Primary Science

Special Issue:
Explorify
September 2019

The Association for Science Education

The ASE's journal for primary science

wellcome

special issue:

Explorify

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Primary science assessment (PLAN)

PLAN is a set of resources produced to enable teachers to have a clearer understanding of National Curriculum (England) expectations for meeting the standard in science. See www.ase.org.uk/plan for more details.

The *PLAN* is evolving

We know from *Understanding the 'state of the nation' report of UK primary science education*, published by Wellcome in January, that only 22% of teachers surveyed 'strongly agreed' that they were confident in undertaking summative assessment and only 21% 'strongly agreed' that they were confident in undertaking formative assessment. We also know from *Intention and substance: further findings on primary school science from phase 3 of Ofsted's curriculum research,* that science assessment is absent or not well embedded in curriculum design in more schools than for English and maths.

PLAN was developed to support teachers with precisely this challenge. To date, the planning matrices are helping teachers ensure that their plans cover all the required knowledge, and the examples of secure work are enabling teachers to confidently judge the knowledge of their pupils.

But we haven't stopped there. We have almost completed the publication of the comparative examples that enable teachers to develop their moderation skills, building their confidence in individual assessment as well as greater consistency across year groups.

We are now turning our attention to supporting the assessment of 'working scientifically' skills. In the near future, we aim to publish new versions of the planning matrices that will include explanations of what the relevant working scientifically statements for each phase mean and, over the next year, we intend to publish examples of what this might look like in practice. If you are interested in working with us to gather these examples, we'd love to hear from you. You can contact us via www.primary-science.co.uk

We are currently trying to capture evidence of how the **PLAN** resources are being used and their impact. We will be creating an online survey for this purpose and would be very grateful if you would share your views with us to inform our plans for the future. Look out on www.ase.org.uk for news of the survey in future months.

PLAN resources – only available to ASE primary teacher/school members!

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Primary Science

Special issue

Editor *Dr Leigh Hoath*

Focus on... Explorify Special issue

For me, Explorify is one of those resources that every teacher should know about. Each year I introduce my primary undergraduate education students to it as a 'must use' whilst undertaking their school experience. I use it in CPD events with in-service teachers. I use it with my secondary science trainees because, although a primary resource, there is scope for them and their learners to also benefit. And one of the most common responses to an introduction to Explorify (after a 'wow'!) is the question: How much is it? It's delightful to be able to say 'free'.

The opportunity to put together this special issue of *Primary Science* is a great one. The chance for teachers to see how this valuable resource, alongside other freely available CPD opportunities, is used within the classroom is important. The articles also have a theme of confidence-growing, Explorify acting as a gateway to more science taking place within the classroom and a general shift in how science is viewed in schools.

I hope that this issue supports you in taking steps to considering how Explorify can support you, your colleagues and, perhaps most importantly, your pupils in doing more science.

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The Association for Science Education

Why Explorify?

Children are naturally curious and science at primary school should enable every child to investigate and understand the world around them. Through learning science, they explore scientific concepts and develop a range of transferable skills, especially those of enquiry, that will support them throughout their lives.

Wellcome developed Explorify[1], a totally free digital resource, to support questioning, thinking and reasoning about science, often in less familiar contexts. Teachers use Explorify as stand-alone short activities at the start of the day, after lunch, as lesson starters or for plenaries. Each activity is easy to deliver, with just the right amount of background science to give you confidence as a teacher to get discussion going with your class and support your children to get started with their own enquiries.

There are eight different types of activities to choose from, each one linked to the curriculum and the year group you teach, in whichever part of the UK you teach. We suggest trying a **Zoom In Zoom Out** activity to start with. These are a sequence of images that reveal a little more information each time. What do children think the image could be, and why? Encourage them to talk and explain, listening to each other and building on each other's ideas. Remember that every idea is valid when children can say 'why'.

Odd One Out activities follow a well-tested format[2] and give teachers a chance to probe children's thoughts deeply. Find out what children can tell you about the three linked images. Ask what is the same or different and encourage children to tell you more about their ideas. Finally, ask which would be the odd one out for them and why – you could ask them to elaborate more in writing too, an opportunity for science to be the stimulus for explanation texts.

The **What's Going On?** videos are useful in enabling you to see something in practice, talk about it and then investigate yourselves, changing just one variable at a time. The **What if** activities encourage children to extend their thinking and apply their learning in new ways, offering insight into children's understanding of science concepts. As you complete more activities together, you'll notice the impact on your pupils, including better observation and explanations, use of scientific vocabulary, linking science concepts together and confidence to share ideas too.

The remaining four activity types may take a little longer to do in class, or need a little prep, but they're easy to include in your planning and will help to enrich your teaching and extend children's thinking. We're adding to the Explorify content all the time, from activities that link to topical issues and posts to help with teaching, rather like the content of this issue of *Primary Science*.

We're delighted to share articles from UK teachers in this issue of *Primary Science,* which show how they are raising the profile of science in school, how Explorify has helped them to achieve this and their top tips for teaching and leading science. If you're not using Explorify yet, why not sign up?

'Explorify has opened up the children's minds to what science really is and how we can explore it in our everyday lives. It has helped me to encourage the children to think outside the box and to make links to our everyday surroundings'
(Teacher, June 2019)

[1] https://explorify.wellcome.ac.uk

[2] EEF (2015) Thinking, Talking, Doing Science - Evaluation report and executive summary. London: Education Endowment Foundation. https://educationendowmentfoundation.org.uk/projects-and-evaluation/projects/thinking-doing-talking-science-effectiveness-trial

Teachers from Kates Hill Primary School describe uniting the school in a vision for science and raising the profile of science through enrichment

A whole-school vision for science

Children caring for chicks at Kates Hill Primary

Kevin's story...The Science Co-ordinator

When I was appointed as Science Co-ordinator in September 2017, there was little science happening across the school and interest in it was low. Teachers were nervous about lesson content, resources were limited and it had been pushed to the bottom of the priority list, losing out to English and maths. I wanted to bring the whole school together, to get everyone excited about science and improve the quality of our science education.

Creating a buzz

I do not have a background in science, but I have always been passionate about it. For science to be successful within the school, I knew I had to get other people passionate about it. I discovered Explorify and it proved to be the vehicle that drove interest in science at Kates Hill. The activities are short and require no preparation from teachers; it allowed us to raise the profile with a very quick intervention!

I asked teachers to use them after lunch, or before or after break times. Some of the teachers who were more confident in their science teaching would use them as part of the main lesson right from the start, which was brilliant. But for those that weren't so confident, just that small amount of time every day was enough to move science to the forefront of people's minds. As the year went on and teachers became more familiar with the activities, they were able to embed them more in their teaching. For example, we're doing STEM's Polar Explorer this year and we were able to find related activities on Explorify and incorporate them into the topic.

Building confidence

I think that many teachers lack confidence in science, perhaps because of their experiences of science at secondary school – my personal experience and memories are of science being very hands-off, lots of copying out of text books and observing teachers doing experiments. Science was focused on the 'right results' rather than any sense of enquiry or real investigation. Often primary school teachers have little science beyond GCSE level, which compounds their lack of confidence when their subject knowledge is based on a qualification from some years ago.

One of the ways we addressed this in our school was through accessing the wealth of good, free, online resources to help with subject knowledge. Reach Out CPD (see useful links below) helped to improve staff confidence and they have described how much they have enjoyed engaging with it. Explorify

Polar Explorer display

also offers excellent background science to support the teacher. As well as the question prompts with the activities, there is a cushion of confidence in terms of being able to offer an explanation of what is happening.

I know from personal experience and leading science in the school that there is still a lot of fear amongst teachers about being asked a question to which they don't know the answer! I have provided much staff training around what to do if this happens – my go-to principle is to ask the children what they think and reason it out together. We encourage children to ask questions and support them to find the answers when they don't know them, but there's this perception that teachers should know everything! Every day, we teach children that it's ok to fail – it's better to have a go and give the wrong answer than not try. But teachers aren't as good at doing the same.

If you ask any of the teachers in my school which of their lessons they'd least like to be observed, most of them will say science – it's a mix of anxiety around practical work and controlling the class, and being asked a question that they can't answer – potentially highlighting gaps in subject knowledge. It's just too scary. Since discovering Explorify, we have seen that it helps to fill in the gaps for a teacher. It's an incredibly easy introduction to science, which helps to make them feel confident in front of the class and debunks that myth that you need loads of equipment to do good science!

Seeing the opportunities

I feel very lucky to have a Headteacher who supports my ideas and efforts to bring science back to the forefront. We sat down together to add science to the school improvement plan and even designed a rapid improvement plan to address some of the immediate concerns that I had. I'm also able to have release time to do things like attend conferences and CPD, and was given time to complete our PSQM award, which we gained in September 2018.

Taking it outside

While I was at the Education Show, I found a stall from Trees for Cities (see useful links) and they are coming into school to build an edible playground for us. We are very excited to get this established and bring learning back into the school grounds. Many children in this area haven't got gardens and so we want to give them a learning experience around sustainability and food provenance that they might not get at home. We also do a lot of growing and planting around school and we are very lucky to have the space in our grounds and passionate staff who are willing to have a go – with some trial and error! – to do as much gardening as we can. I went on a training course called 'Explorify in the Garden' with the RHS (see useful links) at a lovely little inner city school in Birmingham. It was inspiring to see what excellent use they'd made of the space they had and the course was really useful. We came away with lots of ideas for our own school grounds and were armed with many ideas for teaching.

We use Forest School to help us with outdoor learning but, as that is located offsite at an allotment, having more immediate grounds to support science is a fabulous opportunity.

Aside from the more obvious learning we do around growing, we also do wellbeing work in that space, with many opportunities for supporting writing and maths. The kitchen team have also agreed to cook as much of what we grow as possible – the rest we will send home with the children or to school fairs. The advantage of having a school-focused group like Trees for Cities to come in and help with this, rather than us going it alone, is that they revisit to help teachers make the most of the space and they also plan the planting around school terms and holidays, so there's nothing growing over the summer holidays when there's no one here to tend it and produce might be wasted. Once the edible playground is in and established, our aim is to develop science trails and getting families involved.

STEM outside the classroom

We are fortunate at this school that the philosophy is that teachers volunteer their time for after-school clubs – we have several clubs running every evening (free of charge), ranging from film studies to oracy to top trumps to science club across the school week. There wasn't much happening at lunchtime though, so I started a science club where we did a CREST award (ages 7-9 and 9-11 – see useful links). I wanted to target children who wouldn't normally come to any of these after-school clubs for whatever reason: pupil premium children, children with speech or language difficulties, children who could improve their teamwork – those who perhaps would not engage elsewhere.

There are some great, simple activities in CREST that the children really responded to. There's plenty to choose from, so we could pick activities that aligned with the children's interests. One, making your own birds' nest, was absolutely fascinating to watch! The children were all sure that they would be able to do it easily, but it was so challenging for them. We were out for ages trying to build one and what they came up with

I also spend a lot of my free time researching opportunities, grants and bursaries to help develop science within the school…I apply for everything! I have also been able to attend a few trade shows, such as the Education Show at Birmingham NEC (2018), to root out opportunities.

We've got a CPD grant from STEM Learning (the Enthuse partnership) **(https://www.stem.org.uk/employers/enthuse-partnerships)**; I applied for a bursary to attend the Primary Science Teaching Trust's conference in Edinburgh **(https://www.primaryscienceconference.org/)**; we've been selected to receive some microscopes from the Royal Microscopic Society for microscopes (**https://www.rms.org.uk/discover-engage/microscope-activity-kits.html**); we got a place on the Polar Explorer programme from STEM Learning **(https://www.stem.org.uk/welcome-polar-explorer-programme**), where we were able to turn the whole school into a scene from the Arctic.

