Improving Engagement with Good Practical Science

Benchmark Action Planning Pack

Response to Gatsby Report: Good Practical Science
www.gatsby.org.uk/GoodPracticalScience

ROYAL SOCIETY OF CHEMISTRY

Introduction

As described in the Good Practical Science report by Gatsby; policy makers, professional bodies and many other relevant organisations regard practical science as an important part of science education. The report also finds that students find practical science engaging and that, if a student engages with a subject, they are more likely to apply themselves to learning.

This Improving engagement with Good Practical Science: Benchmark action planning pack has been produced to support schools in identifying opportunities for improving their standing against the 10 good practical science benchmarks set out in the Gatsby report, thereby improving practical provision and ultimately student engagement with science learning.

It is important to note that these benchmarks are the world-class standards and should be considered pragmatically by schools. Exactly how they are used will depend, in part, on circumstance but findings from the full report suggest they have a role for science leaders in:

- self-evaluation to under-pin continuous improvement
- making business cases for changes or improvements in science provision
- assisting in identification of training and development needs for teachers and technicians

The full report, including further details of why schools should consider these benchmarks is available here: **www.gatsby.org.uk/GoodPracticalScience**

Usage instructions

The objective for this action planning pack is that it will become a working document to support schools in their use of the 10 good practical science benchmarks. It is not intended to be used as a ranking of one school (or science subject) against another.

Within this pack, each of the 10 benchmarks for good practical science are broken down into sub-criteria. Schools should:

- Consider their status against the sub-criteria as a percentage and mark their position along a continuum.
  - A status of 100% signifies that the sub-criteria is fully met by the school.
- Mark whether attaining 100% of the sub-criteria is fully controllable by the school.
  - Whilst the 10 benchmarks are aimed at schools, it is important to note that the full report calls upon government, policymakers and member bodies to act too (see appendix 1).
  - If a sub-criteria is not considered fully controllable by a school, give reasons and note a realistic attainment target in the current environment to provide a goal.
- Reflect upon the marked statuses to derive an implementable action plan for improving the school's position.
  - Note that attaining the full benchmarks is demanding and any improvements should be celebrated as milestones along a journey to full attainment.

Benchmarks 1, 3 and 6 are considered to be 'enablers' for the others and should therefore be prioritised (section 5.3, pg52 of the full report).

This document was produced by Heidi Dobbs (Royal Society of Chemistry education coordinator) in collaboration with the Gatsby Charitable Foundation.

Benchmark 1: PLANNED PRACTICAL SCIENCE

Benchmark summary:

Every school should have a written policy that explains why teachers use practical science, the outcomes they expect from it and how they achieve those outcomes. The process of producing the policy is as important as the policy itself.

School status against sub-criteria:

1a. The policy should be produced as a team effort by teachers and technicians across the science department.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

1b. The policy should explain the differences in practical science between different age groups.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

1c. The policy should say how special educational needs and disabilities (SEND) are accommodated.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

1d. The policy should include any use of opportunities for practical science outside the school, in universities, employers, science centres etc.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

1e. The policy should be annually reviewed against practice.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

1f. There should be a member of the senior leader team who will act as a 'sponsor' for practical science among senior leaders.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% — Fully controllable

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 2: PURPOSEFUL PRACTICAL SCIENCE

Benchmark summary:

Teachers should know the purpose of any practical science activity, and it should be planned and executed so it is effective and integrated with other science learning.

