

CONNECT

THE JOURNAL OF PRIMARY
SCIENCE DEVELOPMENT IN
STOKE-ON-TRENT

ISSUE 5: STRATEGIC PERCEPTIONS

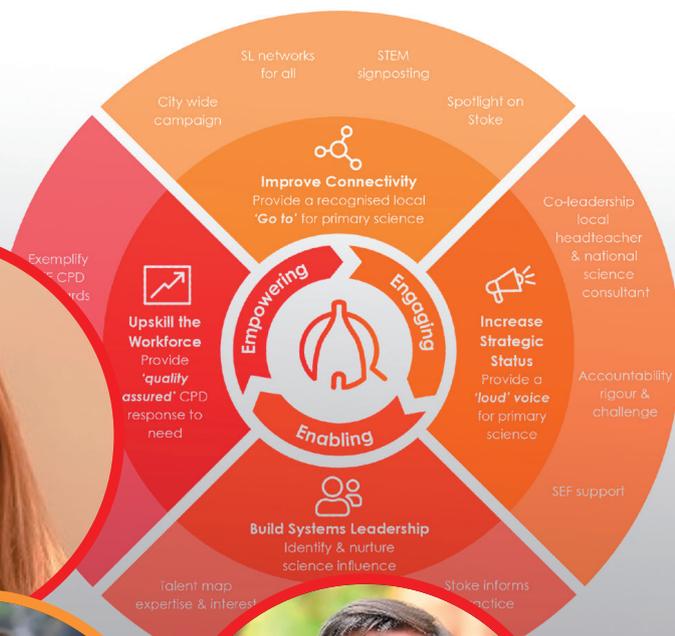
FEBRUARY 2022



THE 10 KEY ISSUES
WITH CHILDREN'S
LEARNING IN
PRIMARY SCIENCE
IN ENGLAND

by Dr Lynne Bianchi, Christina
March 2021

TAPS Working
Scientifically Cycle



A huge Stoke-on-Trent welcome to Jules Pottle in her role as palaeontologist Mary Anning. Her workshops are appearing in schools currently in advance of the upcoming Puppet Theatre event. Everyday throughout the week commencing 22nd March HMDT Music will perform their STEM Sisters production at Mitchell Memorial Theatre. Cultural Capital meets Science Capital. For additional ticket request please contact Olivia Stanyer.



Looking ahead: Future issues are already in the making.

Contributions from local schools and teachers are always welcome. To find out more or express interest in contributing to future issues- Contact Olivia Stanyer ostanyer@moorparkjunior.co.uk

Issue 6	Are we nearly there yet?	Science subject leaders reflect on just how far they have come since they submitted their PSQM evidence in the spring of 2019
Issue 7	Gender Equality Opportunity (GEO):	Changing stereotypes and debating unconscious bias. What are we hearing from pupils and teachers about the GEO themes?

This issue of **CONNECT**, along with previous issues, can be downloaded from The Science Across the City website <https://www.scienceacrossthecity.co.uk/>
They can be located by clicking on the Impact tab.

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Symbiosis: Increasing the connect such that theory affects practice and practice affects theory

That research matters is a given for the majority of people involved in the education sector. Since 2016 The Education Endowment Foundation (EEF) have collated, signposted and evaluated research to increase teacher access to key messages of influence. (<https://educationendowmentfoundation.org.uk/>) The most recent Ofsted Education Inspection Framework, a known policy influence, identifies and publishes the depth of research that underpins and informs its guidance for inspectors and schools. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/963625/Research_for{EIF_framework_updated_references_22_Feb_2021.pdf



Tina Whittaker,
National Consultant
for Primary Science,
Co-lead of SATC.

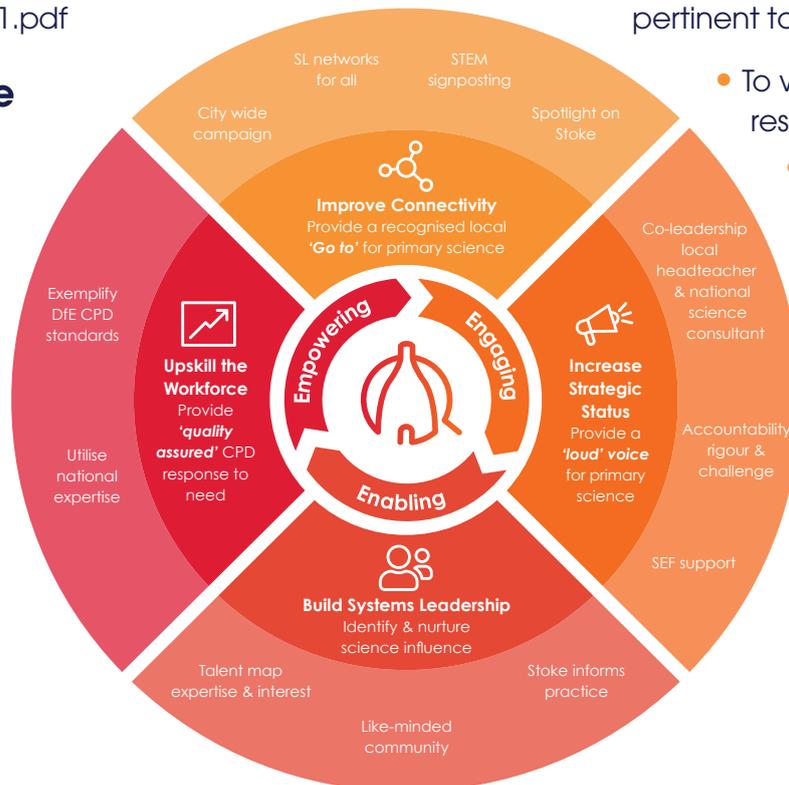


Karen Peters,
PSTT Fellow, Headteacher
Moorpark Junior School,
CEO New Guild Trust.
Co-lead of SATC

For primary science there are known and recognised key players busy in the act of research and innovation, but the question pertinent to all this activity is:

Science across the City, if asked to summarise its strategy in one word would respond with 'Connect'. Indeed, this journal series carries that name to reflect that purpose.

Fig 1: The Strategic Plan set by SATC, 2019.



- To whom are these research bodies known?
- Which policies are steered by which findings?
- How can current national messages from policy and research become a foci for professional discourse and reflection for those in school setting long term goals?

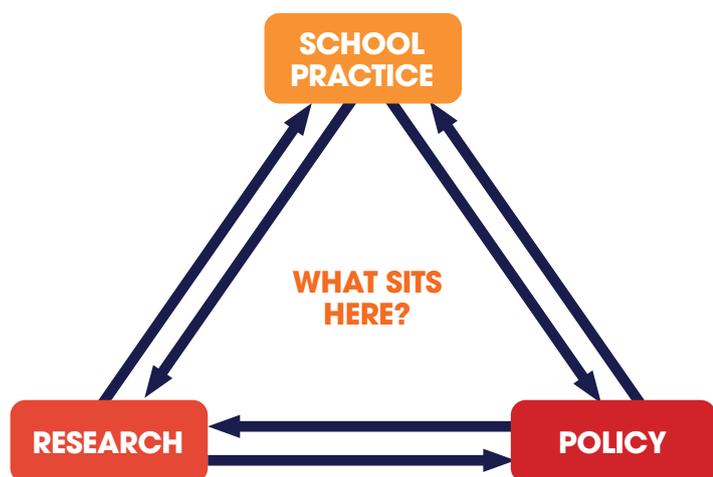


Fig 2: Model of connectivity

Figure 2 links each point of the research-policy-practice triangle with a two directional arrow showing the desired flow and transfer. The challenge of knowledge transfer at all the arrows is a national one and not specific to science, that whilst it is desirable that education policy, education research and the practice of education in schools is interconnected there remain barriers to the depth or expedience of this symbiosis.

Science across the City contributes at the centre of this model, knowing what exists and who needs what, who is interested in what and why it helps now. It is with pride that we recognise those Stoke-on-Trent schools contributing to research projects and how the number of engaged schools has increased during the project lifespan.

Considering the line in figure 2 between practice and research and between research and practice, it is strong in both directions in Stoke on-Trent. To increase the symbiosis between policy and practice, the strategic users of policy need to know what is contemporary and current to evaluate and comment on its relevance and usefulness to their setting and vision. Busy headteachers, and particularly so during COVID times, have been supported by the SATC project to be familiar with and knowledgeable about key influencing documents in a time effective manner. The SATC team play a key role in sifting and sorting, prioritising and summarising.

To conclude national expertise and theory is core and central in affecting practice and enabling a meaningful senior voice in Stoke-on-Trent. This issue of CONNECT captures some of those voices and their strategic perceptions. We are very grateful to the senior leaders who made the time to meet with our editor to reflect and contribute to a conversation designed to encourage comment on policy and/or research. In the words of one headteacher and professional friend who messaged after her conversation, 'making time to reflect re-energises you!.' Can this issue re-energise you as you find time to reflect upon the views and perceptions of your colleagues and peers across the city?

**Best Wishes
Karen and Tina**

Local school practice increasingly contributing to research

Research Link	Phase 1	Phase 2
PSCTA- Primary Science Capital Teaching Approach – King’s College	One School St Maria Goretti,	Two further schools Newford Primary & St Mark’s Primary
10 key issues in primary science – developing the next phase- UoM	One Consultant	Two Schools St Maria Goretti and Milton Primary
Moderation CPD tools developed alongside TAPS researcher.	6 Stoke schools currently in phase 1 Newford Primary, Gladstone Primary, The Willows, Hillside, Milton, Burnwood & Sutherland	
Action research: Story books to tackle difficult concepts	Classification: 5 Schools St Wilfrid’s Sandford Hill Hillside Rushton Spencer Ellison Primary	Gravity: 11 schools Moorpark Junior School, Our Lady and Saint Benedict, Carmountside, Packmoor Ormiston, Heron Cross, Saint Nathaniel’s, Priory, Gladstone & Forest Park

Reflections from the Editor



Clare Warren

It truly is a huge privilege to edit CONNECT and never more so than at this point as we approve the articles for issue 5. Having just read the journal cover to cover, my previously stated opinion that something very special is happening on Stoke-on-Trent has been confirmed. Recently Tina asked me if this issue of CONNECT shows evidence of theory affecting practice or practice informing theory, and I'm happy to confirm at least one of those is happening, although I am not sure which, and it is probably a bit of both.

Interviewing leaders and strategists was an absolute joy. I found myself engaged, alongside the interviewees in some deep thinking and questioning. I was left pondering not only about the research findings, and therefore implications for teachers and leaders, but as a researcher I became acutely aware of the need to ask questions of the methodology behind the review outcomes that inform practice in schools.

