Why&How? Magazine

Summer 2023: **Issue 18**

Resources to support working scientifically

Explorify – new activities for EYFS

Take science to the beach with our brand new free book

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

In this issue...

Why & How? is the brand name of the Primary Science Teaching Trust

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Welcome

Welcome to this 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, an update on the latest developments in Explorify, and support for climate science education. We also highlight brand new resources from PSTT and share contributions from our collaborations with other organisations.

In **news** we are delighted to welcome the latest group of award-winning teachers to the PSTT College. We look forward to celebrating their achievement at our awards dinner in June. If you know an outstanding teacher of science, why not nominate them for one of next year's awards? We also celebrate the winner of our glass design competition as well as an award for Explorify.

Alongside our usual picture for talk, the **resources** section highlights two newly released resources. Seashore Science, written by PSTT Fellows Caroline Skerry and Nicky Collins, is a free to download book of fifteen science lessons you can do at the beach. Primary Science Skills and How to Teach Them, written by PSTT Fellow Tracy Tyrrell, supports the development of disciplinary knowledge through the discrete teaching of working scientifically skills; units 1-4 are now available, with 5-8 due out soon.

We are delighted to welcome guest authors Leigh Hoath and Heena Dave whose article for the **climate science** section shares the work of the Climate Adapted Pathways for Education alliance and gives key recommendations for schools about incorporating effective teaching about climate.

Explorify recently launched a new set of activities for early years which has been widely welcomed by the sector. There are more new activities in the pipeline for this age group so keep an eye out for these. Also new in Explorify is the upgraded teacher support section, including a helpful search facility. To find out more about the research evidence that underpins much of the Explorify approach, see the Thinking Doing Talking Science piece in **collaborator updates**. Also in this section we include an article from PSQM that reflects on PSTT's ten years of support and the growth of the programme over this time.

In this issue's **I bet you didn't know article**, PSTT Fellow Rebecca Ellis explains the role of Arctic ice in maintaining global temperatures, and how an innovation in geoengineering can slow down the rate at which sea ice melts.

PSTT's Primary Science Enhancement Award scheme (PSEA) continues to grow, and we share updates on this in the **initial teacher education** section. We are expanding the scheme and we encourage any new tutors who would like to offer the scheme to their students to register their interest.

This is the 18th issue of our magazine and we hope that it continues to be a source of practical support and useful updates about PSTT resources, projects and collaborations. 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.

Martin Pollard
Chief Executive Officer

Sue Martin
Chief Operating Officer

Ali Eley
Outreach Director

Dr. Alison Trew
Impact and Research Director (acting)

Peter Sainsbury
Cluster Director

News

Presentation to our winning glass designer, Heidi

Regular magazine readers will be aware that we announced the winners of our glass design competition, run with support from the Worshipful Company of Glass Sellers in our spring issue.

We were recently able to join Heidi, her mum Sally, St Bede's RC Infant School Widnes' science subject leader Miss Tittensor, and a host of other guests at the VIP Royal Opening of Stourbridge Glass Museum by HRH the Duke of Gloucester, during which Heidi was presented with her design by glass designer Allister Malcolm.

Allister has turned Heidi's design of 'the magnificent bottle' into glass, with both Heidi and the school taking away an exclusive piece of glasswork as a lasting reminder of her success. During the visit, we were able to see other glass production in action, as Allister's studio is contained within the museum. We are delighted that Allister has filmed the process of blowing and sculpting Heidi's design, and this is currently being shown as a series of short clips across Allister's various social media accounts (search for Allister Malcolm Glass Ltd on LinkedIn, Facebook, Twitter and Instagram). This fascinating process could lead to some great discussions with children studying states of matter and materials.

Response to 'Finding the Optimum' (Ofsted, 2023): a new guidance report for practice

A response to the Ofsted **Finding the Optimum** report: **Implications for practice in primary science** will be available for download from **15th May 2023** via ASE, SEERIH, PSQM and PSTT websites. Drawing on expertise from these organisations, the guidance document has been written by Jane Turner, Dr Lynne Bianchi and Dr Sarah Earle.

The guidance will stimulate dialogue and reflection amongst primary science subject leaders, all science teachers and professionals who support them. While the report was based on findings in schools in England, many themes resonate across all UK nations, and any key issues should be discussed in relation to particular school contexts.

A follow up webinar to discuss the guidance and ask questions is being held on **14th June at 3.30pm** – register your place **here**.

Explorify wins a Gold Award from Teacher Tapp!

We are delighted to share that Explorify has been given a gold award by Teacher Tapp. Gold awards are given to organisations or resources which are used by a minimum of 10% of all teachers and of these, more than 90% recommend them. The Teacher Tapp app builds a community of teachers and delivers a 'daily bullet of professional development' to its users.

*Teacher Tapp Brand Tracker, 2nd April 2023. Each month Teacher Tapp polls over 7000 teachers on their awareness, usage and recommendation of 20 education brands. Brands are included on a 6-monthly or annual basis. Gold Recommendation Awards go to any organisations with at least a 10% usage rate and at least 90% of users also recommend it.

Primary Science Teacher Awards 2023

We are delighted to announce our most recent Primary Science Teacher Award (PSTA) winners, those nominated in 2021-22, who will be recognised as PSTT College Fellows from September 2023.

We will be holding a celebration dinner as part of our annual PSTT College Conference on 8th June 2023, during which presentations will be made to these winners alongside those of the previous year's awards.

We would like to thank the organisations that continue to endorse our PSTAs: the Royal Society of Chemistry, the Royal Society of Biology, the Institute of Physics, the Ogden Trust, SHINE Trust, STEM Learning and SSERC; and also The Royal Society, the Association for Science Education and TTS for their continued support for the Primary Science Teaching Awards.

Congratulations again to all these outstanding teachers.

Climate science

Changing today's education for tomorrow's climate

CAPE Climate Adapted Pathways for Education

CAPE – Climate Adapted Pathways for Education – is a new alliance of researchers, educators, schools, and partners across the UK that aims to support schools to integrate meaningful climate science education into their curricula and organisational culture.

We are delighted to welcome guest authors Leigh Hoath and Heena Dave, the co-founders of CAPE, who share more about the vision, strategy and key recommendations of the alliance.

There is not a great deal that is 'good news' in many climate change publications: the most recent reports make for distressing reading, which is why the work towards a better climate change education should neither be competitive nor slow.

Where time is taken it should be about how we can best integrate this content into existing curricula with care and compassion. It is important that our teaching leaves young people with some hope.

"Climate change is one of the most serious problems confronting humanity. Many people, especially young people, are worried about climate change, and quite many experience helplessness and even hopelessness regarding this problem and the global future. At the same time, it is of utmost importance that all societal actors take their responsibility in fighting climate change. Therefore, one could argue that it is vital to promote a hopeful outlook concerning this problem and humanity's ability to mitigate it ... some see hope as an absolute must, both for mental wellbeing and climate-change engagement."

Ojala, 2023

Who we are

CAPE is a new alliance of researchers, educators, schools, and partners across the UK who are working to change today's education for tomorrow's climate. As an alliance, we are committed to making sure that children and young people have the knowledge and skills to protect our increasingly fragile planet. Our alliance is made up entirely of volunteers and we are immensely proud that we have succeeded in building CAPE through the support of inspirational organisations and people. At CAPE, equality, diversity and inclusion is a priority. We know that environmental and education spaces are failing to amplify and lift those voices from diverse backgrounds. We've worked tirelessly to make sure we have representation from a range of people from different ethnic backgrounds (25%) at all levels of our organisation. We still have a lot of hard work to do in this space – but in an incredibly short time we believe we've achieved something unique: we've created an alliance that has equity embedded within its culture. Our visual identity aims to communicate our environmental and educational expertise alongside our trusted, evidence-informed, participatory, and empowering approach.

Our Vision

At CAPE we will equip all teachers and school leaders with the knowledge and skills to help children and young people take climate action and protect the environment.

Our Values

We are working towards our vision through our values - we are firmly committed to:

- Being kind and respectful: we know that creating a culture of kindness in our work distributes the joy of problem-solving, creates a safe environment and creates a foundation for equity.
- Being evidence-informed: we believe that people who make decisions in education and about the environment need to know what the research says - we know there is a need to equip school leaders and teachers with better insights so that they can understand how human activity is impacting the planet.
- Working collaboratively: we will amplify the voices of partners from all sectors and backgrounds working towards solving complex environmental education problems through high-quality evidence-informed approaches - especially those voices that have been historically silenced.