We like to do as much as possible with STEM Learning – their resources, CPD and science days are fabulous. We try to get STEM Ambassadors to come into school and speak to the children.

That's to name just a few! There are so many opportunities out there: it's just having the time to seek them out.

barely resembled a nest! It led to great discussions about birds, the differences between us and birds and how they adapted to their environments. After that, we tried to make spider webs – I hadn't planned to do it that day, but we discovered the most beautiful web in the playground and it was too good an opportunity to miss – which made us all realise how incredible nature is. The longer-term plan is to get school-based Science Ambassadors to run lunchtime clubs as well as set up more after-school STEM clubs.

Becky's story...Year 2 (age 7): Putting the children in charge

I've been teaching for six years and though I had always loved science it felt like my classes hadn't been that engaged with it. Explorify has been a great hook to get them really excited about science!

One of the greatest benefits of Explorify is that it opens things up to the children that they can't do in school. For example, their favourite activity at the moment is 'SPF Natural' (see useful links below), which we came across one day prompting a great discussion during the lesson, but we then spent another hour discussing sun cream and how to protect ourselves from the sun. The children don't see the animals in the video in their day-to-day lives, so the clip allows them to have a good look and a good think about something very far from their everyday frame of reference.

We are learning about plants at the moment and looking at the importance of water. After watching a video to get the children thinking, one child asked *'What would happen if we gave a plant vinegar instead?',* so we have set up an investigation around it! Our science teaching is a lot more child-led this year, because the starters we now use, such as the ones on Explorify, have inspired them to come up with their own investigations – the children are using phrases like 'I wonder if…', 'what if we…' or 'what could we do next', which is a positive shift since adopting these approaches.

They are less afraid of getting things wrong now, too. So, in the investigation about watering plants with vinegar, we were using mouthwash for one of them and, one day, a child said *'I think we've drowned this one in mouthwash, I think we need to start again'.* It's great that they're learning from that and not being hindered by the possibility of being wrong.

I like to have an Explorify Odd One Out or a Zoom In Zoom Out activity when children are coming back after play or after lunch. As well as engaging them in learning, their interest in what they are doing means that they will sit down on the carpet and start chatting with a partner about the activity. Rather than general chit chat about what they'd eaten for lunch, they start wondering, questioning and thinking in a more scientific way, which sets them up for an afternoon of learning. Using Explorify has promoted behaviour for learning.

Responding to shifting priorities

Priorities within the Academy Trust changed to favour a more cross-curricular approach and we quickly realised that science at times took a bit of a back seat. We do still try to take that cross-curricular approach if the topic allows, such as materials, but we found that we preferred taking some of the science topics discretely, allowing all the topics to be covered. We lead with science and incorporate English and maths into that, rather than the other way around. We are trying to put the focus back on the children, placing them in charge of their learning.

This approach is more in line with the new Ofsted framework (see useful links), which will focus on opportunities for writing across all curriculum subjects – but appropriate writing, allowing children to show their understanding across all subjects. We have had staff meetings to discuss the framework and how we will attack it coming into the next school year. We want to create as many opportunities as possible for the children to demonstrate what they know, through writing, across all subjects, not just discrete writing in English books.

The Academy Trust is moving to a STEM focus across the 4 schools, rather than just a science focus, so my role will become STEM Co-ordinator rather than Science Co-ordinator.

Zoe's story...Reception class: The power of observation

Last year we had butterflies in class and watched them turning from caterpillar to butterfly. The children loved it! They were so excited to see the changes and eventually watch the butterflies emerge. It was a fantastic learning experience for them and the only downside of this was that they took about four and a half weeks to emerge, so it was hard at times to keep the children really excited and engaged with them.

This year we were looking for something else to have in the classroom and, after a trip to the farm, we decided to bring in some chicks. They came in as eggs in an incubator, so we had lots of discussions about what the eggs were, why they were in an incubator and what that was giving them. We hadn't told them that we were getting chicks, so we asked the children to say what they thought might be in the eggs and they came up with all sorts of ideas. Largely, they didn't have a clue what might be in there – one said it might be a cow! We had many discussions about the size, shape and look of the eggs to help them to identify what might be inside. A few of the children did identify the eggs as something they had eaten before, so we had some interesting discussions around that too as we looked at life cycles of the chicks.

My chick diary

We didn't have to wait long for things to start moving along – we got the eggs on Monday and, on Tuesday, the first one started to hatch. We observed that first chick, and the others as they hatched, to see how they changed. The children were desperate to hold them and were really interested in why they could hold some but not others – how some had fully dried out and become fluffy and how some took longer to do that.

The children were so excited to come in every morning and see how the chicks had changed. We did a little investigation and monitored the amounts of food that each chick was eating as they hatched, to try to explain why some ate more or less than others.

The children have really enjoyed caring for the chicks and have taken real ownership over the tasks of giving them food and water every day – we've had them for a week where they've been able to come out of the cage, so the children have really been able to get hands-on and interact with them. The children know that the chicks aren't staying and that they are off to a farm, so we were able to have discussions about what their lives will be like on the farm and what they might look like when they are fully grown. These particular ones are going to be used as show chickens!

Kevin's conclusion...Fast forward five years

In five years, I want to see evidence around the classroom that science is part of everyday lessons – not just a quick display here and there, but a flexible and fluid thing. We have a science table in our Year 5 (age 10) class, where something new appears on the table every week. It's about visibility.

When you talk to the teachers, they will have a genuine love and passion for science and be excited about it and have more confidence in their science teaching. The more confident they feel, the easier it's going to be for them to teach science.

The children will be able to tell you what they have been doing in science and how that fits with everyday life, be able to talk about wider issues such as global warming, plastic use, etc. and connect their science learning with real-world issues.

Science will be at the front of the cross-curricular approach – it needs to be all around you, incorporated into everyday teaching and everyday life, and that's a culture shift.

Useful links and references

ReachOut CPD is freely available here: https://www.reachoutcpd.com/

Explorify 'SPF Natural' activity is available from: https://explorify.wellcome.ac.uk/en/activities/whats-going-on/spf-natural

Trees for Cities is available from: https://www.treesforcities.org/

RSC Explorify in the Garden is available from: https://schoolgardening.rhs.org.uk/Training-courses-and-events

For information on the CREST awards, see https://www.crestawards.org/

Ofsted inspection framework is available from: https://www.gov.uk/government/publications/education-inspection-framework

What does CLEAPSS say?

For more information about keeping and studying chicks and other animals in primary schools, please search http://science.cleapss.org.uk/resources/ for the latest information. Don't know that you're a member of CLEAPSS? Most schools in England, Wales and Northern Ireland have membership directly, or via their local authority. To find out if your school is a member and to receive your CLEAPSS ID and password, e-mail **membership@cleapss.org.uk** with your school name and postcode.

Kevin Orchard, Becky Hall and **Zoe Milward** are all teachers at Kates Hill Primary School. Kevin is Year 6 teacher, phase leader and Science Co-ordinator. He has been teaching for 12 years. Becky is a Year 2 teacher and Zoe is a teacher in Reception.

Janet Morris talks about using Explorify to build confidence and the importance of not being scared to just have a go!

Building confidence through having a go!

Children investigating sound

Like in any other school, some teachers are confident in teaching science and some feel that they are less so. I see my role as Science Leader as being to support, engage and inspire staff to deliver an exciting curriculum that gets our children to ask questions, build confidence to have a go…and have a go again. I like to do this by example – if staff see me trying new things and enjoying myself at the same time, they're more likely to feel confident doing so themselves. Explorify has helped us hugely with this!

Anytime activities

After initially introducing staff to Explorify, it was used as an 'anytime' sort of activity at registration, or before and after lunch or break time. Through me initially supporting staff with using it, they quickly started to undertake Explorify activities and plan them into science lessons. Staff did not take long to see the value of using Explorify, far beyond an increase in just developing science experiences for our children and, once they did, there was no stopping them! Any time I'm timetabled to give an assembly, I somehow squeeze it in, regardless of what I'm supposed to be focusing on.

Our school favourite Explorify activity is 'Bottoms Up!' (see useful links) and, although the children have seen it at least twice, they still love it and want to watch it again. You can see the impact of it because, in the days after the assembly, I've had children come to me and tell me facts about dung beetles after they've gone home to research more about them. I love the fact that they go home with questions! For me, it's all about asking questions, and not having to know the right answer but knowing that the answers are out there. Explorify is great at inspiring that kind of curiosity in the children and supporting them in their formulation of good scientific questions.

I often use Odd One Out for a starting activity when the children come into class in the morning – I will have the photos up on the screen and ask them to discuss, or write down, what's the same and what's different about them. 'Unusual Houses' (see useful links below) has been a surprise hit. They now talk more confidently about the images, looking closely and noticing more details as this type of activity is repeated. The conversations are really constructive and there is often

Making and tasting our own homemade butter

debate with each other about them. They're much better at justifying their opinions now too.

It is part of my philosophy that, if colleagues see me doing an activity, such as using a new resource, it encourages them to have a go too! To be able to suggest and share links using new resources or activities to colleagues helps them in their own planning. There are so many resources, and even social media groups, which share up-to-date resources that inspire not just children but also teachers, often in fun interactive ways. Likewise, I like to make staff meetings fun and practical, often involving food. We have done investigations around the leaking bottle experiment, sorting sweets, colour-mixing with skittles, careful observation drawing of cookies before they are eaten, or finding out if all crisps contain the same amount of salt!! I like to play on what really engages them and introduce them to fun investigations, hoping they follow my example and do the same for the children in their classes.

Knowing your class and making it work for everyone

I encourage teachers to explore beyond the age range on Explorify and adapt the activity for their own class and learning needs, and to use them in tandem with the ASE PLAN matrices (see useful links). This means that they are able to look at the activity and identify the vocabulary that the children should be using to ensure progression. For example, we looked at 'Shooting Sprouts' (see useful links below) and, for about an hour, had a great discussion about how plants grow, challenging and extending the children to use new Tier 3 vocabulary with confidence. A Year 1 (age 6) class might have said *'it's sticking its head out of the ground'*, where Year 6 children (age 11) might be talking about root structure or seed dispersal.

A brilliant example that I'm planning to use in a staff meeting is 'Get Your Blood Pumping', which is about circulation (see useful links) – there are so many possible answers depending on the year group and/or experience of the audience. It's an Odd One Out with a human, a whale and a worm. We know that predominantly it's an activity about hearts and circulation and the science is all explained in the background information. If you don't, or can't, make that link about circulatory systems, though, there are many other possible answers, e.g. 'the Odd One Out is a human because it's the only one with legs', or 'it's the whale because it's the only one that lives underwater' and those answers are all valid too. I love the fact that there's no right or wrong answer. It gives children the freedom to just share their ideas and have a go. We like children to APE their responses: answer, prove, explain, and, as long as they can do this, we're happy. It helps to build their confidence enormously. It's not always the case in maths, where there is right or wrong but, in our Explorify sessions, if you can APE it then you have a valid answer.

Zoom right in

I like to use the Zoom in Zoom Out activities to monitor the progression of observation and inference skills.

After the discussion about the first close-up image, I ask the children to write their observations, or what they think it might be at this point, on a sticky note. Then, the same after the next image, and the next image, and the next, as it is great for the children to see how their ideas have changed with more information.

Sometimes it will take children a long time to be OK with the fact that their first answer was great based on the information they had but, ultimately, not the correct answer. We are teaching children that it's OK to change their minds when they have more information – when we have done this on a whiteboard, they rub out their earlier answers as if they didn't happen – so the Post-its allow them to look back over their previous answers and embed the idea that it's OK to change your mind, and this helps to build resilience.

