The Association for Science Education
Promoting Excellence in Science Teaching and Learning

Best Practice Guidance

Guidance for senior leaders about science

Context

This guidance has been produced to support senior leaders (SLs) in primary and secondary schools who have no recent experience of leading science. Understanding and supporting an effective science curriculum is a challenge, and your science subject leaders are best placed to explain the complexity of the curriculum offer, and the implications this has for timetabling. Taking into account the poorer retention of science teachers, this document makes suggestions for improvement. When observing science lessons SLs will focus on good learning but should be aware that 'wow' experiences may have a limited impact on learning.

The position of ASE

- Accountability profiles have led to a skewed focus on mathematics and English, with the status of science being eroded, particularly in the primary phase. SLs are reminded that science is a core subject, line management by the head-teacher or deputy would help to increase its' status.
- The ASE has extensive support for leading science in both primary and schools with 11 – 18 students (Currently being updated Autumn 18)
- The ASE promotes the entitlement to subject specific CPD for teachers, technicians and teaching assistants in all phases. Developing Great Subject Teaching supports the provision of subject specific CPD to bring about better subject knowledge and pedagogy (and therefore learning) Other evidence also shows regular access to this type of CPD impacts on teacher retention. All of which can lead to professional recognition for both teachers and technicians (Chartered Science Teacher and Registered Science Technician).
- Science is a practical subject, which has consequences for class sizes, equipment, and provision of suitable laboratories in secondary schools. Technical support and resources to support effective science learning are needed across all phases. The Good Practical Science report, Gatsby (2017) lists ten benchmarks which are a good starting point for evaluation of practical provision.

- Secondary science teachers are affected by several factors which impact on retention: a complex curriculum (separate sciences and combined science) often leading to teachers working in areas outside their degree subject; practical activity with large class sizes and the implications this has for planning and resourcing; behaviour management in laboratories or during practical activity; coping with reducing technical support. Minimising the effect of these factors by SLs could lead to better retention.
- The ASE's Science Teacher SOS resource is provided to support those thinking of leaving teaching.
- The ASE understands the demands on school budgets that science can make, however claiming back any underspend in science, may prevent saving for a more expensive resource, a longer term view of the budget by SLs is helpful
- The ASE believes that science should be delivered within a balanced curriculum that ensures all students are able to keep their options open and are not encouraged into routes that could restrict their later life choices.

Best practice should seek to include:

- effective enquiry and practical science that is supported by access to appropriate learning environments. This has implications for staffing, timetabling and resources so that pupils can work in small groups. In secondary contexts the demands of some examination courses means that only first-hand experience can contribute to pupil's success.
- practical work that is purposeful, that has clear learning outcomes. Pupils should be able to tell you what they are doing, and why they are doing it. Be challenging about activities that take up the whole lesson, with no time for analysis or evaluation of any data collected.
- a mixture of different types of scientific enquiry. These should be identified in the scheme of learning and a range of opportunities should be planned. There should be examples of observing over time, classifying and sorting, interrogating secondary sources, comparative and fair tests, and looking for patterns.
- joint observations and follow up discussions with your science subject leader.

- reference to the benchmarks for resourcing and equipping laboratories for primary and 11-18 science available from SCORE -The Learned Societies (no longer updated, but still relevant) These include equipment and consumables, laboratory facilities, access to outside learning space and access to technician staffing.

- the use of science to provide an excellent context for learning in English and Mathematics.

- the valuing of technicians who bring scientific expertise from different contexts and are also pivotal in supporting early career teachers and non-specialists (Good Practical Science p58). Recognise the role technicians play in retaining your science teachers. Use the "Service Factor" calculation to estimate the number of technician hours needed to effectively support the science team (see ASE Best practice guidance: Technicians)

- a focus on Health and Safety as part of routine lesson observations/ performance management. Head teachers and governors are ultimately responsible for Health and Safety in science. All schools (Including primary) should be members of CLEAPSS/SSERC as these provide appropriate training for teachers and technicians as well as some legal safeguarding. Academies, since leaving LA control should confirm their membership status,

- appropriate challenge by SLs of science subject leaders, a good stimulus for discussion are the questions designed by the Wellcome Trust to support primary and secondary governors. These Questions for Governors can be used by SLs to research and structure questions for your science leaders.