Our Mission

Our collective mission is to ensure that we:

- Build collective operational climate literacy amongst children and young people.
- Create a knowledge-rich story of climate change so that children and young people develop expert mental models about sustainability and climate change throughout their education.
- Develop a taught curriculum that engenders attitudes and behaviours which motivate children and young people to protect the planet for future generations.
- Ensure that this curriculum is underpinned by the cognitive principles of learning and implement these principles within curriculum design to maximise children and young people's chances of securing a deep understanding of sustainability and climate change.
- Support school leaders and teachers to develop their own expertise in relation to sustainability and climate change education – creating enough momentum to ensure that school improvement in relation to this priority is driven from within the school system.
- Integrate climate change education into a school's organisational culture, so that it is "the way we do things around here".
- Acknowledge the complexities of climate change education and mitigate this by connecting business and the wider environment sector with educators.
- Commit to being informed by high-quality evidence and to make the rigour of that evidence transparent.

CAPE Patron Mary Myatt supports the organisation's focus on a coherence and well sequenced curriculum. Pictured here with Co-Founders Heena Dave and Leigh Hoath at the CAPE Launch in the Guildhall, London, March 2023

How we are working

CAPE is currently working with a range of school and trust leaders in order to make a difference on a whole school level. We are in the midst of creating the second version of our report which will highlight the case studies around implementation, curriculum and professional development which are being developed and piloted by our supporting school trusts. We are working collaboratively with organisations outside of schools in order to align national projects and developments with what is happening within schools. For example, we have a close working relationship with the Natural History Museum who are leading on the National Education Nature Park work, responding to the DfE's Sustainability and Climate Change Strategy (2022) as well as organisations such as the ASE, the British Science Association and Cambridge University Press and Assessment. What is key, for us, is that climate change education is not just the responsibility of one person in a school – all too often these things falls to an enthusiastic early career teacher or someone identified as caring for the environment. Climate change education needs to be part of the culture of the school which is why our work currently focusses on leaders.

There are two other things that we often see happening which can be the downfall of change within schools. The first is that too much is moved too quickly. Our curriculum work is focussing very closely on primary science and geography where we are enabling and empowering schools to use their existing curricula to find the best ways to teach climate change education through the means they already have in place. A one size fits all approach is problematic – the diversity we see within schools and between them means that there is rarely a single solution to any educational issue and climate change education is no different. So to ensure that climate change is taught well in the context of the school we are using curriculum as a driver for ensuring that pedagogies are appropriate, and only then considering what high-quality resources look like to support this. This brings us onto the second issue around change. When faced with something new in schools it is really challenging as we already have a very full day and curriculum. There are limitations with subject knowledge, pedagogical support for teaching and in class resources. It is really important that schools do not simply find 'nice' resources online and allow these to dictate what happens within the classroom. This is in part why our collaborative stance is so important – it means we can support trusts and schools in finding the resources that work best for them, and those that are quality assured, such as through PSTT.

Expert Advisors from an Avanti School after speaking at the launch event in London

What is also key in addressing this issue is ensuring that subject knowledge and pedagogical needs are met through longer term professional development. This must not be conflated with 'going on a course' but rather be sustained support over some months for the school, at leadership and at teacher levels. There is a commitment required for this to happen – and we already know that science CPD is often falling short of the mark in terms of support in schools. This again is why we are working with leadership teams to ensure that there is professional development for this important issue.

We do know that teachers, pupils and parents want to see a change in climate change education. There are multiple reports which indicate this on some scale. The voice of the young people is incredibly powerful and important. At the launch event on 30th March this year CAPE heard from two of their Expert Advisors from an Avanti School in Essex. They form part of the alliance and offer challenge in relation to what we are doing and how we are doing it. They are young, inexperienced with adult life, but they are the people we are making the changes for, and it is imperative that we hear from them.

Key recommendations

- **Implementation and planning for climate change curricula should be a whole school cultural issue driven and supported by leadership.**
- **Small steps and getting right is better than a sweeping change that will ultimately fail.**
- **Use your existing curriculum and adapt this to best support your learners – then consider how to teach the new content before choosing resources.**
- **Do not feel this is a one-person job – schools should make use of the wider community to best support this agenda.**

Engaging with CAPE

- Follow us on **Twitter**
- Look at our **Website**
- Send us an **Email**

References

Ojala, M. (3023). Hope and climate-change engagement from a psychological perspective. Current Opinion in Psychology, 49. Science Direct.

Professor Leigh Hoath is a Co-Founder of CAPE and a Professor of Science Education at Leeds Trinity University

Heena Dave is a Co-Founder of CAPE and a Senior Curriculum Designer for the Teacher Development Trust

New resources

Picture for talk

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. Show the picture. Ask the children to discuss, in groups of three, the following questions:

What do you think is wrapped in the yellow plastic?

Where do you think this has come from?

Do you think the white material is natural or synthetic?

Why do you think it has been wrapped in plastic?

After the children have had a few minutes to share their ideas, download fig 2, and show a closer image of a cotton plant before the bolls have been harvested. Ask them to consider whether they would want to change their initial ideas and why.

Cotton is the soft, fluffy fibre that is produced around the seed of the cotton plant. The cotton is formed inside the boll, which is a harder protective case that surrounds both the seed and the cotton. When a plant is ready to drop its seeds, the boll breaks open and the cotton helps to disperse the seeds more widely. The cotton is usually harvested by machines that pick the cotton from the plant. Cotton plants are native to tropical and sub-tropical regions, but it has also been grown on the Moon in China's Chang'e lander capsule!

Cotton fibre can be spun into yarn and woven to make fabrics, making it an important cash crop in many countries. The material is both soft and strong and is considered 'breathable' – these properties make it widely used and it is known to have been produced across the world for thousands of years.

You might like to show these further images (figs. 3 and 4)

Click to download image

Fig. 2

Click to download

Fig. 3

Click to download

Fig. 4

Other questions to generate and promote thinking and explaining:

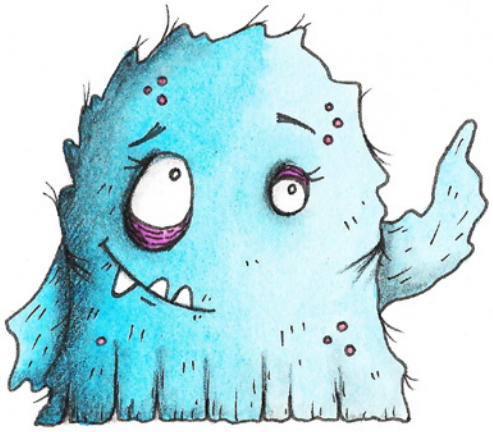
- How do you think the cotton fibre helps with seed dispersal?
- Can you describe ways that other plants' seeds are dispersed?
- Why do you think it is important for plants to disperse their seeds?

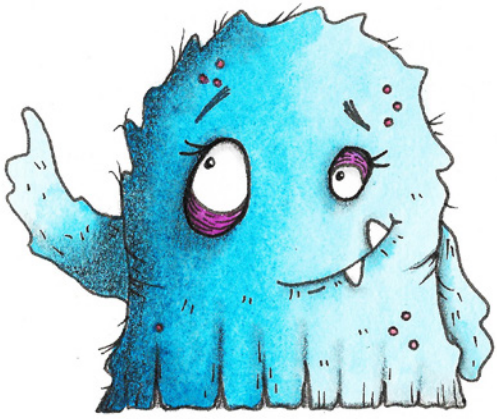
Explain that the cotton fibres from the plant must be cleaned and spun together to create lengths of yarn that can be woven to create fabrics.

- Can you think of uses for cotton fabric?
- What properties of cotton do you think make it a useful material?
- Do you know any other fibres that can be woven into fabrics? How are these materials similar and/or different to cotton?
- Are all fabrics made from natural materials?
- Why do you think cotton is farmed in some countries?
- Why do you think there are many bales of cotton together in a field in the picture?

New resources

Primary Science Skills and How to Teach Them: Getting to Grips with Scientific Enquiry





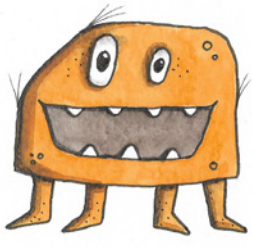
These brand new resources provide strategies and activities to support upper primary children (aged 7-11) to develop a range of scientific skills, which can subsequently be applied in their own scientific investigations.