I also love using small sticky notes because it means that it's not in their science books, and that gives those children who are not as confident in writing the freedom to have a go because they know it isn't going to be marked or assessed. Often children can articulate things brilliantly, but struggle to write them down, so a 'throw away' Post-it gives them the freedom to just think.

In order to support my planning, I make use of the save feature and the dashboard on Explorify – I use the notes section to prompt the next piece of learning, or I record a note to let another teacher know that this will be great for their upcoming lesson on the next topic.

Much outdoor learning takes place at school. We can make most topics work outside! Lots of the space learning takes place on the playground – the children do light and shadows, forces (we did an investigation where we threw meteors onto the ground to test the impact, testing size, force and surfaces). We're hunting for bugs to see how many we can find, trying to work out if it's nearly winter based on how many brown leaves compared to green we can find. Observing, classifying, recording, patterns, observing changes over time, etc. are all key scientific enquiry skills that our children are taught, given time and opportunity to practise and develop over time, and there is no doubt that Explorify has helped in this.

Why only look at a photograph of a shadow, when you can go outside and make your own and draw round it on the playground?

Checking in

I don't believe in writing reams in science books just for the sake of it. It's important to use science as a writing opportunity, but my approach is to encourage the practical activities to go on in lessons and so I monitor progression by looking for evidence in books, which may be photographs of practical science that the children are so enthusiastic to talk about. I hold pupil conferences every term with a selection of pupils from each class, in which we talk about their science books and the photographs of the practical investigations, and the children love to explain to me what happened that day and what they've learned from that particular investigation. It's great for getting them to recall learning and it's much more meaningful to them. I ask them what they've enjoyed about science from the term and they always have a huge amount to say. I can get much more from that than from just reading a piece of writing in books. Though we do see science in their maths, English and Topic books too, they still understand that what they're doing is science. For example, they learn about careful observations in science, which they'll use across maths too. We like them to identify skills used in a subject, rather than topics across all subjects; for example, a scientist is asking questions, looking for patterns, testing out ideas, carefully recording, etc.

I use Twitter a great deal to check in on what science our children are doing too. I get to see what's happening in science lessons across the school on a weekly basis. Sometimes a teacher may say that they don't think they've done enough practical activities in a certain topic, but I can see all the great things they've done through the Twitter feed, so it can help encourage staff to see all the hard work and exciting activities the children have done. Teachers stop me as I'm around school to let me know how their plants are growing, or what experiment they've got set up, or what Explorify activity they have used that has really engaged their children and hooked them in to a lesson – they used to stop me to show me a new display or working wall probably because they felt they needed to show me, but now it's because they're proud of the work they're doing – and so the staff team should be.

Being in a school that uses its Twitter account so much to share the great work we all do with our school community made the PSQM process much easier too. I know that all the images we put on Twitter have photo consent, so I can pull off any images to show our story of progression and achievement, saving me time too. If I want a snapshot of all the exciting science that our children are doing in school at this moment, I just go on Twitter! It reflects that the teachers and children are so enthusiastic about science, and it also provides learning opportunities and examples of lesson activities for other schools I work with to support them in further developing their own science in school.

Useful links and references

Our favourite Bottoms Up! Explorify activity:
https://explorify.wellcome.ac.uk/en/activities/whats-going-on/bottoms-up

The popular Odd One Out 'Unusual Houses' is available at:
https://explorify.wellcome.ac.uk/en/activities/odd-one-out/unusual-houses

ASE's PLAN resources are available at: https://www.ase.org.uk/resources/plan-matrices

'Shooting Sprouts' activity:
https://explorify.wellcome.ac.uk/en/activities/whats-going-on/shooting-sprouts

'Get Your Blood Pumping' activity is available at:
https://explorify.wellcome.ac.uk/en/activities/odd-one-out/get-your-blood-pumping

Janet Morris has been teaching for 22 years and is Science Lead at Hollyfield School, which was awarded PSQM Outreach last year.

Lynne Scott writes about building resilience in an ever-changing digital landscape and the benefits of putting science into context

Children engaging in a discussion about plants

Developing resilience in a digital world

A digital landscape

Children in most schools, especially in Primary 7 (age 11, England Year 6), are increasingly engaging with technology and social media in a way that is completely different from 10 or even 5 years ago. More time is spent on phones and devices and, as a result of this, observations and appreciation of the wonderful natural world around them are potentially on the decrease. This is proven with the removal of words such as bluebell, conker, magpie, dandelion, etc. from the Children's Oxford Dictionary. As teachers, we have to take cognisance of this and put in maximum effort to opening up their world and encourage them to notice what is around them and widen their horizons.

Alongside this, we are working on resilience, which is hugely important for development as well as for their scientific thinking. When you're trying an experiment, you need to have the skills and resilience to have a go, then adapt and try again to achieve a better outcome. In a world of instant gratification, it is common to see some students switch off straight away after not getting something quite right the first time and become frustrated. We know, however, that life doesn't work in that way; we very often do need to do things a few times to get them right. Children need to get used to having thinking time… it's a key skill for scientists, but also a key skill for life!

The growth mindset is at the heart of all of our teaching where, if things don't quite work out, you try again using a multitude of strategies, asking yourself what didn't go so well, what can I do to do it better, do I need help from a peer, teacher? We see FAIL as the First Attempt In Learning and that it is very important to make mistakes and learn from them. The biggest mistake we will ever make is by being too afraid to make one.

We know that children are naturally curious, but that declines slightly as they get older; even at P7/Year 6, with this instantaneous culture, you can see them not wondering quite so much about how things work, or why certain things happen, and I think part of that is confounded by an increase of time spent on the new online digital world.

Developing the right atmosphere in class

To encourage the children to participate in class discussions, you have to develop the sort of environment that gives a platform for everyone's voice to be heard and, to do that, you need an atmosphere in which people feel confident enough to share their opinions.

The **Making Thinking Visible** programme is part of a wider Glasgow City Council initiative and it is being delivered in partnership with Tapestry. Pupils are encouraged to develop their skills and knowledge through the **thinking** routines and moves. It helps to promote the idea 'I think, I see, I wonder' and those questioning skills that are so vital to science and to education in general.

Explorify's Odd One Out activities offer a wonderful platform to facilitate this kind of questioning. The children feel more secure as there is no wrong answer, so they won't be embarrassed to give opinions or be in fear of offering an opinion that could potentially be shot down in flames. They know that, if they can give evidence to support their opinion, then their answer is valid. Explorify gives an open forum for everyone's opinions to be respected. I've seen changes in attitudes through classes in the school; for example, Primary 4 (age 8, Year 3) are so eager and enthusiastic, whereas Primary 7 are at times more reticent – some are very conscious of being 'cool' and not wanting to embarrass themselves. When they do share their thoughts, though, they give greater evidence and discuss the reasoning behind their ideas. They are also great at debating with each other. Using Explorify and these approaches has helped them to develop excellent talking and listening skills and the very important social etiquette of not interrupting others when they are in full flow, developing the patience to

time their input. The ability to wonder, question and share their ideas is great for building their confidence and self-esteem. We are trying to instil the belief that, in science, anything is possible if you have these abilities.

Becoming problem solvers

I love the Problem Solver activities on Explorify. They're really engaging for the children and so easy to execute, as all the things that you might need for them are easily found around the classroom or the wider school. There's a perception that to do good practical science you need a lot of specialist equipment and therefore a large budget or well-stocked science cupboard. While much of the science we do here does cost money and requires special pieces of equipment, Explorify's Problem Solver activities do not, so it is a great way of increasing our practical science without needing more investment. We all know that budgets can be an issue so, at times, you have to be a bit creative to do a lot of practical science.

We did the 'Water Carriers' Problem Solver (see useful links below), where we asked the children to design something that would allow them to carry 1 litre of water across a certain distance a certain number of times, which kept them engaged for hours! We did this just using items we had around the classroom. We also did the 'Mission Survive Ice Lollies' challenge (see useful links below), where we tried to stop an ice cube from melting, exploring ideas around insulation.

This allowed some of our pupils who were not overly fond of numeracy and literacy to excel and they were delighted, as was I and the rest of the class. It gave them their chance to shine and show how great they are too. They really embraced the challenge, identified the best materials to use and were greatly enthused. We ran with their ideas and went off course from the planned lesson; it was great to feed their interests and extend sessions or topics that excite and engage. The best way for children to learn is by discovering – I hold back from providing too much input – maybe a top tip! Apart from that, they're on their own and, every time we do this, it is as much an experiment for me, and a learning platform! They're more engaged when they're discovering through their learning – if I just tell them how something works, then the engagement factor can slide down significantly.

Widening the environment

Some people have a misconception that science is all about explosions and white coats, but it is our responsibility to show the children that science is all around them and in everything they do. You can work in a scientific job and not wear a white coat and have crazy hair. This is a damaging myth and so, when I ask the children what science is and then show them examples of what science ***really*** is, they're blown away. This real-world application is so vital to their understanding of science and what a science-related job looks like.

Protecting ice cubes

We're also trying to take part in as much enrichment as possible and to take the children out of school on trips to expose them to as many experiences as we can. Recently we went to the RSS Discovery Centre, Dundee (see useful links)] to broaden and deepen our learning about our Polar Explorer topic . We have the Science Centre just down the road too and we are very fortunate to get free access as a Glasgow City Council school. We also invite a variety of professionals into our schools to discuss their careers, to broaden the chlidren's horizons.

After we started using Explorify, we took the children outside on a biodiversity day to look at the living things around the school. They were spotting all sorts of things in really fine detail, which was a huge difference from the previous year where they had not noticed things as closely. We are aware of giving them the time and skills to look closely and notice the finer details. Overall, we are fine-tuning observation skills and leading them in their thinking. At first, our thinking can be a bit narrow, but that's all part of growing and learning.

By showing images, films or ideas that are quite foreign to our children, this is really opening their eyes to the wider world around them, as well as helping them to notice what is in their immediate surroundings – having that unfamiliar context offers an even playing field for all the children. They might never have seen a certain animal, for example, but they can really notice the detail and discuss what's up on the board.

Practically, one of the reasons I love to use Explorify is that it's arranged by the topic areas in the Curriculum for Excellence, so everything is so easy to find but is broad enough to use outside science time. Explorify is all about developing scientific thinking and the skills associated with that, so if you find an activity that relates to a different topic, or just something that the children are interested in, you are sneaking that scientific thinking time into other subjects. Those scientific thinking skills benefit literacy, maths and other subjects. Science helps them to build those transferrable skills and apply them across the board.

Acknowledgement

We have been delighted with the Explorify Science resource at Sandwood. The success of Explorify Science within Sandwood Primary School is very much attributable to our P7 teacher, Lynne Scott. She is passionate about STEM and her drive and enthusiasm to involve our pupils and staff in the world STEM is what has made this resource produce such an impact.
Fiona Donnelly, Headteacher.

Useful links and references

The Water Carriers problem solving activity: https://explorify.wellcome.ac.uk/en/activities/problem-solvers/water-carriers
The Ice Lolly challenge: https://explorify.wellcome.ac.uk/en/activities/mission-survive/ice-lollies
Information about the RSS Discovery Centre: https://www.rrsdiscovery.com/plan-your-visit/
The Polar Explorer Programme: https://www.stem.org.uk/welcome-polar-explorer-programme
Glasgow Science Centre information: https://www.glasgowsciencecentre.org/

Lynne Scott is the Primary 7 teacher at Sandwood Primary School, Glasgow.

