A response to the Ofsted *Finding the Optimum* report: implications for practice in primary science

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Content

About this **guidance**

Finding the optimum: the Ofsted science subject report was published online in February 2023, drawing together observations and recommendations from recent inspection visits to schools.

Whilst the latest report does have separate primary and secondary sections, there are some areas that merit further guidance for primary science practice.

This guidance builds on the Ofsted Research Review response (Turner, Bianchi, and Earle, 2022) and has been brought together by Primary Science Quality Mark, The University of Manchester's SEERIH and the Association for Science Education. Professional dialogue and consultation with members of these organisations gave the opportunity to reflect on the Report through a primary science 'lens'. From this five implications for practice emerged and each are considered in terms of:

- **What this means for primary science**
- **How this could happen in practice**
- **Prompts for next steps and further discussions in school.**

How to use the guidance

The guidance should stimulate reflection and dialogue amongst primary science subject leaders, teachers and professionals who support them. The guidance should be shared with all teachers of primary science, and ideally discussed with senior leaders and within a staff meeting. Use the prompt questions to encourage reflection on current practice from which to identify next steps towards high-quality science education.

Five implications for practice in primary science

Five implications for practice emerge from the Ofsted 2023 report that are of particular relevance to primary science teachers, science subject leaders and their senior leadership teams. Guidance is provided on each of the following:

1. **Professional learning and development:** Meaningful professional learning for staff and leaders should be planned for by having clear purposes related to the needs of your whole school.
2. **Connected curriculum:** Science is a core subject that requires whole-school planning which 'dovetails' between key phases of learning to ensure coherence and progression.
3. **Disciplinary knowledge:** Progression in disciplinary knowledge, the ways of working in science, needs to planned for and assessed in the same way as it is for substantive knowledge of science.
4. **Purposeful assessment:** Assessment information should be used to support learning.
5. **Evidence-informed pedagogy:** Decisions about selection of teaching approaches for science should be based on evidence from within school and informed by evidence from the sector.

1.

Professional learning and development

'Very few schools had a clear plan of how teachers' knowledge of science, and how to teach it, was developed over time through ***continuing professional development****.'*

'Not all subject leaders had access to ***dedicated leadership time*** *and* ***subject leadership training****. This is a concern, given their central role in ensuring good quality teaching in their subject.'*

'Create a ***systematic and continuous approach*** *to developing the science expertise of staff and leaders. This should align with the school's curriculum and take account of any specific needs and expertise.'* **(Ofsted, 2023: Main findings)**

What does this mean for primary science?

All teachers need opportunities for science-specific professional learning to achieve the optimum outcomes from teaching science to their pupils. There are a wide range of professional learning opportunities that go beyond 'going on a course', including reading, team teaching, discussion with colleagues, social media, higher level study, membership of local and national networks etc. In addition, science subject leaders require specific professional learning focused on management and leadership of the subject and staff.

How could it happen in practice?

Teacher professional development needs to be aligned to the needs of learners, identified through regular monitoring of science across the school. It needs to be planned for, systematic and sustained, in order to improve ***teacher understanding of how to teach science*** as well as enhancing subject knowledge (DfE, 2016).

Other key aspects of effective professional development include the way that it is cascaded across the teaching team, and how new learning is embedded and evaluated once the professional learning has been completed (Bianchi et al. 2023). Routines for information and skill sharing, along with a good awareness of the intended outcomes for teachers and learners from the professional development, should lead to the learning influencing more than just the person who took part.

What's the key message?
Meaningful professional learning for staff and leaders should be planned for by having clear purposes related to the needs of the whole school.

Priority prompts for discussion

1. **Is there a system in the school to identify the needs for professional learning and evaluate outcomes?** Are decisions informed by internal monitoring? What changes to practice and pupil outcomes do you want to achieve? How will you evaluate the impact of professional learning?

2. **Does the subject leader know where to go for support?** Are they aware of expertise locally, nationally and internationally? Is the school a member of subject associations and networks? See page 12.

3. **Is the subject leader confident to judge the quality and relevance of the sources of professional learning?** What are the indicators of high-quality professional learning? What evidence is this based on? Does it align to current policy messages? Is it relevant to address the needs of the school?

4. **Are senior leaders and budget decision-makers able to allocate ongoing funding and time towards primary science for all teachers, and not only the subject leader?**

2.

