An evaluation of the Science across the City project as seen through the lens of PSQM
Second report

University of Hertfordshire Protocol number: cEDU/SF/UH05078

Clare Warren
c.warren4@herts.ac.uk
AUGUST 2021

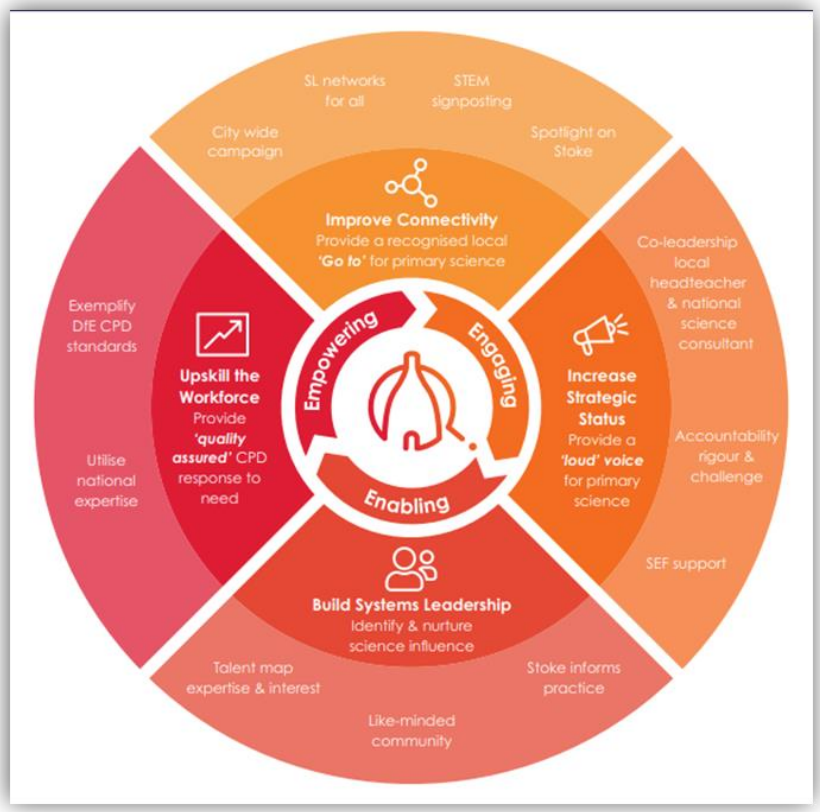
Table of Contents

An evaluation of the Science across the City project as seen through the lens of the Primary Science Quality Mark

Introduction

SATC background

The purpose of this report is to contribute to the evaluation of the Opportunities Area funded Science Across the City (SATC) project in Stoke-on-Trent. The project seeks to narrow the gap in opportunities for pupils in different schools such that every child experiences child led, enquiry led science for success. The image below (from www.scienceacrossthecity.co.uk) summarised what the project was intended to do, along with the reasons why, and how this would be achieved. In 2020 the project was evaluated against the central themes of Engaging, Enabling, Empowering. (See the previous report at https://www.scienceacrossthecity.co.uk/evaluators-feedback-2020/). This 2021 report evaluates against this same ambition, but explores in more depth, by considering the effectiveness of the project in terms of the next layer of the project plan below. This level provides more detail on how Engaging, Enabling and Empowering would be facilitated through Upskilling the Workforce, Increasing Strategic Status, Improving Connectivity and Building Systems Leadership.



This evaluation focuses on the seven schools that started PSQM in March 2020, and, submitted their evidence at the end of March 2021. This evidence constitutes the data that have been used for this research. During the year education was severely disrupted by the Covid-19 pandemic, with schools only educating certain groups of children on site with others learning at home. "Risk assessments and management of 'bubbles' to keep school sites safe have been necessary but time-consuming. Many schools have also had to cope with staying open while staff and/or large groups of pupils are required to self-isolate to stop the spread of Covid-19" [1]. Evidence Nationally suggests that the Covid-19 pandemic has widened the attainment gap between disadvantaged pupils and their peers[1]. Almost one third of Stoke-on-Trent's population is classified amongst the 10% most deprived in England[2] and it might therefore be expected that the attainment gap between the pupils in Stoke-on-Trent and their peers will have continued to widen during the Covid-19 pandemic. Because of Covid-19 restrictions, the impact evident within the PSQM submissions may be different to what might normally be expected.

PSQM background

The aims of the Primary Science Quality Mark (PSQM) include raising the profile of science in primary schools and providing schools with a framework and professional support for developing science leadership, teaching and learning. Science subject leaders work in local hubs supported by a PSQM hub leader. They attend four half day (or equivalent) CPD sessions. The year-long process starts with a self-evaluation of the school's provision for science teaching and learning, a decision as to which of the three quality marks to aim for (PSQM, PSQM Gilt or PSQM Outreach) and the creation of an action plan to enable them to meet the specified criteria at the end of the year. For most of the year the focus in schools is on activities to raise the profile and quality of science teaching and learning with a process of evidence collection at the end of the year. The evidence consists of written reflections and core documents that are subsequently reviewed by a PSQM hub leader from a different region. In most cases the quality mark is agreed, but in a small minority of cases, further evidence is requested, or a different quality mark is awarded.

Combining PSQM with other CPD

PSQM was a significant feature of a wider 'menu' of initiatives made available to Stoke-on-Trent schools to support science subject leaders to raise the profile and quality of science teaching and learning. The impact of other items on the same 'menu' can be seen through the teachers' perspectives presented as part of the evidence in the PSQM submissions.

[1] https://educationendowmentfoundation.org.uk/public/files/Publications/Covid-19_Resources/The_EEF_guide_to_supporting_school_planning_-_A_tiered_approach_to_2021.pdf
[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/696855/Social_Mobility_Delivery_Plan_Stoke-on-Trent_v8_FINAL_WEB.PDF.PDF

To collect data to evaluate the SATC project, while minimising the impact on the science subject leaders, the researcher downloaded the core documents that had been uploaded to the PSQM website. This includes a substantial, wide range of qualitative data, such as logs of activities and teachers' reflective comments. Thus, having worked hard to implement their action plans, and compile their submission in unprecedented circumstances, the science subject leaders were not asked to take part in other data collection methods.

Full ethical approval for the study was granted by the University of Hertfordshire social sciences, arts and humanities ethics committee. All participants were given a participant information sheet to keep and consented to data being collected from the PSQM VLE. To maintain the confidentiality of the participants and others in their schools, the school names have been changed to colours; Scarlet, Royal, Ivy, Navy, Burgundy, Magenta and Ochre.