School status against sub-criteria:

2a. Teachers should have a clear purpose for every practical activity and know how it relates to the rest of what they are teaching.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

2b. Teachers should plan to their satisfaction how to introduce each practical and how to follow it up.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

2c. Teachers should take account of students' special educational needs and disabilities (SEND) in their planning, so all students can participate equally.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

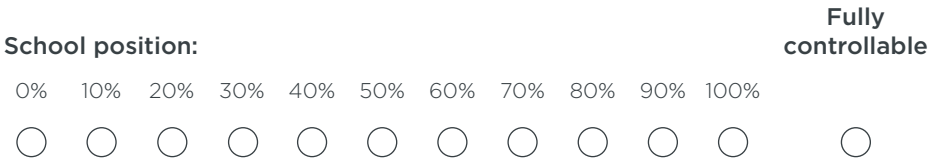
Benchmark 3: EXPERT TEACHERS

Benchmark summary:

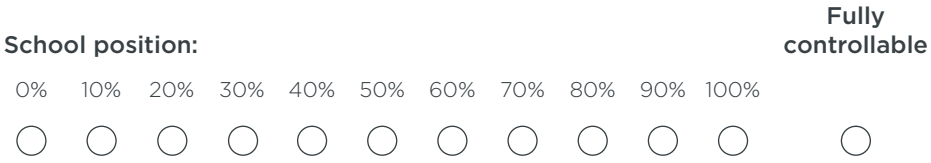
Teachers should have subject-specialist training (both initial and continuing) in the subject (biology, chemistry, physics etc.) and age range they teach, so they can carry out practical science with confidence and knowledge of the underlying principles.

School status against sub-criteria:

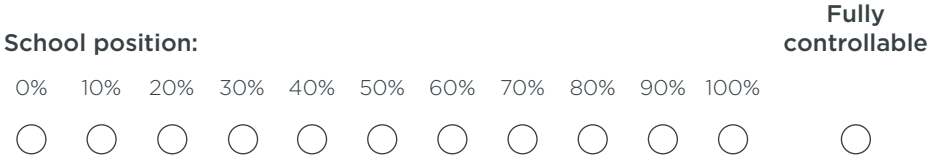
3a. At post-16 level, teachers should have a post-A level science qualification related to the science subject they teach (biology, chemistry, physics), together with relevant pedagogical training.



3b. At pre-16 level, if teachers do not have a post-A level science qualification related to the subject they teach, they should have had sufficient additional training to give them the confidence, subject knowledge and skills to conduct effective practical work at that level.



2c. Teachers should take account of students' special educational needs and disabilities (SEND) in their planning, so all students can participate equally.



Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 4: FREQUENT AND VARIED PRACTICAL SCIENCE

Benchmark summary:

Students should experience a practical activity in at least half of their science lessons. These activities can be short or long, but should be varied in type.

School status against sub-criteria:

4a. On average, across the year and across all the sciences, at least half of lessons should involve direct practical activities, whether hands-on or teacher demonstration.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

4b. Practical activities can be short or long. There should be enough long science lessons (of at least 50 minutes) in the timetable to give teachers flexibility about when they do experiments.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

4c. Practical activities should be varied and balanced in type.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 5: LABORATORY FACILITIES AND EQUIPMENT

Benchmark summary:

Schools should have enough laboratories to make it possible for every teacher to do frequent practical science safely. Each laboratory should have sufficient equipment for students to work in small groups.

School status against sub-criteria:

5a. There should be enough laboratories so that the availability of labs is never a barrier to carrying out practical activities in the science subjects taught.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

5b. Laboratories should be large enough to safely accommodate the size of classes that will occupy them.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

5c. The spaces should be flexible enough to allow students to work individually, in pairs and in small groups.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

5d. There should be sufficient equipment to make it possible for teachers to do standard practical activities expected in their specialist subject at that level.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

5e. There should be ready access to the technology required to enable collection and analysis of digital data.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

5f. Laboratories should be accessible to students with any special educational needs and disabilities (SEND) encountered in the school.

School position: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100% Fully controllable

Benchmark 5: LABORATORY FACILITIES AND EQUIPMENT

School status against sub-criteria:

5g. The school should have laboratory facilities such that students can carry out extended practical science investigations (see Benchmark 8).

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	**Fully controllable**
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

5h. There should be a preparation space or spaces with well-organised, safe storage with easy access to laboratories.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	**Fully controllable**
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

5i. There should be an accessible outdoor space where practical activities can take place.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	**Fully controllable**
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 6: TECHNICAL SUPPORT

Benchmark summary:

Science departments should have enough technical or technician support to enable teachers to carry out frequent and effective practical science.

