₂ being produced. Another means to remove the excess CO₂ is necessary.



What happens when soil is warmed up?

Due to increases in CO₂, the Earth's temperature is predicted to rise by more than 1.5°C within the next 20 years. This will lead to increasing soil temperatures. Scientists predict that this will lead to an increase in bacteria that feed on the soil and respire, and the release of yet more CO₂ into the atmosphere.

Creating soils that can store more carbon could therefore be one answer to reducing CO₂ in the atmosphere. Luiz Domeignoz-Horta and his colleagues have shown that soil produced by specific groups of fungi and bacteria working together result in better carbon storage at higher soil temperatures. The scientists created their own soil to test. They separated bacteria and fungi from forest soil and grew them in petri dishes for 4 months. The microbes were fed on a simple diet of sugar and allowed to churn out soil. Finally, soil was heated to see how much CO₂ it produced. Bacteria-rich soils made more CO₂; those with more fungi created less CO₂.

This new study shows that fungi-rich soils grown in the lab release less CO₂ when heated than others. This suggests that fungi are particularly important in making soil that store more carbon.

The diverse communities of organisms that live in soil are also very important in the process of carbon storage. By understanding soil and the organisms that live within this most precious organic commodity, scientists hope that they will be able to create soils that store more carbon, and keep it there for centuries or even millennia, reducing CO₂ in the atmosphere and the rate of global warming.

The **Teacher Guide** that accompanies this article suggests how children could investigate different types of soils and find out more about organisms that live in soil.

The paper that inspired this work was:

Direct evidence for the role of microbial community composition in the formation of soil organic matter composition and persistence

By Luiz A. Domeignoz-Horta^{1,2}, Melissa Shinfuku¹, Pilar Junier³, Simon Poirier⁴, Eric Verrecchia⁵, David Sebag^{4,5} and Kristen M. DeAngelis¹

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1. Department of Microbiology, University of Massachusetts, Amherst, MA, USA.
2. Department of Evolutionary Biology and Environmental Studies, University of Zurich, Zurich, Switzerland.
3. Laboratory of Microbiology, University of Neuchâtel, Neuchâtel, Switzerland.
4. IFP Energies Nouvelles, Rueil-Malmaison, France.
5. Institute of Earth Surface Dynamics, University of Lausanne, Lausanne, Switzerland

Glossary

carbon – a simple chemical substance that exists in all plants and animals and is an important part of coal and oil

carbon cycle – the process by which carbon is continually transferred from the atmosphere to the earth and back again

carbon dioxide – a gas formed from carbon and oxygen

climate change – a long-term change in the average weather patterns on Earth

decomposer – an organism that breaks down dead organisms (and their waste) into the substances that plants need for growth; examples include fungi, earthworms, beetles and bacteria

fossil fuel – fuels containing carbon that have been created by natural processes, such as decomposing plants and animals, over millions of years; examples include coal, crude oil, natural gas and petrol

global warming – the long-term heating of Earth's surface observed since the pre-industrial period (between 1850 and 1900) due to human activities

humus – the dark, organic material in soil, formed when a plant or animal decays

microbe/microorganism – microscopic organisms (life forms) that can exist as a single cell or colony of cells; examples include bacteria and fungi

minerals – substances required by plants and animals in tiny amounts for various functions, for example calcium and copper

mycorrhizal fungi – fungi that form beneficial associations with plant roots in soil

nutrient – a substance that plants and animals need to survive, for example carbohydrates and proteins

organism – a living thing capable of a separate existence

organic matter – any material produced by a living plant or animal, such as leaves or dead animals

pedosphere – the uppermost layer of the Earth's surface, composed of soil and subject to change due to erosion by water and wind

photosynthesis – the process where plants use energy from the sun, with water and carbon dioxide, to create their own carbohydrate or food store

Initial Teacher Education

The Primary Science Enhancement Award



Background

PSTT has developed the Primary Science Enhancement Award (PSEA) for Initial Teacher Education (ITE) with the eventual aim that this will be open to any student teacher wanting to increase their experience and understanding of teaching and learning in primary science. The scheme supports the student teacher to undertake additional activity and development in primary science during their ITE phase. It draws on rationales, processes and resources developed by the PSTT's Teacher College, the Primary Science Quality Mark, and by Stranmillis College, Belfast (who developed their own primary science accreditation scheme for their student teachers).