The SATC team pride themselves on their research led or evidence informed approach and even has a 'go to' list of documents and websites referred to by the team of science coaches. In issue 2 of CONNECT we asked how children can learn to read like scientists. This links to how we might read the four pieces of research considered in this issue like scientists or researchers. The documents discussed are:

1. Ofsted research review series: science¹
2. The DfE Standard for teachers' professional development² which was developed following the research review Developing Great Teaching³
3. 10 key issues with children's learning in primary science in England⁴
4. The Primary Science Capital Teaching Approach⁵

I regard it as the editor's privilege to challenge assumptions, and advocate that research outcomes or policy proposals should be read like a scientist or academic. This requires questioning of the methodology as well as the content. I invite the reader to compare, contrast, and, ask questions about two research reviews considered in this issue of CONNECT. Summary information about each is included in the table below which might be a good starting point to rehearse critiquing research.

Research Review	Developing Great Teaching ³	Ofsted research review series: science ¹
Aim	"The government announced its intention in 2015 to support the creation of an independent College of Teaching, as well as to offer a new fund which will support high quality, evidence-based professional development programmes, and rigorously evaluated for impact."	"support and inform those leading the thinking on subject education in our schools. Professionals from the education sector will also be able to see the research that is informing our conception of a high-quality education."
Where are details about the methodology?	Pages 3 and 4 of the report.	Separate document: Principles behind Ofsted's research reviews and subject reports ⁶ (as the same methodology applies to all curriculum subjects).
Are any weaknesses of the research acknowledged?	"It does have weaknesses - for example, it can miss the most recent evidence published because it is dependent on studies published prior to the reviews involved, which themselves take time to complete. However, it is valuable both for identifying gaps in the evidence, and providing a reliable "birds-eye view" of the status quo."	"Educational research is contestable and contested, and so are documents such as these research reviews. Therefore, we are sharing our thinking with subject communities so that we can get input from the broader subject community."

¹ <https://www.gov.uk/government/publications/research-review-series-science>

² <https://www.gov.uk/government/publications/standard-for-teachers-professional-development>

³ <https://tdtrust.org/wp-content/uploads/2015/10/DGT-Full-report.pdf>

⁴ https://www.scienceacrossthecity.co.uk/wp-content/uploads/2021/03/3634_Childrens_Learning_in_Primary_Science_Report_2020_v8.pdf

⁵ <https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/stem-participation-social-justice-research/primary-science-capital-project>

⁶ <https://www.gov.uk/government/publications/principles-behind-ofsted-research-reviews-and-subject-reports>

Research Review	Developing Great Teaching ³	Ofsted research review series: science ¹
How is the research selected?	"connoisseurial accumulation", (using experts in the field to highlight known, relevant and valuable reviews) augmented by a broader search of the literature via FirstSearch, JSTOR, Google Scholar, and other similar aggregators of academic literature."	"The primary focus will be on curriculum research relevant to the subject. However, we will also look at any research on teaching, assessment, school systems and policies that is relevant." "As well as academic papers, the research review will also include information from: the Education Endowment Foundation, the Department for Education, large-scale international studies, such as the Programme for International Student Assessment (PISA), our own research and guidance, and secondary evidence, such as teacher-authored blogs"
Rigour and/or validity	"the most rigorous claims featured in this umbrella review are equivalent in strength to medium to large for positive effects in the nomenclature used by What Works Clearinghouse, or the four padlocks used in the Sutton Trust-EEF Toolkit"	"We are committed to doing all we can to ensure the reliability and validity of our inspections and to being a force for improvement."

I wish to further support the ethos in Stoke of critiquing research that informs practice, by highlighting a few publications of interest and relevant to primary science education.

Clare's primary science education suggestions for reading like a scientist!

Books	Reports and articles
The Teaching of Science in Primary Schools – W. Harlen with A. Qualter	What makes great teaching? Review of the underpinning evidence (2014) https://www.suttontrust.com/our-research/great-teaching/
The ASE Guide to Primary Science Education Edited by N. Serret and S Earle	Thinking, Doing, Talking Science Evaluation report and Executive summary (2015) https://d2tic4wvo1iusb.cloudfront.net/documents/projects/Oxford_Science.pdf?v=1630926003
Assessment in the primary classroom: Principles and practice -S Earle	Vision for science and mathematics education The Royal Society https://royalsociety.org/topics-policy/projects/vision/
Misconceptions in Primary Science – M. Allen	Getting Practical – the evaluation School Science Review (2011) – I. Abrahams, M. J. Reiss and R. Sharpe
Quality Teaching in Primary Science Education: Cross-cultural Perspectives – Edited by M. W. Hackling, J. Ramseger, H-L S. Chen	Developing policy, principles and practice in primary school science assessment (2012) Report from a working group led by Prof. W. Harlen https://www.nuffieldfoundation.org/wp-content/uploads/2019/11/Developing_policy_principles_and_practice_in_primary_school_science_assessment_Nuffield_Foundation_v_FINAL.pdf
ASE Guide to Research in Science Education (2012) – Edited by John Oversby	Talk and learning in classroom science - L. Dawes https://thinkingtogether.educ.cam.ac.uk/publications/journals/Dawes_Science_677-695.pdf

Returning to the content of this issue, following a brief diversion into the new and exciting world of SEFSS, Zoe Cooper shares her thoughts on how teachers at her school are taking full advantage of the CPD offering from SATC. The focus is the

DfE standard for teachers' professional development, and Zoe discusses the ways that practice in her own school reflects the five strands of the Standard. Themes from the earlier discussion reinforce the positive difference that effective professional development opportunities can make to so many different aspects of science teaching and learning. In addition to offering opportunities for teachers to develop expertise. However, money to pay for equivalent professional development opportunities once the OA funding is no longer available is questioned.

The next conversation features Karen Peters, co-lead of the SATC project, explaining more about the 10 key issues document and how it may be used as a tool to support the development of science teaching and learning. Karen explains how some of the issues identified chime with the Ofsted research review and the ways in which the SATC project is supporting schools to address the issues. In addition, Karen acknowledges that the 10 key issues report validates much of what was already known about areas for development across the City, and improvements in these areas are already being implemented by the SATC team, with more to come.

Our final article relates to science capital. Although the concept was relatively new to Michelle and Lee, they were able to make links to their existing practices and reflect on ways that children from deprived backgrounds might have their aspirations raised. Once again, the SATC project is acknowledged as supporting improvements in science teaching and learning and developing an effective science subject leader and local experts.

After further reflection I think I can now answer Tina's question. Research is clearly informing practice and practice is informing theory in primary science education throughout Stoke-on-Trent and beyond. The combination of practitioners and leaders who are happy to take on board new theories, but have the nous to question those theories and their relevance to their own settings, is incredibly powerful!

In conversation with Paul Mitchell, Debbie Sims and Tina Whittaker about the Ofsted research review: Science¹



Debbie Sims – Principal, Our Lady and St Benedict Catholic Academy, Paul Mitchell, Director of Learning, St Chad’s Academies Trust, and Tina Whittaker, Independent National Consultant

In April 2021 Ofsted published the first in a series of subject specific research reviews summarising their views on the academic research on science education. As ever, any document published by Ofsted is scrutinised by senior leaders with the intention of understanding what Ofsted might be looking for when they next visit the school. A panel of strategists and senior leaders was convened to reflect how this document is informing their thinking. Whilst the report is comprehensive and includes both primary and secondary science, for the purpose of depth this panel discussion focused on four specific areas from the report:

1. The new terminology of substantive and disciplinary knowledge
2. Practical work,
3. Pedagogy - Teacher directed instruction versus enquiry-based teaching, and
4. Teacher knowledge and expertise

The Science across the City team invited, Jasper Green, the Chief Ofsted Inspector for Science, to present the findings of the report to Stoke-on-Trent teachers and leaders, June 2021, resulting in some interesting discussions. The aim of this panel discussion is to explore some areas in greater depth.

Due to COVID restrictions virtual tools and flexible scheduling were used for these conversations meaning that not every panellist contributed to the discussion on every aspect of the report. Therefore, views expressed may not represent all panel members.

¹ <https://www.gov.uk/government/publications/research-review-series-science/research-review-series-science>

Panel discussion focus 1: The new terminology of substantive and disciplinary knowledge

Ofsted state that, “a useful framework for constructing science curriculums makes the distinction between the following:

- **substantive knowledge** (knowledge of the products of science, such as concepts, laws, theories and models): this is referred to as scientific knowledge and conceptual understanding in the national curriculum
- **disciplinary knowledge** (knowledge of how scientific knowledge is generated and grows): this is specified in the ‘working scientifically’ sections of the national curriculum and it includes knowing how to carry out practical procedures”

What do you think about this use of new language?

I think the language is new to teachers of science and as far as I’m aware it has not been discussed at a national level before. Therefore, it is not in the sphere of how staff think about science and it will be quite hard for teachers because they will suddenly see it as something extra. It does however define information that’s always been there, but is taking it a step further. My view is that substantive and disciplinary knowledge are not commonly understood to be distinct and therefore are often not taught as well as they could be. This can then lead to misunderstandings by the pupils.

While Ofsted state they do not define the national curriculum and they are very cautious about explaining in exact terms what they want, if there is a sequence of knowledge that they are looking for then it would be useful to know precisely what that is. I think that these concepts of disciplinary and substantive knowledge link closely to the sequencing element that Ofsted have identified. In their language you need a schematic of where you place the knowledge and the skills, so this is something else that we have to put in place, and it feels like the workload could be quite large.

I think thousands of schools around the country will all be creating their version of what they think Ofsted are looking for and it leads to misconceptions and misunderstandings. I am not disagreeing about which bits of information need to be taught, but I feel that Ofsted need to be clearer about what it looks like. It will be interpreted as Ofsted requiring xy and z, but I don't think we know exactly what xy and z are.

Jasper Green, the Chief Ofsted Inspector for Science, has stated that there is no expectation that teachers will use the terms substantive and disciplinary. Do you think that teachers using this language would be a help or a hindrance?

I have reflected on this, but I still don't think I have a good answer because I see both sides of the argument. In essence we must consider what we want the children to learn.

As a teacher it is worth knowing about substantive and disciplinary knowledge, and I think Table 1 in the research document is quite helpful. But on the other hand, it's about the professional development. For teachers to gain knowledge, the support that is necessary has not been provided in many schools. Teachers and subject leaders have not been given the time and space to think about it. So, I question how is this information going to be disseminated to the teachers?

Most primary teachers are not science specialists so we need a frame of reference in order to create tools that will help teachers know what it is they need to know that they don't currently know.

Do you think having disciplinary knowledge embedded within substantive knowledge is a new concept for teachers?

The language hasn't been used before. So, although the concepts have always been there, they have not been explicit. For me the question is what do we need to know at what stage? This idea about degrees of uncertainty; are we asking them to choose a thermometer that is more or less accurate or are we asking them to just bear in mind that as a measuring instrument it is intrinsically inaccurate? In some schools, just having a thermometer that works is a bonus.