Children sharing their work at the science fair

Leading on science and raising the profile

Amberlee Marshall writes about taking on the role of Science Co-ordinator, changing expectations, and raising the profile of science in her school

If you had visited my school last year, you would have seen nothing to distinguish science from any other subject: we didn't take part in Science Week or even teach science on a weekly basis. We'd had two different subject leads in two years so, after being given the role of Science Leader while I was on maternity leave, I decided that it was time to raise the profile of science in the school and restore it as a core subject alongside English and maths.

Getting decent CPD in Norfolk, as with many other areas of the country, can be difficult, so I was lucky to be sent to a science leader boot camp to set me up in the role. I didn't know anything about what was expected of me, having come from a non-scientific background, so it was useful to get the basics of what to do as a Science Leader and really made me realise what I'd taken on! We looked at the Ofsted expectations and setting up a file, as well as more practical, hands-on skills around working scientifically. I left with a solid understanding of the five types of scientific enquiry and how to teach them. It set me off in good stead to come back to school, take stock and implement some of the things I'd heard about – Explorify and PSQM (see useful links).

Explorify was mentioned by the leader of the course and it is being

We've found that the best way to share Explorify isn't to tell people, but to show them. We've created an interactive presentation, complete with script, that can be used to deliver a quick yet comprehensive introduction to Explorify:
https://explorify.wellcome.ac.uk/blog/staff-meeting-presentation

As with the Explorify activities themselves, we've done all the hard work for you! The presentation demonstrates a selection of our most popular activity types and will help staff to navigate the easy-to-use website.

mentioned everywhere I go now! It was the easiest thing to implement from the course; I came back and shared it with my teachers during a staff meeting the very next week. I showed it on screen and we did a few activities together, so everyone knew what it was all about – I even set up logins for each teacher, so all they had to do was take the login and get going. There was no excuse not to do it!

Starting the day in a scientific way

We have always done early morning work so the routine was a familiar one, but this was usually some reading or quick maths. I saw this as a great way to implement more science – it's up there as a core subject and needs to be there along with everything else, so there was no reason not to be using that time to do it. Initially, I asked that teachers implement Explorify as early morning work, once a week, as the children come in. That time for me, as a teacher, can be pretty frantic, so it's great to know exactly what I'm doing and Explorify really helps with that.

The children start arriving at 8.45am, so we use that first 15 mins of the morning to get them thinking a bit differently, in a more scientific way, to get those science questions going around in their heads and prompt them to use some great science vocabulary. Each class does their science early morning work on a different day, whichever works for them, and I can pop in and see what they're up to. There have been some slips, of course. It hasn't happened every week, but it's a positive step in raising the profile of science within the school.

Freedom to think

I like doing Odd One Out activities with my class, as I find they're great at getting vocabulary going, getting children talking, and hearing about their different points of view. We did the 'Sources of Light' Odd One Out (see useful links) recently and one of the children suggested that they were all symbols of God (we are a Church of England school). It's not science-related, but it's wonderful how the children find the cross-curricular links without you having planned them. It wasn't what we were talking about that day, but the great thing about Explorify is that there's no right or wrong answer. Especially during this early morning work, when there aren't any specific learning objectives to be achieved, they can really explore their ideas wherever their minds take them. It's wonderful seeing the children relax and have the freedom to think. That was different for the children particularly in upper Key Stage 2 (ages 10-11) with SATs, where they are so focused on right or wrong answers – are you getting a tick or a dot? But science isn't about that, it's about *Exploring*.

Although we'll often do a little bit of writing alongside our science early morning work, we don't mark for spelling – if it was a writing exercise and was marked, the children would be more hesitant to get their thoughts and ideas down. We use the back of our science books to separate this from the main science work we are doing, in case it doesn't fit with the unit. Those activities that do fit, or might serve as a hook into a different lesson, will go in the front of the book with the rest of the work. Teachers of the younger classes tend to print off the pictures or questions, so they've got them in front of them. In my Year 4 (age 9) class, I use the interactive whiteboard and write questions that I would like them to consider around the activity, and then we discuss them before we start the day of lessons. It really depends on your class – there are many different ways that you can use Explorify to get the best from the children. The children really enjoy starting their day in this way, often coming in and asking *'Is it an Explorify day today?'*.

Changing the way we plan

When wanting to bring science back to the fore to compete with English and maths, I knew that asking teachers to plan science would be key to getting it into the weekly timetable of lessons. This was one of the things that undertaking the PSQM helped me to implement. For example, now there are some non-negotiables that I expect to see in planning from each teacher: that the five types of scientific enquiry are all there; there's an outdoor learning element; and cross-curricular writing (we do practical in science, then write it up in English time).

We're already starting to improve our own subject knowledge using ReachOut CPD – we spent a whole staff meeting just doing modules on ReachOut, not talking about anything, just dedicating time to building confidence in some areas in which we were not so confident. It's important that the teachers know where the help is if they need it and that the time is available for them to do it.

I didn't want to be one of those leaders who cracks the whip and makes what might seem like excessive demands without providing all the tools to support teachers to produce their plans. I have to do it too – I'm teaching Year 4, so I have to incorporate all these things into my own planning. I wanted to give everyone the 'how', as well as the 'what', and make sure that all the tools were there to help them if they needed them.

Taking science home

As well as raising the profile of science within the school, I've been trying to engage parents with our science

Science snake takes flight

journey in the hope that they will start talking about science to the children outside school. We've done this in a few ways: we trialled a science fair with parents last year in which parents saw the science that was taking place. It was a great opportunity for children to 'present' their work back to their parents and share that learning. It went really well and the feedback was all very positive. The science fair is now a non-negotiable in planning – in the future, every class will lead a science fair at least once a year.

Along with a 'science experiment of the month' on the science page of our school website, we also send a little kit home with each child to encourage a bit of scientific discussion. Each class has a toy snake known as the 'science snake'. Every week, the snake goes home with a different child along with a copy of *Whizz Pop Bang* magazine, a long list of websites that they can use for experiments or activity ideas, and a book, and they simply are asked to do some science with these and send the work back with some photos of the things that they did.

I've taken the same approach with this as I have with planning – we're asking parents to go out of their way to take part, but giving them enough tools and resources to make it as simple as possible to participate, rather than making big demands and sending them off to go and get it done!

Last year, 'science snake' went home to a family with a parent in the RAF and it happened to be the week of the RAF 100 Flypast to mark the RAF centenary, so our science snake got to ride in the cockpit during the flypast! The snake doesn't usually get such an exciting outing, but we have found that this helps to build up science capital and raise the profile of science with parents as well as in school. It is optional, but we've never had a parent send it back and say that they didn't want to, or couldn't, find time to do it.

What's next? Still to do...

It's vital to show children more examples of scientists. This is so important in our area, as aspirations in schools in West Norfolk are not always high. Having access to people who use science in their day-to-day work is vital. As a rural school, we have found it hard to get STEM Ambassadors in for talks and visits. It is those children who need this the most, living in such a rural area and having little contact with science careers. They don't want to keep listening to me! We're thinking of trying Facetime/Skype meetings with some Ambassadors, which is not ideal, but better than nothing.

It would be great to see more children getting excited about moving up to secondary to do science and then welcoming them back after a year to hear them tell me that they're scientists! I know that a child decides whether science is for them or not by the age of about 11, so, as primary school teachers, we play such an important role in inspiring the next generation of scientists.

More practically, I want to use the resources that we have more efficiently – developing our pupil science ambassador role with Year 6 (age 11) ambassadors becoming science technicians – getting teachers to prep the previous Friday and let the technician know what they want so that they can keep track of what's in the cupboard, what's being used, etc. It's really getting the technicians to spy a bit for me too, in a nicer way than me standing over them and seeing what's happening! This also helps us to keep track of the resources as well as making sure that everything in there is really getting used and that we have everything we need.

I want to go further to engage the whole school with more whole-school events – I have dabbled during Science Weeks (slowest spinner), but want to tie in with STEM and maths and do one every term, particularly during roll-up week (children going up to new classes), when we are slightly less focused on the curriculum. Seeing more cross-curricular links is a priority – we are planning a book week around *Secret of Puffin Rock* to kickstart this. There's lots of science to tie in/hook up with that.

I hoped that the time that marked the start of my Science Co-ordinator role would serve as a benchmark – we didn't have much science happening in school, so I thought that if we start from here and spend the year doing PSQM we'd see a marked difference and start as we mean to go on. My aim was to bring science to the foreground again, and I think that we've really done that and that Explorify has certainly helped with this.

Amberlee Marshall became Science Co-ordinator in January 2018 and, more recently, in January 2019, Assistant Head at St. Martins. She currently teaches a Year 4 class.

Useful links and references

Primary Science Quality Mark information can be found: http://www.psqm.org.uk/

'Sources of Light' activity:
www.explorify.wellcome.ac.uk/en/activities/odd-one-out/sources-of-light

A science display at Swalecliffe

Finding new ways to record science understanding

Ben Thwaites outlines using questioning to gauge understanding and change the way that science is recorded

I believe that science within a primary school is there to enable children to be interested in the world around them and to help them start to understand it, getting them interested in the very basics, just pointing out things around them that they hadn't considered, so that they can start asking the questions 'why' and 'how' and 'what' and explore those. Explorify fits in so well, because it leads them to do just that.

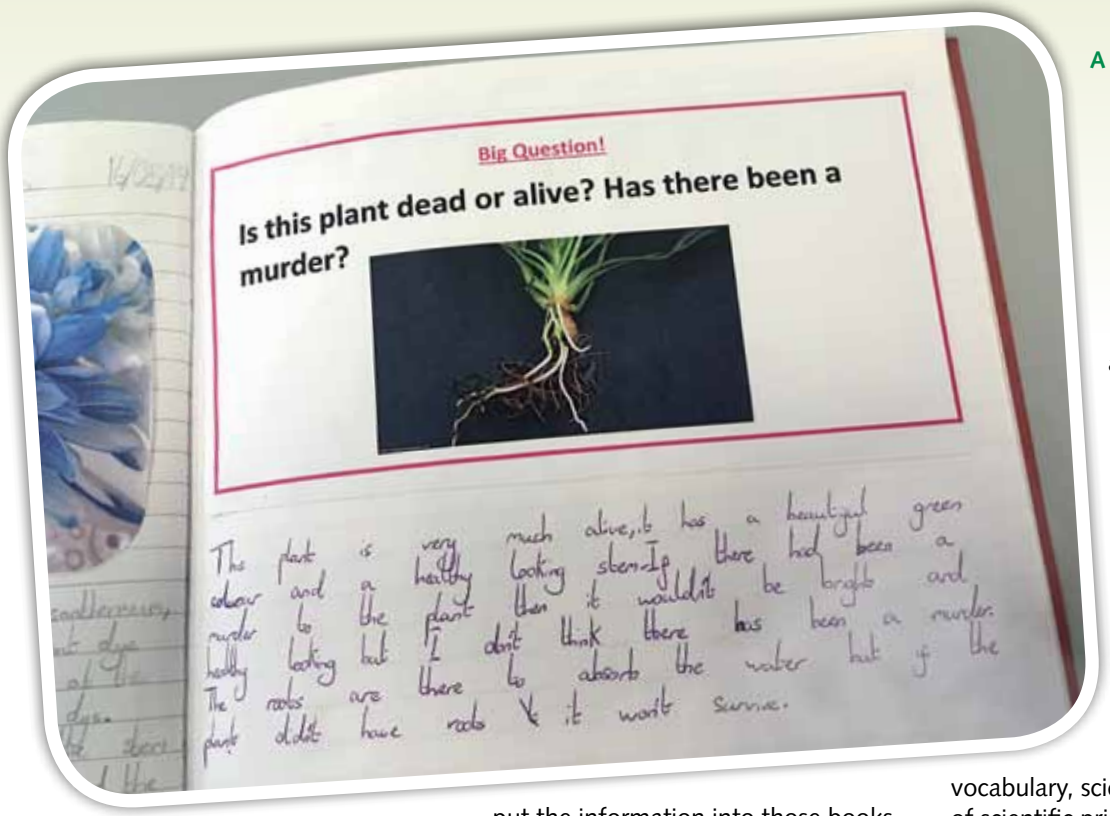
The skills they learn within science will then stay with them – research skills, utilising and applying maths and literacy skills. Science builds on those other subjects and, without it, the world doesn't make any sense, so why learn those other things? Science is something that all children can get involved in. They are all passionate about it, because you can physically go and do an experiment, or you can look at something.