Scientific enquiry is essentially a thinking process. For children to undertake effective science enquiries in the classroom, they need to know how to collect and interpret useful data. Simply meeting science skills during practical activities is rarely enough for them to be learned and embedded.

Primary Science Skills and How to Teach Them has been written by PSTT Fellow Tracy Tyrrell and illustrated by PSTT Fellow Rufus Thomas.

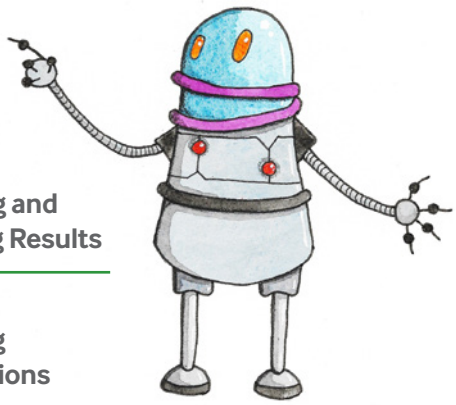
The resources supports the development of working scientifically skills. Building on the more open-ended, exploratory approach of lower primary, these materials cover the skills required at each stage of a scientific enquiry and are mapped to different scientific enquiry types, providing teachers with a comprehensive choice of activities.

The need for the explicit teaching of how to work scientifically was recently highlighted by Ofsted (2023) who note that, 'In general, not enough consideration was given to identifying the disciplinary knowledge, including concepts, that are needed to work scientifically. This limited how effectively leaders could plan a curriculum for pupils to get better at working scientifically over time. Too often, the focus was simply on identifying practical activities for pupils to complete.'[1]



[1]Ofsted (2023) Finding the optimum: the science subject report.

The resources are organised into eight units, with each covering specific science enquiry skills.



Unit 1: Encouraging Exploration

Unit 2: From Questions to Enquiry

Unit 3: Planning and Predicting

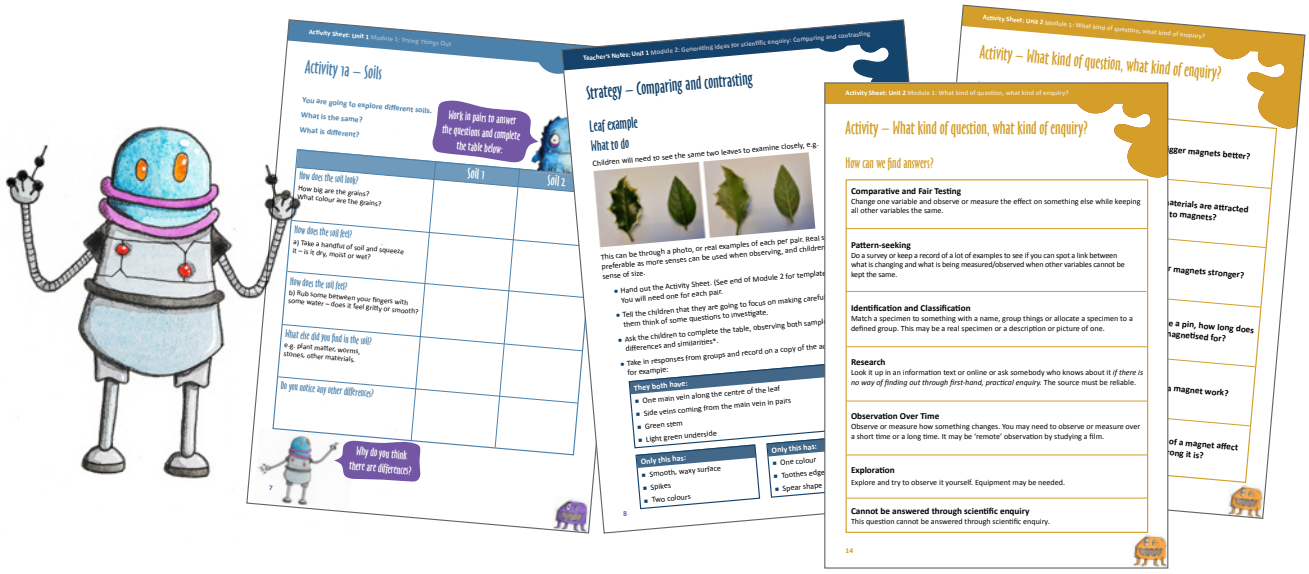
Unit 4: Gathering Useful Evidence

Unit 5: Collecting and Recording Results

Unit 6: Presenting Results

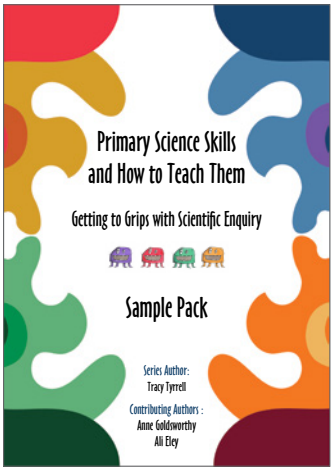
Unit 7: Describing and Explaining Results

Unit 8: Evaluating Investigations



Each unit includes comprehensive teacher notes, printable skills development sheets for children, along with answer sheets for the teachers. The first four units are available now, with the remainder being released very soon.

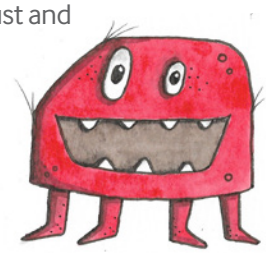
Free sample pack



Click to download the sample pack containing an introduction to the series along with exemplars of teacher notes and children's activities from the first two units.

To find out more or to buy the resources, **click here**. They are a bargain at £5.99 for one unit, and £9.99 for two!

Primary Science Skills and How to Teach Them are based on two earlier books written by Anne Goldsworthy, Rod Watson and Valerie Wood-Robinson which were originally created for children aged 9-13. Getting to Grips with Graphs (1999) and Developing Understanding (2000) were the outcomes of the AKSIS project: a three-year research collaboration between the Association for Science Education and King's College London, funded by the Wellcome Trust. The original versions of the books have been reworked and developed through a collaboration between the Primary Science Teaching Trust and the Association for Science Education.



New resources

Seashore Science

Seashore Science – take science learning to the beach with our brand new free resource

Learning science at the beach offers all the benefits of outdoor learning as well as specific opportunities to encourage awareness of environmental issues such as plastic pollution and global warming. Exploring the impact that these have on marine and seashore ecosystems will help to cultivate a greater environmental awareness and a sense of stewardship, giving children a lifelong appreciation for the world around us.

Seashore Science is a 'pick up and go' set of 15 lessons to carry out at the beach, all with minimal requirements for equipment and preparation. The lessons cover substantive concepts relating to the biological, chemical and physical sciences, a nd they all offer opportunities to develop disciplinary knowledge and to learn and apply skills of working scientifically. The lessons are highly adaptable so they can be used with any primary age, and in a variety of coastal locations and types of shoreline.

Each Seashore Science lesson contains the following:

- Expected learning outcomes for children's conceptual development as well as skills of working scientifically that the children might learn and apply
- Key vocabulary
- Pre-visit checklist – what to do before you go to the beach
- At the beach – a step-by-step list of suggestions about what to do
- Key questions to support children's thinking and explaining
- Ideas for extending learning back in the classroom
- Suggestions for further resources related to the lesson
- Background science explanations to support teachers
- Links to UK science curricula

Download your free book **now**

"Seashore Science is simple and straightforward to use. Everything is included to enable teachers to deliver a fun and engaging practical session that challenges the children and meets requirements in the curriculum."

PROJECT TEACHER

"The key questions are brilliant, especially for supporting parent helpers, and for providing a challenge during the activities."

PROJECT TEACHER

"Seashore Science helps children think about what they already know. The Power of the Sea lesson was great as they made links with their prior learning about rocks and about forces."

PROJECT TEACHER

"Everything is incredibly user-friendly and clearly set out - it can be used by leaning support assistants and teachers, and is great for anyone less confident in science."

PROJECT TEACHER

Explorify

What's new? LOTS is new!