Aims of the scheme

For PSTT:

- To develop a recognised scheme for supporting ITE providers and student teachers
- To connect and build supportive relationships with teachers as they start their careers

For Initial Teacher Education providers:

- To have access to a scheme to enhance their support for student teachers in science
- To stay up to date with primary science education developments through engaging with PSTT and their wider collaborations

For student teachers:

- To start their careers with increased competence and confidence to teach science
- To be confident to take up a position of school leadership in science

For schools

- To make more informed, confident appointments of teachers/science subject leaders

The scheme has been piloted over two years. As the initial pilot involving 4 ITE providers and 30 student teachers in 2020/21 was significantly limited by the pandemic, a larger pilot involving 15 ITE providers and 74 students was conducted in 2021/22.



Summary of outcomes of the 2021/22 pilot

The results of the student teacher survey (74 responses) at the end of the second pilot show that all student teachers valued taking part in the scheme.

100%

responded that their **competence** to teach science had increased or greatly increased

98%

responded that their **confidence** to teach science had increased or greatly increased

97%

responded that their **awareness of strategies to teach science** had increased or greatly increased

100%

agreed that the scheme was **manageable**, and with tasks pitched at an **appropriate level**

97%

responded that the tasks were **relevant to their experiences on school placements**

100%

responded that they **would recommend** the scheme to other student teachers

Student teachers reported a greater awareness of where to find support for science. Many said that taking part in the scheme helped them when it came to applying for a job; having done the scheme and earned the certificate enhanced their application, and they also felt more empowered to identify a school that would be 'right' for

them. A particularly valuable element of the scheme was the experience of 'interviewing' a science subject leader who had recently completed PSQM. This helped student teachers to develop a good understanding of the role of a science subject leader, as well as providing inspiration for their future careers.

Comments from student teachers included:

"The scheme was really helpful. I particularly enjoyed the first two compulsory activities as these encouraged me to have a look at a range of articles to develop my science teaching and during this I came across loads of ideas I would like to take to the classroom!"

"I think the scheme is a great opportunity for training teachers as it allows for more importance to be placed on science and its delivery, so there is a higher likelihood that children will be inspired to pursue science in the future."

"I think the scheme is incredibly beneficial for any level of confidence in science teaching."

What next?

For 2022/23, we have expanded the scheme to accommodate more ITE providers and their students, and we are working with 36 ITE providers in England, Wales and Scotland. Student teacher and ITE tutor teacher feedback from last year has been used to make improvements to the process and to support the planning and implementation of the wider roll-out this academic year.

The scheme is supported by the Association for Science Education, the Primary Science Quality Mark and The Ogden Trust. During 2022/23, The Ogden Trust is also funding and piloting a version of this scheme for Early Career Teachers (ECT).

To find out more or to watch videos of student teachers talking about their experiences of the scheme, please click [here](#)

Collaborator update

PSQM

Through a partnership with the University of Hertfordshire, PSTT has been a core funder of PSQM for over nine years. In this article two members of the PSQM leadership team, Dr Clare Warren, a senior regional PSQM hub leader and Helen Sizer, PSQM co-director, together with Director Jane Turner, describe how doctoral research funded by PSTT has enabled PSQM to articulate its practice, and has informed the PSQM programme and the future strategy of the organisation.



The Primary Science Quality Mark is a one-year school improvement programme for primary science. Working within a collaborative hub, led by an expert PSQM hub leader, and using the PSQM evaluative framework, the science subject leader is enabled to develop as a confident, knowledgeable and effective leader. This targeted and personalised professional development enables the subject leader to raise the profile of science across the school, increasing the engagement and participation of children, staff and the wider school community. At the heart of PSQM is reflection: throughout the PSQM process subject leaders are required to use a range of evidence to understand the impact of different actions and interventions on science leadership, teaching and learning in their schools. This enables them to develop a model of informed and sustained school improvement.

As an organisation, PSQM is also defined by a reflective approach to its own practice. The leadership team regularly evaluates process and outcomes to understand what works within the PSQM programme and why, evaluating not just the professional support they provide for subject leaders in schools, but also that provided for the ninety plus PSQM hub leaders who work with them across the UK.

Developing primary science subject leaders

For many subject leaders, taking the school through the PSQM process is a transformative journey. But what exactly is it that brings about this change? This was the focus of Dr Clare Warren's recently completed PSTT-funded PhD, titled: "Primary science subject leaders creating communities of practice: Stories of professional development". In the

next section, Clare describes some of the findings of her research and the factors she identified as key to the changes in the science subject leaders.

Research findings

My research involved tracking the progress of eight science subject leaders over a year as they worked to gain a PSQM. I am delighted to say that all were successful. Some were experienced teachers and subject leaders while others had taken on these roles more recently. One was a teaching assistant. Some saw themselves as 'sciencey', while others rejected notions that they were or could ever be a scientist. I gathered data that allowed me to examine how these science subject leaders, and the science teaching and learning in their schools, changed over the course of the PSQM year and to understand the processes involved in these developments.