School status against sub-criteria:

6a. For an average-size school, there should be specialist technical expertise to support practical work in each of biology, chemistry and physics.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
○	○	○	○	○	○	○	○	○	○	○	○

6b. Technicians should be given regular opportunities to have professional development.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
○	○	○	○	○	○	○	○	○	○	○	○

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 7: REAL EXPERIMENTS, VIRTUAL ENHANCEMENTS

Benchmark summary:

Teachers should use digital technologies to support and enhance practical experience, but not to replace it.

School status against sub-criteria:

7a. Virtual environments and simulated experiments have a positive role to play in science education but should not be used to replace a good quality, hands-on practical.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

7b. Digital technologies are rapidly evolving and teachers should have access to evidence about what works, and training in their use, before implementing them in their science lessons.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 8: INVESTIGATIVE PROJECTS

Benchmark summary:

Students should have opportunities to do open-ended and extended investigative projects.

School status against sub-criteria:

8a. There should be opportunities for students to do open-ended extended investigative projects in science.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

8b. The school should have laboratory facilities such that all students who want to can carry out extended practical science, particularly among post-16 year olds.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Benchmark 9: A BALANCED APPROACH TO RISK

Benchmark summary:

Students' experience of practical science should not be restricted by unnecessary risk aversion.

School status against sub-criteria:

9a. Responsibility for safety is shared between the school or local authority as employer, the teacher and the technician. This should be clearly understood by all members of science staff.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

9b. The school should ensure that teachers and technicians have access to authoritative and up-to-date guidance including model risk assessments.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

9c. Teachers should assess the risks and benefits for every practical activity, and act accordingly.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

9d. Teachers and technicians should adopt a balanced and proportionate approach to managing risks, and be supported by senior management in doing so.

School position:

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Fully controllable
◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

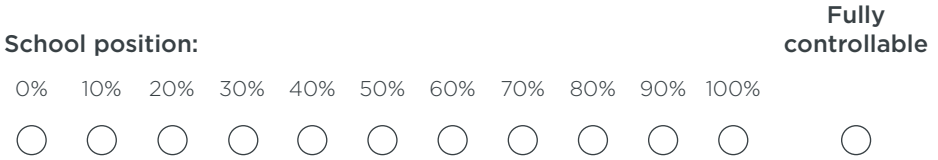
Benchmark 10: ASSESSMENT FIT FOR PURPOSE

Benchmark summary:

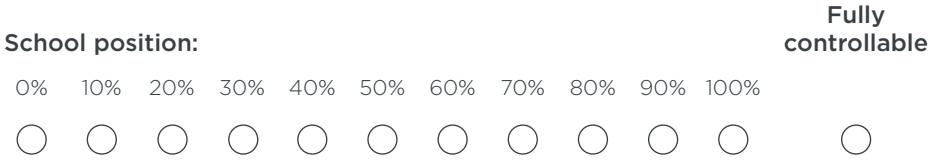
Assessment of students' work in science should include assessment of their practical knowledge, skills and behaviours. This applies to both formative and summative assessment.

School status against sub-criteria:

10a. Teachers should reflect on students' practical skills and knowledge when awarding a grade for science.



10b. Teachers should regularly use practical activities as an opportunity to formatively assess students' understanding of science, where it is appropriate to do so.



Action planning to progress status (or maintain status if benchmark met):

What needs to happen?

How can this be implemented/changed?

Who needs to agree/take responsibility?