Connected curriculum

Ensure that enough time is built into the curriculum for pupils to learn and remember key knowledge. **(Ofsted, 2023: Recommendations)**

In a significant minority of schools, pupils were not developing secure knowledge of science. Often, in these schools, the focus was on covering the content, rather than ensuring it was learned, or completing practical activities. There were a small minority of primary schools where pupils went for entire half terms without learning science. This is a concern because science is a core subject of the national curriculum, and pupils benefit from regular opportunities to revisit and build on their knowledge so that it is not forgotten. **(Ofsted, 2023: Main findings)**

In most primary schools, leaders had considered how the curriculum in Reception supported pupils to learn science in Year 1. Often this involved leaders from different parts of a school all working together to make sure that Year 1 and Reception curriculums 'dovetailed'. This required leaders to have a clear understanding of the key vocabulary and concepts that they wanted children to learn, and the scientific phenomena that they wanted children to encounter and learn about **(Ofsted, 2023: Primary)**

Ensure that the science curriculum is planned to take account of what pupils learn, particularly in mathematics **(Ofsted, 2023: Recommendations)**

What does this mean for primary science?

As well as a good subject knowledge of the science they teach, teachers need to have a holistic understanding of the big ideas of science. They need to know how what they are teaching in their year group links with children's previous learning across all science topics and the foundations it builds for future learning in science.

Sufficient curriculum time should be allocated to science each week throughout the year and across the whole school. Long-term planning should be whole-school and involve all teachers in all year groups, drawing on secure understanding of how science knowledge (substantive and disciplinary) develops and also is supported by learning in other subjects.

How could it happen in practice?

Where there is a long-term approach to science planning, underpinned by a strong understanding of how knowledge in science topics and the skills children need develop, Early Years Foundation Stage (EYFS) and individual year group teachers can ensure that their own science planning is part of a progressive continuum. This should reduce issues around coverage, as planning builds on previous experiences and learning.

Key Stage 1 and EYFS teachers should discuss what science experiences children have and the vocabulary they develop. This will vary from school to school according to context and need, but science should be planned with an awareness of what came before and what is to follow. To ensure successful transition in science year 5 and 6 teachers should not plan to teach beyond primary statutory content, but instead focus on secure understanding of the science children have experienced across the primary phase.

Practices that support this connected planning may include:

- Long-term planning where teachers from different year groups work together to ensure that they understand how the National Curriculum supports progression in substantive knowledge topics and disciplinary knowledge.
- Planning which takes into account learning in other subjects, particularly maths, which connect with learning in science.
- School display boards where children's work from a science topic such as plants, materials or forces shows the progression.
- Whole-school investigations to emphasise enquiry types and skills and provide opportunities for showing progression in each year group.
- Systematic teaching and use of science vocabulary, both conceptual and process.
- Regularly beginning lessons with prompts for what was learnt last week, last term (different topic) and last year (another different topic), making explicit how this links with the learning in the current topic.

What's the key message?
Science is a core subject that requires whole-school planning which 'dovetails' between key phases of learning to ensure coherence and progression.

Priority prompts for discussion

1. **Is long-term planning for science managed at whole school level?**
2. **Do subject leaders have a secure understanding of how science topics develop across the National Curriculum? What sources of support can they draw on, what support for professional learning accessed?**
3. **Are staff confident about the science they teach, knowing where it fits into a continuum of knowledge progression?**
4. **Are reading and writing used effectively in science lessons to support science learning?**
5. **Is the connection between learning in maths and science explicit?**
6. **How is transition between year groups and phases managed?**

3.

Disciplinary knowledge

'In general, not enough consideration was given to identifying the disciplinary knowledge, including concepts, that are needed to work scientifically. This limited how effectively leaders could plan a curriculum for pupils to get better at working scientifically over time. Too often, the focus was simply on identifying practical activities for pupils to complete.'
(Ofsted, 2023: Main findings)

What does this mean for primary science?

Disciplinary knowledge is a new term for primary schools, but not a new idea. The Ofsted Research Review (2021) introduced it as a term to describe the knowledge in the Working Scientifically section of the National Curriculum. Teachers can continue to use the term Working Scientifically with the awareness that this includes knowledge children need to do science (e.g use a thermometer, control variables, which primary teachers have traditionally referred to as skills), and knowledge children need about science (e.g. that scientists work in different ways to collect evidence, which is why it is important that children use different enquiry types to answer questions).

How could it happen in practice?

Working Scientifically describes an area of knowledge which must be explicitly taught. It can be learned through a variety of teaching approaches, including direct teaching, demonstration, enquiry based learning, teacher explanation and practical work; but there must be always be a focus on what is being learned. ***"Pupils should not be expected to learn this disciplinary knowledge simply as a by-product of taking part in practical activities"*** **(Ofsted, 2023).**

Progression in Working Scientifically is organised into two-year development stages in the National Curriculum. Leaders need to identify what children will do at each stage to progressively:

- *'build knowledge of the methods used to answer questions*
- *knowledge of apparatus and techniques, including measurement*
- *knowledge of data analysis*
- *knowledge of how science uses evidence to develop explanation' (Ofsted, 2023)*

What's the key message?
Progression in disciplinary knowledge – the ways of working in science, needs to planned for and assessed in the same way as it is for substantive knowledge of science.