In trying to understand the changes that happened over the year, I drew on the idea of communities of practice (Wenger, 1998). Wenger claimed that a community of practice was present if there was:

- A domain; where members have shared interests and competence,
- A community; where members build relationships through discussion and activities, and
- A practice; members are practitioners sharing resources and problem solving strategies.

At the start of the PSQM year, some science subject leaders provided evidence that there was no science community of practice in their school because all or some of the three elements were absent: for example, very little science was being taught, there was no communication between teachers and not all children were involved in practical work, science enquiry or outdoor science. However, over the course of the PSQM year, as a result of initiatives instigated by the science subject leader, each school either created or developed an identifiable science community of practice. These initiatives (which included agreeing shared principles of good practice, engagement with CPD, a resources audit, development of science pedagogy and assessment, home-school science and enrichment activities) were stimulated by the PSQM criteria which required subject leaders to bring colleagues together to evaluate and develop whole school practices in science curriculum planning and pedagogy. The year-long PSQM process ensures that there is time to engage the wider school community to participate in a range of science development initiatives.

In my work I also identified a broad primary science community of practice: one you probably belong to if you are reading this magazine. This 'community' includes organisations like the Association for Science Education, STEM Learning, the Wellcome Trust, charities such as PSTT and The Ogden Trust, and the learned bodies and other organisations that support primary science education.

I represented the two communities of practice as different sized circles (Fig. 1), using the model to show how, over the course of the PSQM year, the science subject leaders' engagement with this broad primary science community of practice, helped move their schools further into the larger circle.

This engagement with the broader community of practice was evident through the introduction of some of the discourses and practices from the community into their own schools. Examples included the following: subject leaders borrowed practical resources from outside

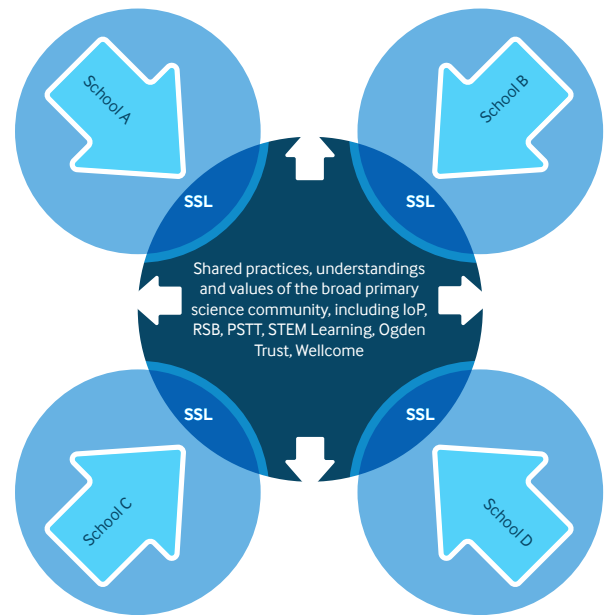


Fig. 1

agencies, trained colleagues to use them, and children increasingly engaged with practical science; they arranged for science visitors to come to school and tell the children about science in their work; they read ASE publications and attended ASE conference events and applied ideas to their own teaching; they attended additional CPD funded by the local authority. Each school's own primary science community of practice became more embedded in the broad primary science community of practice and, in turn, the broad primary science community of practice benefited and expanded as it welcomed these science subject leaders and their schools. I recognised that PSQM enabled science subject leaders to cross boundaries between the broad primary science community of practice and their own schools, thereby facilitating the development of science communities of practice within their own school.

Using the research

The outcomes of Clare's research are now informing PSQM's future strategy, as Helen Sizer explains in the remainder of this article. Clare's research on communities of practice is now integral to the PSQM Theory of Change. It has helped PSQM's leadership to understand that regular interaction around a shared concern or passion is a key element in driving improvement in practice in primary science at both school and wider community level and therefore validated the PSQM local hub model. It made clear how the science subject leader is crucial to the process of enabling change by crossing boundaries between the two communities. This both confirms the importance of authentic engagement with the wider



science education community, and emphasises the significance of the hub leaders' knowledge of, and participation in, the sector. This continues to inform the PSQM approach to hub leader development. At their induction, Clare's model (fig. 1) helps new hub leaders explore how the PSQM programme promotes subject leader membership within the broader primary science community of practice. Consequently, the research is helping to articulate the concept of communities of practice, and to deepen organisational understanding as hub leaders consider the importance of their role in facilitating this process.