Going back to Table 1, it's the conceptual disciplinary knowledge which is most unknown to the primary education sector.

Table 1: Knowledge can be categorised according to its disciplinary nature and how it is used by an individual

	Substantive knowledge	Disciplinary knowledge
Conceptual ... know that... because...	Liquids expand when they are heated (for example, the liquid inside a thermometer)	All measuring instruments, such as a thermometer have a built-in degree of uncertainty.
Procedural know how to... and be able to...	Draw a particle diagram for a liquid.	Use a thermometer to measure the temperature of a solution.

In conversation with Paul Mitchell, Debbie Sims and Tina Whittaker

Do you think the terms conceptual and procedural add another layer of complexity for already overworked teachers?

Since I read the report I have been questioning myself and my science teaching practice. I'm optimistic I've taught that thermometers are inaccurate, especially when you've had to give a group two thermometers and they give different readings and that's when I've drawn it out. However, I expect my main learning objective was something about the insulating properties of different materials. So, my question is, are we to teach about working scientifically separated out from when you have to apply it or is teaching disciplinary knowledge in standalone 'skill' units should be avoided. It's tricky because we've got a very loose framework.

So, does the complications of conceptual, procedural, disciplinary and substantive knowledge kill the sense of awe and wonder that Ofsted expect teachers to evoke?

I think good teaching always shares a sense of wonder about the material world. When you get confusion about how and what is to be taught, then teachers can begin to see science as very pigeonholed information and that detracts from awe and wonder. I think people with good subject knowledge and good pedagogical knowledge will draw out key learning points. Teachers need more national guidance to be clear on the outcomes required. It's still a bit amorphous as to what we're trying to achieve. Ofsted have entered the realms of telling us what good science teaching looks like and that needs to be more clearly articulated so that teachers understand the expectations.

What actions should the primary science community be taking as a result of this report?

What support are we going to be giving subject leaders and teachers to achieve this high-level theoretical thinking that will change practice on the ground? It is about how we change theory into practice to ensure there is a positive impact on the children's learning. How do we envisage this becoming a reality in such a way that it doesn't detract from pupil learning? What

do we ultimately want them to know and be able to do? How do we want them to turn out at the end? And how do we support subject leaders to equip themselves and their colleagues to get there? How do we give them that knowledge and clear messages in a world where there are diversified educational organisations?

Panel discussion focus 2: Practical work

What do you see as being Ofsted's key messages around practical work?

The key messages are that practical work is really important and for me this has always been such an essential part of science. It is how science develops and should be embedded within the subject knowledge or substantive knowledge. Although some people would claim a lot of money has been put into STEM initiatives, the investment in primary science has been low. Where are the national programmes for science if you a newly qualified teacher? What science do you experience if you are training to be a primary teacher now? It is very much left up to the schools to train the teachers which brings me back to my question about what do they need to know so that we can train teachers appropriately. There are no longer any local authority sessions.

Looking at Table 2 in the Ofsted research review, it seems to be about learning something rather than testing something. So that learning could be both substantive and disciplinary because if we refer back to Table 1 there are two things going on at the same time.

Table 2: Millar's different ways in which practical work can help pupils learn substantive knowledge

Purpose	To help pupils to...	Example of curriculum intent
1	Identify objects and phenomena	Materials such as glass, wood and metal: 2 magnets moving apart
2	Learn a fact	Pure water boils at 100°C. salt dissolves in water but not oil
3	Learn a concept	Osmosis
4	Learn a relationship	Hooke's Law
5	Learn a model or theory	Brownian motion as evidence for the particle theory of matter

Consider from Table 2 'Identify objects and phenomena; two magnets moving apart'. You are carrying out practical work and learning a fact at the same time. This means that there needs to be sufficient time both before and after the practical to interpret and explain the observations made or that are about to be made. So, for me, the crucial question is what is sufficient time, and how far down that magnetic rabbit hole do you want to take them? So, taking magnets as an example, do you want them to go as far as to know the magnetosphere is declining and there will be a pole change in the earth every 500 million years because of the banding of the iron? Where does the national curriculum begin and where does it end?

Are the schools you work with taking any actions with regard to practical work as a result of this report?

At the moment, the schools we work with are covering the national curriculum but some of this feels like we need to add to that. I think head teachers will have difficulty, in trying to define what is new and what is already there so they can evaluate the schematics currently in place. Working scientifically has been a focus for a few years and continues to be a focus, because of the lack of teachers' science subject knowledge. Few teachers have science degrees and then add to that turnover of staff, so, you are always working on improving knowledge and understanding and although you have things like schema, whatever programmes you have in place, it can't be a one hit wonder, it has to continue because you have new people coming in all the time.

Panel discussion focus 3 : Teacher directed instruction and enquiry-based teaching

Ofsted have identified teaching as the single most important factor in schools' effectiveness, and that unguided 'discovery' approaches are not effective. They claim that students benefit from systematic teaching approaches where learning is scaffolded. Data from PISA (2015), is cited, demonstrating that teacher-directed science instruction is positively associated with science performance in almost all countries.

What do you think are the key messages arising from this section?

For this discussion we are talking about the part of the report that relates to pedagogy, as opposed to the term enquiry also used in the curriculum section. It is so important we make this distinction as the term 'enquiry' has become all-encompassing and many educators have strong views about 'enquiry' whilst most teachers would not appreciate that enquiry can be both knowledge and pedagogical or the difference that this makes. Enquiry as part of the curriculum is essential - children need to know what enquiry is and need to know how to do it. The review tries to de-myth the misconception that direct instruction is the same as lecturing. Furthermore, the report states clearly that scientific enquiry and enquiry-based instruction are different another misconception de-mythed. The report notes that responsive teaching improves pupil performance and I do wish that the phrase responsive teaching was more common and used to define effective teacher instruction.

So having established that enquiry as part of the curriculum is crucial, I want to focus on pedagogy. I think the argument of enquiry-based or direct instruction-based teaching is a nonsense. Good pedagogy is a combination of both. Children learn more because they are curious and have the concrete experiences to discover what they don't know. It is the teacher knowing when to instruct that ensures enquiry-based learning is used appropriately. Teacher intervention pre, during and post enquiry is crucial. Instruction and enquiry are therefore integrated.

A good teacher has a repertoire of approaches to explain and build understanding and where these are responsive to the learning needs of pupils, the principles of constructivist learning hold true. Explaining things well is obviously important and to do this a teacher needs to know what a child already thinks, unpick misconceptions, connect to current knowledge, and build upon it. There is no point giving a great explanation if pupils have nothing for it to connect too.

We have accepted a progressive learning model of 'good enough', age-appropriate explanations of scientific phenomena. Models of the atom and particle theory become increasingly complex as learners

In conversation with Paul Mitchell, Debbie Sims and Tina Whittaker

mature, but at each stage we expect teachers to use a 'good enough' model as part of their explanations. It is so important to use the right explanation at the right time because you are responding to the stage each child is at. This expects teachers to have good pedagogical subject knowledge and not simply be reading a few pages ahead of the children.

I think I probably agree with the report's comments about confusion between macroscopic and submicroscopic changes, but this language is not familiar to me and is certainly not going to be helpful currently. The essential point remains that models and analogies can be helpful as long as they connect to pupil's existing knowledge.

The report acknowledges that the term enquiry-based learning causes confusion then goes on to present it through a negative lens. Cognitive overload is cited in the report resulting when pupils seek solutions for themselves, but I believe it is just as likely to occur when using direct instruction as it is in enquiry-based learning. For me enquiry-based versus direct instruction is not a black and white, either/or, option.

If we take the example of a teacher providing direct instruction using recipe style instruction for pupils, telling them exactly how to carry out an investigation; I'm strongly opposed to that. For me this results in passive learners and is not good teaching, in much the same way that lecturing is not good direct teacher instruction. Enquiry-based approaches can be a way of exploring ideas that give rise to question asking and an awareness of uncertainty which leaves children curious to want to know more and a platform on which to build explanations. Obviously, you have to know something about light or floating and sinking to be able to explore. There has to be a purpose and some knowledge to lead learners to want to find out more.

Having been Cognitive Acceleration in Science Education (CASE) trained, I relate this to their five pillars of :Concrete preparation, Cognitive conflict, Construction, Metacognition and Bridging (Shayer 2003). These pillars make sense to me even when trends in education change. CASE contributed to my personal philosophy of teaching and learning, and I think it is important that every teacher has an opportunity to develop their own personal philosophy

of education and that this philosophy is rooted in research.

My conclusion is that the debate between enquiry-based approaches and direct instruction is not helpful. We need skilled teachers who can integrate and select from their pedagogical repertoire with enquiry-based learning being one of the options. CPD provided by SATC, including TAPS and TDTS, have included elements of both direct instruction and enquiry-based approaches. I would like to review these to make it clear that both offered a balance between direct instruction and enquiry and not add to the myths and confusion by it appearing that they were either/or.

Does this section of the research review help you to reflect on practice?

Yes, it does help, especially to understand better the myths that may be present and that need unpicking. It takes me to the work on Rosenshine's principles and how these make sense when viewed through a lens of responsive teaching. It also leads me to the work on metacognition and the importance of teacher instruction in scaffolding, as pupils work towards independence.

Those involved in SATC believe in the importance of enquiry both as part of the curriculum and as a learning approach, but we do not advocate solely enquiry-based approaches. Our CPD helps teachers to reflect on what teaching approach, for what reason, and how they know when an approach is working. Practitioner research in every classroom is our goal.

What questions does this reading leave you with?

Why did CASE disappear and can we bring it back?

Any other thoughts?

I think this teacher instruction vs enquiry-based learning debate risks increasing the KS2-3 transition gap with the secondary phase assuming children in primary schools have been engaged in discovery learning, and primary teachers assuming their secondary colleagues offer a limited diet of direct instruction. Or to put it another way; children do stuff at primary and learn stuff at secondary. These perceptions are dangerous, as is language that creates a polarised either/or and right

and wrong versions. It's how you incorporate the two approaches that makes you a good teacher regardless of phase.

Panel discussion focus 4: Teacher knowledge and expertise

Ofsted talk about primary schools having, "one teacher who specialises in science". Based on your experience what does that teacher need in terms of qualifications, attitudes, skills and support? How realistic is Ofsted's aspiration?

The teacher needs to be confident and interested in science with a positive attitude towards the subject. She or he also needs to be reflective, happy to jump in and have a go. Our ethos is to encourage risk taking. It doesn't matter if it all goes wrong; that provides a great opportunity to learn.

The SATC CPD has really developed a member of staff who was only in her second year of teaching. Initially she was supported by a more experienced member of staff but now she is running with it on her own. We consider her our resident expert.

