



# Draft National Curriculum for science Key Stage 1-2

A SCORE response to the Department for Education informal consultation

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## **SCORE draft response to primary Programme of Study for the science National Curriculum**

### **Introduction**

1. SCORE is a partnership of organisations, which aims to improve science education in UK schools and colleges by supporting the development and implementation of effective education policy. The partnership is currently chaired by Professor Graham Hutchings FRS and comprises the Association for Science Education, Institute of Physics, Royal Society, Royal Society of Chemistry and Society of Biology.
2. SCORE welcomes the Department for Education informal consultation on the draft primary science Programmes of Study. This is a useful document on which to base discussion and it will help development of the primary Programme of Study. We particularly welcome the opportunity to now consult with our communities.
3. This response draws on the expertise of the five SCORE organisations; the main body of the response considers overarching issues for the three sciences and the relationship between them, including the structure and content, the place of the nature and methods of science (or working scientifically) in the National Curriculum and the implications on schools. Detailed comments on the draft Programme of Study are attached in a separate appendix from the Royal Society of Chemistry, Society of Biology and Institute of Physics.
4. In summary:
  - The Programme of Study must allow rich ideas to be explored in depth, to allow the development of fundamental understanding of some key ideas before further content is introduced. This aspiration, a recommendation also made by the National Curriculum Expert Panel, has been lost in the current draft.
  - There needs to be clearer articulation between Early Years Foundation Stage (EYFS) content and that encountered in Key Stage 1. Likewise, progression from Upper Key Stage 2 into secondary requires further consideration as well as how the science Programme of Study interlinks with the mathematics Programme of Study.
  - SCORE strongly recommends that 'working scientifically' is made more explicit in the Programme of Study otherwise there is a danger that these ideas that are fundamental to scientific understanding will not be effectively taught.
  - SCORE recognises the need for a non-statutory Notes and Guidance section but we strongly advise that this section is substantially redrafted to support inspirational teaching.

### **Structure**

5. We welcome the reference in the Purpose and Aims to the sciences at Key Stage 1, early and late Key Stage 2 and are pleased to note that a distinction between biology, chemistry and physics is not made within the body of the Programme of Study.
6. SCORE supports the introduction of two-year key stages, and it is helpful for content to be broken down into what can be taught year-by-year, as long as it is made even more explicit to teachers that this is for guidance purposes only. It should remain the case that

key stages offer flexibility for teachers to introduce content when they consider it appropriate, as outlined in the School Curriculum section.

7. It is also important to recognise that progression of learning within and between key stages is based on more than age; showing the sequencing of how ideas develop should help teachers to plan their own curricula (in terms of both content and timing) to help their pupils progress most effectively. Further work is required in this area for conceptual understanding.
8. SCORE supports the concept of the non-statutory Notes and Guidance section in the Programme of Study, but this section needs considerable work in order to support inspirational teaching. See also paragraphs 21 to 23.

## **Content**

9. SCORE supported the Expert Panel's recommendation that content in the Programme of Study should allow for rich ideas to be explored at depth, to allow the development of fundamental understanding of some key ideas before further content is introduced. However, this aspiration has been rather lost in the way content is currently specified in the draft Programme of Study. We would like to see the guidance notes providing ideas for opportunities that teachers can take to allow children to work in different ways and for some children to explore ideas in greater depth.
10. Content should only be included in the science Programme of Study if it is intrinsically useful in enabling pupils to develop their understanding of one or more fundamental ideas in the sciences (i.e. "earns its keep").
11. The wording of the statements needs to be addressed (see below). As a guiding principle, the authors should consider, for every statement, how they would find out if a child can do what the statement is expecting them to be able to do.
12. Content should also be introduced in a way that facilitates progression; currently some content is introduced too early when pupils would struggle to comprehend it and some is introduced too late when aspects will have been met earlier. There also needs to be clearer articulation between Early Years Foundation Stage (EYFS) content and that encountered in Key Stage 1, as some of the content currently introduced at Key Stage 1 will already have been taught at EYFS. Likewise, progression from Upper Key Stage 2 into secondary requires further consideration.
13. We would like to see a progression in the way that students observe and study phenomena along these lines:
  - a. Key Stage 1 should enable pupils to experience and observe phenomena, look more closely at the natural and manmade world around them; ask questions about what they see; with help, use different types of scientific enquiry to answer them; use non-standard measurements and simple equipment; identify similarities and differences, changes and simple patterns in what they see; begin to use simple scientific language to talk about what they have found out.
  - b. Lower Key Stage 2 should enable pupils to independently raise questions and decide which types of scientific enquiry are likely to be the best way of answering them; use standard measurements and simple quantification; look for similarities

and differences, changes and patterns in two sets of data; draw simple conclusions and use some scientific language to talk about what they have found out.