Developing a professional community of PSQM hub leaders

Clare's research has not just helped us understand how the PSQM social learning model is impacting on schools and subject leaders. It has also prompted us to explore how PSQM hub leaders work together as a professional community. Recent research with school-based hub leaders (those who have a permanent teaching responsibility in school) found that the PSQM professional community provides a shared purpose and social learning space which helps support hub leader practice development. In this respect, it is the sharing of informal knowledge through local community engagement which is valued as a way of dealing with the challenges of a professional development leadership role, for example, managing different school contexts or arising issues and problems. This learning is recognised as anecdotal and different to the more formal learning which takes place through training sessions. In this way the professional community is developing a shared practice

that is helping PSQM adapt to the complex educational environment. While we have always respected the expertise of our hub leaders, we have gained a better understanding of the function and value of the professional community and now consider it as an organisational asset.

In addition to building capability through practice development, we are also considering how our professional community supports the educational systems' leadership landscape through its potential to connect different layers of the system to promote wide-scale improvement. Hub leaders act as a bridge between the professional community and schools in their PSQM hub. In this way they are sharing ideas and information with both communities. Further interaction between the community and the wider education sector helps to connect all layers of the system.

While our future strategy will look to utilise and further build hub leader connections within the professional community, we recognise that a lack of time and imposing work commitments are barriers to community connection. Furthermore, we recognise the importance of gaining senior leadership support. There are undoubtedly challenges in the current system. Nevertheless, our understanding is enabling us to articulate our strategy and theory of change with future funders, helping us to continue building influence within the sector and provide a clear evidenced message to government about the value of professional communities.

Questions for reflection:

- Which communities of practice are you a member of? (Think about domain, community and practice as described above)
- Do you cross boundaries between different communities, thereby strengthening one or other of those communities?
- What are the factors that enable and constrain you as you work to cross boundaries?
- Are you in a position where you can support others to cross boundaries? If so, can you do more to facilitate boundary crossings?

References

Wenger, E. (1998) *Communities of practice: Learning, meaning, and identity*. Cambridge: Cambridge University Press.

Clare Warren is an independent consultant. Her PhD, completed at the University of Hertfordshire, was fully funded by the Primary Science Teaching Trust. Clare says, "I will always be grateful to the Primary Science Teaching Trust (PSTT) whose generous financial contribution enabled me to pursue research into the ways in which the Primary Science Quality Mark (PSQM) enables science subject leaders to develop science in their schools, at the same time as developing their subject leadership skills." Clare's full thesis can be downloaded from [here](#).



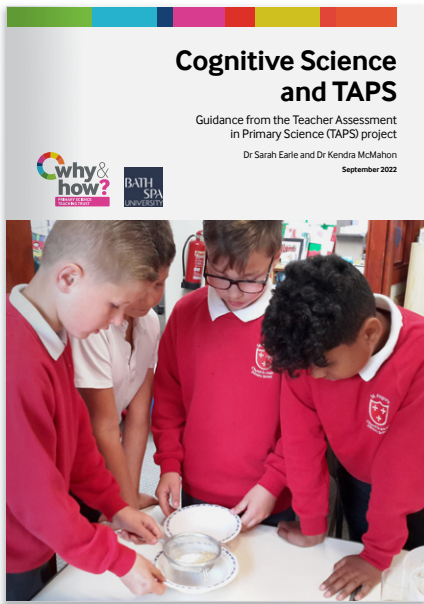
Jane Turner:
PSQM Director



Helen Sizer:
PSQM Co-Director

Collaborator update

Bath Spa University



Cognitive Science and TAPS

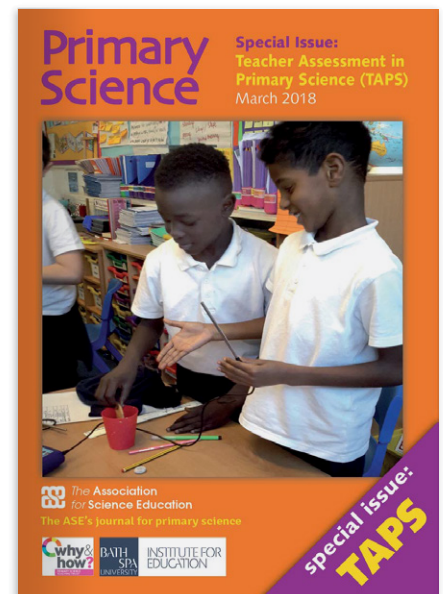
Bath Spa University has published a new guidance document to add to the suite of **Teacher Assessment in Primary Science (TAPS) publications**. Based on research into the cognitive sciences, the booklet takes knowledge and understanding of how children learn and relates this to primary science teaching and assessment. It links ideas about working memory and cognitive load to examples from the TAPS project. The guidance sets out how teachers can judge what the cognitive load will be for learners, and how formative assessment can help with this. It also addresses longer term memory and how, through good assessment practice, children can be helped to revisit content and deepen their learning. The booklet can be downloaded [here](#).