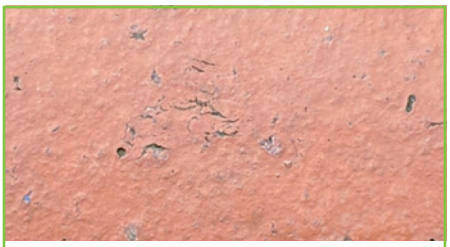
Explorify for Early Years

Hot off the press are over 40 brand new Zoom In, Zoom Out activities created especially for children aged 3-5 years old. Developed with a group of expert practitioners from early years settings, the activities cover the different areas of curricula across the UK. They are all based around objects and phenomena that will be familiar to the children. Following the usual format, the early years activities include background science explanations and ideas for teachers for follow up age-appropriate activities, as well as suggested questions for the adults involved in supporting children's play, and some story book ideas.

What do you think these objects are? Click on the images to go to the activity to find out.

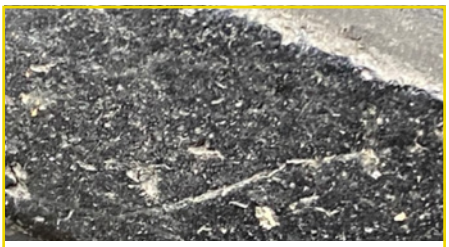
Stripes and patches

VIEW HERE



Red cracks

VIEW HERE



Grey ridges

VIEW HERE

Tips for using Zoom In, Zoom Out activities with early years children

Click on classroom view to give you an enlarged image and ask everyone:

- What do they think the image is and why?
- What does the image remind them of and why?

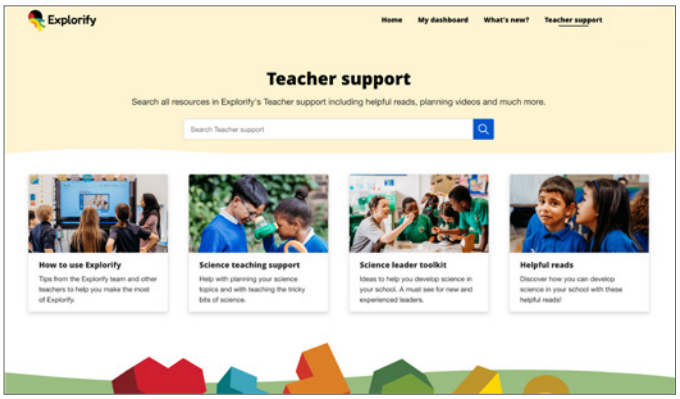
Every time you zoom out, ask:

- Can they describe the colours, shapes and textures?
- What do they think the image is now – have they changed their minds?

You can find all the new activities by selecting Early Years from the drop down menu for Year group on the home page, and you can then refine the search further by topic. For more information about using the new early years activities and to find out what's in the pipeline, have a look at this **three minute helpful read**.

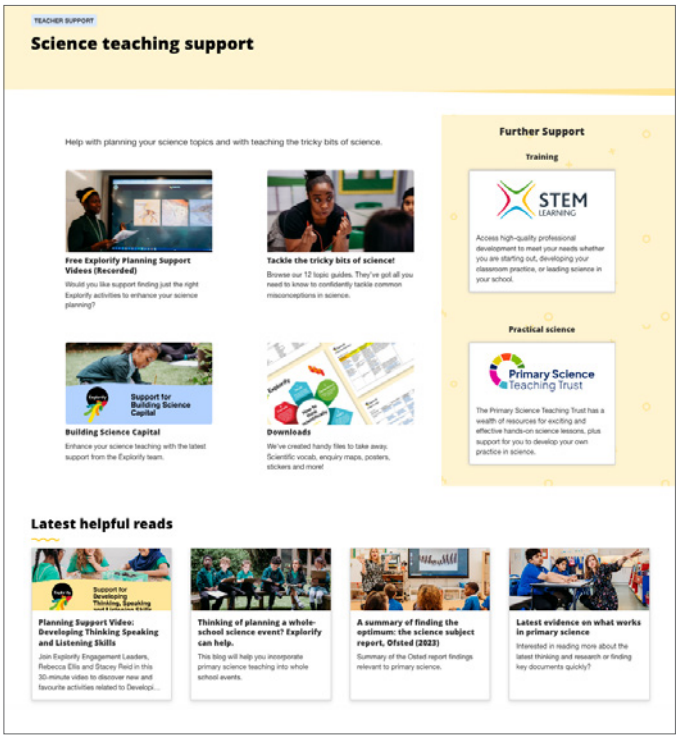
A makeover for the Explorify teacher support pages

The new improved teacher support area is now live. Content has been reorganised so it is easier for users to navigate this area of the website and a new search function has been added so you can use key words to find useful content more easily.



As you explore the new teaching support pages you will see the teacher support area is now divided into four key sections: how to use Explorify, science teaching support, the science leader toolkit and helpful reads. Advice about how to use the new teacher support pages is explained in a video tutorial – click here to watch – it lasts only 90 seconds!

When you click on '**Science teaching support**' you will find a wide range of help and resources, including a series of helpful reads, free 30-minute CPD videos to support planning, advice about tackling the tricky bits, and lots of links out to support from other organisations. Recently added is a new helpful read called '**Latest evidence on what works in primary science**', which gives summaries and links to reports and reviews (including the recent Ofsted report, 'Finding the Optimum') that will help subject leaders, classroom teachers and school leaders develop their science practice. This page will be updated in response to the release of new relevant publications.



Want to become an Explorify Champion?

Are you an Explorify fan who is keen to spread the word to others?

Are you looking for a professional development opportunity where you can engage more in the world of primary science outside your own school?

If you answered YES to both these questions, becoming an Explorify Champion might be just what you are looking for!

Role of an Explorify Champion

- Deliver CPD about Explorify to teachers and networks beyond their own school
- Keep in touch regularly with the Explorify team, giving feedback
- Help promote Explorify on social media
- Opportunities to shape Explorify's development, e.g. through giving feedback on how activities are being used in schools
- Option to support the Explorify team to improve engagement in target geographical areas, particularly where there are high levels of disadvantaged children

Benefits of being an Explorify Champion

- Develop skills to deliver high quality CPD
- Widen your own network and professional reputation
- Use of the Explorify Champion badge

Support provided for Explorify Champions

- Up to date training powerpoints for different audiences and for varied CPD session lengths
- Dedicated support from an Explorify Engagement Leader
- Group meetings with other Champions twice a year
- Regular update emails from the Explorify team

If you would like to find out more about becoming an Explorify Champion, please contact Explorify Engagement Leader, **Stacey Reid**

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.

I bet you didn't know

Geoengineering could slow melting of Arctic ice

Dr Rebecca Ellis
PSTT Fellow
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Figure 1. Foil reflects heat, July 2022 (© Mr J Day)

The UK issued its first ever heat-health alert in July 2022. Temperatures were above 40°C in some places. The advice was to stay cool indoors, have plenty to drink and close the curtains in rooms that faced the Sun. Some teachers covered their classroom windows with foil to reflect the heat (Figure 1). Scientists worked out that the heat wave was ten times more likely because of climate change.

- What were people advised to do during the heatwave?
- Why do you think this will help?

Climate change in the Arctic

Climate change is happening faster in the Arctic than anywhere else in the world. Average global temperatures have risen by about 1°C. In some parts of the Arctic, they have risen more than 4°C. There is no land under the ice in the Arctic, just ocean. Some of the ice melts in the summer and it reforms in the winter. This means there is some old ice and some young ice.

NASA uses satellites to look at the sea ice. They have found two changes in the last ten years:

1. Summer sea ice has decreased by 13%.
2. There is much less old ice now.

- Why do you think the sea ice has changed?

The importance of sea ice

The frozen Arctic Ocean at the top of our world works like a massive sun umbrella. This is because ice (especially the bright, old ice) reflects the Sun's heat. When the ice melts there is darker blue water underneath. This does not reflect the heat as much as the ice. Instead of being reflected, the Sun's heat is absorbed by the planet. Think about the difference we feel wearing a black shirt rather than a white one on a hot day. As sea ice decreases, more of the Sun's heat warms the Arctic Ocean. This causes even more ice to melt. The cycle gets worse and worse. Unless we stop global warming, soon there could be no Arctic ice left in the summers.

- Can you find the simile that has been used?
- How does it help you to understand why the ice keeps the planet cool?

Without sea ice in the summer, what will polar bears do? They rely on it as a habitat for hunting and breeding (Figure 2). The ice also stops ships being able to disturb marine creatures such as narwhals, whales and belugas.

