Module 1: Introduction

Background to the Project

## Supported by the Gatsby Charitable Foundation

## **Aims of the project**

The Gatsby Charitable Foundation commissioned and published a report by Professor Sir John Holman entitled *Good Practical Science* (Gatsby Charitable Foundation, 2017). Its aims are to promote the effective use of practical work in 11-16 school science and to support teaching and non-teaching staff in schools to achieve this. This particular project has a specific function within this, which is to support schools to develop and implement an effective written policy for practical science.

## **Introduction**

There have been various influences upon the policies for practical science that secondary schools have either implicitly or explicitly developed and adopted over the last twenty years or so, including:

1. Many science teachers carry with them a set of attitudes and beliefs about the role of practical work, shaped by their own education, their training, their experience of using practical work in lessons and their ideas about how students learn.
2. Successive generations of specifications, including GCSE, GCE and vocational courses, have shaped practice and required, encouraged or discouraged various practices. Although they haven’t always been perceived as positive, they can’t be ignored and have sometimes been instrumental in securing some form of place for practical work in the curriculum.
3. Various agencies have reported upon and encouraged certain practices, including the work of the National Strategies on Scientific Enquiry and on How Science Works, QCA’s Assessing Pupils’ Progress (APP) in Science, the *Getting Practical* project led by the Association for Science Education (ASE) and the Nuffield Foundation’s work ‘Practical Biology’, ‘Practical Chemistry’ and ‘Practical Physics’.

This project doesn’t aim to replace any of those but rather to add another dimension, that of turning intention into embedded practice by the effective use of policy.

One of the reasons, of course, that a number of schools are now keen to revisit their policy and practice is because the GCE and GCSE specifications first examined in 2017 and 2018 respectively have repositioned practical work in accredited courses. Assessment items relating to practical activities feature in high stakes assessments and schools have to demonstrate that they are getting students to carry out practical tasks. At the same time there are fewer constraints upon how the curriculum is organised; the endpoints may be rigorous and challenging but schools can choose how to get there.

## **Structure of resources supporting policy development**

The materials provided for schools are in six modules; each of these has a specific function within the overall process of developing a policy. Each module is designed to encourage discussion, which leads to the formulation of statements of principle that can then be used to formulate a written policy document.

|  |  |  |
| --- | --- | --- |
| Module | Title | Function |
| 1 | Introduction | To introduce the aims of the project, describe its background, provide a chance for participants to identify their starting points and to draw attention to certain assets that will be used in other modules. |
| 2 | Purposes | To explore the purposes of practical science so that the policy developed reflects and supports the full range. |
| 3 | Planning | To develop an understanding of how practical science could be incorporated and provided for in the curriculum. |
| 4 | Progression | To explore how practical science should become progressively more challenging through the secondary phase and considering policy implications. |
| 5 | Inclusion | To consider how principles and practice relating to inclusion of students’ impact upon policy on practical work in science. |
| 6 | Support | To explore the implications for teaching and non-teaching staff of delivering practical science effectively and developing supporting policy. |
| 7 | Producing a policy | To support the process and skills of developing policy statements that have a positive impact upon practice. |

## **Ways of using these materials**

The materials have been designed and developed to be used flexibly and in response to the context a science team is in. Modules can be selected and used as necessary, depending upon the expertise of a team, its development priorities and the time it has available for CPD.

As far as possible the modules have been developed so that they can be used in any order and irrespective of which others have been used; i.e. that they are free-standing. However, there are some limitations to this; where this is the case it is clearly indicated at the start of each module.

Each of these modules has been designed as a professional development unit, to be led by a member of the science team. The purpose in each case is to engage staff, promote discussion and reflection and to stimulate ideas. In each case this should lead to developing ideas about the generation of policy. The outcomes are clearly stated at the start of each unit; they have a strong functional role and should be considered when units are being selected and used.

It is understood that the team leader will need to take strategic decisions about the amount of time taken to develop policy and also about who should be involved.

## **Model for policy formulation**

We have worked to the following principles when developing these materials:

* A policy is what actually guides and informs practice. If a science team has a form of words as an official policy, but what it does in practice is in accordance with a different and possibly conflicting set of values and assumptions, then it is the latter that is the real policy. Of course, what we are aiming for is for the text and the operational practices to be synonymous; it is by this means that the latter can be critiqued and improved.
* A policy should be developed from a variety of influences and constraints, such as:
  + Whole school policies
  + Health & safety regulations
  + Awarding body requirements
  + Values and attitudes of team members.
* Policies need to be revisited and refreshed for two different and distinct purposes:
  + To ensure that they are still appropriate
  + To ensure that team members, including new members, are familiar with them.

The process of policy generation is dealt with in more detail in Module 1 but, in outline, can be represented as follows:

Implementation and review

Practical science policy

Principles that underpin high quality teaching and learning

Policies of overarching organisations, e.g. whole school, LA, MAT, etc.

Regulatory frameworks, e.g. awarding organisations, H&S, OFSTED.

**Purposes of practical science**

One of the features of the *Good Practical Science* report was to identify purposes of practical science; these were set out as follows:

1. To teach the principles of scientific enquiry.
2. To improve understanding of theory through practical experience.
3. To teach specific practical skills, such as measurement and observation, that may be useful in future study or employment.
4. To motivate and engage students.
5. To develop higher-level skills and attributes such as communication, teamwork and perseverance.

We have quoted those here in order to locate the focus of these materials against those purposes. The first thing to say is that the view of the team developing these units is that this list is concise, comprehensive and complete. We would neither wish to add anything to it or to subtract anything from it. Schools may well benefit from reflecting these in their policy and practice.