Assessment special issue of Primary Science

A reminder that there is an open-access TAPS issue of ASE's teacher journal, Primary Science. This special issue is a collection of ten articles giving multiple perspectives on how TAPS and its associated resources are being used to support the teaching and assessment of primary science in a range of different contexts. Teachers wanting to develop a shared understanding of science and assessment, central to the TAPS pyramid self-evaluation tool, might find the article written by PSTT College Fellows Carol Sampy and Pauline Rodger very helpful. For those schools who are unsure about how to begin a whole staff discussion and get started with assessment in primary science, 'Focused Assessment' has

been shown to be a good place to begin. There are four articles in this special issue which discuss a focused assessment approach to teaching working scientifically. The TAPS special issue is free to download [here](#).

The Teacher Assessment in Primary Science (TAPS) project is funded by the Primary Science Teaching Trust and based at Bath Spa University. TAPS works collaboratively with teachers to develop resources to support teaching, learning and assessment in primary science. All resources are **freely available on the PSTT website**.



Collaborator update

The Association for Science Education

The Journal of Emergent Science (JES) is published by the Association for Science Education (ASE) in partnership with the Primary Science Teaching Trust. The journal is open access and bridges the gap between research and practice.



Issue 23, June 2022: focus on sustainability

This special issue brings together articles to support schools with prioritising education for sustainability. The research reviews, practitioner guidance and case studies all provide insights into raising children’s awareness and understanding of global issues. The importance of ensuring every child can access and engage with these issues is explored in the research review by Meghna Nag Chowdhuri, Heather King and Louise Archer. Jointly funded by PSTT and The Odgen Trust, this research team developed the Primary Science Capital Teaching Approach: a social justice framework that supports children’s voice, agency and active participation in the issues that matter to them, including climate injustice.



Contributing to JES

Contributions to JES are welcome, from practitioners as well as researchers, and full guidance about writing for JES can be found on page 43 of [issue 22](#).

JES is a biannual online publication covering early years through to the end of the primary phase. Copy deadlines are October for the January issue, and March for the June issue. Authors can submit articles in any of the following categories:

- **Original research:** articles describing both small-scale practitioner research and larger projects, to include descriptions of how the research was carried out, as well as discussions of the findings and associated literature.
- **Research review:** articles providing a summary of a larger project or perspective piece, reviewing current research in the field.
- **Research guidance:** articles that support researchers to reflect on their practice through considering research processes and methodology, and utilising relevant examples to provide support for practitioner research.
- **Practitioner perspectives:** articles that consider the application of research from the viewpoint of the practitioner.

Wider collaborations

The Institute of Physics

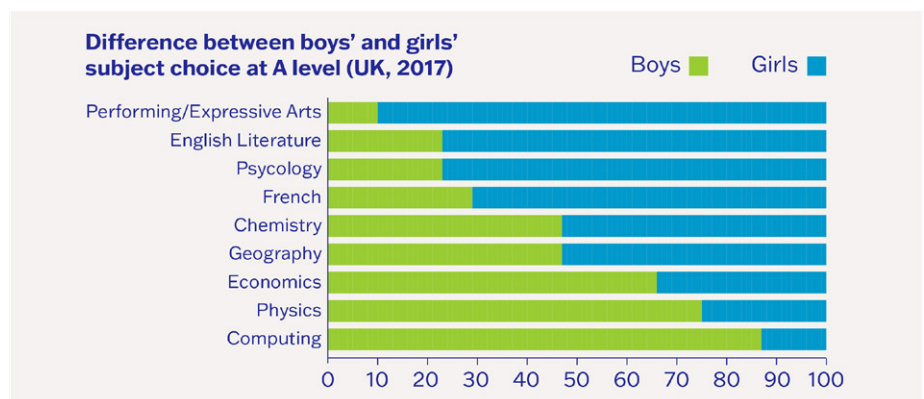


Image credit: Dom Martin

The PSTT works with the Institute of Physics to promote awareness of resources for primary physics and to share opportunities for relevant CPD for primary teachers.