Those that don't excel in maths or English can excel in science. It might be that you have to look a bit harder to see it and ask them for their questions and understanding, or that you allow them to record their data or present their findings in a different way, but science allows for that in a way that other subjects don't. It's great for collaboration, it's great for sharing ideas, it supports and develops language use because it asks them to justify their thinking – it's not simply right or wrong or black and white. It's a profoundly important subject in those terms.

Having said all that, the single most important thing about science is that it's fun! You can have quite a lot of fun writing up a diary entry or measuring a perimeter, but you can have much more fun chopping up a flower and figuring out how it's all working!

Recording

When I first came to Swalecliffe, all the work for subjects except English, maths and art was recorded in a connector book. We took a topic that broadly connected the work, but mixed subjects page by page, e.g. a few pages of history, then geography, then science. Science was either very 'arty', or really prescribed/controlled; for example, the teacher would set out exactly how the experiment should be recorded and then the children would produce a procedural report of what they did. I felt that this wasn't



giving science a high enough profile, but I also found that, when we were monitoring and looking at the book, you couldn't find particular pieces of work very easily and it was hard to compare year groups and classes. As a result, the development across the year groups was hard to track, so there would be fairly similar pieces of work in Year 2 (age 7), then again in Year 3 (age 8), without easily identifiable progression in the way that they were recording or in their understanding.

The school worked very hard at looking at how to resolve that and it was agreed that we would have individual science books. We did this in collaboration with all the teachers, consulting about what we would want those books to look like, so really avoiding implementing change from the top down.

Change is often a gradual process, so when we first got the science books, we were still doing a lot of recording in a very traditional way – predictions, apparatus, etc. There's still room for saying that 'this is my prediction and this is why I think that', of course, but we have moved towards an approach where we are recording either their understanding or findings, or we pose questions to them after they've done their learning to get their deeper thinking and understanding. So, as a joint effort, at the same time as introducing the books we held CPD with the teachers, where we looked together at ways to record and ways to put the information into those books.

We found that we could give teachers, and indeed the children, more freedom to record in their own way, but the difficult part of that is to persuade teachers to be brave and to leave traditional methods of recording behind. We decided to encourage allowing children to show their thinking and understanding through the use of questioning. This was inspired by the Explorify methods of questioning because the children had responded to them so well in class. We are doing it here and people are being fantastic – we frequently find excellent pieces of work in the books that don't fit the traditional structure, but that we can hold up to the whole school as ticking all the boxes, answering all the questions and clearly showing the progress of understanding and learning.

Using questions to show understanding

We have implemented two types of questions: big questions and deeper thinking questions.

Big questions, for example 'How do we hear?', are given at the beginning of a topic to get a picture of what children know, and we might revisit the same question at the end of the teaching sequence to see how that understanding has changed.

We use deeper thinking questions in a few ways. We started by targeting them to just those children we wanted to show deeper thinking. I'm veering away from that slightly in favour of giving them to all children, because the danger is that so many of the children have great ideas that you never get to hear!

These are designed to be independent pieces of work. We don't teach them how to answer the questions, so it is from their use of vocabulary, scientific terms, application of scientific principles or explanations that their understanding emerges.

The children have been really engaged with these questions and have even started coming up with their own questions to explore as a class. Recently, during a sequence on classification, one child asked *'well, what's a mermaid then?'*, which led to a long piece of cross-curricular work where, in addition to the science behind the question, we looked at balanced arguments and reliable sources of information.

These then become not only something we can use to show progression across year groups, but also to measure ourselves across other schools. We've been working within a local alliance of schools to moderate work, which is easy with writing, etc., as we are all doing the same thing, but it is harder with science. We tried an approach where we set a challenge across all the schools – it was called 'frozen' – and we encased a Lego figure in a block of ice and the children had to write up how to release it and explain their understanding. We found that some teachers asked the children to write diary entries, while others wrote up the experiment, so the responses were too different to moderate.

As long as we get everyone using the same questions and teaching their children to respond in similar ways, i.e. not guiding them through it, then we should get something that gives us a basis for moderation. The temptation

for teachers is that you don't want the children to get it wrong, or to ruin a nice book, so you guide them heavily – you have to step back from that and allow them to be independent and to do that work, otherwise you're not truly assessing their knowledge and understanding.

The team

There's a small team working on science here, including staff and pupils! Three of us (teachers) work together to create the big and deeper thinking questions, we run the science club, and look at allocation of resources. The next big step that we'll take is overhauling the curriculum to make it as engaging as we can, as hands-on as we can, make more local links, and to fit in with the new Ofsted guidelines (see useful links on page 8).

We also have children who are Science Champions. At the start of the year, we invite everyone who is interested to write a letter of application saying why they would be a fantastic Champion. My current, most active, Science Champions have taken the role of spreading the environmental message about the use of plastic across the school. They went to talk to the kitchen staff about the amount of plastic and food waste generated here – we spend around £4000 a year on food waste (from two kitchens and a restaurant), so now we're looking to buy a digester to reduce that waste. They've written a presentation and have delivered it to their class before they will present to their year group, then across the whole school.

At the beginning of the year, I tasked them with finding out how many science displays we had across the school in the main areas – when there weren't any! They came back astounded that they couldn't find any and we took that to the School Leadership Team (SLT). Having the pupil voices participating in the audit of the school and calling out for science in the main displays was so much more powerful than if the teachers were asking for them. Now we have four displays, and one of them is all about plastic use within the school and the potential to cut down on waste.

Mistakes and misconceptions

There are some subjects, such as science and maths, that can instil fear in teachers. If a teacher is not confident in maths, the temptation is to just ignore the parts in which they're less confident, so some concepts just don't get taught. That's not quite the case with science and I think the really damaging thing with science fear is that concepts are mis-taught, so misconceptions are embedded and stay with children forever. I worked with a teacher in a previous school who had always misunderstood how magnets worked, and had taught several classes that the atoms within a magnet physically move toward an object to which they are attracted. Her class had accepted the model that had been drawn on the board and would have carried this misconception forward with them. The teacher retaught the lesson the next day and the children were part of a valuable conversation about research and questioning knowledge. Regular conversations about science between all members of staff can help to ensure that everyone has the confidence to develop their knowledge and understanding.

I've been lucky enough to go on the STEM subject leader course (see useful links below), which addressed a few of those misconceptions. I've been able to come back and disseminate this to the teachers here. The content was so rich and varied, so I came back with a wealth of resources that I have put on our Virtual Learning Environment, so all teachers can access them. Future CPD sessions will be based on these resources that are addressing all sorts of misconceptions and errors. We have rolling CPD here, so we're using that time to address areas of subject knowledge that need to be developed. We also do classroom observations of teaching, looking at books to identify those areas of subject knowledge that need development. In staff meetings, we then do experiments and talk through what's happened in the same way that the children would. We focus on modelling and allowing teachers to explore ideas in a safe space, just like they do with the children. This collegiate approach to science CPD supports everyone in doing it better.

One of the things that I found was a really quick win was when Year 4 (age 9) were looking at the molecular model of solids, liquids and gases and this is one of the things that we looked at on the course. They highlighted an error that teachers, including myself, often make in the way that it's taught. Now a model of this is on a display board in school and in all our books. I've found that teachers are very keen to improve their subject knowledge, but one thing that people (not just teachers) are reluctant to do is to say 'I don't know'.

We had a really lovely mistake last year: we did the 'diet soft drink vs full-sugar soft drink can in water' experiment. One sinks, one doesn't... why? In one class it went well and there were conversations about why that had happened. But in the next class, we did it and it didn't work! They both floated and that in many ways prompted a much better, more valuable, discussion. The children thought that maybe the company had cheated them and not put enough sugar in, or sneaked in some extra carbon dioxide. They were so enthused to work out why it hadn't worked, rather than explain why it had. We strapped sachets of sugar to the outside to see how much sugar would make a can sink – it was a ridiculous amount, but the children didn't care, they still wanted to drink those fizzy drinks!

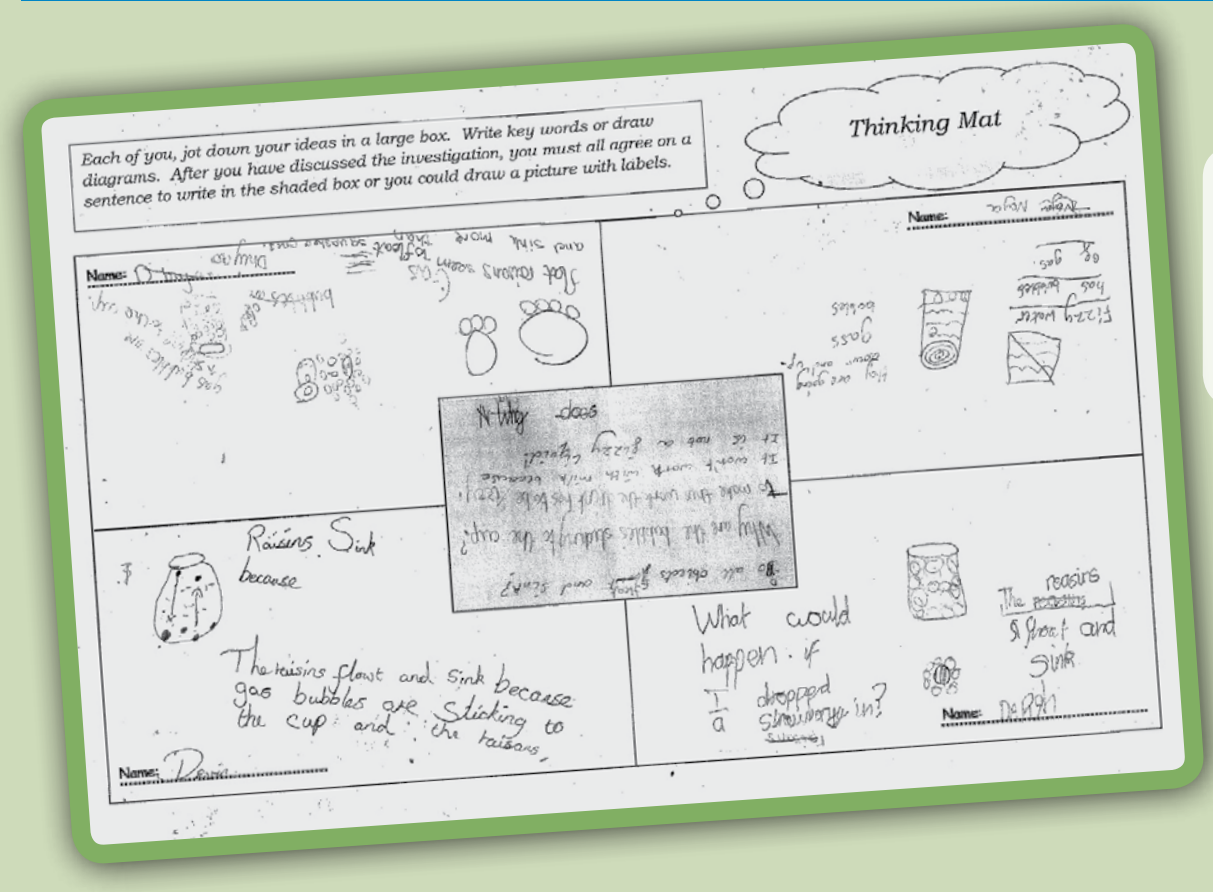
Looking ahead

Going beyond primary school, if as a country we want to continue developing and have an industry that thrives, we need to interest children in science now. If they go through school thinking that science isn't an option for them – particularly the girls, and those from different backgrounds who wouldn't associate themselves with the role models they see in science books – then we have no future. If you don't understand the world, how will you care for and value the planet? How are you going to live in it and move forward in it? How will you even be aware that your choices and actions have consequences? Science isn't just there as another subject to be taught, it's there to provide pupils with an understanding of life.