It's a fine aspiration to have someone who can fill the same role in every school, and we have been fortunate to be able to access high quality support to move towards this; nationally this will be more of a challenge. Even with the funded CPD it is so difficult to get cover and how often is it appropriate to release teachers for CPD and then find further release time so they can work in the classrooms to develop their colleagues. How will it be sustainable once the OA funding has gone?

Another crucial factor is that the SLT needs to be supportive. Teaching is a graduate profession and the skill set required to achieve a degree is transferable, so with high quality support, training, encouragement and motivation any teacher can become an effective subject leader. Sadly I'm not convinced Ofsted's aspiration is realistic across all primaries until there is equality of opportunity. We are demonstrating that one teacher who specialises in science can have impact across a whole MAC, but until schools have the funding to make this affordable it will only happen

in certain niches. I have every confidence that the model proposed by Ofsted can work but the funding is essential to make it a reality.

Does this section of the research review help you to reflect upon practice in your school?

Yes, it does help with reflection, and I think having a designated 'science champion' in our school is effective. With the help of SATC we are developing an approach where we have one teacher who specialises in science teaching. We identified someone who is motivated, interested, and happy to take part in CPD to become a 'specialist', then support colleagues through a coaching model. Using this approach non-specialist colleagues have developed their disciplinary knowledge of working scientifically and using the full range of enquiry types. Teachers' pedagogical knowledge has also improved, however, there is more we can do to formalise the approach and develop the impact across the school.

Not only does our science leader support others in our own school, we are reflecting on how one teacher specialising in teaching science can have wider influence and support several other primary schools. As a MAC we are developing subject hubs and we are the designated school for science, so we are taking the idea of a specialist supporting others to the next level.

What do you think are the key messages arising from this section?

For me it has really heightened the awareness of knowledge types (substantive and disciplinary) required to teach science effectively, and reinforced my view that the SATC project is going in the right direction, supporting teachers to develop those different types of knowledge and developing the necessary teacher knowledge and expertise.

From the Ofsted report we recognise we need to develop knowledge in two specific categories.

For their substantive, or science content, knowledge most teachers are relying on their learning from GCSE which can be limited. This may impact on how teachers can extend, challenge and deepen children's thinking and reasoning. For example, when

In conversation with Paul Mitchell, Debbie Sims and Tina Whittaker

I moved from Early Years to Year 4, I struggled to know how to teach the science content. Ofsted also noted that some teachers lack confidence in teaching science and I think this is linked. We are fortunate in Stoke because the training provided as part of SATC has really developed teachers' subject knowledge.

Ofsted are very clear that children also need to be taught disciplinary knowledge (the ways that science is generated and grows), and I would question if all teachers know how to 'be a scientist'? I'm also not sure all teachers understand how to ensure learners gain that disciplinary knowledge. It is therefore imperative that we have high quality subject CPD available which focuses not only on content and but also how to teach it.

The SATC year group specific CPD is proving a great way to train teachers to develop children's substantive and disciplinary knowledge. Those who have attended already have come back inspired. Their eyes have been opened and science teaching has become demystified. It has been motivational and boosted confidence. I can already see the difference it has made to the Early Years and the Year 2 teachers. Others are very much looking forward to attending the training for their year groups.

What questions does this reading leave you with?

I am in agreement with much of what report says. Non specialist teachers don't know what they don't know therefore we need to open up the world of science to them so that they embrace the subject with the same inquisitiveness and excitement as the children.

But an important question needs to be asked. We are lucky to be part of the Opportunity Area (OA) with the funding for CPD. How are schools without the OA support supposed to be able to develop a 'science specialist'? The CPD our subject leader has engaged with has developed her into an effective 'subject specialist' but in other schools this would be unaffordable. In my opinion the DfE and Ofsted need more joined up thinking so the aspirations set by Ofsted are achievable. For us the challenge is making this sustainable once the funding has gone.

There are challenges in spreading good practice across the MAC when both primary and secondary schools

are included. Perhaps we need to think more deeply about how we can understand each other's approach and ensure transition is more effective. We need to find a way to enable other teachers in the MAC to visit us and see good practice. These are the challenges but it is early days and the prospect of developing science across the MAC is exciting. To find a way to do it and make it sustainable requires will and motivation.

Will the report inform any immediate actions or form part of the broader view of the headteacher?

We need to ensure the science leader has the time to work with all staff. It has to be balanced against the needs of her own class, therefore, quality cover teaching will be a key consideration. There is some urgency to overcome the impact of Covid and secure progression. There is no time to waste, so I will incorporate this into next term's schedule. In primary it's always a balancing act.

Any other thoughts?

When I think back to December 2019, curriculum progression in science was not apparent and the report make it clear Ofsted will now be looking for evidence of progression. We are so fortunate the OA has helped with the provision of CPD and coaching, and in just two years I can now see a huge difference.

And my final thought; in Stoke we are so lucky to have Karen Peters. She has such a strong vision and draws us all in. There is a recognition from Heads across Stoke that what she says has great validity. Her leadership has been of great benefit to the science learning of the children in Stoke.

Strong message arising throughout the discussions are the importance of high-quality professional development opportunities in allowing teachers and leaders to respond to the research review. This is in addition to non-contact time allocated to science subject leaders to carry out their subject leadership responsibilities. The panellists recognise how crucial OA funding has enabled appropriate teacher and leader development, but concerns were expressed about what happens when the funding is no longer available.

While there was a good level of agreement among the panellists, the views expressed may not represent the views of them all.

SEFSS: SCHOOL EVALUATION FRAMEWORK SCIENCE SPECIFIC



School subject reviews will have many aspects of information gathering. The following framework was developed through OA funding in Stoke-on-Trent (2021) and was used during primary science subject reviews carried out by senior reviewers and new subject reviewing coaches. The design was on experience gathered over many years including perspectives from school leaders, systems leaders and primary science consultants. Subject coaches engaged in school improvement scenarios, and headteachers and subject leaders participating in reviews, reported that the framework enabled consistency and rigour. The team that developed the tools have been asked by those experiencing the process to share the framework. This pack is a collation of the tools that have been developed.

NEW!

A framework to support science leaders to evaluate the quality of science teaching and learning in their schools.
4 page sample.
Full editable version available on the SATC website

Pre-Review

1. Preparing a timetable/schedule for a subject review

During Review

2. Subject leader Conversation
3. Teacher Conversation
4. Pupil Conversation (Curriculum)
5. Pupil led tour
6. Book Review (Unguided)

Post review (Collaborative teacher to teacher professional dialogue)

7. A conversation about data - Is it helpful?
8. A conversation about the action plan - Is it helpful?

Full set available at www.scienceacrossthecity.co.uk/usefultools

Subject leader Conversation

Focus	Prompt	Notes
Management	How long have you been subject leader and what are your main roles & responsibilities?	
Curriculum leadership/ NC compliance	As a leader how have you been involved in planning the curriculum? How do you know that learning in the subject is sequenced to ensure pupils build on their knowledge?(including readiness for next key stage) How and by whom are lessons planned and how do you know the coverage is as expected?	
Subject vision	What are the priorities and principles of science teaching in school?	
Consistency of ethos	What would you want us to see in lessons today? 3-5 principles to audit against and give feedback	
Inclusion	How do you know that the curriculum meets the needs of all learners? (disadvantage, gender, HA and SEND)	
Strategic value	How does timetabling support the implementation of the curriculum? Is Science on the SDP or discussed regularly with SMT? How do governors know about science?	
Standards	How do you know that children know more and remember more in science? How confident are you that standards are at least as expected?	
SL CPD	How do you keep up to date with the curriculum/subject? What other STEM agencies do you utilise regularly? What other STEM agencies do you utilise regularly?	
Teacher CPD	What are the CPD needs of staff and how is this supported/provided?	
Enrichment	How is the curriculum enriched, and links with parents, carers and home encouraged and supported?	

Class Teacher Conversation

Prompt	Notes
<p>Where does this lesson fit into a sequence of science lessons?</p> <p>How do you know what went before and what comes next?</p>	
<p>How well are pupils doing in your classes? What data is available? How do you use this data? What does the data tell you?</p> <p><i>(Example: Are there any topics/enquiry types in which children do particularly well or not so well?</i></p> <p><i>Are there any groups of pupils who do better or worse than the majority? e.g. PP, SEN, EAL pupils etc.)</i></p>	
<p>How do you ensure that children learn both the substantive knowledge (the stuff) of science and the disciplinary skills (the how) to do science?</p> <p><i>(Note: Five enquiry types – frequency and challenge, progressive enquiry cycle expectations)</i></p>	
<p>How do you know that the children know what you think they know in science?</p> <p>Summative assessment approaches?</p>	
<p>What CPD have you received in the last two years and how has this helped?</p> <p>What sort of support in school can you / have you accessed to improve science teaching and learning?</p> <p><i>(Note broad definition of CPD. Professional development is not the same as going on a course!)</i></p>	
<p>Are the resources adequate in school?</p> <p>What are your favourite resources to use?</p> <p>How easy are they to find?</p> <p>Do you put out all the resources or are children involved in collecting and selecting resources?</p> <p>How do you feedback to the SL if you identify resources that would help to improve the topic you have taught?</p>	

Pupil Conversation (Curriculum)

Suggested approach: A guided work look. Encourage children to bring their books/ floor books/ ipads/ etc and ask them to 'show you' as you ask the questions. It helps to focus the conversations and avoid answers that children give simply to please their teacher.

Prompt	Notes
Turn to a page in your book and show me a piece of work that you are particularly proud of. Why did you choose this page? What did you learn?	
What have you learnt about before this in Science? (Have a copy of the NC handy to check previous year group teaching.)	
Do you think that you are good at science? How do you know? Where in your book did you do good science?	
Do you ask your own questions in science? Who decides how you will find answers to your questions/enquiries? Find a question your teacher asked. Find a question you asked.	
Why is learning about Science important? Do you know any scientists? Is there a link to a scientist in your work? Show me a piece of work that you might talk to someone at home about? Why that topic?	
What do you do if you don't understand something?	
What do you find hardest in Science? What helps?	
Do you learn about or do or read about or watch programmes about science outside of lessons? Clubs or home	

In conversation with Zoe Cooper

Head Teacher of St. Maria Goretti Catholic Academy



A discussion about how the Standard for teachers' professional development (DfE) is relates to practice in one Stoke primary school

Emily Royal, science subject leader at St Maria Goretti Catholic Academy, is one of the many rising stars of the Science Across the City programme. When I was given the opportunity to delve deeper into what allows teachers to shine in this way I was intrigued. What is special about her school and the senior leaders working there that lead to Emily's ascendance?