Curriculum should be planned so that disciplinary and substantive knowledge are taught together, and that children make progress is made in both. For instance, when learning about whether the properties of different fabrics make them suitable for a raincoat, children learn about how scientists use comparative tests to evaluate a material's suitability for a purpose, how to use a pipette to control drops of water and how to complete a table of results. They may also learn how named scientists in the past and today have developed and tested new materials.

Priority prompts for discussion

1. **Is there a shared understanding of disciplinary knowledge across the curriculum within the school?**
   Do teachers recognise that they need to teach not just how to collect evidence to answer questions, but an understanding of why scientists work in that way?

2. **How is progression in the disciplinary knowledge planned for?**
   Do teachers make the disciplinary knowledge explicit in their planning? When sequencing the substantive knowledge do teachers actively build disciplinary knowledge alongside it?

3. **How is disciplinary knowledge assessed?**
   Do teachers use evidence from what children do and say to assess progress towards the different Working Scientifically objectives in the National Curriculum?

4.

Purposeful assessment

'Ensure that assessment checks whether pupils remember the substantive and disciplinary knowledge they have learned in previous years.' **(Ofsted, 2023: Recommendations)**

'In some schools, assessment as learning was sometimes taking place at the expense of assessment for learning. Some pupils were asked to recall knowledge that they had not successfully learned first time around.' **(Ofsted, 2023: Main findings)**

What does this mean for primary science?

Assessment is an essential part of teaching, so it is important to use this key tool to support learning. By finding out about children's prior knowledge, from previous school years or life experiences outside of school, the teacher can decide on appropriate next steps and identify misconceptions that may need to be addressed during the term. This is particularly important in science, because children develop their own ideas about how the world works and these may not match the scientific view. By explicitly identifying the children's starting points, we base our lesson planning decisions on evidence rather than assumptions. Building on prior knowledge also helps the children to connect their learning, valuing the capital that they bring to the experience, together with strengthening links across the curriculum.

It is not possible to revisit all of children's scientific knowledge from previous years, but engaging with prior knowledge about a topic can be an effective starting point for many lessons.

How could it happen in practice?

When assessment is used 'as learning', the main aim is to support children to revisit and remember, but they can only do this well if they have prior experience to draw upon. For example, retrieval quizzes can support pupils to remember key words, but it is not appropriate to do this before they have developed an understanding of the meaning of these words.

When assessment is used 'for learning', the information is used formatively by children and/or teachers, to help decide what to do next. For example, children might self/peer assess their results table for clarity, or teachers might consider whether the children's annotated diagrams show enough understanding of the concept to move on or not. A wide range of examples and exemplification for assessment strategies can be found on the Teacher Assessment in Primary Science (TAPS) and Pan-London Assessment Network (PLAN) websites. See page 12.

What's the key message?
Assessment information should be used to support learning.

Priority prompts for discussion

1. **Do staff use a range of strategies to elicit and revisit prior knowledge?**
   Using a range of strategies supports diverse learners and helps to build connections in learning.
2. **Are common misconceptions explicitly flagged in primary science curriculum plans?**
   What sources of professional expertise are used to ensure that staff are aware of these?
3. **Is planning flexible enough to support responsive and adaptive teaching?**
   Adjustments could be tweaks within the lesson or changes to the next lesson(s). Teachers may need support from the science lead about what to prioritise.
4. **Are assessment discussions (like pupil progress or moderation meetings) focused on the content of what is being learnt?**
   Do staff know what sits behind a summary 'grade'? What does 'meeting expectations' look like for the topic?

5.
Evidence-informed pedagogy

Teachers rarely drew on evidence-based, subject-specific approaches when teaching science.
(Ofsted, 2023: Main findings)

Ensure that appropriate teaching and learning approaches are selected for specific content.
(Ofsted, 2023: Recommendations)

What does this mean for primary science?

Learning develops from teaching that respond to children's needs, their previous learning, their contexts and the concepts being taught. Subject leaders and teachers need access to information, guidance and training about a range of appropriate teaching approaches in order that they can make informed decisions about which to use in different contexts.

The selection of teaching approaches should be informed by a range of evidence. This evidence can come through school monitoring processes: what needs have been identified, what is working well. Decisions can also be informed by sector expertise: professional learning, published research, teacher journals, Education Endowment Foundation guidance, school case studies, teacher action research, subject association guidance etc.