Figure 2. A polar bear on the sea ice (© Andreas Weith)

Figure 3. Hollow glass microspheres (© Dr R Ellis)

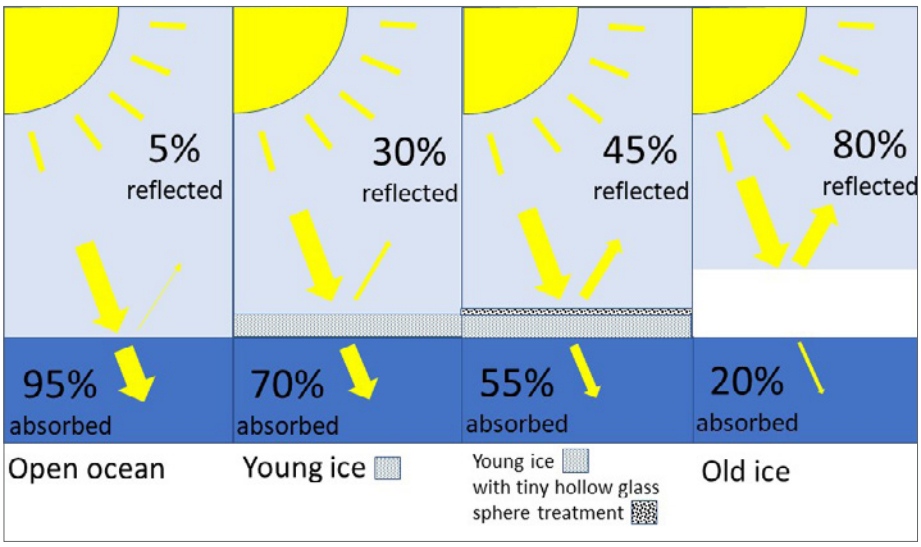


Figure 4. Sunlight reflecting and absorbing (© Dr R. Ellis)

What can we do to protect sea ice?

A team of scientists led by Dr Leslie Field have been developing a geoengineering solution. They tested a selection of harmless materials to see how much heat was reflected (reflectivity). Then, they covered ice with the most reflective of these materials. They compared how quickly the ice melted. Tiny hollow glass beads (microspheres) were the most effective. This is a common, lightweight product that looks like sand (Figure 3). It is easy to manufacture, transport and spread.

- What does the word microsphere tell you about the material?

When a thin layer is placed on young ice, it reflects an extra 15% of the sunlight (Figure 4). This slows down melting. More young ice can then thicken and become bright, old ice. Scientists don't want to put the microspheres all over the Arctic. They would target places where the ice is thin. The longer the ice stays, the less heat will be absorbed.

- Can you summarise what the scientists have found out?

Geoengineering in the future

Geoengineering changes nature. We would not normally want to do this. However, climate change is also caused by humans. Many people think it is probably worse to do nothing about it.

Other geoengineering solutions include space reflectors that block the Sun's light or spraying seawater to increase the reflectivity of clouds. There could be unknown side-effects with geoengineering. It would be better to reduce greenhouse gases and limit global warming. However, our progress in tackling climate change is slow. Geoengineering projects might give us time. Indeed, Dr Leslie Field describes her technology as, "The backup plan I hoped we'd never need."

- Explain the strengths and weaknesses of geoengineering.

Acknowledgement:

This resource contributes to XAIDA – a project supported by the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003469.

GLOSSARY

Arctic – the regions around the North Pole

average – a calculated 'central' value of a set of numbers. To calculate it, add up all the numbers, then divide by how many numbers there are

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

geoengineering (also called climate engineering) – the deliberate and large-scale intervention in the Earth's climate system

heat wave – at least three consecutive days of unusually hot weather

reflectivity – the property of reflecting light or radiant heat

satellites – a moon, planet or machine that orbits a planet or a star

The paper that inspired this work was:

Restoring Arctic Ice: A New Way to Stabilise the Climate.

Arctic Circle Journal (Published 9 March 2021)

By Field, L. and Strawa A.

https://www.arcticcircle.org/journal/restoring-arctic-ice-a-new-way-to-stabilize-the-climate

Initial Teacher Education

The Primary Science Enhancement Award

PSTT's Primary Science Enhancement Award (PSEA) for Initial Teacher Education (ITE) is going from strength to strength. It is suitable for any student teacher wanting to increase their experience and understanding of teaching and learning in primary science.

Calling all ITE tutors! How your students can benefit from this scheme

If you are interested in finding out more about how your student teachers can take part in this scheme, please visit our **ITE support page**. To take part, please complete the **new tutor registration of interest** form by 31st May 2023. We will be in touch with all new tutors registering after this date.

What student teachers say about the PSEA scheme:

"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."

"When I was looking for schools to apply to for my first teaching position, completing the PSEA gave me a better understanding of what to look for in a school. I knew that I wanted to work in a setting that really valued science and reflected my passion for the subject."

To find out more or to watch videos of student teachers talking about their experiences of the scheme, please click **here**

Collaborator update

Primary Science Quality Mark and the PSTT – a long-term partnership moves into a new phase.

As the PSQM moves into a new and exciting phase of development and operation, its director Jane Turner reflects, in true PSQM style, on how the programme began its long and productive relationship with the PSTT, the impact of this and the next steps for what has become, over the last ten years, a strong and mutually valued friendship.

I remember so clearly standing in a corner of one of the University of Hertfordshire's many campus carparks, talking on my mobile phone to the then CEO of the Primary Science Teaching Trust, Prof Dudley Shallcross. It was 2012 and in my memory the sun was shining; but that memory may be affected by the conversation - it was very sunny news! Dudley had contacted me to offer the possibility of PSTT support for the Primary Science Quality Mark, a school improvement and accreditation programme I had launched from the University a few years previously, in collaboration with colleagues from the ASE and Barnet Local Authority. It was a conversation that was to have big impact on 1000s of primary schools and subject leaders, 100s of 1000s of primary children and on the profile of primary science in the UK. The pilot and national launch phases of PSQM, a paid-for CPD programme leading to the award of a quality mark for primary science, had been subsidised by in-kind support from the initial partners and a grant from the Wellcome Trust. With that funding at an end, I needed a new funder to enable the University to provide PSQM at a cost that was affordable to schools. Dudley invited me to apply to PSTT for that funding. It was a big moment.

What followed were two nerve-racking and ultimately successful pitches to PSTT trustees in 2013 and 2018, formally bidding for grant funding to support PSQM through a 10-year consolidation phase, and proposing a model for joint working that would be of benefit to both organisations' aims to improve primary science teaching and learning. The PSTT/PSQM partnership began formally in spring 2013 and achieved its ultimate hoped-for outcome last year, when the Vice Chancellor of the University of Hertfordshire recognised the importance of PSQM to STEM education nationally and agreed to centrally fund the programme as a cross-university strategic project.

Ten years of funding support from PSTT has enabled PSQM to grow in reach and reputation, the trajectory continuing steadily despite the challenges of the Covid-19 pandemic. During that time over 4700 Primary Science Quality Marks have been awarded. On average, half of these were achieved by schools in areas of high socio-economic deprivation.

There are now over 90 active hub leaders, supporting subject leaders locally to use the PSQM evaluative framework to develop their leadership capacity and improve science teaching and learning in their schools. PSQM's effectiveness as a mechanism for improving children's outcomes in primary science was evidenced in the 2019-21 trial conducted on behalf of the Education Endowment Foundation[1]. This impact was made possible by the PSTT grant, which subsidised the cost of PSQM to schools.

However, the relationship has been so much more than financial. Dudley used several metaphors to describe it. One that chimed particularly with me was of a cricket team with those who bat, and those who bowl, the members assuming different positions and roles but all working together in the same field, supporting each other, and seeking the same outcome. I am very proud of the contribution PSQM has made towards developing those excellent subject leaders who have gone on to become PSTT College Fellows, and equally proud when PSTT Fellows use the professional learning and status that PSTT provides for them to become expert PSQM hub leaders, supporting other subject leaders to develop their practice. PSTT publications, both online and physical, are recommended to all PSQM participating schools and we see the impact of them in PSQM submissions. The PSTT work on the Primary Science Capital Teaching Approach has had a significant influence on the PSQM framework and training, enabling us to evaluate the support we provide for this important area.

PSQM and PSTT both provided considerable support for schools during the pandemic, some of it together via online events, and some of it through sharing resources. PSQM directors and hub leaders have been grateful for the opportunity to present sessions at the PSTT International and College Conferences, as well as benefit from the great CPD provided at these events, and have been pleased to welcome PSTT colleagues to present at PSQM conferences and award events. PSQM co-director Helen Sizer and I have benefited from membership of the PSTT Academic Collaborators group and the opportunities to work with, and learn from, colleagues from SSERC and the Universities of Manchester, Bath Spa, Stranmillis and Oxford Brookes.