The Department for Education (DfE) issues many documents and I wanted to explore the content of one particular document in the context of professional development at St Maria Goretti. The Standard for teachers' professional development sets out guidance on the requirements for implementing effective professional development and the five strands are shown in figure 1. The full document sets out what these might mean for school leaders, teachers, and providers of professional development, but my interest is in how the theory espoused in this document relates to the real-life context of a school leader and the way she ensures that her staff are developed to their full potential.

The standard

1. Professional development should have a focus on improving and evaluating pupil outcomes.
 2. Professional development should be underpinned by robust evidence and expertise.
 3. Professional development should include collaboration and expert challenge.
 4. Professional development programmes should be sustained over time.
- And all this is underpinned by, and requires that:
5. Professional development must be prioritised by school leadership.

Figure 1 - The Standards to teachers' professional development (DfE, 2016)

Zoe Cooper, the Head Teacher of St. Maria Goretti Catholic Academy generously agreed to share her perspective on the teaching standard, relating this to her experience of working with Emily Royal and other teachers in her school. Because the fifth strand related specifically to school leaders, we discussed the standards in reverse order.

5. Professional development must be prioritised by the school leadership.

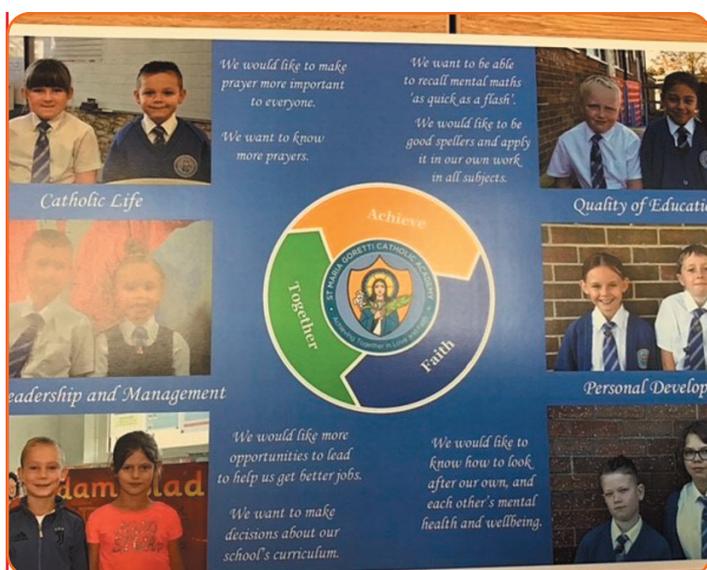
Zoe explained that to build a community of successful learners the school development plan (SDP) is key, and this document clearly states the school's priorities for the year. She recalled a time when the profile of science and STEM needed to be raised to help support the significant number of pupils from deprived backgrounds. Despite, and perhaps because, they are members of low income families, Zoe believes fervently that these children are highly resilient, great problem solvers and amazingly innovative.

Zoe recognised that improving the pupils' STEM education would improve their future employability and their scientific literacy. **"Three years ago, we built STEM into our development plan with science as the driving focus. We identified a teacher, Emily, who had the potential to develop, and a passion for science. She wasn't a member of the leadership team, but we wanted to upskill her. It was so important that Emily wasn't just doing it because it was on the development plan, but because it gave her a platform to share her passion for science with both pupils and colleagues."**

So, developing Emily was the first strand of Zoe's approach, and the second was to set up a STEM Lab. **"Using funding from the Ogden Trust we created a room for science. Initially teachers didn't really know what they were doing so we needed to take lots of small steps and build layer on layer. Our governors are involved in what we are trying to achieve and I make sure they understand the ambition is to give children skills that ensure they have opportunities to be successful in the workforce."**

"We also bring parents on board. We have a poster (see next page) that presents our key priorities so they too can be involved in our SDP. The children are also

In conversation with Zoe Cooper



aware what we are trying to improve this year. I talk to the children and share our ideas and ask what they think. Parents, governors and pupils are all involved in the feedback too. Thus, science is seen as a priority for the whole school community.”

The most important thing is giving staff the time to do what they need to do. Time for reflection is crucial.

Zoe Cooper

“Prioritising science and STEM for a single year is not sufficient to develop the teaching and learning of this core subject. After 12 months a new SDP is written but it builds on the previous layers. We don’t just move on, and that priority disappears. You put your money where your mouth is and give that person time to develop because then they will develop others. They grow professionally, can seize opportunities that arise, like SATC, and can drive a subject forward. It’s been about developing Emily as a specialist teacher, knowing about the curriculum, science capital, assessment and so on. Her confidence has grown and most importantly she has brought others with her.”

“STEM is such a big area that one of my senior leaders takes the strategic lead and ensures STEM has a voice at a senior level to ensure I don’t forget as I spin so many plates. He meets regularly with Emily to ensure nothing is forgotten and if she needs money or time to develop herself or the subject then that is made

available. She’s going to another local school to do a deep dive this week. That will help develop a science subject leader in another school as well as enabling Emily to return to school with new ideas.”

Zoe reiterated the importance of time being available for subject leaders. “I need to know if Emily is drowning. She’s a very humble person. Lots of people from across the City want to access her expertise, but I need to make sure she has time to reflect on how she’s developing as a specialist leader. All of our subject leaders can ask for leadership time. This is another way in which our prioritisation of science can be identified.”

The further detail in the DfE Standards document mentions, ‘a wider culture of evidence informed reflection’ and I asked Zoe how that might be incorporated into the model of teacher development she had just described. “We formally reflect on and review the SDP every term, but informally we are constantly seeking feedback, for example, in staff meetings, and I’d like to say that as a school we have a very open culture. It all has to be properly sequenced, just like the curriculum.”

4. Professional development programmes should be sustained over time

“Over the last few years Emily has made the most of the training provided by the Opportunity Area funding and this has improved her knowledge and confidence to share with other teachers, both internally and externally. She continues to make the most of opportunities to develop. She was one of just 20 teachers nationally who worked with King’s College London and the Institute of Education at UCL to develop the Primary Science Capital Teaching Approach (PSCTA). Now she is sharing her learning more widely.” It is clear that Emily has benefited from a sustained programme of professional development and has now assumed a role in developing others.

Zoe believes that over time it is important not just for professional development to be on-going but to recognise when teachers are ready to take on a new challenge. “It is really important you keep people sustained and satisfied. I think there is a misconception that people don’t want to be developed just because they don’t want to apply for leadership roles. That does not mean they don’t want to be developed in their roles and become experts in their fields. I think perhaps their needs to be an expectation that everyone becomes an

expert. So, if Emily reaches the point that she is ready for a new challenge I will be looking for a new opportunity for her as well as thinking about who is the right person to take on science subject leadership. Strategic thought needs to be given to make sure it happens in the first place and then maintain it over the longer-term.”

The personal perspective is important as well as the professional. Particularly for my school where recruitment and retention were problematic because it's a challenging area. There's got to be a reason why people want to come to our schools, so we recruit staff with the promise that their expertise will be developed.”

Although I had asked Zoe to comment on the sustained nature of effective CPD she made strong links with the strategic importance and prioritisation of professional development we had discussed earlier. The importance of making time available was also reiterated.

“Providing time for development is fundamental to that. We need to give them the time to plan, to read and reflect because it's not good to be doing that at the weekend. Sometimes I might sit with a subject leader, look at documents and listen to what they want to achieve. We talk it through and then I step back and let them run with it. With all the expectations that come with being a classroom teacher we need to be sure they are not running on empty. There is a formal timeline for monitoring and other subject leader activities but sometimes the DfE release documents and subject leaders need the time to read and think about the implications.”

In strand 4 the DfE talk about development being ‘iterative with a rhythm of on-going support and follow up’. “Through a process of feeding back to others and our teaching and learning partnerships we are ensuring that training has impact. After attending CPD staff feedback to both teachers and support staff in meetings. They will aim to incorporate their learning into their classroom practice supported by a colleague who might come and observe their lessons and feedback. We are working in teaching and learning pairs for the first time this year. I've been reading Trust-based Observations by Craig Randall and basically the principle of trust-based observation is about building relationship. Communication and relationships are a real strength in our school.”

Zoe provided a concrete example of how she demonstrated that development does not happen overnight and needs time to show impact. **“At the start I think the CEO was unsure what I was trying to achieve**

with developing Emily alongside the STEM Lab and questioned whether we should aim to raise standards in science first, but this was my way to raise both the profile and standards. I asked her to trust me and although it took time, we focused on the curriculum and progression, and things began to turn around.”

Even though this part of the conversation focused on sustained professional development, it was interesting to hear Zoe reiterate her points about prioritisation and the strategic importance of professional development, as well as subject leaders needing time for reading and reflection, in addition to all the other tasks that might be expected of them. She was so clear that time is needed to attend professional development training and its impact to begin to emerge in the classroom. The importance of relationships also emerged as a crucial factor.

3. Professional development should include collaboration and expert challenge

Interestingly Zoe had already spoken about collaboration in the form of teaching and learning partnerships, so the links between the different strands were becoming all the more apparent. However, I asked her to expand on her thinking about this strand. Her response was to tell me about the way the spirit of expert challenge and collaboration is realised through performance reviews. **“The objectives are linked to the intentions for the teaching and learning partnerships, based on the result of quality feedback from the previous academic year. When we need collaboration and expert challenge it is available from external partners that we know, but, in the main, that collaboration and expert challenge is something that our teachers are able to provide for each other, building those relationship and the all-important element of trust. We aim to support each other within our learning community.”**

“As an example of collaboration and expert challenge, we experienced a deep dive a few years ago that was led by Tina Whittaker which was incredibly useful. Now Emily has the knowledge and confidence to lead deep dives into science teaching and learning at other schools. The same iterative process mentioned in standard 4.”

As part of the ethos of support and collaboration within their learning community, **“we celebrate the successes of our teachers with the children. They are involved**

In conversation with Zoe Cooper

in the process of school development and understand what we are trying to achieve. We hosted some training in the STEM lab last week and I shared that with the children – that’s aspirational. It’s great for them to know we are developing as a school.”

“The SATC network of Science Influencers has been a great source of external support and knowledge. Emily has been pushed out of her comfort zone and the network provided opportunities for her to hear how knowledgeable and brilliant she is at sharing and collaborating with others.”

2. Professional development should be underpinned by robust evidence and expertise

“We provide our governors with the evidence base and the rationale behind the SDP, and we constantly feedback and evaluate, triangulating evidence from a wide range of sources. External partners contribute to the collaboration and expert challenge strand, but, are also sources of robust evidence and expertise.”

Zoe expanded on the way that external partners may provide not just expertise but also validate the steps the subject leaders are taking to develop their subjects. “Partnerships like the Ogden Trust and TAPS, can also provide external validation which is invaluable. For example, staff attending the TAPS training returned to school and they would feedback to Emily, ‘It’s what we’re already doing’, thus it validates their practice. That validation is so important. Feedback should recognise those elements of teaching that are strong, rather than focusing on what can be improved.”