In this article, Beth Bramley, Strategic Lead for Inclusion at the Institute of Physics, shares details of Limit Less: the campaign to support young people to change the world and fulfil their potential by doing physics.

The prospect of the children in your class becoming manufacturing engineers, metrology (measuring) technicians, or IT risk consultants may seem rather a long way off, but the sad fact is that by the time they leave primary school, far too many children



have written themselves out of futures which may have been a perfect fit for them. Indeed we **know from**

research that by the age of seven children's ambitions have already been shaped by gender stereotypes.

At the Institute of Physics (IOP), our work is driven by the urgent need to address the fact that there are far too many people missing from our community. We have identified five groups that are currently underrepresented or underserved in the physics community; young people in these groups are less likely to do physics, and more likely to face a hostile environment when they do.

These groups are:

- Girls
- Young people from economically disadvantaged backgrounds
- Disabled young people
- LGBT+ young people
- Young people of Black Caribbean descent

And of course, there are many and varied intersections between these groups.

The IOP launched the **Limit Less** campaign to ensure that in every place and space where children and young people are exposed to limiting attitudes about what is right for them – because of where they're from, what they look like, or who they are – there is a counter-story working to champion them. We need to smash the detrimental image of physics that is something that is done by lone (male, white) geniuses, and ensure that children see it as a vibrant, creative, and collaborative discipline.

What is Limit Less aiming to achieve – and how?

The campaign doesn't work in a silo because no-one is fully shaped by one area of their life; we're all influenced by our education, our family, our community, the books we read and the social media feeds we scroll. That's why Limit Less is working with:

- TikTok influencers to debunk some of the fusty attitudes around physics [iop.org/LLTikTok](https://www.iop.org/LLTikTok)
- **Founders4Schools** to enable role models from the physics community to speak to young people in education
- Our own **IOP membership** to ensure that events and outreach target the groups above and are fully inclusive
- **Social media creators** to spread best practice for physics content online:
- Teachers and school leaders to spread good practice about evidence-led approaches to remove barriers to inclusion



63.1%

of primary school teachers in the UK and Ireland agreed that societal issues, such as equity and inclusion, have a place in subject specific teaching.

Censuswide survey of 2000 primary and secondary school teachers across the UK and Ireland

Lastly, and in many ways most importantly, the Limit Less campaign works with policy makers and government officials across the UK and Ireland to ensure that systemic and permanent changes are made.

Why primary?

Many interventions to tackle inequity focus on secondary schools and post-16. However, by this time, young people have been exposed to over a decade of stereotypes, biased expectations and narrowing of their options. By reaching young people as early as possible, we can counter the narratives that make them feel that science is not for them.



Image credit: Dom Martin

This isn't just about telling young people, "You can do physics". This is about providing them with the tools – confidence, risk-taking and a sense of adventure – so they can make the most of opportunities throughout their lives, even if actively discouraged by others.

Despite physics not being a discrete subject at primary level, there is so much that primary teachers, science subject leaders, and school leadership can do to ensure that their schools are keeping doors open for children.



Spotlight on whole-school equity planning

The IOP wants to see all schools (and nurseries and colleges) take a school-wide approach to assessing the barriers that certain groups face.

The areas of school life outlined in the table in fig. 1 could form the basis of a whole-school discussion. Schools can look for existing evidence to understand the current experience of young people from our under-represented groups and then put in place actions to dismantle those barriers.

KEY ADVICE: everyone in the school community should be involved in developing this vision: school leaders, all teaching and non-teaching staff, children, parents, and governors.

These prompt questions might be helpful for a staff discussion:

1. Consider the school environment:
 - On the walls – who is pictured? Is there good representation of people from different backgrounds?
 - Learning resources – do they reflect the diversity of our society?
 - In the playground – is it possible that any children feel excluded or unwelcome in particular areas?
 - Sports equipment provided – is this inclusive for all children?
2. Are staff trained on inclusive language and is discriminatory language always taken seriously and reported?
3. When speakers come into school, could this be an opportunity to provide counter-stereotypical examples of jobs? And is the diversity of external speakers monitored and evaluated?



Image credit: Dom Martin

There will be formal data such as attainment and absences which you and your school will already scrutinise to look for any patterns, but an evidence-based approach should cast the net more widely to uncover the experience of different groups. Many teachers we have worked with at the IOP have, for example, done a tally of who they go to for answers in class and often been surprised by the results. The following case studies outline some of the approaches schools in our networks have taken to bring about change in their schools.