Ben Thwaites is an Assistant Headteacher and Science Co-ordinator at Swalecliffe Community Primary School.

Useful links and references

CPD course at STEM Learning:
https://www.stem.org.uk/cpd/449801/leading-and-developing-primary-science-expertise



The thinking mat

Getting to grips with assessment

Sarah Eames discusses why assessment is not something that happens in the plenary at the end of a lesson; it starts with planning and should be embedded throughout your teaching

The one thing I make sure that our teachers understand is that assessment isn't that bolt-on activity at the end of a teaching sequence. If you're doing it at the end of a lesson it's too late; it should be planned right from the beginning.

Before we start a teaching sequence, we need to make sure that we find out what our children already know about the objectives we'll be teaching, or what they remember from the previous lesson. At Sandfield, we set up a discovery activity for the children to do in groups. We have adopted a practical approach so there is, in fact, very little recording or individually written evidence in books. Of course, there's lots of teacher observation, checking in with pupils to make sure we understand what they think they know and can explain. Teachers collate children's ideas by doing many activities on large sheets of paper and one of our favourite ways is using a thinking mat approach.

Children do a discovery activity in small groups and are encouraged to talk and discuss what they think they know; next, they write their own individual ideas on the thinking mat; finally, they discuss and put into the centre of the thinking mat anything that they all agree upon. It doesn't have to just be written, it could be drawings/sketches or simply keywords. As a teacher, I can readily see what seven groups have come up with and this is a lot more purposeful and meaningful – it's a quick and sure way to gauge where the learning is, pick up on areas least understood or spot potential misconceptions. As a teacher, we can then address these and drive their learning forward.

Stimulating discovery

Discovery sessions are usually based around a stimulus that the teacher has set up – we use activities like the 'Dancing Raisins' from Explorify (see useful links).

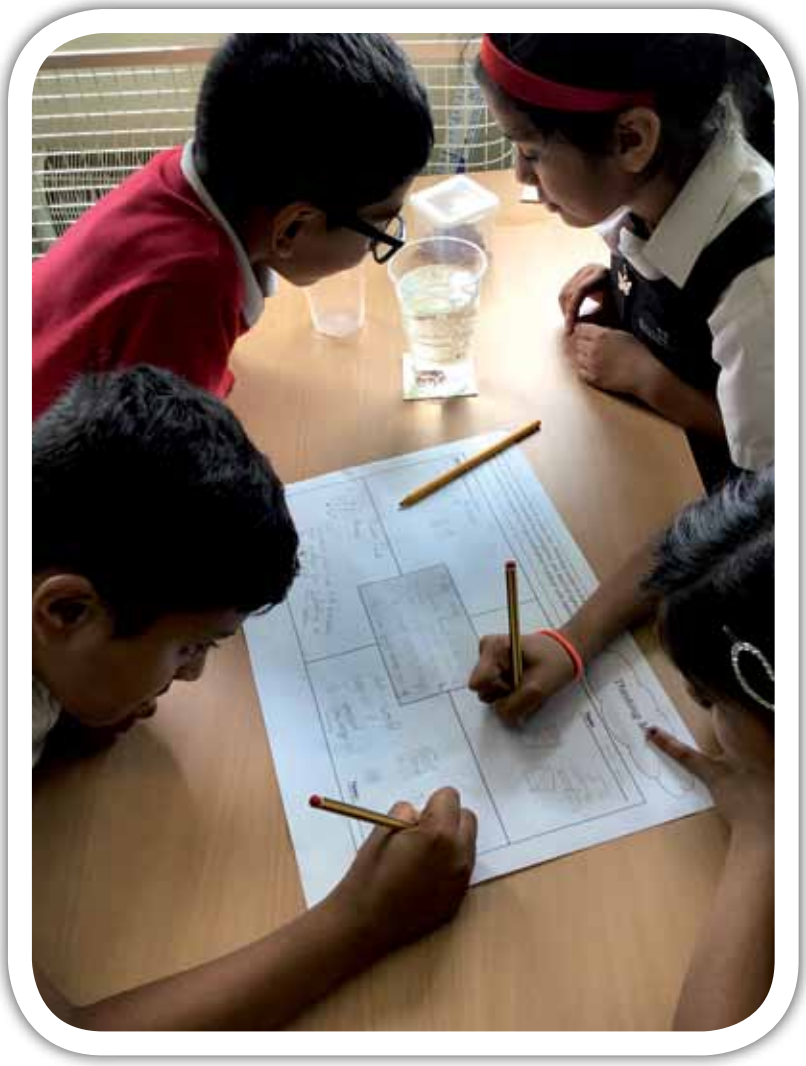
When children are all doing something similar, watching what happens, talking about the science that is going on, you have a way in to learn about their understanding, but then you can take it deeper

into exploring their skills in working scientifically. We ask the children to think about what questions they have and how they could change the investigation. When, for example, the children were exploring the dancing raisins, they all wanted to change more than one variable, but that is valuable learning for us as teachers as the children have to understand that they can only change one variable at a time to truly gauge what happens.

Sometimes this discovery session might take 10 minutes, but I have to tell teachers that, if it takes the whole lesson, that really is OK as it's so valuable for the teaching and the learning that follows. Assessing children's starting points makes sure that we plan a teaching sequence that enables pupils to make good progress in both working scientifically and their knowledge and understanding. And it's OK too when children find out that what they predicted didn't happen; in fact, this often creates more discussion than if it goes as expected. Children need to learn from that too – think about what is going on and why that may have happened.

Using teacher-developed assessment materials to help

We also use some excellent research and teacher-developed assessment materials as well: PLAN [see article on page 11 for useful links] from ASE, and the TAPS materials too, especially for assessment of children's skills in working scientifically (see useful links below). At our recent Ofsted inspection, the inspector was keen to see these in use and understand how we could have confidence in our assessment, both formative and summative.



When we first looked at TAPS, we explored the rocket mice activity (see useful links) in a staff meeting session, then we all did it with our classes and discussed the progression in working scientifically throughout the school, from Early Years to Year 6 (age 11). Teachers looked at the objectives in the National Curriculum and discussed their expectations for the task and their year group. We expect our Year 6 pupils to be able to work scientifically independently – but it's still a challenge and we are not quite there yet in some areas. There's the issue of children needing to apply their maths skills, such as plotting graphs completely independently instead of using a proforma to save time. When you look at the outcomes, you have to be clear about what you are assessing and what you are assessing for: is it the maths, or working scientifically? What does that mean for your practice in school?

The ASE PLAN materials really support, as they give a clear structure and exemplify what is needed to be secure in children's understanding, plus they provide exemplars of evidence or annotated work, which gives teachers confidence and ensures that their professional assessments are valued. Teachers can get caught up in thinking that they need to show lots of written evidence of children's learning, but we should consider a range of evidence alongside our professional judgement: talking to children is as important, if not more so, as looking in books to get the whole picture for assessment. Less is really more here. We should be asking open-ended questions: 'What have you found?', 'Why do you think that?'. The 'how' and 'why' questions are really important.

You shouldn't need to produce evidence for the sake of it; schools need to develop a science policy that is clear about the assessment expectations of the teacher. Book looks are only one part of the picture and evidence needs to be triangulated, from talking to the children in pupil voice meetings to discussing with the class teacher about how the science lessons have gone. Each school is different, but confidence comes when there is a secure and robust assessment system.

Top tips for getting to grips with assessment!

1. Look at your own practice first, reflect on your lesson and decide if it has enough assessment opportunities. Does your planning have a clear assessment focus? Do the children have enough opportunities to achieve it?

2. Look at the resources out there – PSTT, TAPS, ASE PLAN materials are the first step, most of them are freely available (and you might then realise it's worth joining the ASE too!).

3. Use Explorify! Pick an activity and look at the assessment opportunities that are there. Look at the possibilities from using it, record yourself, and look at the pupils' responses, reflect on their responses and see what you can learn from how they respond. Teachers probably don't always realise that's what they're doing all the time; assessing and planning their next step – that's our job as teachers!! Teachers probably do more assessment than they realise but, when you stop and reflect, you'll then think of other things that you could put in place to make it more focused, too.

Consistency in assessment

We have a broad and balanced curriculum at Sandfield. Our Headteacher is really supportive and keen for science to have a strong place in the school, and it really is a core subject. She has high expectations about the science across the school and, in turn, expects me to lead science fully, and this also allows me to do many things across the school, and outside, which support my own professional development too – keeping up-to-date and learning from others is very important.

I'm lucky at Sandfield as I get regular release time to lead science. Teachers complete a questionnaire at the beginning of the autumn term and CPD is planned from this. Teachers usually choose a 'team teaching' approach instead of wanting to observe a science lesson that I teach, or have me observe them teaching. This team teaching approach is rewarding for all involved: as the Science Lead, I plan the lesson with the class teacher, we teach it together and afterwards we reflect on the lesson, the assessment opportunities, how we used questioning, etc. We seem to get more out of it that way – it not only empowers me as Science Lead, but also empowers teachers.

We are using the PLAN materials together as they provide such a clear framework when you plan your teaching – we compare the annotations with things we've done. I target teachers in a (very nice!) way, perhaps working with less experienced teachers differently from others, offering coaching, and mentoring teachers rather than singling anyone out. It's about being professional, and teachers know when they need some support and can ask me.

Explorify has been one of the things that has really helped to give teachers confidence in their science; they realise they can teach science. They go from being not very 'sciencey' to feeling more confident about their teaching, and adapting their teaching, and I see that in their classes as they're using the activities – the pupils' responses in early morning work, for example.

Moderating within a cluster of schools

I lead a Primary Science Teaching Trust (PSTT) cluster in Leicester, and several other networks. It is important that, in these, we moderate our assessments and discuss what we think is secure for that year group. In our last moderating meeting, we looked at written evidence for the Year 4 (age 9) science objectives, we shared books, often picking up new ideas, and looked at the evidence for a range of working scientifically skills plus the knowledge and understanding of individual children. It was important for us to develop a shared understanding of what secure understanding science looks like in Year 4: the vocabulary, the skills, types of enquiry and maths. Again, ASE PLAN resources are extremely helpful in this.

As a class teacher, it's not just about an understanding of the progression that our children are making in science; science also means that we are more aware of the interests of our children and we can build upon their science capital. Explorify can really help with this too and, when participating in Explorify sessions, the children really show what their interests are and as teachers we can pick up on these and value them. We watched the Explorify video where a vulture was seen eating the bones ('Takeaway Dinner' – see useful links below)]. One of the children knew about vultures, and this gave him a platform to talk about what they were doing – as a result, I was able to write a food chain on the board. As a teacher, I'm going to look more carefully at using Explorify to see if we can find out more about children's interests and learning. With Explorify, children can use higher order thinking skills and those who have a lot of science capital can still be challenged to think more widely and more deeply.