Teaching approaches need to promote inclusion and accessibility for all pupils, and be tailored to suit the scientific knowledge and skills being taught.

How could it happen in practice?

Teachers have a wide repertoire of teaching approaches which may include practical work, teacher demonstration, direct teaching, enquiry based learning, modelling, drama, outdoor learning, cross-curricular, dialogic teaching etc.

Subject leaders could consider what teaching approaches are being used in science across the school and how they support children to develop disciplinary and substantive knowledge.

What's the key message?
Decisions about selection of teaching approaches for science should be based on evidence from within school and informed by evidence from the sector.

As a school, share practice that works well for particular year groups and science topics, and critique those that may not. Support colleagues who lack confidence in using a range of approaches through training or co-teaching.

Subject leaders can engage with professional learning and networks to broaden the range of evidence-informed pedagogy and their appropriate use in school.

Priority prompts for discussion

1. **Which science teaching approaches are appropriate, when and for whom?**
2. **Do staff take part in regular professional learning with opportunities to learn about different teaching approaches?**
3. **How are teaching approaches shared across the school? Do teachers co-teach or team-teach to see teaching approaches 'in action'?**
4. **When practical work takes place, is the purpose clear?**
5. **To what extent are teaching approaches inclusive and supportive to the needs of all learners in science?**

Signposts to additional support

Teachers benefit from a wide range of professional support offered by organisations, charities and individuals within the primary science education sector. Below is a non-exhaustive list of starting points to stimulate ongoing dialogue and development.

Science subject leadership

Primary Science Quality Mark (PSQM)
www.psqm.org.uk

Science & Engineering Education Research and Innovation Hub (SEERIH) and campaigns including the Great Science Share for Schools
www.seerih.manchester.ac.uk

Science planning and teaching

Explorify
www.explorify.uk/teacher-support

Primary science education association membership

Association for Science Education (ASE) with local and national networks, events, journals, guidance and resources
www.ase.org.uk

Regional support and resources

Primary Science Teaching Trust (PSTT)
pstt.org.uk

STEM Learning
www.stem.org.uk

The Ogden Trust
www.ogdentrust.com

Assessment

Teacher Assessment in Primary Science (TAPS)
www.pstt.org.uk/unique-resources/taps

Pan London Assessment Network (PLAN)
www.planassessment.com

NB. A primary science guidance report is currently being put together by the Education Endowment Foundation, so do look out for this later in the year.

References and recommended further reading

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Wellcome (2013) Developing Great Science Subject leadership.

Wellcome (2021) Primary science education beyond 2021 – what next?

About us

Jane Turner

Jane Turner is Director of the Primary Science Quality Mark, based at the University of Hertfordshire where she is an Associate Professor. Jane is lead author of the 2011 ASE guide to Science Enquiry; *It's Not Fair Or Is it?* which is currently being revised and is series editor for *Snap Science* published by Harper Collins. She worked with the Dept for Education as Curriculum Advisor for Primary Science and also as a consultant to the BBC, Wellcome Trust, Learned Societies, Education Endowment Foundation and industry on primary science assessment and curriculum. She is the immediate past chair of the Association for Science Education, chair of the Learned Societies Primary Curriculum Advisory Group and co- editor of *Science Teacher Education* journal.

Prof Lynne Bianchi

Prof Lynne Bianchi is a specialist in curriculum and professional development, innovation and research in primary science and engineering education. She is the Vice Dean for Social Responsibility & EDIA in the Faculty of Science & Engineering and Director of the Science & Engineering Education Research and Innovation Hub at The University of Manchester. Lynne is founder of national campaigns including the Great Science Share for Schools and Engineering Educates, and principal investigator on several research projects . She works with Learned Societies including the Royal Academy of Engineering, Royal Society and Institute of Physics and is currently an expert advisor for the Primary Curriculum Advisory Group and Education Endowment Foundation. She is currently engaged in a Nuffield Foundation Research project focused on practical work in primary science across the UK.

Dr Sarah Earle

Dr Sarah Earle is Reader in Education at Bath Spa University and leads the Teacher Assessment in Primary Science (TAPS) research and development project across the UK. She leads the Education Endowment Foundation Focus4TAPS trial and the south west region of the Thinking Doing Talking Science trial. She is an active member of the ASE, locally in the West of England and nationally on Research and Publications committees. She is editor of the Journal of Emergent Science and co-edited the flagship *ASE Guide to Primary Science Education*. She is also a PSQM Senior Regional Hub Leader for Wales and West. She is currently engaged in a Nuffield Foundation Research project focused on practical work in primary science across the UK.

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Primary Science Quality Mark,
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Science & Engineering Education Research and Innovation Hub
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