A whole-school approach truly involves the whole school – areas to consider are shown below:

Personal practice: supporting staff to reflect	All teaching and non-teaching staff within the school should be included in such work, trained to play an active role and made aware of the effect of biases, conscious and unconscious.
Student voice: putting young people at the heart of change	A crucial step is supporting children and young people in understanding and challenging injustice and stereotypes and allowing them ownership of the issues.
Curriculum and learning	Resources and the curriculum should be audited to ensure equal opportunities. Learners should be able to choose subjects and activities based on their preferences and skills, rather than being guided by their gender, race, sexual orientation, disability or background
Progression, choices and jobs	Everyone has a role to play in opening learners' eyes to the diversity and range of options available for their future, which should not be limited by their own or others' expectations
Internal and external communications	Schools communicate with a wider variety of audience including parents, carers, students, staff and the wider community. Processes should be put in place to make sure communication and materials counter stereotypes and do not reinforce bias.
Engagement with parents, carers and the wider school community	The biggest impact will be made when the whole school community works together. Involving parents and carers from the start can help children and young people challenge inequality in wider life.

Fig. 1



Case study 1 – improving diversity in curriculum texts

A primary school wanted their curriculum to be as diverse as the students it is serving. The school conducted an audit of the texts used within the curriculum as a means of monitoring the diversity of reading material chosen for the children to study. The findings showed that:

- There were 63 male authored books to 32 female.
- Black, Asian and Minority Ethnic children were not represented in the book selection.
- Ten of the books by female authors had male protagonists and seven of the books with female leads had the word 'princess' in the title.

- Only one book by a female author with a human female protagonist (named in the title) was being used in the school: Rosie Revere, Female Engineer.

With this evidence, it was possible to take action and monitor progress. They established upfront what success over the course of the next year would look like, and how they would measure it. After introducing a wider variety of books, embedded into all subjects, they found a demonstrable change in pupil perceptions of the curriculum compared to the baseline. Following a staff CPD session, teachers reported increased confidence with challenging stereotypical views.

Case study 2 – identifying and reducing harmful language

A primary school wanted all staff to identify, understand, and be confident with challenging harmful views and language in order to be proactive in promoting equality. To benchmark, they monitored behaviour logs for instances of prejudiced language and stereotyping, conducted questionnaires with children about their experience in school, and updated whole-school policies. As part of their staff training, colleagues co-created 'scripts' to challenge instances of harmful language and play.

They identified playtime as a particular issue, finding examples of boys dominating games of football, and incidences of prejudiced language. With a new whole-school ethos launch planned, it was therefore vital that support staff, who oversee the playground and games, were fully included in all the training and planning. Part of this whole staff training included a workshop to build case studies and scenarios of how to deal with biased views and language.

Case study 3 – challenging stereotypes

An early years setting and a primary school wanted to close the academic gap for boys without reinforcing stereotypes about hobbies or preferences for ways of learning. The school was alert to the dangers of creating 'add-ons' and wanted any changes to be embedded and based on a deep and shared understanding of equality. Work involved exploring biases as adults and how these manifest in the staff's actions, language and teaching approaches.

The initial work was set for one academic year and involved staff meetings that provided opportunities for open-ended discussions. The school also provided academic reading and research to prompt further discussions on the difficulties associated with gender

stereotyping and its impact on children's self-esteem and wellbeing. The project explored how the staff team can challenge stereotypes through small actions rather than grand gestures. The school put in measures place in order to assess impact which included pre- and post-training questionnaires, evidence in changes in curriculum materials, and peer classroom observation to consider time spent with girls/boys and the language being used.

Note: all case studies are taken from the Gender Action schools award, which the IOP supports. You can find some great [resources here](#).



What can we learn from these lived experiences?

“It was at primary school, when I was about seven, that I was first told I wasn’t good at maths. My dyspraxia (a motor coordination disorder) meant I had bad handwriting and my dyslexia meant I sometimes reversed my numbers when copying problems off the board, so my answers would be wrong. On top of that, I was an August child, so my co-ordination was always going to be delayed. I was put in the bottom group for maths and my parents were told I was not keeping up with my classmates and that I was not an academic child. That really bothered me, because I loved maths. Being written off and underestimated made me determined to prove my teachers wrong.”

18-year-old female student with neurodiversity

“I loved physics even before I knew what it was, especially magnets, light and space. When I was 8 years-old I asked for a telescope for Christmas. I was quickly dismissed and told it was a boys’ toy and to look at the Barbies instead. Later on, as my passion grew, people tried to direct me towards biology or chemistry instead as they were more suitable for a girl even if she was into science, and my parents got me a microscope for Christmas. While this was progress, I still had very little interest in anything but physics.”