The following core documents submitted by each of the seven schools to support their application for a PSQM have been examined to collect data:

- The *Principles of science teaching and learning*. A statement, in simple terms, (several bullet points) of what good science teaching and learning looks like at the school in question; typically presented as a single A4 sheet. This is created collaboratively by staff and possibly other members of the wider school community.
- The *Action Plan* states the actions required to move the quality of the teaching and learning of science from the position identified during the self-evaluation to the standard required by the quality mark targeted.
- The *Subject Leader and Continuing Professional Development (SL/CPD) Log* records any science CPD attended by staff shortly before, or during, the year. Both formal (courses) and informal (a meeting with a colleague after school to assist with planning) CPD are recorded. There is an expectation that the science subject leaders facilitate some CPD for colleagues. The impact of any CPD should to be stated on this document.
- The *Calendar of Events* records science enrichment activities involving pupils. For example, it might include science assemblies, science clubs, visits to museums and other science related places of interest, visitors, like STEM ambassadors, and any science days or science weeks. The impact of such events should be stated.
- *Reflections***,** of no more than 300 words, written about each criterion to justify how the school has achieved the descriptor at the chosen level. There are 13 criteria, therefore 13 reflections are written.

A glossary (see page 24) is provided to explain terms for those unfamiliar with the vocabulary and acronyms used in primary science education. Terms described in the glossary are denoted in **bold** font in the following text.

Each of the four areas in the **SATC** plan will be considered in turn and the evidence in the **PSQM** submissions that relates to each area will be outlined. Comments will be made to describe the success or otherwise of the project in meeting each of these objectives. At the end of each section the outcome of that section will be summarised in a blue box. The report concludes with a brief description of the limitations of this research and further questions arising.

A. Increased Strategic Status

PSQM submissions are expected to demonstrate how the profile of science in the school has been affected over the twelve months. Within the SATC submissions there are many examples of statements that reflect the increasing value that has been placed upon the teaching and learning of science within each of the schools during the Opportunity Area funding phase. All seven science subject leaders in this research attest to the fact that science is now valued more highly than it was at the start of PSQM.

> Two examples are provided to show how the profile of the subject has been raised. The science subject leader of Scarlet School states, "As soon as you set foot through our school doors you are met with a burst of science which we have now extended to other areas of the school. We have ensured that the importance of science within our school has been shared to pupils through science assemblies and science competitions. We have also arranged science fayres and 'watch me learn' science lessons to promote the importance of science to parents." The science subject leader at Royal School has also ensured the profile has been raised with the wider school community asserting, "There has been a significant increase in the profile of science in school." "Science is regarded with the importance it deserves, this is reflected in the way pupils and adults talk about science, the displays that can be seen around school and the work done by the children. The high profile science has on our social media, communicates to parents and stakeholders how important science is in our school."

Furthermore, science featured in strategic planning for all the schools included in this research. In every case the science subject leader had written an action plan that was implemented as she[3] worked towards gaining a PSQM. Reflections on the implementation of the plans were written, including next steps.

> The science subject lead at Scarlet School mentioned a meeting with the head teacher to write the science development plan and the School Development Plan (SDP). "Science is always included in the trust's development plan and this cascades to all schools in the trust. Each school has a detailed annual plan for science." (Scarlet School). The science subject leader at Royal School refers to a review of, "subject policies to ensure they are in line with revised expectations and current practice."

In addition to science being prominent in terms of its profile in school and in strategic planning, the science subject leaders also provide many statements showing an increasing recognition that science is important and relevant to children's lives.

> For example, the Principles at Navy School include the statement, "Children can make connections with what they are learning, and real-life contexts deepen their understanding of science, today and for the future." Similarly, the Principles at Magenta School state that science learning should be, "Enquiry based through real-world contexts". At Burgundy School the Covid-19 pandemic created an opportunity to connect science with real-life problems. "We have reacted to current events, using the opportunity to discuss and research the pandemic and have taught sessions about Covid-19 thus keeping science relevant and meaningful."

[3] As most science subject leaders are female, feminine pronouns will be used throughout to protect the anonymity of male science subject leaders.

A. Summary - evidence in the PSQM submissions highlights that the increased profile and perceived importance of science' became heard more loudly throughout all the schools and their wider school communities. Science was more highly valued at the end of the year than it was at the start in each of the seven schools. As part of the development process science became higher profile in strategic planning with science plans written and implemented. As part of the SATC aim to Increase Strategic Status it is not obvious if this would or should include pupils' understanding that science is important and relevant to their everyday lives, but nevertheless this was the case. This presents an opportunity for the SATC leaders more closely define this aim.

B. Build Systems Leadership

Science Influencers, a role established by SATC to create a network of like-minded enthusiastic leaders, were nominated for the role by their head teacher. This network of Science Influencers, along with other networks connected to primary science, was important to the science subject leaders in developing their roles as systems leaders.

> "There are now 15 science influencers- a 'go to' for solutions and signposting and from this group several specific focussed subsets- including two new **PSQM** hub leaders, eight Chartered Science teachers, three **TDTS** champions, four **TAPS** champions, one science **SLE** and three science subject coaches." The science subject leader at Ivy School wrote, "The support network has really kept me afloat and had given me the help and guidance I have needed." Burgundy School's science subject leader noted, "My highlight has been the level of support and comradeship from colleagues within the Academy Trust, Science Across the City and OA Funding. I feel that with science teachers in Stoke and our Academy Trust, we are part of an enormous family and supportive community. I have been afforded so many opportunities for personal and professional growth through high quality CPD, resources and just plain old chats over a cup of coffee." The science subject leader at Ivy School identified the benefits of being part of this community. "I feel it has really developed my confidence as a leader, it has allowed me to develop relationships with my colleagues and it has been a great opportunity for us to come together with other schools to make Science teaching and learning the best that it can be!"

In their development as system leaders, support from within their schools and academy trusts was also appreciated by the science subject leaders.

> "Science in our school is fully supported by the Academy Trust, our head and governing body; teachers in our school love teaching science and have continued to do so and the pupils love it too!" (Burgundy School). The science subject leader at Navy school appreciated, "The amount of time I can dedicate to science, the reading around the subject and the training I can engage with due to the support from my school", and at Royal School, "there is an allocated budget for science in order to

> purchase appropriate resources and provide training in order to support teaching and learning of Science."

Throughout all the sample schools **PSQM** submissions there is evidence that systems leadership developed and the science subject leaders became increasingly effective.

Through the process of monitoring, leaders became explicitly aware of the strengths and areas for development in science teaching and learning. The **SATC** project and the co-ordinated communications campaign informed leaders about best practice in primary science education and science subject leaders were able to influence colleagues to improve practice across their schools. Effective monitoring, good knowledge of the primary science education landscape, along with meaningful assessment underpin effective system leadership and evidence for each, as detailed in the seven sample schools' submissions, will be discussed in turn.