1. Professional development should have a clear focus on improving and evaluating pupil outcomes.

This strand links seamlessly back to strand 5 where we started. Here Zoe recognised that a strategic priority related to STEM would address some of the needs of her pupils. She expanded on other ways in which the needs of the children are catered for. “We identify areas of the curriculum that need developing very specifically based on the needs of our pupils. For example, three years ago I didn’t feel that our assessments of some of the SEND pupils were providing a fair reflection of their abilities. They could solve



problems practically but their difficulties with recording their work meant we didn’t always recognise what they could do. Their special needs do not mean that they are unable to excel, so that was an example of a particular area that needed addressing. When we identify a group of pupils who are passionate about a specific curriculum area, we need to make sure they have access to an after school or lunchtime club to develop them in a similar way to the way we have developed Emily.”

“In year 6 every pupil writes a letter of application for a role in a specific area of the curriculum that they would like to excel in. They are all interviewed and everyone is given a job, so we try to meet the needs of all the children allowing them to become experts in a very similar way to the way we enable our teachers to develop their expertise.”

The continuing conversation

Zoe had presented such a glowing summary of the way she is able to meet the Standard for teachers’ professional development that I felt the need to ask about the barriers that might block the route she had outlined. “We have to prioritise, which is why the model we use for identifying key areas for development, the SDP, ensures we allocate funds appropriately. There isn’t much money so you have to be clever with how you use it. Putting an area in the SDP raises the profile and subsequent SDPs ensure that improvements are sustained. To overcome the barriers we need a good team of people who are open.”

In summary, Zoe’s approach to the professional development of her teachers, as exemplified through Emily’s growth as science subject leader, demonstrates the importance of the five strands of the DfE guidance. However, what interested me the most was her focus on the more personal elements:

- The acknowledgement of the importance of relationships
- Knowing when a teacher is ready for a new challenge
- Embedding an ethos of honest and open discussion

The importance of relationships is often underrepresented in research around effective education and has perhaps similarly been neglected by the DfE standard for professional development.

In conversation with Karen Peters

Headteacher of Moorpark Junior School



Discussion about the '10 Key Issues with children's learning in primary science in England'

In March 2021 the University of Manchester and the Ogden Trust published a joint report identifying ten key issues in primary science education. This report has been shared widely and was cited in the recent Ofsted research review for science. The intention of

the report was to, "support organisations and schools to create or tailor their support or interventions against known learning issues." Ten months later, I am interested in one Headteacher's reflections on the report and the ways in which it is informing thinking, plans, actions and practices. I am grateful to Karen Peters, the Headteacher of Moorpark Junior School, for taking the time to speak to me about this report and share her thoughts.

10 KEY ISSUES The issues are not hierarchical -each are of equal worth.

Issues identified	Implication	Observations
1 CHILDREN'S SCIENCE LEARNING IS SUPERFICIAL AND LACKS DEPTH	Children are not developing a deep understanding of the big ideas of science.	<ul style="list-style-type: none"> Lesson planning lacks sequence: the 'Why this? Why now?' isn't clear Teachers and senior leaders align success in science with vocabulary recall, often using age inappropriate terminology Overload of inappropriately selected science
2 CHILDREN'S PRECONCEPTIONS AREN'T ADEQUATELY VALUED	Children are not able to process or build on their prior learning.	<ul style="list-style-type: none"> Staff have limited science subject knowledge relevant to their year group teaching Assessment does not inform next step teaching
3 CHILDREN'S SCIENCE LEARNING LACKS CHALLENGE	Children do not meet their full potential which limits their opportunities and aspirations.	<ul style="list-style-type: none"> Assessment practice does not inform teaching leading to insufficient response to pupil needs Resources are selected with insufficient professional critical analysis
4 CHILDREN ARE OVERRELIANT ON TEACHER TALK AND DIRECTION, THEY LACK AUTONOMY AND INDEPENDENCE IN LEARNING SCIENCE	Children's learning outcomes in science mimic those of their peers, as such not supporting individual feedback and progression.	<ul style="list-style-type: none"> Teacher talk often dominates the lesson Learning is not structured to be truly collaborative with decisions on groupings steered mainly by organisation of equipment, or behaviour issues Talk for learning is compromised Children's work lacks value and ownership
5 CHILDREN EXPERIENCE 'FUN' SCIENCE ACTIVITIES THAT FAIL TO DEEPEN OR DEVELOP NEW LEARNING	Children retell the 'magic' moments in science learning and aren't able to explain what they have seen or the concept explored.	<ul style="list-style-type: none"> Teachers misunderstand the point and purpose of practical work
6 CHILDREN ARE NOT ENCOURAGED TO USE THEIR OWN CURIOSITY, SCIENTIFIC INTERESTS AND QUESTIONS IN THEIR SCIENCE LEARNING	Children lack motivation towards working scientifically	<ul style="list-style-type: none"> Inconsistent understanding of how to model working and thinking scientifically Contexts for learning science relevant to children or of public interest are poorly utilised or seized
7 CHILDREN ARE ENGAGED IN PRESCRIPTIVE PRACTICAL WORK THAT LACKS PURPOSE	Children experience working scientifically that is formulaic and lacks authenticity.	<ul style="list-style-type: none"> Being 'hands on' dominates being 'minds on' Teachers are working harder than the children
8 CHILDREN DO NOT DRAW ON THEIR LEARNING FROM PRIOR SCIENTIFIC SKILLS. THEY DO NOT BUILD ON REPEATED AND REGULAR EXPERIENCES	Children have gaps as they move to the next phase of learning.	<ul style="list-style-type: none"> National curriculum coverage is not met Formative assessment is not focused on developing skills Availability of equipment or its accurate use when available is ad hoc Inappropriate scheduling or timetabling for science
9 CHILDREN RARELY SEE THEMSELVES, THEIR FAMILIES, COMMUNITY MEMBERS OR THEIR TEACHERS AS SCIENTISTS	Children believe that science is about other people making a difference, not them.	<ul style="list-style-type: none"> Unconscious bias reinforces messages of scientific stereotypes, gender and BAME (Black, Asian and Minority Ethnic groups) The needs of disadvantaged children are not met Contexts for science learning are poorly utilised
10 CHILDREN DO NOT APPLY LITERACY AND NUMERACY SKILLS IN SCIENCE AT THE STANDARD THEY USE IN ENGLISH AND MATHEMATICS	Children fail to see the interconnectedness of their science learning.	<ul style="list-style-type: none"> Limited opportunities for children to transfer, practise and embed skills

In conversation with Karen Peters

So, what do you consider has been the impact of the 10 key issues report?

Probably the way it's used for school improvement has had, and will continue to have, the greatest impact. For us it's really useful as a working document, not just in my school but in the schools across the Academy Trust, to use alongside their development plans. For example, it's a helpful way for senior leaders to structure a discussion with the science subject leader, using it to identify which issues you feel are priority areas for development in school. Typically, this would take account of evidence from observations, looking at pupils' work, and talking to the children. We structure a discussion on each of the 10 areas and then determine which are the three key areas we want to address first. This enables us to build in any CPD for the teachers. For example, based on observations, one area we are still working on is around questioning; the children asking their own questions. We have done some work on that but we agree it needs extra focus, especially due to the pandemic, so that focus is included in the school development plan and the teachers are responding positively. The school development plan is being constantly reviewed and we keep coming back to the 10 key skills document to reflect on our evaluations.

When primary science learning isn't what it should be, the issues are so often exactly what they've got in the purple document. For leaders, especially those that are not as confident with science, it is really useful to be able to know what to look for and identify issues that should be addressed. If you're not confident with science you might not realise that certain areas need to be developed, so it is a great tool to help identify the issues that need work. It is also supportive for leaders to see that it isn't just my school; it's very common. Through the networks that we are involved in, I know other schools are using it in a similar way.

Moorpark leads an Ogden Trust network and when we last met, everybody had a copy of the purple

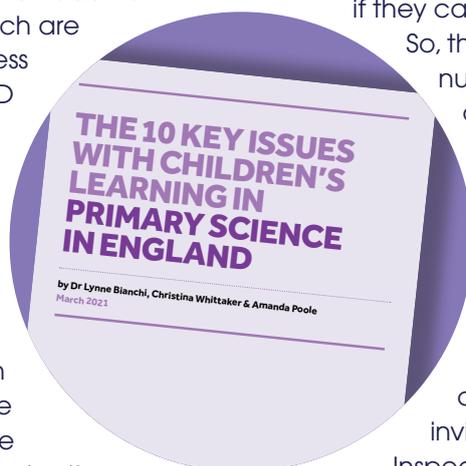
document. Some were using it as I've already described, with the senior leaders in school. But some people had not had the chance to look at it yet and appreciate how useful it could be to their subject and school development. It provides a common framework that everybody can relate to, so we are all talking the same language. It is still relatively early stages, but useful in terms of timing and helping school leaders to understand the most recent Ofsted framework.

The parts of the document I find really valuable are all the examples showing what good looks like in the classroom, the examples of practice that are the issues are also valuable learning points, teachers will relate them to their own practice, but I've asked Tina if they can include more positive examples.

So, the next stage is increasing the number of examples of good practice, and I understand that a follow-up document is being worked on at the moment, so I am looking forward to this.

The timing of the launch was very good, just before the Ofsted research report and the purple document was cited in there of course. Science Across the City invited Jasper Green, the Chief Ofsted Inspector for Science, to present the findings of the Ofsted research review and it was good for us all to be part of the conversation. As a result, we are really getting schools to reflect more and senior leaders engaging with the primary science school development agenda. It has prompted lots of discussion with other Heads about where they're at with science. That good practice that Ofsted is hoping to see would have been far more embedded for everybody if it hadn't been for Covid and being side-tracked, but it will be really interesting to see how that develops.

The purple document has had impact because it is so easy to read. It is clearly based in practice but the links to other research are so important to back up what they are claiming, and why these ideas are relevant. Wynne Harlen, the Gatsby Foundation and the other expertise that is referenced makes it so much richer.



For you, which of Jasper Green's main messages relates most closely to the purple document?

I think the main message was around science not just being a series of wow moments; flashy activities with no purpose. We need to focus on the learning and that is very clear in the purple document. One of the other things, highlighted by Jasper, that we're working on currently is clarity around the difference between skills, working scientifically, and how they link with knowledge and understanding. That is one of the issues Ofsted identified. That mainly relates to issue 8 in the purple document and it probably fits into some others as well.