The PSTT Primary Science Enhancement Award for ITE students is a great example of PSQM and PSTT collaboration, led by PSTT Outreach Director Ali Eley. Working with Ali over the last seven years has been a tremendous professional and personal boon. She has supported my leadership of PSQM, formally through the Executive Group and informally as a valued critical friend. This has led to Ali's valued role in other sector activity I have led, including the Learned Societies' Primary Curriculum Advisory Group and producing primary school guidance for the 2021 and 2023 Ofsted reports.

The PSTT funding contract to support PSQM is at an end, having achieved its aim, but the relationship endures. Last year I stepped back from full time leadership of PSQM. It is Helen Sizer who is very ably leading developments in PSQM now. She is undertaking a comprehensive review of the PSQM framework and training, strengthening our regional structure, and establishing an effective systems leadership model for primary science. As part of that she will be working with PSTT to agree how the Primary Science Quality Mark and PSTT continue to work together for the benefit of all invested in primary science, and of course the informal friendships and collaborations will continue. My new role is to lead the PSQM impact strategy, working with Dr Clare Warren, whose PhD researching the impact of PSQM participation on subject leaders was funded by PSTT. We look forward to working alongside CEO Martin Pollard as he leads similar work at PSTT, contributing together to sector wide work identifying effective support for different aspects of primary science.

I have been very glad to have had the Primary Science Teaching Trust batting for PSQM over the last ten years and want to sincerely thank the PSTT Trustees, staff and Fellows for their support and collaboration.

Associate Professor Jane Turner, Director of PSQM

[1] https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/primary-science-quality-mark Accessed 03/02/23

Collaborator update

Thinking, Doing, Talking Science

Thinking Doing Talking Science (TDTS) is a national primary science CPD programme, developed by Science Oxford in partnership with Oxford Brookes University.

Based on an original project funded by PSTT (then AZSTT), it has undergone two large scale evaluations, funded by the Education Endowment Foundation. These have shown that TDTS can make a significant difference to pupil attainment, interest and self-efficacy in science. PSTT is currently supporting the development of a strategy to roll out the CPD programme and expand the trainer network.

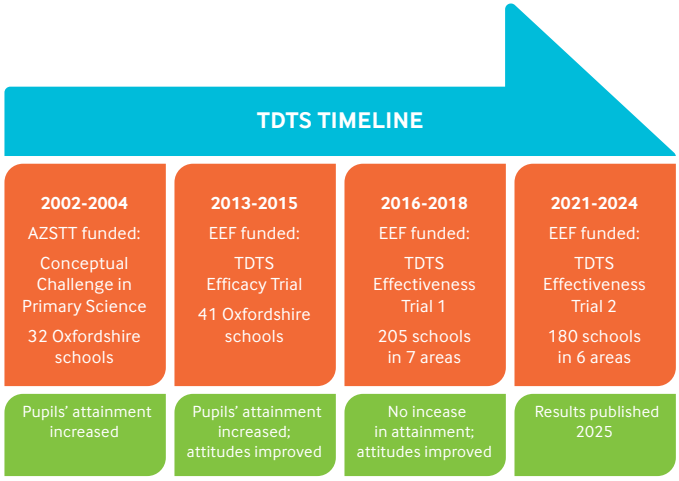
Three members of the project team, Helen Wilson, Alison Trew and Bridget Holligan, outline more about the TDTS programme and its impact.

Thinking, Doing, Talking Science (TDTS) is a four day evidence-based CPD programme that is built on more than twenty years of research with teachers.

TDTS has its roots in a research project, 'Conceptual Challenge in Primary Science', led by a team from Oxford Brookes University in 2002 and funded by the AstraZeneca Science Teaching Trust (now the PSTT). This provided quantitative evidence that an imaginative, creative and cognitively challenging approach to science lessons in Year 6, rather than an emphasis on rote recall, increased children's attainment in the national Key Stage 2 science SATs that were operating at that time.

Research was undertaken with the participating teachers as to what they had actually changed in their practice as a result of the project, and they reported that their lessons included more of the following:

- Encouragement of Higher Order Thinking (Thinking)
- Practical work and investigations (Doing)
- Discussion of scientific ideas (Talking)



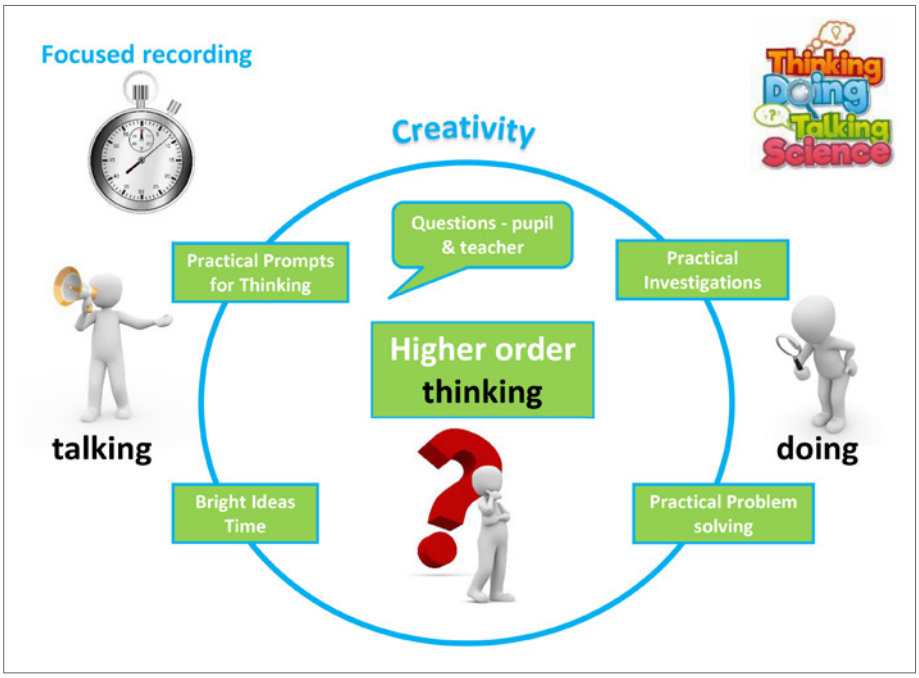
Time was released for this by the children focusing their recording on the lesson's learning objectives, thus trimming the time spent writing. The recording, however, was sharp and focused and as such was an effective assessment tool.

Hence 'Thinking, Doing, Talking Science' was born and became the name of the subsequent projects funded by the Education Endowment Foundation, all as randomised controlled trials (RCTs) to provide fair comparisons. The co-founders of TDTS are Helen Wilson, one of the Oxford Brookes researchers on the original project, and Bridget Holligan, of Science Oxford, an informal science learning provider whose practice exemplified the effective approach revealed by the 'Conceptual Challenge in Primary Science' research. Bridget and Helen combined their expertise to undertake the successful first (efficacy) trial with 41 Oxfordshire primary schools and this time children's attitudes were also measured. Overall, the Year 5 children whose teachers participated in the TDTS course, made approximately three additional months' progress, and demonstrated improved attitudes to science lessons compared with the children in the control group.

Higher Order Thinking[1] is at the centre of the diagram and the TDTS ethos is to maximise every opportunity to encourage this, so that the children engage in deep learning, through both talking and doing science. This then inevitably leads to creative and engaging science lessons.

Teachers engaged in a TDTS day of CPD

The TDTS approach to teaching is summarised in this diagram:



What is Higher Order Thinking (HOT)?

'Higher order thinking occurs when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations.'[2]

Higher order thinking goes beyond basic knowledge recall or comprehension, and involves the ability to analyse, evaluate, synthesise, and apply information. Tasks requiring higher order thinking skills might include:

- Analysing and evaluating the reliability of information
- Developing and defending an argument or point of view
- Solving complex problems with multiple possible solutions
- Creating novel solutions or products
- Making connections between different pieces of information

[1]Bloom, B. S. (1956). *Taxonomy of educational objectives, Handbook I: The cognitive domain.* David McKay Co Inc.
[2]Lewis, A., & Smith, D. (1993). *Defining higher order thinking. Theory Into Practice,* 32(3), 131–137. https://doi.org/10.1080/00405849309543588

TDTS Strategies

One of the key TDTS strategies is the Bright Ideas Time, a dedicated discussion slot for children within every primary science lesson. Examples of suggested prompts for this: the Odd One Out, the PMI (exploring what is Positive, Minus and Interesting about a certain scenario) and the Big Question, are on the **PSTT website**, including downloads of examples for all ages and across curriculum topics. There is no one 'right' answer, so the children are encouraged to think deeply and creatively, justifying their responses and acting as cognitive role models for each other as they listen to different ideas.