Effective Monitoring

Across the schools many different monitoring activities were mentioned as having been used to inform the science subject leaders in Stoke-on-Trent about the teaching and learning of science across their schools, including:

- Floor book scans
- Pupil surveys
- Children's work
- Staff voice and informal conversations with staff
- Pupil discussions
- Parent survey
- Parent Consultation Group
- Lesson observations and lesson visits
- Collaborative planning
- Planning scrutiny

Initially these monitoring activities were used to identify areas for development.

> For example, the science subject leader at Royal School used the information gleaned from monitoring to inform strategy. "As a result of regular monitoring of science, such as lesson observations, 'watch me learn', book scans and planning scrutinies, the leader has been provided with a strategic view of science across the school." (This use of monitoring to inform strategy links to section A above.) Child voice interviews at Ochre School informed the science subject leader, "that the children do not want lots of writing in science." A Floor Book scan at Scarlet School, "showed staff needed to ensure that prior knowledge was being assessed and that formative assessment was being practised. As a result of this, the subject leader led a staff meeting to show ways of assessing prior knowledge." Similarly at Navy School, "Another thing that was identified as part of the monitoring cycle was gaps in knowledge from staff. This led to staff being booked onto additional training when required, particularly an NQT and co subject lead."

Monitoring was effective because **CPD** was arranged in response to the needs identified. Further discussion about the **CPD** made available through **SATC** and its impact on classroom practice follows in section D – Upskilling the Workforce.

Once **CPD** had taken place, or areas for development had been addressed through other means, the science subject leaders once again monitored provision for science teaching and learning, but this time to ensure the issues had been addressed.

> The Scarlet School science subject leader wrote, "Floor book moderations and conversations with staff show that staff are beginning to consistently assess children in lessons and also recording their observations for each science unit." At Magenta School, "as a result of every monitoring cycle science is constantly evolving in our aim to deliver best practice and consistently high-quality lessons to all pupils in all year groups in our school. I work collaboratively with the curriculum coordinator to implement and monitor the impact for both teachers and pupils of these in the next cycle. We are constantly reviewing and reflecting on the teaching and learning of science." The Magenta science subject leader also stated, "Through planning and book scans, it is clear to see that there is now a greater focus on child-led investigations and discussions within lessons and can work at increasingly independent levels throughout the key stages to plan, complete and evaluate investigations. As a result of these changes, children are becoming more confident in sharing their ideas and understanding." The science subject leader at Ivy School used monitoring to identify where previous CPD had been less effective than hoped and plans to address the weakness identified. "As a result of the book scan, a development point is to reshare the five **enquiry types** with staff to ensure they are being covered equally."

The foci for the monitoring activities varied in line with each schools' strategic plans, their context, and long-term vision and provides further evidence for developing systems leadership.

> At Ochre School the principles of science teaching and learning provided a focus for monitoring. "The impact of having clear science vision is that everyone clearly knows what is expected. Therefore, when carrying out planning/ book scrutinises and lesson observations the teachers know what I would be looking for." However, at Burgundy School, through monitoring of the medium-term plans, the science subject leader was able to confirm full coverage of the curriculum. "Even though there are new to KS1 staff and trainee teachers and sometimes supply covering science, we have maintained a consistent approach with coverage of required learning and development of skills."

Knowledge of the primary science landscape

Throughout the submissions there was evidence the science subject leaders were becoming effective systems leaders by keeping up to date with developments in the landscape of primary science education. Well-known organisations, initiatives and events in the world of primary science education were mentioned including:

- **ASE**
- **The Great Science Share for Schools,**
- **Explorify,**
- **The Thinking, Doing, Talking Science project,**
- **The TAPS project,**
- **Science Capital,**
- **Big Bang event,**
- **Reach Out CPD,**
- **CREST awards,**
- **STEM Learning, and**
- **The Ogden Trust.**

> The science subject leader of Scarlet School noted, "I am better informed and more aware of the wider STEM community and the resources that exist that we can and do utilise."

Having established connections with the primary science education community and connected to networks the science subject leaders are in a position to stay up to date with developments enhancing the sustainability of the project. These connections are a part of the legacy of the project.

Meaningful Assessment

The final area of systems leadership to be considered is assessment. One of the areas addressed through the **SATC** professional development 'menu' was assessment, where a **TAPS** extended **CPD** community was one of the options available. Three types of assessment are mentioned in the PSQM assessment criteria: formative, summative and statutory. Formative assessment is crucial in enabling teachers to identify prior learning and misconceptions, thus ensuring pupils are ready to take the next steps in their learning. Summative assessment can be used to track progress over time. Statutory assessment in science is required at the end of key stages 1 and 2 and in each case is teacher assessed.

Starting with statutory assessment, before the SATC project commenced, the teacher assessment data at the end of Key Stage 2 for Stoke-on-Trent and England are as shown in table 1.

Percentage of pupils achieving age related expectations (Key Stage 2 Science) 2019 England	Percentage of pupils achieving age related expectations (Key Stage 2 Science) 2019 Stoke-on-Trent
82.9%	77.9%

The SATC project hoped to close the gap in the data, but because of the Covid-19 pandemic no teacher assessment data were collected in schools in 2020 or in 2021. Therefore, it is not possible to confirm whether the gap in pupil attainment is closing.

Despite the Covid-19 pandemic the science subject leaders continued to develop assessment practice in the areas of formative and summative assessment. Assessment is explicit within PSQM criteria and so, as expected, all seven schools were working to improve aspects of assessment and the evidence reflected the stage of individual school's progress.

> Some of the leaders identified weaknesses at the start. The science subject leader at Ochre School, "realised that we were not assessing the children's enquiry skills." In each case, formative assessment strategies were introduced and the subject leaders noted how the information gleaned from these is now informing planning. For example, "The emphasis we now have on a dialogic approach to teaching Science has made it easier for teachers to promptly assess and then address gaps in the pupils' learning, as well as aiding in their formative assessments" (Magenta School). Similarly at Ochre School, "Teachers can also identify gaps in the children's knowledge and skills and then use their assessments to inform their planning."

There is also evidence of improvements in summative assessment. At Royal School, "As a result of training, delivered by the Science leader, all staff carry out formative and summative assessments, identify gaps and provide work accordingly. We know this because of evidence in books, through staff meeting discussion and lesson observations." At Scarlet School the, "subject leader introduced use of **TAPS** assessments every half term. Because of this, teachers feel more confident completing assessments within science and have also used this to upload summative data at every assessment point."