We are rightly proud that across our Stoke-on-Trent schools there is science happening; it is time tabled; it is on people's school development plans; teachers are definitely more skilled with the progression in knowledge; and, by repeating and revisiting, they are ensuring the knowledge sticks. But then I do feel there is a lack of progression on skills, especially thinking scientifically and some confusion, even among science leaders, on the way that subject knowledge, working scientifically knowledge and skills, and the different types of enquiry all fit together.

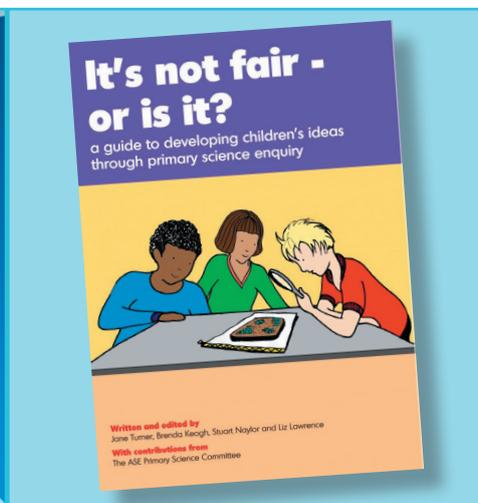
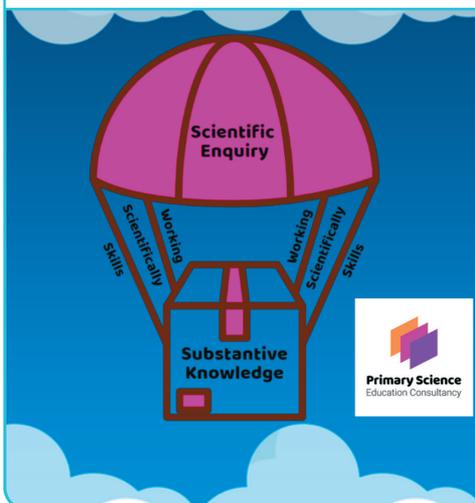
We are working on developing even more tools for that. I came across something last week at the Primary Science Teaching Trust regional network.

Kate Redhead used Naomi Hiscock's really clear analogy and everybody I have spoken to since says it makes sense and offers clarity for teachers so I think that will really help. I intend to share it with the Science Across the City leaders to see how we can develop it further. The analogy made perfect sense on how to connect it all up for teachers to be clear when planning for all areas of primary science.

The canopy of the parachute being types of science enquiry, the basket is your knowledge and understanding, and the ropes are the 10 skills that link the working scientifically with the subject knowledge. (see image bottom left). I think this will help provide clarity on which skill you are using,

for example measuring, then where is the progression in that. Further to that, making sense of where this fits into disciplinary knowledge and how that is almost the guy ropes, small learning steps, that lead to each skill. That's precisely what Jasper talked about in his presentation; where do you start learning about how to use a thermometer and how does that progress through the primary phase? It made the way those three parts of primary science link together very transparent.

We need to test it out to find out if it helps the children in trying to develop themselves. That comes back to what we were saying about having a second issue of the purple document that goes alongside the first and gives teachers and leaders ideas to address the issues.



In conversation with Karen Peters

Locally which of the 10 key themes are resonating?

I have already mentioned issue 8 but number 4 also stands out because we often find that the children are not really asking their own questions and the teachers are controlling the lesson. It does come down to teacher confidence and a balance in how much freedom they are given. Allowing children ownership of science doesn't mean it's free for all play and it hasn't got structure. It's helping teachers know the next steps for learners and it's that clever way of getting the children to develop their own thinking.

Many teachers believe they have to answer every question that the children might ask, whereas it's more important to say "OK. That's interesting; let's find out together." It's just small tweaks in mindset and approach rather than a whole new way of thinking and I have seen plenty of examples of teachers who are successful with that.

The TDTS and TAPS training were particularly helpful with number 4, and the teachers who have taken part in that CPD have found that their teaching is transformed. They know how to achieve that balance, providing activities giving children the freedom, but it is still structured to ensure the learning is happening. They no longer worry that the pupils are not learning anything because they are just playing with stuff. Often, we see that early years really get it right and independence is taken away from the children as they go through the school. The good news is, we are seeing that less now.

You obviously feel that the SATC offering has helped with Issue 4 but are there any other parts of the SATC CPD offering that has support developments relevant to any of the other issues?

The year group training with Nicky Waller has definitely supported development for number 5 and number 4 again, because it's supporting teachers to give the children their independence. Also, Emily Royal from Saint Maria Goretti was involved in developing the Primary Science Capital Teaching Approach (PSCTA) and Tina is currently pulling together another network around PSCTA Handbook that was recently published, to allow that training to be shared more widely. This

would help support schools struggling with issue number 9. That links to another project starting soon in Science Across the City related to unconscious bias. We are all very excited about the STEM Sisters theatre performances, science clubs with a STEM focus for girls and so much more.

I know the data from the diagnostic testing across the City showed that girls achieved as well as boys, so we are confident the girls are not underperforming, but we know they don't enter STEM careers or further study as they leave high school.

Do you have any closing thoughts you would like to add?

I am now so confident science is being taught in all Stoke primary schools whereas before SATC English and maths had such prominence that science became the neglected third core subject. But that's changed and is continuing to do so. It is such a privilege to observe and know that ongoing primary science development in the City is secure and exciting for the near future and beyond.



Behind the scenes

The next phase of development from the UoM 10 Key issues team includes practice based research from two Stoke-on-Trent subject leaders. The contributions from Emily Royall and Ash Jones are helping to shape teacher guidance for effective monitoring and evaluating through a learning lens. Watch this space launch anticipated January 2023.

In conversation with St Mark's CE Primary School



Michelle Jonhstone executive Headteacher, and Lee Nicholls, Head of School

A discussion about science capital in relation to one Stoke primary school

The Primary Science Capital Teaching Approach was launched in October 2021. Co-developed by researchers and twenty primary teachers the aim is to make primary science teaching engaging and equitable. It will take time for training on this approach to reach primary teachers across the country, but I wanted to find out from one Stoke school how their practices in the teaching and learning of science might already be making a difference to children's science capital. Lee and Michelle were kind enough to share some of their thoughts on science education at St Mark's CE Primary School and the ways in which the school community might support the development of their pupils' science capital.

What is your understanding of science capital as it relates to your school?

Michelle responded, "I think science capital is about the children understanding how they can build on what we do in schools and how we can encourage them to be inspired. For a long time we've been very focused on cultural capital and global issues, but science capital is more specifically related to science." Lee added, "We want children to take inspiration from the science teaching in school and be aware of different vocations and options for career choices they might consider in the future. The experiences of our children are very limited out of school, so we are looking to build on those experiences in school."

Given recent Ofsted reports, curriculum is currently a hot topic, so I asked them to explain how they are developing a science curriculum to both support progression and develop science capital?

Lee shared his thoughts, "We have to ensure that our

science curriculum is built to allow children to explore, investigate, think about the wider picture and what they could go on to be in the future. When Michelle first came to the school the expectations for our children were quite limited. They perhaps aspired to be taxi drivers or take away workers, but now our children are saying I'm becoming a doctor, or a pharmacist. I want to do a physics degree." Michelle continued, "We want the children to have that wider understanding of science, that it isn't necessarily somebody in a white coat and it could be you. We need to make sure that children understand a wide range of careers and where science fits within those." Lee agrees. "It's about us making sure that the children can see science in everything they do, and not just in a science lesson."

Lee links this ambition to raise expectations with the development of a curriculum for both science and other subjects. "Our curriculum is exploratory, inquisitive; it's question-based. We are encouraging children to ask and answer questions and I think we've been surprised by how our children now think like scientists and believe they are scientists. They're become quite vocal and the conversations they have with us are amazing; they teach us so much."

"The whole curriculum is encouraging children to be curious and ask questions, whether it's a science topic or a history topic. We know our children have a huge range of starting points in their learning journeys, partly due to the high levels of mobility. We have got a little bit of work to do to ensure the children know what they know, and understand what they need to know next. We need to unpick some lessons so teachers understand the pupils' prior learning and children are able to articulate their next steps. We have a curriculum map that takes the national curriculum as a starting point, but then we look for the learning children need to be able to build knowledge. We want to ensure they're able to link back to their previous learning and then how that learning is expanded as they move through the school and onto their high schools."

"The next step for us is to give them opportunities to

In conversation with St Mark's CE Primary School

understand that actually a baker is a scientist. There is science involved in being a joiner; he or she needs to understand the properties of wood. We try and ensure that every half term the children have a trip or a visitor that links to that topic, and we need to develop that further, so pupils relate science to possible careers and understand it's importance in their lives and in the world around them. Those experiences are so important. Unfortunately, Covid has restricted opportunities for children to meet people and understand the part science plays in their work."

The PSCTA notes that children with higher science capital are more likely to identify with science and see science as 'for me'. How are you supporting children to see science as 'for me'?

Michelle reiterated the importance of questions in the curriculum. "To be a successful scientist or in a profession involving science, asking questions, open questions, is crucial. And you must be able to think about how you might answer those questions." Then she expanded on how the curriculum is organised. "We have an overarching question, for instance, it will be history or geography question." Lee added an example. "Like the history one, for year 6, 'What was the impact of World War Two in Europe?' Then each week a smaller question is posed, so at the end of the topic, children have the knowledge to answer the overarching question. Science works in exactly the same way."

So how do you make children feel more 'science-y'?

Lee shared an example that helped him develop his thinking in this area. "One evening on the way home I bumped into an ex-pupil. At school he wasn't academic. I asked what he was doing now and he replied, 'It's not the best. I am training to be a plumber'. I said, 'Why is that not the best? That's fantastic', and he said, 'You think so?' So I said, 'yeah, everybody needs to plumber'. Then I thought to myself we need to celebrate with our children the skills of the plumbers, the fitters, the carpenters of this world, as well as the ones who do ophthalmology degrees and

science degrees. Science is such a broad subject and encompasses so many great skills for life."

Michelle continued, "We have a children's guarantee including activities based on the National Trust 50 things to do by the time you are 11 and three quarters. Many of them are scientific like stargazing and building a shelter. These show how science is part of the children's everyday experiences. Science is a huge part of their lives." Lee looks forward to the sorts of activities that will be reintroduced once Covid restrictions lessen. "Even simple things that we might have done growing up, like pooh sticks. Standing in the flow of water and observing how it is different and questioning if you should choose sticks that are large or small."

Lee shared another example. "Some of our children had the opportunity to meet a high class chef, and actually this was all about the senses. About the flavours and our taste buds and how they are in different positions, picking up sweet, sour and the other tastes. They loved that and it made science very relevant to them."

Can you describe some of the other changes to science teaching and learning that have resulted from the SATC training and help support children's science learning and science aspirations?