Another TDTS strategy was the use of 'Practical Prompts for Thinking' – short teacher-led demonstrations designed to intrigue children and act as discussion starters for exploration of the underlying scientific principles. An example is the 'uphill tin': a tin held on a slope and released – it rolls uphill! Can the children think of reasons why this might be? A 1kg mass has been taped on the inside of the sealed tin, but they will come up with all sorts of amazing ideas. This example was included in the video on the EEF website, explaining the TDTS principles. One of the PSTT Fellows, Jules Pottle, features in this **video**, and it includes her showing the children the uphill can - their excitement and curiosity is palpable.

Science is per se a practical subject and the TDTS emphasis is to encourage children's HOT through a variety of different types of science practicals, including problem solving, fair testing and simulations. Inevitably this also encourages more thinking through talking as the pupils collaborate through participation in practical activities and investigations. It is not necessary or desirable for the pupils to record everything that they do, and the teacher plans for the recording to be clearly focused on the specific learning objectives that they intend for the practical work to serve.

Explorify and its origins in the work of TDTS

The Wellcome Trust drew on the evidence from the EEF efficacy trial in their development of Explorify, hence the inclusion of many examples of Odd One Out. Some, such as the **Earth, the Sun and the Moon**, come directly from the TDTS course.

TDTS 'Big Questions' are designed to build on children's existing knowledge and encourage them to apply this in a new situation to develop their HOT. Often the question is accompanied by an image, (see below).

Explorify's 'Big Questions' have a slightly different focus. Also based around an image and question, the activities are more often designed to develop children's enquiry skills through planning and possibly carrying out an investigation rather than specifically on building higher order thinking. For example the activity **What are the best shoes for running?** acts as a prompt for a science enquiry.

Why do the cyclists and their bikes look like this?

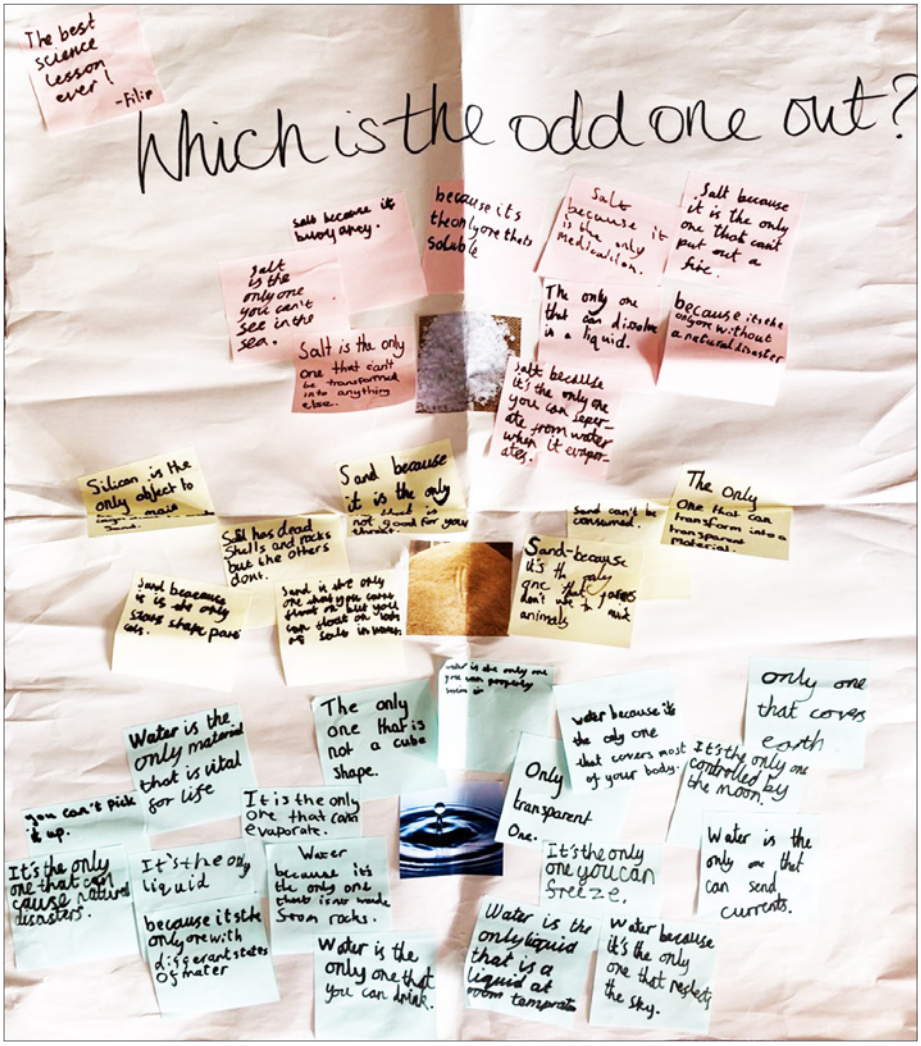
© Roberto Castro, licenced by Creative Commons & accessed here:

Evaluations of TDTS

The EEF has developed a progressive testing of projects, moving from efficacy trials to effectiveness trials. Efficacy trials test whether an intervention can work under developer-led conditions in a smaller number of schools; effectiveness trials test whether impact can be retained at scale and so a 'train the trainer' model of delivery for TDTS was developed. As the timeline shows, this trial involved 205 schools in 7 areas of the country and the **results** again showed improved attitudes to science, but this time there was no significant impact on attainment. However, given the positive attainment results from the first trial, the promising outcomes for pupils eligible for free school meals in the second trial, and the retention of the positive impacts on attitudes, TDTS remained on the EEF 'promising project' list. The developers were invited to reflect on what they had learnt and changes that were needed and a second effectiveness trial is currently underway.

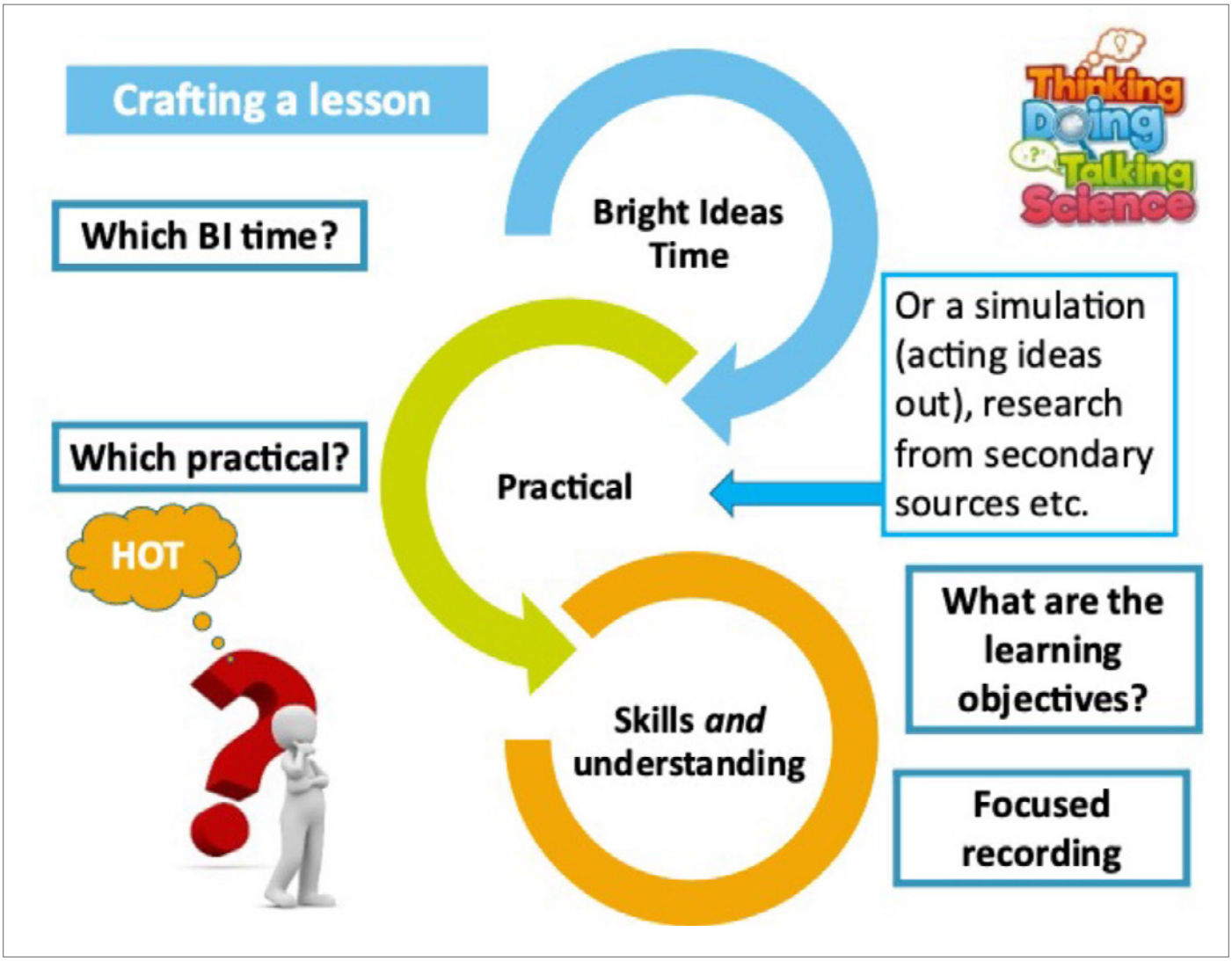
> "Teachers are clearly engaged with the course during the day and leave enthusiastic about teaching primary science and looking forward to trying new things in their classes.
>
> Why? I think there are several reasons but the main one is this - TDTS training gives teachers direct experiences of simple, tried and tested strategies that provoke thinking and talking, and alternative ways to present and carry out practical science, all modelled in an environment that they can replicate in their classroom. In other words, TDTS training allows time for teachers to rehearse new practices and consider how they can be adapted for their setting."
>
> **ALISON TREW, TDTS CPD COURSE TRAINER**