The science subject leader at Magenta School noted how science assessment is now more accurate. "Science attainment was often in line with their writing attainment as there was an over-reliance on written worksheets in science. By giving teachers the tools and the opportunity to use discussions to assess progress and understanding, it has allowed those children who may be poorer in writing to show their scientific understanding through other channels and therefore show progress."

The science subject leader at Navy School had not been able to make as much progress with assessment as hoped but planned to do this in the future. "The plan this year was to roll out the **TAPS** assessment across the school, following completion last year. Due to the pandemic this has been a challenge for this year. We are still taking part in the **TAPS** process and have moved this to a science priority on the science action plan for next year." At Magenta School, "Our next step is to ensure that our tracking system is more effective at assessing progress in Science (especially Working Scientifically) so that the tracking system is in line with teachers' assessments. I have had several meetings with SLT to discuss possible options and we are implementing a new system after Easter." (Further evidence relevant to Section A – Increased Strategic Status.)

B. Summary - the project was successful in building systems leaders. Science Influencers were identified and nurtured through the project and the networks they created, supported and learned from were important factors in supporting their development. Systems Leaders need to identify strengths and areas for development for science in their schools and they did this through monitoring. They became increasingly familiar with the primary science education landscape and the impact on their schools is evident through the CPD they provided to colleagues and the changes to curriculum and pedagogy that were implemented. This relates closely to the CPD provided which is considered in greater detail in section D.
Assessment was the final area of systems leadership considered. Those who attended the **TAPS CPD** wrote confidently about improvements in both formative and summative assessment and even those subject leaders who did not attend the **TAPS** CPD were nevertheless better informed about best practice. However, there were few mentions of moderation of assessment judgements either within or between schools. This presents an opportunity for future development, to ensure that once the statutory assessment of science at the end of key stage 2 is reintroduced in summer 2022 that judgements are rigorous and accurate.

C. Improve connectivity

Connections within schools were apparent in the PSQM data. To connect their colleagues with best practice in primary science the subject leaders started their PSQM year by creating a vision and principles of science teaching and learning. The PSQM submission requires each school to create such a vision for science in the form of Principles of science teaching and learning. This is one of the **core documents** that science subject leaders present as part of the evidence submitted. It is therefore to be expected that a whole school vision for science has been created and implemented in each school.

Through the collaborative creation of the vision teachers, and in some cases, pupils became better connected and began working towards a shared goal.

> For example, at Royal School the science subject leader commented that, "Clear principles for Science are now well-established within the school."
>
> In each case the Principles were created collaboratively with the teaching team informing their content, but some of the schools also allowed other stakeholders to contribute. For example, at Navy School, "the principles were made in collaboration with the student leadership team. The children have ownership of them, and they are focused on what the children want from their Science learning."
>
> The principles have given the science subject leader at Royal School, "a much clearer view of science across the school and a vision which I am able to communicate to stakeholders." At Burgundy School the science subject leader stated the, "principles are robust and seen in action, even during lockdown learning for key-workers in school and some for home learners." The science subject leader at Magenta School makes the impact of the principles clear. "All teachers are aware of our vision for Science and use this to support their planning and preparation of whole topics and individual learning opportunities, not just in Science but throughout the curriculum where poignant and relevant connections can be made."
>
> In terms of making sure colleagues are advised and supported on the pedagogy and appropriate resources to achieve their stated vision, the science subject leader at Scarlet School ensured the principles were displayed, "on all classroom working walls and are used within lessons; staff will ask the children which of our science principles have we met today?" "Furthermore, the science principles are embedded through the SDP which is used to develop our staff meeting timetable." At Navy School the science subject leader shared how, "the pupils have begun to talk about how the principles link to their science learning particularly how language links to their learning." Ochre School's science subject leader linked the principles to monitoring activities (see section B). "The impact of having clear science vision is that everyone clearly knows what is expected. Therefore, when carrying out planning/book scrutinises and lesson observations the teachers know what I would be looking for.

The process of creating the vision and the implementation phase, where the vision became a reality, both served to increase the quality and quantity of connections within schools. The science subject leaders also increased connectivity within schools by sharing their learning from national and local networks within their schools, during staff meetings. Information was also shared by email and in other ways, especially when Covid-19 restrictions prevented face to face communication. Implementation of national initiatives and events mentioned above (see page 10) have further ensured that broad developments in the landscape of primary science education have been shared more widely within schools. (See also Section D – Upskilling the Workforce.)

The network of Science Influencers across the city increased connectivity between schools and served to provide the recognised 'Go to' for primary science, however this was not the only network and other networks mentioned included: Ogden Trust partnerships, Multi-academy trusts, Science Influencers visiting other schools, SATC network meetings, networks created through CPD (e.g. TDTS and TAPS). Information has been shared widely throughout these networks of science subject leaders established across the city. This was, in part, facilitated by opportunities to meet at **CPD** sessions and network meetings.

> The science subject leader at Royal School mentioned how, "The regular half termly network meetings have enabled science leaders to plan collaboratively, resulting in greater collaborative learning, co evaluation and professional understanding of the pedagogy of science teaching across the key stages."

Networks proved significant as noted by several of the science subject leaders.

> The science subject leader at Burgundy School mentioned playing an active part in both the **SATC** community as well as the science community for the school's multi academy trust. Networks were also important to leader at Ivy School who noted, "A strong support network has been Science across the City, and the **Ogden Trust** partnership who, through regular email updates, WhatsApp messages and newsletters, have guided us to relevant materials to use with children in school and whilst learning remotely." The importance of these networks in improving the quality of primary science provision is highlighted by the science subject leader at Magenta School. "Liaising with other members of the Academy Trust has provided me with ideas (such as the investigation word mats and the use of CREST investigations across the school) that have improved, supported and enhanced the quality of children's science education." At Ochre School the significance of networks can be seen through thoughts about the future; "It would be even better if next year I could work collaboratively with other schools in my area to apply for the **Ogden Trust** school partnership."

C. Summary - Connectivity both within and between schools improved as a result of the **SATC** initiative. There is evidence that through both the collaborative creation and implementation of a vision and principles of good primary science teaching and learning, connections were made within schools. Staff meetings to share CPD provided further opportunities to increase connectivity within schools. The network of Science Influencers, along with other primary science networks, was fundamental in developing connections between schools and science subject leaders in particular. These networks were valued for their supportiveness and the expertise within them, and the support of senior leaders in providing resources of both time and money for developments in science teaching and learning were also appreciated.
Through developing relationships with other funding bodies (for example, The Ogden Trust) the sustainability of the SATC has been increased.