In Michelle's opinion the training provided by Science Across the City has been inspirational. "One of the things that's been a real success for our school is the training that we have attended through the opportunity areas. There hasn't been a member of staff that hasn't come away from the Science Across the City training, where they haven't been inspired and wanted to have a go at something. We can see the impact in teaching and learning."

Lee continued. "All the training that has been provided by Science Across the City has made us question and improve what we do in the classroom. So instead of it being today we're going to do an experiment like this, we're saying right, would like you to have a go yourself and explore around this. You can create your own experiment allowing learners to build up their knowledge, their vocabulary, their language through exploration." "We have also rethought the amount of recording we

do. If we think back, previously in science lessons, children would write up a science investigation in full. A title, a prediction, a method, why it is a fair test, a picture, a graph, and a conclusion. But in the real world, when scientists do an experiment they spend time focused on elements of that investigation, so now we are doing the same and focusing on just one element in each investigation and writing up that element. We've also introduced floorbooks, so instead of every child recording the same mundane thing, we can include photos and perceptive comments that children have made that show their learning. Children talk enthusiastically about their work because they haven't had the curiosity squashed out of them by having to write pages about it."

"We find this approach empowering for those children who, maybe have a SEND need, maybe EAL, being brand new to English, because we have a lot of people in school, who are brand new to English.

We want every child to have a wide range of opportunities. We strive to create an environment where they can thrive and we want them to succeed so we invest time and energy in discovering their gifts and talents."

Lee is keen that children learn skills that are important for life. "We also encourage children not to be afraid to make mistakes; learn from mistakes. We all make mistakes, and we share that we make mistakes too. And not being afraid to say, well that hasn't worked, why hasn't it worked, and those children find the answers for themselves without the teacher using a scheme that gives detailed instructions. The real world isn't like that it. You may get it wrong loads of times. We want our pupils to learn skills, understand why we're doing what we're doing, but also how we have to adapt and solve problems."

Your aspirations sound fabulous, but at a time where schools and teachers are under such great pressure, how do you make those changes you described?

Michelle answered, "We strive for consistency, so all the all the teachers really understand our expectations for quality first teaching, for the delivery of the curriculum, for visits and visitors, the children's guarantee. It's making sure that everybody is working consistently. To

ensure this is the case we have frequent reviews."

"We make sure there is buy in from all the teachers and if they see something that needs to change, they will come and tell us. When we say teachers, we are referring to every member of staff. We are all equals; we are all teachers; midday supervisors are teachers. For instance, we've got a teaching and learning assistant who is passionate about the environment. He's created a lovely habitat and wildlife area. We're an inner city school with no grass, no playing fields; one playground for all the children. So, to have plants growing really enhances our environment."

In school everybody's treated the same. Everybody has a high expectations. It doesn't matter where you're from. We have 31 languages; around 17 ethnic groups. Some children, are brand new to English. We empower them; we believe in them; and our children have a belief in themselves. Given the ever-changing demographics: last year, we had a 126 children come or go; 77 new arrivals; 49 leavers. and you would think that would impact behaviour or learning but it doesn't because the children in school have those high expectations and they want to better themselves."

So how do the high expectations, question-based curriculum and other ideas you have described impact on the pupils?

"After holidays they skip through the door with smiles on their faces because they're proud to be here and they're proud of their learning and that empowers them. We have values; our core values is respect. It links to the learning in class and everything that we do revolves around respect. We make sure that we are pushing ourselves and that results in a community that's proud of the school and proud of where the children are going."

We know that home is the greatest influence on a child's science capital, so how do you engage with parents and carers?

Unfortunately, Covid has had a detrimental impact on opportunities to work with parents. Lee explained. "We want our parents to have high aspirations for their children, but we still have some work to do in that area. We used to do workshops but then Covid took hold

In conversation with St Mark's CE Primary School

and so sadly we were not able to support them in that way. We need to support parents, so they understand the opportunities available to their children. The good news is we've got more children than ever going on to college courses and definitely more going on to university degrees."

"Whilst we have a large proportion of families living in deprived circumstances, we also have some really highly professional families, for example, university lecturers. We now need to focus on how we can involve those parents, and get them to come to our school and talk to our children about their work."

"Computing is an area that sometimes gets forgotten within the science arena and many of our parents would appreciate support with this. Some really struggle and the children are probably more skilled than their parents. In the past, to help them to develop their skills and to allow them to support their children at home, we have offered training but that came to an end with the Covid lockdown but we hope to get back into that."

Lee went on to explain the importance of establishing good relationships with parents and how those relationships are developed. "I think we do really well with building relationships with parents especially offering guidance and advice about transition to high school when parents are unsure. We have very open relationships with our parents because we don't take the moral high ground. We know the barriers, and we don't go in with a judgmental attitude. We want to reinforce those high expectations and I think that parents appreciate that. We work together to achieve the outcomes that are best for the children. They appreciate that; they really do."

Closing thoughts

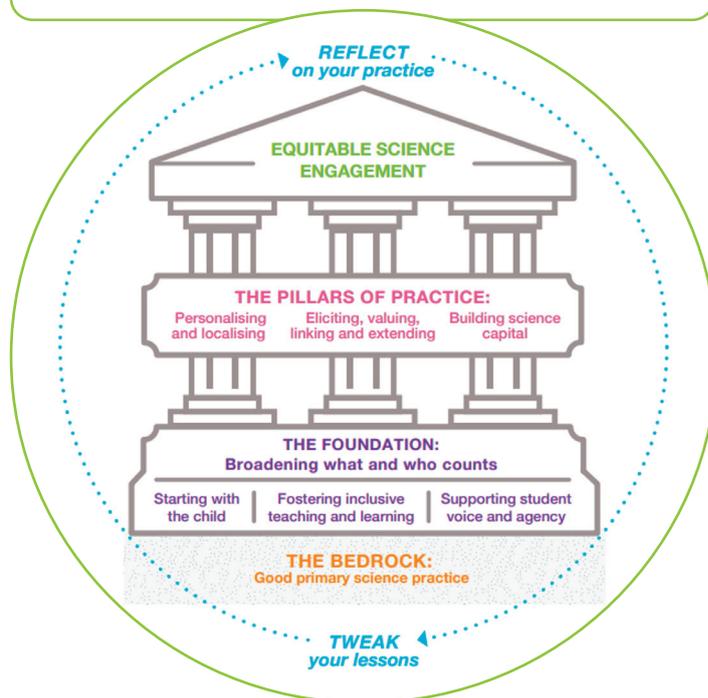
Michelle, Lee, and the other teachers who work at St Mark's clearly care deeply about the aspirations of the children in their care. When we spoke, the PSCTA model (see figure 1) had not been widely shared, but I was interested in just how many aspects of the model were present in the thoughts they articulated. The Bedrock – the foundations on which the PSCTA is built is 'good primary science practice' and good practice was apparent in the way they described science teaching and learning at St Mark's.

They are already beginning to 'broaden what counts'

by valuing science in the roles of plumbers, chefs, and joiners as well as more highly qualified scientists. Through the questions-based curriculum student voice and agency are being encouraged and they have plans to make science more personal and local by inviting parents to speak about their careers. Finally, they are also working on building science capital though increasing:

- What the children know about science
- Who they know; simply by recognising science exists in so many careers
- How they think; increasing the visibility of science in the world around them, and
- What they know; through their science lessons and the Children's Guarantee.

Michelle and Lee were so honest with me when they recognised there is more to do – there always is in any school, and I wish them and their whole school community well as they develop a winning formula to support their pupils for many years to come.



The Primary Science Capital Teaching Approach <https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/stem-participation-social-justice-research/primary-science-capital-project>

1 Decide what you want to achieve...

Identify school priorities using internal data and professional judgement

SATC have a review process that is thorough, rigorous, and research informed. 10 Key Issues in Children's learning in Science, (Bianchi, et al, 2021) and Ofsted Science Research review (Ofsted, 2021)

SATC created a framework of prompts for subject reviews now used by all local coaches and available to download free at

www.scienceacrossthecity.co.uk

(Launched in this issue of Connect pages 15-18)

2 Identify possible solutions...

External evidence from the guidance and elsewhere can be used to inform choices

What's in the SATC coach kit- bag? The 'go to' known and quality assured science interventions active in the City include all those listed on the back cover. Teacher talk focuses on national best practice in local context.

5 Securing & spreading change...

Mobilise the knowledge and use the findings to inform the work of the school to grow, or stop the intervention.

Informing teachers in Stoke-on-Trent

CONNECT: The journal of primary science professional development in Stoke-on-Trent. (<https://www.scienceacrossthecity.co.uk/>)

A network of enthusiastic Science Influencers celebrate across schools (<https://www.scienceacrossthecity.co.uk/our-team/>)

Capture and collate good practice as reported in local PSQM submissions (<https://www.scienceacrossthecity.co.uk/>)

Action research mindsets to evidence impact

4 Did it work?

Evaluate the impact of your decisions and identify potential improvements for the future.

SATC have scheduled for 'Temperature Dips' as part of the review and improvement offer. The reviewer will revisit a key identified need and dip into the measurable change in school. What will the reviewer see? (Teacher or pupil output) What will the reviewer hear? (Teacher or pupil voice) What will the reviewer find? (Diagnostics and gaps)

3 Give the idea the best chance of success...

Applying the ingredients of effective implementation

Action planning phase. Schools using the PSQM programme, having familiarity with the Five strands of the DfE standards for CPD (2016) and aligning to the key messages in the EEF implementation guide.

SATC strategy design embedded within the EEF model for school improvement



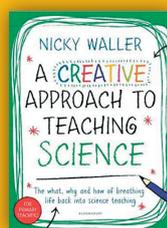
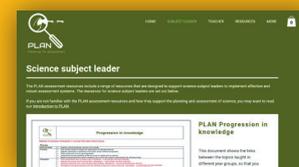
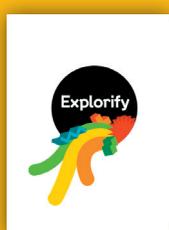
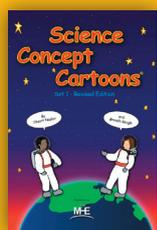
Research and Policy: What is in the bag?

The Science across the City coaches are trained in coaching and mentoring and have a growing understanding of the primary science education landscape. We know they are great coaches because they listen to and support coachees to clarify need, identify next steps and set clear goals. They are good mentors because they suggest options and alternatives for consideration by mentees based on knowledge in a specific theme or topic.

It is our approach that teachers support other teachers through a model of reflection. Together they consider external resources or statements and provide more than a set of tips and tricks transferred from one classroom to another. All school contexts are unique and therefore discussing the work of recognised others allows depth and meaningful professional constructive dialogue.

What is in the bag of all the SATC coaches providing consistent key messages across the City, rooted in current national best practice?

Primary science knowledge for teaching - Reference tools



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