However, it is worthwhile saying that the detailed and explicit emphasis in the materials tends to be on the first three purposes, which have a science specific focus. This is not in any way to detract from the latter two but, in our consideration, it is the first three that call for detailed treatment in order to ensure effective coverage in the development of policy. It might, therefore, be appropriate to refer to D and E here.

We have worked to the assumption that practical work has the capacity to engage and motivate students but that it won’t automatically do so. Some students are less positively inclined towards practical work; they need to be ‘won over’. Furthermore, some ways of running practical activities are more motivational and engaging than others. The aspiring teacher cannot regard the job as having been done and hearts as well as minds secured simply because the test tubes have made an appearance. Neither should we regard it as simply being a case of getting the experiment to work. Experiments that don’t work can be disappointing, but may provide important learning opportunities, and some of those that do work can be pretty tedious unless other aspects are sorted out as well.

A few years ago, a slide used in a National Strategies resource quoted a GCSE student as saying *“My heart sinks every time the equipment appears. Either the experiment will work, in which case it will show what we already knew, or it won’t, in which case there will be hell up, trying to explain why”.* The skill set of managing practical work effectively includes the ability to get the equipment to perform, but it doesn’t stop there.

As science teachers, we haven’t perhaps always been as robust as we might have been about promoting the way in which practical work can develop a wider set of skills. We know that it can, but we don’t always refer to it as much as colleagues in, say, P.E. or arts subjects do. Yet those ‘soft skills’ are often ones that STEM employers value and request. We haven’t proposed the adoption of specific learning objectives relating to those higher-level skills, but we have borne those in mind. Good teachers and effective departments will want to build those and recognise them. So they should.

## **Glossary**

What we are not doing in these materials is to redefine terms that relate to practical work. This is beyond the scope of the programme and, in any case, may have little impact. However, we have had to adopt a certain taxonomy to ensure consistency within the materials. This is the way that certain key terms have been used:

***Activity.*** This has been used to indicate any type of learning episode in which equipment, materials or observations are used to further learning. It includes demonstrations and brief student activities that serve to pose a question or prompt interest, as well as more extended and involved episodes.

***Experiment.*** This indicates an activity of a more extended nature. It could be to answer a question, or it could be used to illustrate a point or demonstrate a procedure. It could be a demonstration, a small group activity or an individual activity.

***Investigation.*** This indicates an experiment that is being used to answer a question. There is an assumption that the student doesn’t know the answer to the question (even though the answer may be known, and the student may well know that the answer is known).

There is, in essence, a Venn diagram in operation here, with investigations as a subset of experiments and experiments as a subset of (practical) activities. This could be challenged of course; students could be asked, for example, to investigate the claim that average sea temperatures fluctuate in a cyclical way and could do so without using any laboratory equipment themselves. However, for the purposes of a project predicated upon practical work, this is what we’ll use.

***Concept.*** A concept is taken to be a scientific idea and, at secondary, is likely to be some aspect of a theory. It might, for example, explore some aspect of gravity or the rate of photosynthesis.

***Process.*** A process is an aspect of Working Scientifically, such as developing a testable question or deciding if the evidence is sufficient to support a conclusion.

***Skill.*** A skill is a particular action that is relevant to scientific enquiry. It may be manipulative, such as being able to read a burette accurately, but it can also include items such as tabulating results.

The dividing line between processes and skills is imprecise, but we have tended to assume that processes often subsume skills and involve a higher order of judgment. For example, drawing a graph is a skill, as is deciding which type of graph to use, but presenting the findings of an investigation is a process.

The GCSE specifications and the underpinning subject criteria from the DfE have been influential in this; there is a strong relationship between the processes we have referred to and the criteria for Working Scientifically, and between the skills we have identified and the Apparatus & Techniques list within the science GCSE criteria. However, this isn’t a guide on how to organise the required practicals to comply with regulations.

## **Further reading/useful links**

* Good Practical Science, Gatsby Charitable Foundation, 2017, [www.gatsby.org.uk/GoodPracticalScience](http://www.gatsby.org.uk/GoodPracticalScience)
* Getting practical - a framework for practical science in schools, ASE and partner organisations [www.gettingpractical.org.uk/index.php](http://www.gettingpractical.org.uk/index.php)
* Practical Work in Science, SCORE [www.score-education.org/policy-themes/curriculum/practical-work-in-science](http://www.score-education.org/policy-themes/curriculum/practical-work-in-science)
* National Strategies materials on How Science Works [www.stem.org.uk/elibrary/resource/31705](http://www.stem.org.uk/elibrary/resource/31705)
* Assessing Pupils’ Progress (APP) in Science, QCA [www.stem.org.uk/resources/elibrary/resource/29133/assessing-pupils-progress-app-science-materials](http://www.stem.org.uk/resources/elibrary/resource/29133/assessing-pupils-progress-app-science-materials)
* Nuffield Foundation practical science websites:
  + Practical Biology: [www.nuffieldfoundation.org/practical-biology](http://www.nuffieldfoundation.org/practical-biology)
  + Practical Chemistry: [www.rsc.org/learn-chemistry/resource/listing?searchtext=&fcategory=all&filter=all&reference=nuffpract&Keyword=KCN00000009](http://www.rsc.org/learn-chemistry/resource/listing?searchtext=&fcategory=all&filter=all&reference=nuffpract&Keyword=KCN00000009)
  + Practical Physics: [www.practicalphysics.org/](http://www.practicalphysics.org/)