D. Upskill the workforce

A wide range of **CPD** opportunities, offered as part of the **SATC** project, were taken up by both the science subject leaders and their colleagues. The opportunities mentioned included:

- **PSQM**- Leadership **CPD**
- **Thinking, Doing, Talking Science**- Pedagogical Approaches **CPD**
- Teachers Assessment in Primary Science (**TAPS**)- Enquiry and Assessment **CPD**
- Practical Action
- Phizzi Forces
- Better Reading: Better Science
- **Science Capital**
- Digging Deeper Series
- JCB Primary Physics
- and on-line topic specific sessions from Reach Out **CPD**

The 'menu' of **CPD** opportunities was responsive to need, in that science subject leaders were able to select the most appropriate courses for themselves and their colleagues

The science subject leaders were positive about the impact of the **CPD**.

> For example, the science subject leader at Scarlet School wrote, "staff confidence with certain areas of science has improved. This means that teachers are not concerned about giving children more freedom in lessons and therefore the working scientifically strands of the curriculum are consistently being hit in lessons." At Magenta School, "My Thinking Doing Talking Science **CPD** has had a fantastic impact throughout the school. As we have implemented the "Bright Ideas Time" with particular focus on "Odd one Out" activities, teachers are immediately aware of children's prior knowledge and misconceptions. As an example of this simple yet highly effective activity, teachers in Year 5 are able to see any gaps in learning or misconceptions from children's Year 4 learning on States of Matter and are able to address these almost immediately." (This links to formative assessment which was covered in Section B.) Burgundy School's science subject leader claimed that because of the **CPD** input, "The biggest difference is that teachers now confidently access a range of useful resources to support planning and the development of scientific enquiry skills."

It is important that **CPD** is targeted to meet need and this is addressed by some of the science subject leaders in their comments.

> For example, the School Development Plan for Royal School stated, "Subject leaders to identify and provide appropriate **CPD** for teaching staff." Not all in-school CPD was in the form of staff meetings and could therefore target the specific needs of individuals. The Ivy School science subject leader organised an, "Individual meeting with a year 1 teacher to support planning of plants topic, and individual support for NQT to develop plans to teach sound."

The science subject leaders also wrote about the impact of the **CPD** on themselves as subject leaders.

> At Navy School the science subject leader now felt she was, "a strong leader of science" and at Magenta School the subject leader felt **CPD** had "improved my subject leadership and allowed me to implement changes across the school and effectively support staff development."

Where the science subject leader or another colleague had attended training there were examples where this was shared with colleagues (further developing connections; relevant to section C).

> At Royal School, "Following a trial of **TAPS**, the Science leader identified gaps in practical work which led to staff training on the Plan, Do, Review approach." The Burgundy School science leader stated, "Colleagues have benefitted from high quality **CPD** both from myself, **Reach Out CPD**, **ASE** and **ESERO**. They have continued to develop their knowledge and understanding of **enquiry types** by examining progression and **AfL** strategies whilst building up a bank of 'go to' websites and resources."

The **TAPS** training provided as part of the **SATC** initiative and the resulting improvements in assessment practice were frequently mentioned by science subject leaders and further evidence of the impact of this training can be found in section B – System Leadership.

> The science subject leader at Ochre School noted, "teachers use the **TAPS** approach and focus on one part of the working scientifically cycle. The impact of this is that the teacher has a clear focus and the children understand what skills the teacher is assessing. Prior to using the **TAPS** approach, the children were overwhelmed with planning, implementing, recording data and reviewing their investigation all in one lesson." At Ivy School, "All staff have been given a **TAPS** Working scientifically poster to share with the children in their class and to display in the classroom. As a result of this, staff, children and Science Lead are able to easily assess and monitor opportunities to work scientifically in science lessons." At Magenta School the **TDTS** training was credited with introducing **AfL** strategies, "allowing teachers to establish pupils' understanding so far and any misconceptions."

The **TDTS** training influenced many areas of practice, including assessment and developing pupils' scientific questions.

> The science subject leader at Scarlet School stated that the TDTS training, "introduced staff to a range of websites and resources that could be used to assess children's prior knowledge." At Royal School, "teachers have been introduced to a range of strategies that can be used throughout their science teaching, to develop children's scientific reasoning and thinking. Teachers have used resources from this training, such as odd one out pictures, in their lessons to help develop children's scientific question."

Upskilling of the workforce is evident in all the areas covered by the PSQM criteria. These include science capital, science enquiry, assessment, range of teaching and learning approaches, and outdoor learning. The multifaceted approach of the SATC initiatives makes it difficult to isolate the impact of a single element and the data are all based on reflections written to demonstrate that the schools now meet the **PSQM** criteria. While **TDTS, TAPS, Better Reading: Better Science** and other elements of the **SATC** offer have had impact in several areas covered by the **PSQM** criteria, the development of a vision for science teaching and learning and the monitoring criteria are perhaps the ones least likely to be influenced by other training provided as part of the **SATC** offer. The impact the vision has already been discussed in section A – Increasing Strategic Status and the impact of monitoring has been discussed in section B – Building Systems Leadership.

It is also highly likely that the science subject leaders became aware of the concept of **science capital** through the **PSQM** criteria. This concept emerged from the Aspires research[4]. This

[4] https://www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/aspires-research

identified the personal, social, familiar, institutional and structural factors shaping young people's aspiration regarding STEM education and careers. The research found, "students who were significantly more likely than others to aspire to a career in science were the most socially advantaged students, but particularly boys and those from middle-class families, and especially those with a family member who has a science qualification and/or science-related job."[5] The research also concluded the demographic profile of those expressing science aspirations becomes less diverse over time. The science subject leaders in this study were aware of the negative impact of deprivation on STEM aspirations and the science subject leader at Scarlet School stated, "being based in a deprived location, broadening the experiences and future aspirations of our pupils is a top priority." The science subject leaders therefore acted in the wider interest of deprived students to raise their aspirations rather than solely focusing on the STEM aspirations of girls.

The developing understanding of the concept of **science capital** was evident in the submissions written by all the science subject leaders.