- encouraging membership of the ASE, which is the largest subject association, and the only one for science. The ASE has a Royal Charter, and is able to award professional recognition including Chartered Science teacher and Registered Science technician to members. Funding this membership for teachers and technicians, shows that you value the contribution science can make to the curriculum as a core subject.

Links

See the seven recommendations for "Improving Secondary Science" from the Education Endowment Foundation (2018)

See ASE's other Best Practice Guides
Professional recognition
CPD entitlement and provision
Technicians
Governors
www.ase.org.uk/bestpractice

Turner J. *CPD entitlement in primary science.* Teacher Development Trust, Jan 2018. http://tdtrust.org/cpd-primaryscience

Background to the debate about the effectiveness of practical work in science Millar. R & Abrahams. I (2009) www.gettingpractical.org.uk/documents/RobinSSR.pdf

Enhancing Learning with Effective Practical Science 11-16 Abrahams.I and Reiss.M (2017)

Good Practical Science Report: The Gatsby Charitable Foundation, September 2017. www.gatsby.org.uk/education/programmes/support-for-practical-science-in-schools

There are a number of purposes for assessment in education:

- assessment is **summative** when attainment is measured at a particular moment in time and the outcomes are reported to others, including school leaders, parents and employers, for example using end of topic tests and public examinations. Outcomes from summative assessments may also be used for **quality assurance**, to monitor the effectiveness of the teacher, school, or system.
- assessment can also be used for **formative** purposes when the evidence is used by teachers and learners to inform decisions about what happens next in teaching and learning.
- there is a further purpose for assessment in **clarifying** the intended learning outcomes for the teacher and learner – for example, knowing what students are

expected to do in an examination helps teachers understand what is intended by the specification.

This guidance focuses on the uses of assessment to improve teaching and learning.

The position of ASE

- For assessment to be effective and informative teachers should plan their teaching with assessment in mind.
- Continuity between phases of education is vital to ensure that children's prior knowledge and skills are acknowledged and built on, and that any gaps are addressed.
- We encourage Senior Leaders to support the professional development of science teachers, as confident professionals, who are able to use a range of formative assessment tools to identify appropriate interventions that will progress the learning; information from these assessments may at times be used for summative purposes.
- A good assessment policy will be clear about how assessment outcomes will be used to support teaching, how often they need to be recorded for summative purposes and how they might be communicated to parents.

Best practice should seek to include

- The use of formative assessment to inform day-to-day planning. Teachers should consider what it means for children to have secure knowledge and understanding of a chosen aspect of the science curriculum, and what tasks will provide evidence of learning,
- Responsive teaching: planning formative assessment activities should also include considering the response the teacher will make once the information is collected.
- Opportunities for children to express their understanding in a variety of ways, not just on paper: what might they say, do, write or draw? This will lead to the use of a variety of assessment strategies.
- Assessment activities that probe understanding and reveal misconceptions so these can be tackled, rather than focusing solely on knowledge and key words. An over-reliance on test/examination questions as a basis for formative assessment should be avoided as this could limit progress in scientific understanding.

- The use of formative assessment which recognises the context of the learning that has gone before. It is helpful when clusters of schools collaborate to ensure that the children have studied a common core body of science knowledge in primary school to support their progression to secondary school.

Useful links

Nuffield / ASE report Developing policy, principles and practice in primary science

PLAN – the Pan London Assessment Network has developed assessment guidance for primary schools related to statements for science in the National Curriculum for England – also useful for secondary schools planning the teaching of pupils in year 7.

Teacher Assessment in Primary Science Project (TAPS) has developed the TAPS pyramid tool to provide schools with a supportive structure to evaluate and develop their assessment processes. There is also a database of activities to support with the assessment of working scientifically skills.

STEM learning worked with Christine Harrison and Dylan Wiliam to produce a free online course *Assessment for Learning in STEM Teaching* which is available on the FutureLearn platform.

Department for Education

Assessment without levels – Advice for schools on assessment after the removal of the national curriculum levels system for grading students

Other publications

Black, P., & Wiliam, D. (2018). Classroom assessment and pedagogy. *Assessment in Education: Principles, Policy & Practice*, 1-25. doi:10.1080/0969594X.2018.1441807

Wiliam, D. (2011). *Embedded formative assessment*. Bloomington, IN: Solution Tree Press.

Harrison, C. (2013). *Testing times: Reforming classroom teaching through assessment,* chapter in Excellence and Equity IPPR