Other notes/thoughts (e.g. key dates, aspects outside of school control)

Appendix 1: Good Practical Science Report: Gatsby

Summary of Recommendations

The full summary for policy makers can be downloaded here:
https://www.gatsby.org.uk/uploads/education/reports/pdf/good-practical-science-8-page-summary.pdf

1 THE 10 BENCHMARKS	**To schools, policymakers, Ofsted and teacher trainers** We recommend Benchmarks 1 -10 as defining the elements of good practical science in secondary schools. Schools should use them, policymakers should be guided by them, and teacher trainers and professional development leaders should use them to help shape their programmes. Ofsted should guide schools towards them if their science needs improvement. Schools, and the science departments within them, should be funded adequately to enable them to achieve the benchmarks.
2 TRAINING EXPERT TEACHERS	**To government and teacher trainers** Secondary science initial teacher training (ITT) should have a strong subject-specific component relating to the science they will teach, especially its practical aspects. This should be reflected in the standards for Qualified Teacher Status (QTS), which should apply to teachers in all state-funded schools, including academies. Government-funded Subject Knowledge Enhancement (SKE) courses for prospective science teachers should include sufficient laboratory time to develop practical skills. Courses that are only delivered online cannot provide this experience. Government should ensure that the Teacher Supply Model (TSM) accurately forecasts the number of specialist teachers required. Government should use the TSM to increase the number of specialist teachers in each of the sciences, through additional recruitment and through retention programmes, so that schools have enough high-quality applicants when they advertise posts.
3 CONTINUING PROFESSIONAL DEVELOPMENT FOR TEACHERS	**To government, teaching unions, professional bodies and other stakeholders** Over the next five years, England should move towards an embedded system of continuing professional development (CPD) for teachers, with clear expectations of quantity and quality of CPD. Teachers' CPD should have a strong subject-specific focus and in the case of science teachers it should include practical work.
4 ACCOUNTABILITY AND PRACTICAL SCIENCE	**To government** Government should review accountability measures compared with other nations, to assess how they could give teachers more autonomy and freedom to innovate in the way they teach, particularly in the case of practical science. **To Ofsted** When inspecting school science departments, Ofsted should take particular note of the quality and frequency of practical science, and record it in the report on the school.
5 VALID ASSESSMENT	**To government and Ofqual** Government and Ofqual should monitor current arrangements for assessment of practical science at GCSE and A level to check their impact on the quality and frequency of practical science. If negative effects are found, changes should be made. **To research funders** Research should be done into valid, reliable and manageable ways of assessing practical science, in particular where assessment is indirect and by means of written questions.

6 PROJECTS IN THE CURRICULUM	**To government and Ofqual** The curriculum should evolve to include more requirements for extended projects in science. In particular, an extended project should become an embedded, compulsory part of post-16 study for all students on pre-university courses. For those studying a majority of science subjects, the project should have a science focus.
7 RECRUITING, RETAINING AND DEPLOYING SPECIALSIST TEACHERS	**To school governors, headteachers and science leaders** Schools should take a strategic approach, using a combination of shrewd recruitment, retention measures and CPD, to get a better proportion of science subject specialists in their science team. Where subject specialists are scarce, they should teach within their specialism where possible, and schools should take a strategic approach to deciding which classes and age groups to use them with. **To science professional bodies and funders** A study should be commissioned to produce practical recommendations for schools on how to achieve the above. The result of this study would be a practical guide for schools, illustrated with case studies, on how they can get a better proportion of science subject specialists, and how best to deploy them
8 VALUING SCIENCE TECHNICIANS	**To school governors, headteachers and science leaders** Technicians should be valued as an integral part of the science department. They should be given professional development opportunities to refresh their professional skills and their expertise in health and safety, and to give them new ideas for practical science. They should have opportunities to get professional recognition through Registered Science Technician (RSciTech) and Registered Scientist (RSci). They should have opportunities to get professional recognition through Registered Science Technician (RSciTech) and Registered Scientist (RSci).
9 PLANNING FOR SUCCESS	**To the Association for Science Education and science professional bodies** Drawing on the experience of schools, guidance should be produced on how to go about developing a written policy for practical science.
10 MANAGING RISKS	**To school governors, headteachers and science leaders** All schools in England should belong to CLEAPSS, either individually or through their local authority or Academy Trust, and should use its expert advice to ensure a balanced approach to risk.

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