> For example, at Ochre School, "it was evident that the children had misconceptions about what makes a scientist. A pupil said 'Oh cool a real scientist' (a typical older man wearing a white coat)." In response the subject leader, "created a school display to remind the children that not all scientists wear a lab coat and that there are many jobs linked to science. The impact of this was that children felt inspired and empowered throughout the day I had girls approach me saying that they can be a scientist." Magenta School's science subject leader, "Introduced **Science capital** and why it was a really important focus in our school." She decided to, "run a STEM club in Summer term with Pupil Premium children who have a low **Science Capital**" and believed this resulted in, "great impact on the SEND learners who have benefitted from a collaborative classroom environment, peer support and discussions in helping them to convey their own understanding of scientific concepts." The impact of an initiative to raise **science capital** at Ivy School was perceived to be, "the children to feel excited about their learning and also help raise aspirations for what jobs they would like to go in to in the future. Staff have fed back that they feel able to raise **science capital** effectively." Burgundy School received, "Outstanding for the Primary Careers Award- a lot of which was STEM and **science capital** related." One of the highlights selected by the science subject leader at Navy School was, "Before **PSQM**, the children did not speak often about science and particularly science careers. The children now have a rich knowledge linked to science and the world around them and want to become 'scientists' in the future."
>
> The science subject leader at Navy School recognised gender stereotyping as an issue and led assemblies "to promote women in science, as this is the area in school where aspirations are low in the careers chosen." Both assemblies started with a story, Ada Twist, Scientist, and Rosie Revere, Engineer. Similarly, Scarlet School's science subject leader discovered that gendered stereotypes were present in her school but took action to begin to address this. "Before the workshops, girls seemed to have stereotypes in terms of which genders complete certain jobs. After the workshops, pupils were enthused and excited about engineering and showed an interest in the subject."

One particular area in which the workforce became upskilled was I teaching science enquiry.

> At the start of the year the science subject leader at Ivy School noted, "Teachers showed little understanding of the five **enquiry types** so a staff meeting was planned and resources were collated

[5] https://discovery.ucl.ac.uk/id/eprint/10092041/6/Moote_9538%20UCL%20Aspires%202%20report%20online%20version.pdf p8

to help staff when planning. Medium-Term-Plans were adapted to ensure an equal coverage of all **enquiry types** are focused on throughout the year." Similarly, "Previously in the (Magenta) school, there had been a perception that experiments were all fair tests and this was limiting the children's experiences in science. Through our training we were able to highlight areas in the curriculum where we could use the different types of science enquiry for each year group." To address any lack of knowledge about different types of enquiry and the appropriate times to use them, the science subject leaders attended and shared **CPD**. For example, at Navy School, "after a staff meeting on the 5 different types of enquiry (with examples of each) staff commented on how they now felt confident delivering enquiry lessons." At Ochre School the science subject leader, "adapted our science planning to ensure that all **enquiry types** are being covered", and "created school display to reinforce the working scientifically cycle and the five **enquiry types**". At Ivy School, "Staff have been given posters of the five **enquiry types** to add to their display boards which allows children to be part of the developed understanding and ensures coverage of all types."

By the end of the year most of the science subject leaders were confident that all **enquiry types** were being taught. For example, monitoring at Burgundy School, "shows that pupils are given opportunity to engage in a full range of **enquiry types** from Y1-Y6." However, at Ivy School the science leader aspired to also have pupils as well as teachers aware of the five **enquiry types**. "This continues to be a development point to focus on post covid with next steps being to make all children aware of the five **enquiry types** so that they too can develop their independent thinking when taking part in practical investigations."

In addition to the coverage of the five **enquiry types** the national curriculum also requires pupils to develop certain enquiry skills and pupils developing many of these skills were mentioned by the by the science subject leaders. At Royal School, "As a result of training for staff by the Science lead on 'Plan, Do. Review', children are being taught to ask questions, plan investigations and present and comment of findings." Through engaging with a range of practical enquiries, at Navy School, "the children have more time to explore and test their predictions and are beginning to understand the link this has on the conclusion."

One teaching and learning strategy that became increasingly prominent was practical work which is frequently associated with science enquiry. There is evidence that opportunities to engage in practical science activities are increasing for the pupils.

The teachers at Ochre School, "agreed that science should be practical and hands on. Across the school, staff are trying to make lessons more practical. Classes have used making models to promote learning. For example year 3 pupils, used dog biscuits and pasta to create the human skeleton. They made fossils using play dough. Year 4 created a model of teeth and Year 2 used clay to explore materials." At Burgundy School practical science activities were facilitated as part of home learning. "Science has proven to be one of the subjects that has transferred most successfully to home-learning and key-worker learning. Practical and cross-curricular tasks have been set for pupils. Bringing science into the home is a step on from the family homework that we set previously each half term. It demonstrates how science is part of their everyday lives and encourages family collaboration." The science subject leader at Magenta School indicated the availability of equipment was important in facilitating practical work. "Having a fully stocked Science cupboard has encouraged all teachers to plan more practical lessons thus engaging pupils."

The benefits of practical work were highlighted by the science subject leader at Ochre School. "Prior to **PSQM** staff would rely on worksheets and labelling activities. Practical work allows SEN and EAL children to participate and to share their ideas. When working practically children are talking and

sharing their ideas." The Magenta School science subject leader thought similarly, "Science has become more practical and dialogic between pupils as well as between pupils and teachers with a greater focus on the Working Scientifically objectives."

As a result of **CPD** there was evidence of teachers across the schools amending the ways in which pupils recorded their learning.

At Magenta School, the way in which science learning was recorded and assessed was altered. "Science has changed beyond recognition as we have completely shifted the focus from full experiment write ups to focused writing and discussion-based assessment." The impact was clear to the science subject leader, "a result of focussing on the Working Scientifically objectives, children are presenting data more in science than they have done previously in KS1 and KS2 in the form of graphs, pictograms, tables. On recent NFER testing in maths children performed well in statistics questions across the school which I believe is a benefit of the extra work that they have done in Science on presenting and analysing data." "Over 90% of children stated they enjoyed science more now there is less writing involved." No further comments on the methods for recording and presenting different types of data were identified, possibly as a result of the **PSQM** criteria not focusing on how work is recorded. "A greater variety of learning opportunities is reflected in class books, big books and pupils feel more engaged." Burgundy School

One other area in which development occurred was in teachers' and pupils' use of scientific vocabulary.

At Scarlet School the development of the use of scientific enquiry was seen as important. "Children need to have vocabulary rich lessons that enable them to talk confidently about their learning. The use of key vocabulary in lessons has been a focus across our whole curriculum and was seen as important by all staff. From this we embedded the use of key vocabulary in our science curriculum overview and science principles. Key vocabulary is now displayed on working walls and referred to during lessons. When talking to pupils, they could use the key vocabulary to talk through their work and showed a deeper understanding." Plans to continue to develop in this area were in place. "In the future, we aim to further develop the pre-teaching of key vocabulary so that all learners, including those with EAL (English as an additional language), are able to have a deeper understanding in science."