Inclusive challenge is a feature of TDTS and many participating teachers have noted that they have been surprised which pupils rise to the challenges and that children across the whole ability range feel confident to contribute to discussions.



Children's responses to the Odd One Out: sand, salt, water

> "The children kept returning to the responses on the board and wanted to add their new ideas at a later date. Lower attaining children were less reluctant to contribute because they could observe shape, colour and these were as relevant and pertinent as the more 'scientific' responses."
>
> **PROJECT TEACHER, TDTS**



Summary: how TDTS 'works'

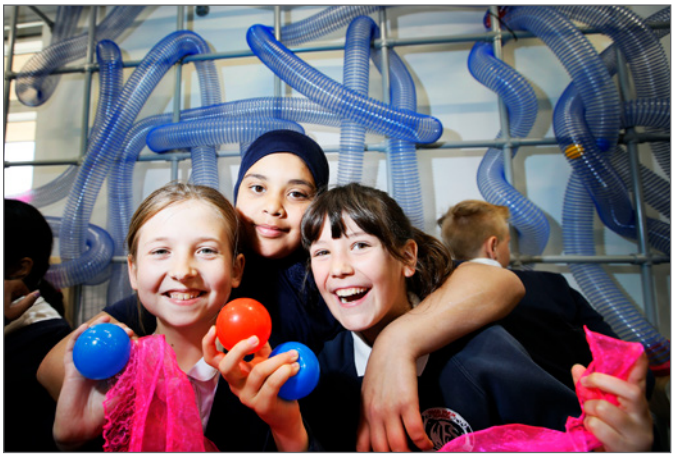
So, the TDTS way is to encourage children's thinking at every available opportunity, through talking and doing. Teachers are encouraged to build on their own existing best practice and to 'craft their lessons', so that they are carefully planned to facilitate this and clearly focused on the learning objectives, thus combining creativity and rigour.

Science Oxford

The Science Oxford Centre is the UK's first indoor-outdoor hands-on science education centre for early years and primary-aged children. **Science Oxford's education programme** is based on the Thinking, Doing, Talking Science ethos, giving children the opportunity to develop understanding and skills through the excitement of investigation, exploration, experimentation and discovery.

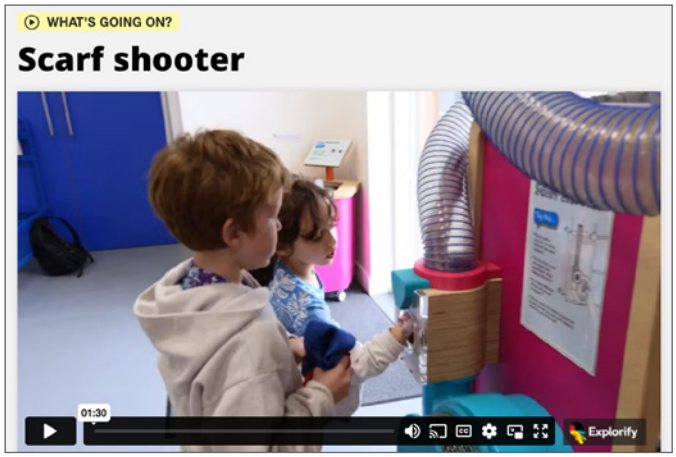
Schools can visit the centre and the outreach team provides in-school workshops, shows and kit loans that link to the primary curriculum, as well as CPD for teachers and a STEM Careers Programme which encourages positive choices about STEM career pathways for secondary school students.

The Science Oxford Centre



One of the hands-on exhibits at the Science Oxford Centre, Scarf Shooter, features in an Explorify What's Going On? activity.

Science Oxford is delighted to be working closely with the PSTT, which is supporting the development of the ongoing outreach, with partners, of the Thinking, Doing, Talking Science programme beyond the EEF trials, so that the benefits can be provided to as many schools as possible.



Find out more – click on the links:

- **Information about TDTS and available courses.**
- **Some free TDTS-based resources from the Science Oxford resources page, including Science Oxford Bright Ideas and Science Oxford Challenges.**
- **Particularly recommended are the garden version of the game, Guess Who? and the Make Your Own Creature Creation challenge.**
- **Find out more about how Explorify, which is underpinned by evidence from TDTS research, can support the development of speaking and listening skills in this 30 minute CPD video.**

Helen Wilson is a joint developer and lead for TDTS. She is an Affiliate Lecturer at Oxford Brookes University, having been a Principal Lecturer in Science Education. She has been both a secondary physics and a primary teacher. As a primary science consultant, primarily for Science Oxford, she continues her research into the links between creative, challenging primary science lessons and pupils' attitudes and attainment.

Bridget Holligan is a joint developer and lead on TDTS. She has worked in the field of informal science learning since 1993, working with teachers and children in primary school classrooms. She has been the Director of Education and Engagement at Science Oxford since 2014. In 2020 Bridget was awarded the Beetlestone Award for her vision and leadership in the field of informal science learning.

Alison Trew is PSTT's Impact and Research Director (acting) and Website Resources Developer. She was a primary teacher for nine years and has been a fellow of the PSTT since 2014. Alison has helped create many new PSTT resources: Floorbooks, Play Observe and Ask, A Scientist Just Like Me and Did you know? (previously, I bet you didn't know). Alison has written for teacher journals, is co-author of Standing on the Shoulders of Giants and is on the editorial board for the Journal of Emergent Science.

[1]Bloom, B. S. (1956). *Taxonomy of educational objectives, Handbook I: The cognitive domain.* David McKay Co Inc.

[2]Lewis, A., & Smith, D. (1993). *Defining higher order thinking. Theory Into Practice*, 32(3), 131–137. https://doi.org/10.1080/00405849309543588

Wider Collaborations

Great Science Share

Key dates

28 MAY 2023

ASE Annual Conference
Deadline for proposals

13 JUNE 2023

Great Science
Share for Schools

14 JUNE 2023

Ofsted guidance
report webinar
3.30pm

21 JUNE 2023

Royal Society of Chemistry
Education Prizes
Deadline for nominations

4-6 JANUARY 2024

ASE Annual Conference
University of the West of
England

12 JANUARY 2024

Deadline for PSTA
nominations

www.pstt.org.uk

The Primary Science Teaching Trust (formerly the AstraZeneca Science Teaching Trust) was fully endowed with a grant from AstraZeneca PLC

Primary Science Teaching Trust

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