Sarah Eames is a part-time teacher in Sandfield Close Primary School in Leicester, an active member of ASE, with Chartered Science Teacher status, and is proud to be Primary Science Teaching Trust Fellow and a Regional Mentor.

Useful links and references

'Dancing Raisins' activity:
https://explorify.wellcome.ac.uk/en/activities/whats-going-on/dancing-raisins
TAPS resources: https://pstt.org.uk/resources/curriculum-materials/assessment
Rocket mice activity: https://www.stem.org.uk/resources/elibrary/resource/419662/rocket-mice
'Takeaway Dinner' activity: https://explorify.wellcome.ac.uk/en/activities/whats-going-on/takeaway-dinner

Overcoming science fear!

Maxine Roberts describes facing her fears head-on, transforming her science teaching and becoming a science superfan

When my head asked me if I would consider being Science Co-ordinator after 25 years of being an MFL lead, I laughed at the very idea of it! I have no science background whatsoever. I didn't even pass O-level science. When I started teaching, it wasn't a requirement, which was lucky for me as it meant that I didn't have to retake my O-level exams.

Twenty five years on, I completely understand the value of having science and I see now why it's essential for primary teachers to have that basic understanding. We are living in an ever-changing world and children need to be aware of what's going on around them, and understand that science is in everything, absolutely everything, that we do. If we, as primary teachers, can't make that known to them and make them aware that science is all around us, not just separate, then we are failing them.

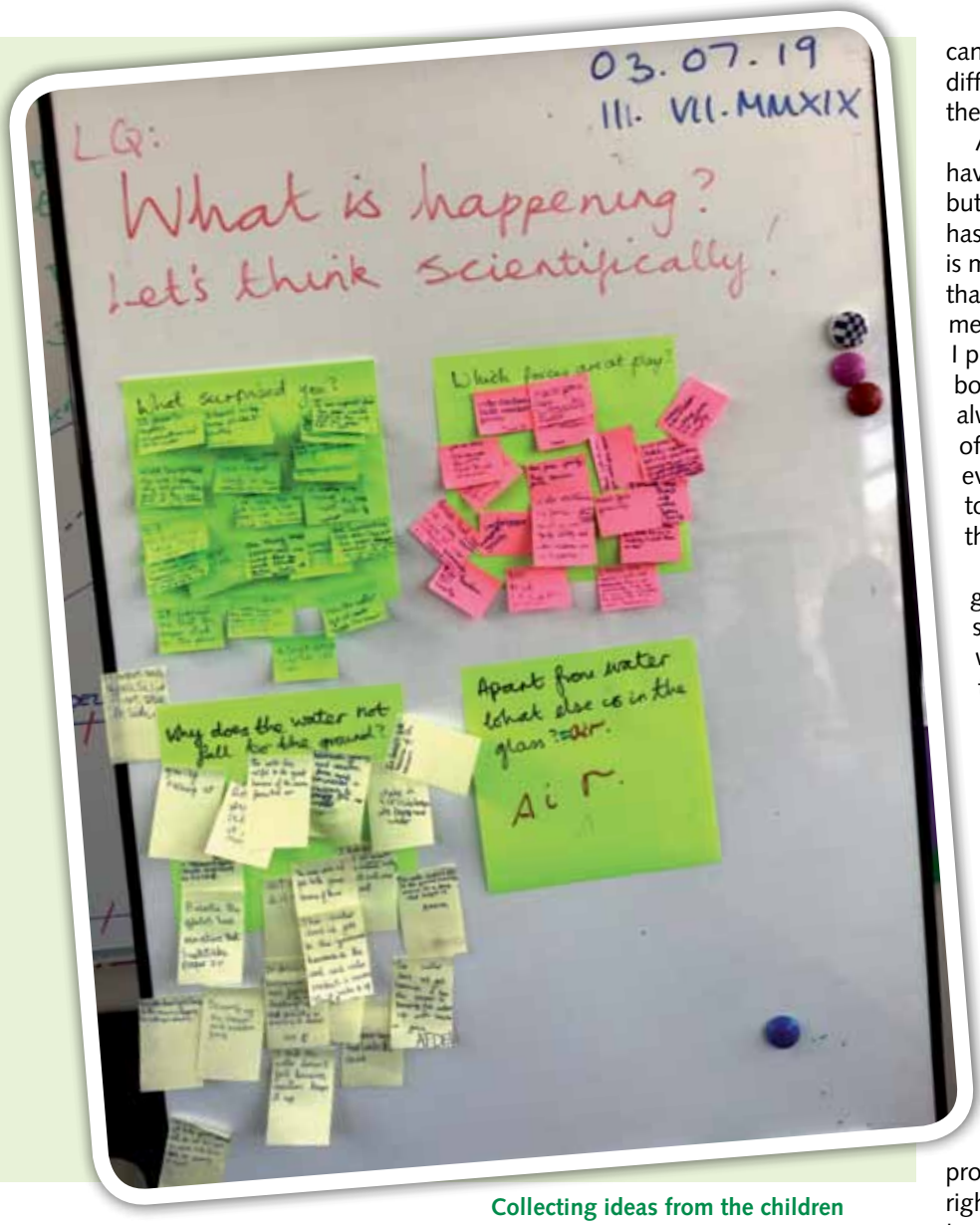
Science before – the fear

On reflection, my science teaching before becoming the subject lead just wasn't good. I was trying to be in depth with the children but, in reality, I was hanging onto some quite poor planning that'd I'd taken from other people and used. I don't think my lessons were particularly interesting or engaging for the children; there was much not-very-useful book work happening. Children were less independent, less creative and not doing as much investigation. They were still learning, but in a very different way.

Vitally, I wasn't letting the children talk to me about their understanding of a concept or subject – I was doing a lot of the leading and not leading them terribly well. If a colleague recommended something to me, I would try to incorporate it into my teaching, but even picking up a new resource was frightening, because I didn't know enough science to feel confident picking up something new, and I felt it was just not my strength.

I didn't feel confident with either the delivery of the lesson or the subject knowledge.

I had really compartmentalised science, which is something I'm pressing to change now I'm Co-ordinator, so we have a more cross-curricular approach, not just in science but across all subjects. This



Collecting ideas from the children

is reminiscent of best practice when I started teaching 25 years ago, and seems to be having a resurgence and is a much better way to teach, as it makes those connections from science to everything else, reiterating this idea that science is all around us.

Science after – the confidence

If you were observing a science lesson in my classroom now, you would see lots and lots of discussion – whole-class discussions, small groups, peer-to-peer. You won't see me standing at the front of the class and talking to convey facts.

We begin with a discussion about their understanding of a concept or topic, then I support the children in their investigations and bring them back to evaluate. There is much more independent learning in the classroom.

I use Explorify as a starter or a plenary – often it takes over the whole lesson as the discussions generated are so good – then I have to put in another lesson to do the thing I'd originally planned. I use Zoom In Zoom Out and Odd One Out frequently, and the discussion activities – they really deepen the children's thinking.

Now I'm not afraid to teach a lesson, even if I don't know much about what I'm teaching, because now I know where to go for support. I'm confident enough to work with the children to find answers. I'm teaching forces this year, which I haven't taught for 3 or 4 years (and didn't teach very well then!), but this year I love it because the children and I are having the most brilliant discussions and finding out together. I used the 'Standing on Eggshells' What's Going On activity (see useful links) and the children were absolutely blown away! It led to a great discussion about the shape of the eggs, which bit of the egg is strongest, how the weight mass can be spread…there were so many different ideas, all of which came from the children.

All these changes to my practice have improved my science teaching but, without a doubt, the thing that has changed the level of engagement is my enthusiasm. The children can feel that excitement and enthusiasm from me, which transfers to them. When I put an Explorify activity up on the board, whatever it is, the children are always really excited. It's a great way of getting them to talk and it doesn't even necessarily need to be about the topic you're doing – it's just about thinking about what they can see.

Science across the school wasn't great at the time I took on the subject leadership either. The profile wasn't high and we simply weren't talking about it. Now, we are talking about it and making the most of every space available for science. Every display has a principle for science – we have all got to think about why we're doing it. People are using their walls more as working walls and prompts for discussion. The science is there, front and centre. What the children are putting in their books now is really valuable to their learning, rather than book work for the sake of it, and you can see the evidence of the changes in the work that they're producing. You can see the changes right through the school from Years 1 to 6.

Working on my subject knowledge

I am constantly trying to improve my own knowledge – I had a great deal to do two years ago to get up to speed and I've informed myself a lot through searching for resources, groups and organisations on the Internet. I am constantly downloading resources and, just in doing that, you're reading them, absorbing that knowledge and making a judgement about what's good, shareable, and what's not. I've done quite a few of the Reach Out CPD modules online to help develop those areas in need of improvement. I encourage my colleagues to do that and I have done various other free STEM courses.

There's a great community of primary science practitioners on Facebook and Twitter. That's how I heard about STEM Learning's CERN

trip (see useful links). Even though I look at STEM courses regularly and get e-mail updates, I saw a post on Facebook saying that there were spaces available and that's how I knew about it! I learned so much at CERN. I've been to many Oxfordshire primary science conferences, which were brilliant, really mind-blowing. I have a few friends who work in science-related jobs, so have had conversations with them along the way. I've created links with our local secondary school – also part of the Academy Trust – our Year 5s and 6s (ages 10-11) go up to them in rotation and work in secondary school science labs with the secondary teachers.

It's all helped to improve and build my knowledge. When I started this journey, I had no idea how much there was out there and I feel a bit disappointed that, prior to me taking this on, there were all these lovely resources that weren't being shared or talked about. I'm not surprised that the staff are overwhelmed! I find it overwhelming at times looking at all the things that are available. Of course, you do need to pick and choose, but having a small budget, or none at all, does not need to prevent development of science within the school when there are all these great resources out there. You can take your pick and be as creative as you like.

Sharing with staff

We have had several science-focused staff meetings at school, in which I share resources, plan practice and lead CPD with staff. Science Oxford CPD came in to run a whole staff CPD and I've led some 'Thinking Talking Doing Science' (see useful links) sessions on assessing, progression and practical work, all of which have proved extremely valuable.

I'm really proud because, this year, I have been asked to do a science planning meeting with staff for next year. I think the staff here might be feeling overwhelmed with the changes I have implemented – some staff have adopted the new planning practices but have carried on using some of the same resources they used before. I've really tried to push for them to look at different things to try and make their science teaching more interesting. They know that the resources are there – on our drives – but the next level of support they need from me is to go through all the resources and point them in the right direction.

One of our top Explorifiers!

Continuing to raise the profile

As staff, we've made big changes to move towards a unified vision for science and there's now a great deal of enthusiasm for science through the school. We all agreed that science hadn't been a focus for us, but now it is, and that's wonderful. I'm making an effort to find things that continually raise the profile and keep up that enthusiasm for science; for example, we entered the Big Oxford Science event and had finalists, which was really exciting and the buzz around school was amazing!

Taking part in PSQM has been brilliant for really pushing science at school. It has changed the way in which we plan, changed the way we teach and really helped to engage pupils with science. We've combined PSQM with embedding our Academy's Engagement model, which works really well for science as it incorporates higher order thinking and questioning skills. We like to display our planning on screen for the children: the objective, links and questions are all there for the class to see.

PSQM has supported us in pulling all of this together and reinforced that this science journey has a real purpose to it. We've worked really hard and it's looking great.