Other schools also focused on vocabulary acquisition. At Navy School, "Key knowledge and vocabulary are revisited regularly to promote long-term learning." Both Navy and Magenta Schools introduced knowledge organisers which included key vocabulary and Navy School found, "a range of key vocabulary and diagrams are beneficial for EAL learners." But at Magenta School, "although there has been some improvement with vocabulary, I feel that this is an area where we can really focus on for the remainder of the year to ensure that children are using the correct age-appropriate vocabulary. Science investigation word mats are being introduced throughout the school next year. This will enable children to independently think about what they need to consider when setting up an enquiry and therefore take ownership of their own investigations."

Also, as a result of **CPD** there is evidence that the science subject leaders were aware of a range of teaching and learning strategies and were introducing them to their colleagues.

For example, at Royal School the subject leader also links teaching strategies to **CPD** and science enquiry. "As a result of engagement with professional development, teachers have been introduced to a range of strategies that can be used throughout their science teaching, to develop children's

scientific reasoning and thinking. Teachers have used resources from this training, such as odd one out pictures, in their lessons to help develop children's scientific questions."

Outdoor learning was introduced by some science subject leaders.

At Navy School year 1 pupils walked round the grounds to look for evidence of seasonal change, identify trees and follow a sensory trail; year 3 pupils named flowering plants and collected flowers to dissect; and year 5 pupils examined strawberry runners and discussed how not all plants reproduced through seeds. The outdoor area at Royal School was developed and used increasingly. "As a result of the outside area being developed for class use, children have had increased opportunities to access Science outdoors." The science leader at Magenta School also referred to, "the increased use of our outdoor spaces" and noted the benefits of this. "Children's use of the outdoor environment (especially during Forest School) has engaged learners and developed their enthusiasm for science within a real-world context which is vital in improving the low **science capital** identified across our school." While opportunities to visit places beyond the school gates were restricted because of Covid-19, alternative opportunities were presented. The virtual visit to Chester Zoo was mentioned above, and pupils at Magenta School were able to visit the Blue Planet Aquarium and a local farm.

Because of Covid-19 and the restrictions placed on schools, subject leaders used strategies they may not otherwise have considered.

The subject leader at Royal School stated, "Rather than see this [Covid] as a negative, we have grasped the opportunity to teach Science in a different way and use the virus to show children the importance of science and the role of scientists in today's world." At Ivy School, "Remote teaching has been adapted by staff to ensure that science is still at the forefront of our curriculum delivery. Staff have used alternate strategies of teaching, such as live demonstrations on Teams calls which the children enjoyed and this has encouraged children to take part in investigations independently, at a level suited to their understanding. Planned Science activities have been adapted and personalised to learners at home. We have invited parent speakers on to our Zoom calls to speak with their children if they have a scientific job. During lockdown, we had a whole school virtual visit to Chester Zoo. Children thoroughly enjoyed the day exploring habitats and share experiences with friends virtually afterwards. It was great to see children learning in this positive and exciting way during these challenging times."

Teachers at Burgundy School experimented with other teaching and learning approaches. "Staff have welcomed these **AfL** ideas as we already have **AfL** teaching hubs in school focussing on **AfL** strategies, metacognition and philosophy for kids." The range of strategies used at Magenta School also expanded. "Teachers use a range of methods and resources such as videos, practical demonstrations and questions to engage all learners." "There are also close links between Science and English as most year groups use a science based book in English such as Stone Age Boy and Pig-Heart Boy. Across EYFS, all science units are linked through a story such as "The Three Little Pigs" or "And Tango Makes Three" which enriches the children's learning."

Some of the science leaders also referenced plans for the future and their commitment to continuing to use **CPD** to improve science teaching and learning.

At Ochre School, "My next steps would be to offer **CPD** for TAs and HLTAs." For the science subject leader at Navy School, "This has encouraged me to actively seek out training, resources, and networking to ensure the school thrives further."

D. Summary - It was apparent that science subject leaders as well as teachers within the schools became upskilled through the use of both formal, **CPD** courses and through more individual targeted support. Evidence of developing skills was present in classroom practices of both the science subject leaders and their colleagues. This included the areas of science enquiry, practical work, **science capital**, recording science learning, range of teaching and learning strategies, science vocabulary and outdoor learning. In addition, the science leaders also felt upskilled in their systems leadership skills related to science.

Overall summary -

The SATC project has been successful in each of the four areas that have been the subjects of this evaluation: Increasing the Strategic Status; Building Systems Leadership; Improving Connectivity; and Upskilling the Workforce. Connections between the four areas are numerous. For example, increasing the strategic status, improving connectivity, and building systems leaders enabled CPD to be provided to address identified areas for development within the schools taking part in the project, upskilling not just the science subject leader but other staff within the school.

The data collected from the PSQM submissions anecdotally indicates that pupils also became upskilled, however, that is not verifiable through quantitative data because statutory teacher assessment data for science were not collected nationally in 2020 or 2021.

While the SATC project focused on practice in Key Stage 2 no evidence was found in the PSQM submissions to indicate that improvements in science teaching and learning were limited to Key Stage 2. The teachers have managed to apply the strategies across a wider age group so that pupils throughout the schools have benefited.
The teachers involved in the project have developed science teaching and learning during unprecedented times and have mitigated the extent to which the restrictions imposed because of the Covid-19 pandemic presented barriers.

Based on many years as a PSQM Hub Leader and reviewer, the area that distinguishes the schools in the SATC project from other schools that participate in PSQM, is the influence of the many communities that became available to, and were joined by, the science subject leaders. While science subject leaders engaging with the PSQM would normally engage with primary science networks, the extent to which this happened

within the SATC communities is unprecedented. Membership of SATC and other networks, and the presence of 'knowledgeable others' within them, was instrumental in each of the four areas of Improving Connectivity, Building Systems Leadership, Upskilling the workforce and Increasing the Strategic Status of science education.

Limitations of the research

It should be born in mind that the data on which this report is based have been self-reported by the science subject leaders, although there is substantial evidence in terms of examples of pupils' work, photographs and other documents to support their claims. The evidence has been written with the aim of presenting progress in science teaching and learning in a positive light to ensure that the reviewer will agree a primary science quality mark should be awarded. Each of the science subject leaders was successful in gaining a Primary Science Quality Mark for her school.

Because the evidence was presented to demonstrate that the **PSQM** criteria had been met, there may have been other evidence relevant to this report that was not contained in the **PSQM** evidence. Also, evidence regarding any areas of weakness may not have been mentioned in the **PSQM** submission. However, these disadvantages have been balanced against the additional workload that would have been imposed on teachers had data been sought to match directly the four areas on which this evaluation has been based. The decision was made to minimise the impact on teachers while presenting an evaluation of the **SATC** project.