Working-class female in her mid-20s

Taking action to Limit Less

Please lend your support to this campaign so we can show our politicians and decision-makers that there is a groundswell of support for change from educators that they can’t ignore. What you can do:

- ⇒ Sign the [manifesto for change](#)
- ⇒ Read the report for Early Years and Primary [here](#).
- ⇒ Find out more about Limit Less and the IOP’s support for primary science, [click here](#).
- ⇒ Get in touch: we are also keen to act as your loudspeaker – please be in touch with campaigns@iop.org to let us know about work you are doing so we can showcase your successes both to other schools, and also to show decision makers what is possible.

Wider collaborations

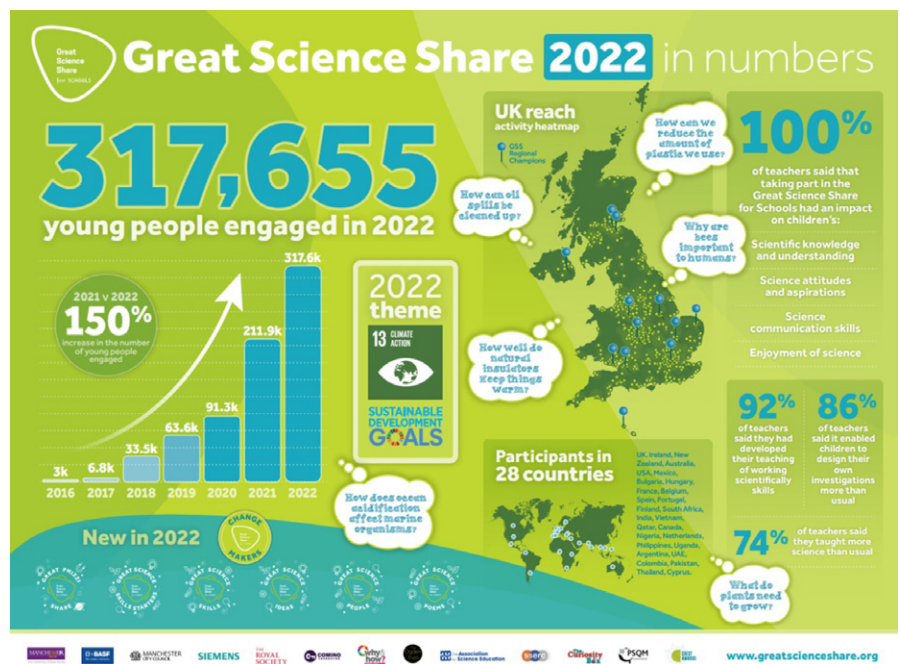
SEERIH (The University of Manchester) Autumn Splash!



The Science & Engineering Education Research and Innovation Hub at the University of Manchester has long been supported by the PSTT. In 2022-23, a range of new projects are coming on-stream to engage teachers across the UK. Here, Dr. Lynne Bianchi gives an overview of three of these.

GREAT SCIENCE SHARE FOR SCHOOLS

The largest 5-14 year old national campaign promoting children to get involved in asking-investigating and sharing their scientific questions. The theme for this academic year is **'Science Around Us'**, building on last year's focus on global sustainability, climate change and making a difference. A range of resources is readily available to support question asking and investigation. Make connections with the science in your school, communities and more widely, and share your enquiries on **Tuesday 13th June 2023**. Don't miss out on key information and resources - registration is free via greatscienceshare.org



Engineering Educates

A 7-14 STEM project supported by the National Farmers' Union. This year, SEERIH launches a new campaign to encourage children to use the engineering design cycle, applying their creativity across science, technology, maths and computer science. Three pathways of resources, tailored to different age groups, are curriculum linked and supported by teacher professional development and are available from November 2022. Register your interest to take part in the **Farmvention Challenge** [here](#)



SHINING A LIGHT ON INCLUSIVE SCIENCE TEACHING AND LEARNING (7-14 YEARS)

A new report, co-authored by PSTT Fellow Bryony Turford, that supports reflection on how inclusive your science classroom is. You can download the report [here](#).

➔ For more information about SEERIH visit seerih.manchester.ac.uk

➔ For more information about the Great Science Share for Schools visit greatscienceshare.org



Key dates

5-7

**JANUARY
2023**

ASE conference
in Sheffield

**PSTA
NOMINATIONS
2022 EXTENSION**

Closing date now
13th Jan 2023

10-19

**MARCH
2023**

British Science Week

**FEBRUARY
2023**

Royal Society
Partnership Awards

Applications open

sharing
& learning

excitement
& exploration

discovery
& delight

investigating
& questioning

www.pstt.org.uk

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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