Up until two years ago, teaching science used to absolutely terrify me. Taking on the Science Co-ordinator role and getting to grips with science was a huge challenge, but one that I threw myself into and now I absolutely love it! This has given me a new lease of life, as well as some headaches along the way. I think it's remarkable that you can get to my age and realise that you can almost start again with a subject and really feel enthused!

Maxine Roberts is a class teacher and Science Lead at Harriers Banbury Academy in Oxfordshire. She has responsibilities in many areas of the school (MFL/TRIPS/MLT/RA) but, until two years ago, had not considered science as a natural avenue for her talents.

Useful links and references

'Standing on Eggshells' activity:
https://explorify.wellcome.ac.uk/en/activities/whats-going-on/standing-on-eggshells

For details about STEM Learning's CERN visits, please see:
https://www.stem.org.uk/cpd/44096/cern-study-visit-and-follow-conference

For information about 'Thinking Talking Doing Science' visit: https://tdts.org.uk/

Louise Robinson talks about giving children the bigger picture around science and STEM and making it relevant

Making STEM relevant

A changing landscape

I've been working at St Julian's for 10 years and have been Science Co-ordinator since 2014. It's a really exciting time to be teaching in Wales and we are embracing the new Curriculum for Wales (LINK), which puts STEM high on the agenda. It's been fantastic that, during the development of the new curriculum, teachers in Wales have had the opportunity to mould and shape the curriculum, working alongside other professionals and academics as it's gone through the consultation process. The last curriculum (from 2008) was heavily based around skills, but this new proposal gives a happy medium between skills, knowledge and experiences, focusing on big ideas (Harlen, 2010, 2015).

I'm trying to ensure, here, that we maintain good progression in science so that the knowledge and understanding are formed around a big picture. It's not enough, during a thematic unit on WWII, to look at parachutes, for example, without the children understanding how that sits within the bigger picture of forces. I want the staff to have this big picture too and that's where Explorify really helps. Teachers can pick an activity and run with it and it'll support the big ideas behind the topic or theme that they're exploring. It's vital that we show children the big picture in primary because, when they move to secondary school and science is split into 3 strands (chemistry, biology and physics), we want them to understand how they all fit together and be able to relate them back to those big ideas.

Establishing an engaging topic

A great example of this is a topic we have been doing based around renewable energy. We have taken part in a project run by Greenpower, a UK charity that aims to enthuse children in STEM. It's for ages 9-11, so we did this with our Year 6 (age 10/11) classes. We are a 3-form entry school with three Year 6 classes. Each class formed a 'team' and had a car to engineer and build. It's a topic that has enthused the boys and girls equally, but it was wonderful to welcome a female engineer from Greenpower who came in to help us with it. Senior leaders were supportive of the project, because

it covered a few important topics, such as sustainable energy, electric power, etc. There are four purposes at the heart of the new curriculum, two of those being: to develop 'Ethical, informed citizens' and 'Enterprising, creative contributors'. As a school, we felt that this project would provide many opportunities for our children to develop as such citizens. The theme starts with the kart engineering, but the project allows us to research and find out about electric energy, fossil fuels, how and why they are becoming problematic and the issues around that.

Building the car is complicated and quite a time-consuming task, so we started building in the autumn term – and the race was in June! We have had some help from parents and organisations in our local community; for example, a team of engineers from the Intellectual Property Office came to support the children in building and wiring the circuits to power the karts. At the same time, children developed their problem-solving skills when deciphering the instructions – they saw it much more as a puzzle to be linked together than we, as adults, did. They were great at it.

It's a long topic, introduced in the autumn term when we started talking about cars, forces and electric energy, then continued in the spring/summer term. We were able to link it to geography and sustainability. We've found that the children are so engaged and enthused that it doesn't lose momentum. Having said that, you could do it intensively in a few weeks in the summer term and we are considering that when we do it again next year.

Using a range of skills

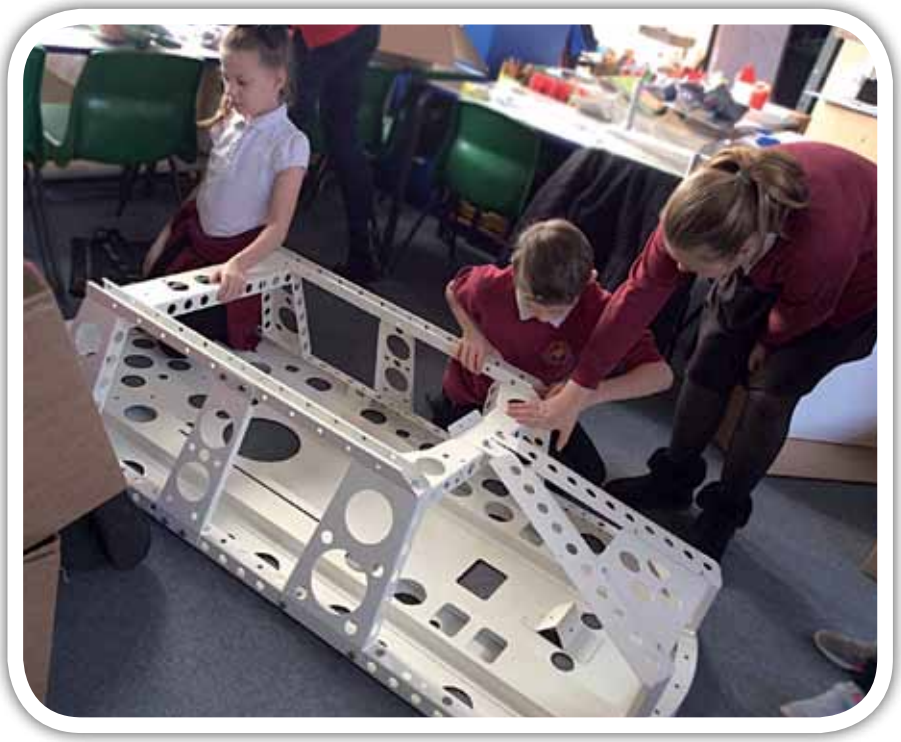
Once the cars are built, the children start to look at the other aspects of the challenge, which incorporate many different subjects and skills:

- They use various types of software to design a logo for their race team;
- They take part in time trials on the playground, calculating average times and speeds, and working out who the quickest drivers were. They also use this opportunity to see how cars are performing and if anything can be optimised;
- Each team needs to get a sponsor for their car and race equipment, so they write letters to local businesses to explain what they're doing and ask for sponsorship in exchange for advertising space on their car bodywork. We have a big focus on engaging boys with literacy here; it's something we've been developing for a while. When a genuine purpose and audience is provided for a writing task, rather than a fictional event or activity, the quality of writing really improves and the level of effort and engagement from the pupils greatly increases; and
- It's a team challenge, so it's great for their communication, collaboration, oracy and presentation skills. They work out how to collaborate effectively, assigning roles for each other, all with a shared goal and agreed outcome. On race day, they have to present their process and tell some rather official-looking people all about their car and race team.

They get vital scientific thinking skills. It's a genuine design-build-evaluate cycle at every stage of the building, time trials and even in the race itself. We have participated in the rally for 2 years now – in the first year the cars did really well, but this year they didn't perform so well. But that failure is so important – not just to build resilience but also to show them that life and learning is all about trying something and then trying again. During the race this year, in the pit stop between laps, the children were recognising that the cars weren't going as fast as they could and were running around checking all the variables that could be letting the car down. They're developing really excellent scientific thinking skills, without really thinking about it. When you can introduce those skills in a natural way through a topic and project that the children are enthused about, that's when they really stick.

You could easily take this cross-curricular topic challenge approach with many different resources. We use activities from the Intellectual Property Office (https://crackingideas.com/) to promote creative thinking and teamwork, for example. There are plenty of free resources, such as Polar Explorer, Explorify, Mission X or CREST awards that build to a big topic or theme, which would lend themselves to a similar sort of challenge and are really easy to pick up and run with. The key is to find a subject or theme that your children are interested in and then sit down and identify all the cross-curricular links.

Building the cars



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Harlen, W. (2010) *Principles and Big Ideas of Science Education*. Hatfield ASE and Harlen, W. (2015) *Working with the Big Ideas of Science Education*. Hatfield: ASE. https://www.ase.org.uk/bigideas

Louise Robinson is Science Co-ordinator at St Julian's Primary School in Newport, Wales. She has taught throughout the school.

Improving science in your school

Feedback from teachers using Explorify tells us a great deal about how they use the resource and the impact it has on their teaching and pupil outcomes:

> *'It encourages them to share their ideas and reasons and for others to be respectful of these. It gets great discussions going about why things might be happening and they are able to learn from each other's ideas'.*

However, there is a lot more research that gives context to the state of primary science in the UK and which can be useful when looking at school improvement plans for science.

In 2017, Wellcome published its State of the Nation report on primary science[1]. This UK representative report analysed data collected from more than 1000 teachers, 900 science leaders and over 2000 pupils. Nearly everyone agreed that science is important for pupils and helps to develop transferable skills.

Schools spent on average less than 90 minutes a week teaching science. Of course, as an average, this means that there are schools teaching a lot more science and some a lot less – but is 90 minutes enough time, really, to teach science well? The Welsh inspectorate, Estyn, said that schools should teach science for at least two hours a week[2]. Quality of teaching matters more than the quantity, but pupils need enough time to explore and investigate science phenomena to make good progress.

Both Ofsted[3] and Estyn[2] have commented on the importance of planning to make sure that there is good progression in both teaching and learning. The consequence of choosing activities to match curriculum objectives, rather than planning a sequence of learning, is that it might look like there's a lot of science being timetabled but that it might not result in effective learning. Good leadership is essential to support planning.

Just over 90% of schools have someone responsible for leading science, but only 51% of these leaders receive dedicated release time to do this. Furthermore, only 52% of them had undertaken professional development for leading science in the past year. Worryingly, however, nearly a third of teachers said that they had no support of any kind in school for science:

'It really matters to me that I'm not the only teacher teaching science well in school. I want the whole school to be teaching it well so that all children in the school are enjoying science and are passionate about science'.

The good news is that there's a great deal of support for teachers and science leaders, wherever you are in the UK, that is accessible and evaluated, so you know that it's worthwhile. This journal, for a start, has a lot of useful ideas and tips, showing how teachers and leaders have taken steps to improve science in their schools and there's more on the ASE website[4], especially the excellent PLAN resources to support teacher assessment. If you're looking for subject knowledge support, not only will the background science in Explorify help you, but there are also some very accessible digital modules on Reach Out CPD[5] provided by Imperial College in London, and STEM Learning has a free online course, *Teaching primary science: getting started*[6]. For support with science leadership, you'll find much more on the Explorify, Primary Science Teaching Trust[7] and ASE websites.

So what next?

We hope that this special issue of *Primary Science* has helped you to reflect on the science in your school or in your class, and perhaps identify something to celebrate and something you want to change or improve. So, take that step now and follow up on that great idea! Ultimately, what matters is that pupils progress their understanding and identify with science, recognising that science is for everyone.

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[1] Wellcome (2017) State of the Nation report of UK primary science education. London: Wellcome Trust. https://wellcome.ac.uk/sites/default/files/state-of-the-nation-report-of-uk-science-education.pdf

[2] Estyn(2017) Science and design technology at key stage 2. Cardiff: Estyn

[3] Ofsted (2019) Intention and substance: further findings on primary school science from phase 3 of Ofsted's curriculum research. London: Ofsted

[4] www.ase.org.uk

[5] https://www.reachoutcpd.com/

[6] https://www.stem.org.uk/cpd/449993/teaching-primary-science-getting-started

[7] www.pstt.org.uk