The data have been collected from only seven schools which may or may not be representative of the other schools involved in the **SATC** project. The seven schools will have been guided in their approach to developing science teaching and learning by the **PSQM** framework so schools that have not chosen to complete the **PSQM** may be different in some respects to those that have. Although this report has been based on the seven schools completing **PSQM** in March 2021 a total of 47 schools out of the 71 school in Stoke-on-Trent have either completed or are currently working towards a **PSQM**.

Questions Arising

Considerations for the SATC project strategy team

- Does or should the strategic aim to 'Increase the Strategic Status' of science, include the ambition for pupils to understand the importance and relevance of science in their lives? Based on the evidence the project has been successful in this regard, and as such could potentially build upon this success further.
- The SATC plan show the four elements considered as part of this evaluation as separate entities. The evaluation made many links between them and the project leaders might consider if these links might be made more apparent in the project plan showing explicitly how the layers build upon each other towards the overall aim.
- Moderation of the assessment of science between schools has been restricted (possibly because of restrictions resulting from the Covid-19 pandemic). Could the project leaders consider this as a

potential next step to develop a tool to ensure the reliability and validity of teacher assessment data within the City?

- While connectivity between and within Science across the City schools increased, some schools remain hard to reach. What is happening to science teaching and learning in these schools? The project aimed to close the gap between Stoke-on-Trent and National data but in the process has the gap between schools within Stoke-on-Trent become wider?

Considerations for future evaluations

- It is impossible to isolate the impact of PSQM alone from to the impact of the full SATC offering. It would, however, be interesting to consider the impact of the SATC project on those schools that completed PSQM prior to the commencement of the SATC project and the additional developments that have occurred since SATC began.

As Director of the Primary Science Quality Mark programme, I am delighted that PSQM has continued to play a key role in the Science Across the City (SATC) project. The submissions for Primary Science Quality Marks from participating schools are impressive, demonstrating clearly, in a way that is familiar to me, the positive impact of effective leadership on science teaching and learning. However, this report's analysis of the successful submissions against the four SATC aims of Increasing Strategic Status, Building Systems Leadership, Upskilling the Workforce and Improving Connectivity provides exciting new insights into PSQM's Theory of Change which will be used to improve the programme for the future. Of particular significance to me is the evidence of the impact of strategic leadership at school level through development plans and monitoring, and at city level through networks and collaboration, and how at each level this is driven and supported by connectivity with the wider science education community. This report shows that the success of sector leadership depends on the development of strong, strategic communities of practice, which are enabled and informed by a broad and clear understanding of best practice. Working with the Science Influencers on a curriculum recovery resource has been a highlight of my year. I experienced at first hand their individual expertise and what a powerful resource this was when combined with external agencies to meet a shared goal.

The report also evidences the outstanding resilience, commitment and motivation of the subject leaders involved, at a time of unprecedented difficulty for primary education, made even harder in Stoke due to socio- economic challenges. They deserve praise and congratulations, as do the SATC project leaders who have driven this initiative so effectively and energetically, working with many different organisations to ensure that Stoke schools have engaged with the very best in primary science practice.

My thanks go to Dr Clare Warren for this insightful report, Tina Whittaker for her brilliant and compassionate leadership of the SATC project and to the amazing science subject leaders in Stoke City schools. Together you have shown how PSQM has, in collaboration with other organisations and programmes, supported school improvement in science on a city-wide scale which is immensely gratifying. More importantly you have shown how PSQM can improve how it works in the future, to ensure that the aims of SATC can be realised in other parts of the UK. Thank you.

Associate Professor Jane Turner CSciTeach
Director: Primary Science Quality Mark
University of Hertfordshire

PSQM is based at the University of Hertfordshire and supported by a partnership between the University and the Primary Science Teaching Trust.

Glossary

AfL	Assessment for learning, also known as formative assessment.
ASE	Association for Science Education – A registered charity supporting all those involved in science education.
Big Bang Fairs	National and regional events to celebrate STEM, combining theatre shows, interactive exhibits and careers information. Targeted at 7 to 19 year olds.
Core Documents	The PSQM requires subject leaders to upload a wide range of qualitative data in the form of specific core documents to the website for review. This includes the **principles** (see below), logs of **CPD** and activities undertaken by staff and children, the School Development Plan, written reflections covering 13 criteria statements and a portfolio in the form of a Power point presentation of about 20 slides containing examples of planning documents, children's work, children engaging in various science related activities and other supporting information.
CPD	Continuous Professional Development or Continuing Professional Development
CREST awards	A nationally recognised scheme for student-led project work that inspires young people to think and behave like scientists and engineers.
Enquiry types	The National Curriculum in England specifies five types of science enquiry that primary children should engage with. These are research using secondary sources; identifying, grouping and classifying; pattern seeking; observation over time; and comparative and fair testing.
ESERO	European Space Education Research Office, also known as the UK space education office.
Explorify	A free digital resources for teaching primary science offering a range of activities to develop curiosity, discussion and reasoning skills.
Great Science Share for schools	An annual campaign to inspire young people to share their scientific questions with new audiences
Ogden Trust	The Ogden Trust aims to increase the uptake of physics for all at post-16, particularly for those from under-represented groups. The Trust supports schools, projects and programmes that are committed to enhancing physics teaching and learning.
Primary Science Quality Mark (PSQM)	The PSQM is a national, **CPD** supported, accreditation programme aimed at improving science leadership, teaching and learning and raising the profile of science in primary schools. It is based at the University of Hertfordshire where it is supported by partnership with the Primary Science Teaching Trust (PSTT).
Reach Out CPD	30 on-line courses for teachers of 5 to 11 year-olds, covering the primary curriculum. Each one provides teachers with concise topic knowledge and resources to use in class, including short videos, practical activities and experiments, and whiteboard visuals.
SATC	Science Across the City
Science Capital	The concept of science capital is a way of encapsulating all the science-related knowledge, attitudes, experiences and social contacts that an individual may have. Those with higher science capital are most likely to choose to continue studying science.
SLE	Specialist Leader of Education. A role that focuses on developing leadership capacity and capability of other leaders, so they have the skills to lead their own teams and improve practice in their own schools.

STEM Learning	The UK's largest provider of education and careers support in science, technology, engineering and mathematics.
TAPS	The Teacher Assessment in Primary Science (TAPS) project is a 3-year project based at Bath Spa University and funded by the Primary Science Teaching Trust (PSTT). It aims to develop support for a valid, reliable and manageable system of science assessment which will have a positive impact on children's learning.
TDTS	The Thinking, Doing, Talking Science project is based at Oxford Brookes University. A programme that aims to make science lessons in primary schools more practical, creative and challenging. Teachers are trained in strategies that aim to encourage pupils to use higher order thinking skills.