- c. Upper Key Stage 2 should enable pupils to raise questions about a wide range of scientific ideas and phenomena; be able to choose and carry out the most appropriate type of scientific enquiry to answer questions; select appropriate equipment and use it accurately; draw conclusions based on their data and observations and explain why they are valid and use scientific knowledge and understanding to explain what they have found; use some simple models that explain phenomena.

14. This development can be emphasised through the language used to introduce statements. So, for example, statements could be prefaced by words like:
  - explore, observe, compare, identify, notice, find out and describe in Key Stage 1;
  - explore, notice, describe, associate, identify, compare and group, investigate and find patterns in Lower Key Stage 2;
  - explain, determine, understand and predict in Upper Key Stage 2.
15. These phrasings would make more sense if they are not preceded by the words “taught to”. It would be preferable if the column of statements used the heading “Outcomes and experiences”.
16. We are particularly concerned about the use of the word “explain” as the stem of statements in the lower part of primary school. While children are able to explain in different ways and at different levels of complexity at different stages of development throughout their primary years, there is a danger that using the word “explain” in statements within the Programme of Study could result in children having to reproduce learned descriptions. We believe the changes outlined above should limit this possibility.
17. SCORE welcomes the mix of biology, chemistry and physics in this Programme of Study. The primary curriculum does not need to be balanced in terms of equal coverage of all sciences. There should be an emphasis on ‘authentic experiences’ which provide opportunities for pupils to begin to progress towards scientific ideas and for the development of appropriate language/vocabulary that will enable them to communicate their ideas and experiences.
18. SCORE welcomes the principle of a challenging curriculum, but care needs to be taken to take account of the way individual pupils learn. There is currently too much emphasis on factual recall rather than the development of deep understanding, and while this may be a means for some pupils to engage with and take ownership of knowledge, it should not be the only means specified for doing so.
19. SCORE welcomes the statement on spoken language, and would like to see it reflected throughout the Programme of Study, particularly in the important and well-recognised role that children’s questions about science and dialogue play in developing their ideas and understanding about science concepts. This is developed in EYFS as good practice and should be encouraged to be continued throughout the Primary phase.
20. Mathematics is integral to the teaching and learning of the sciences, and can offer a valuable aid in understanding and describing scientific phenomena. It is important to

ensure that there is coherence between the Programmes of Study for mathematics and science, and for the document to highlight where topics can be introduced in the optimum way to ensure pupils learn content in one area in order to apply it in another. It would also be useful to include a statement at the beginning of each key stage, similar to that currently included for phonics, that content should be consistent with the development of mathematical knowledge. There is clear progression in mathematics through the development of science skills already embedded in good practice.

## **Notes and guidance**

21. In this early draft, the Notes and Guidance section contains a number of disparate ideas, which could create confusion and fail to provide teachers with the most useful assistance. SCORE would like to propose a common structure for the Notes and Guidance section, comprising the following sections:
  - a. Narrative: how each topic and its statements fit with the development of ideas;
  - b. Boundaries of expectation: signposting of where ideas will be developed further in the curriculum and indicating limits on what children are expected to do; of course, in some cases, teachers may wish to explore some ideas in greater depth.
  - c. Guidance: further information about how to develop deeper learning; it would also be possible to provide examples of how to embed and contextualise the 'Working Scientifically' elements of the curriculum (see paragraphs 24 to 26);
  - d. Notes: more discussion, possibly with ideas for enquiry and practical work that could develop pupils' understanding.
22. Restructuring the Notes and Guidance in this way will also highlight areas of the curriculum that are currently out of sequence or unnecessary.
23. While SCORE agrees with the principle of including some biographies to illustrate and personalise the science being learnt, we would like those included to reflect a more diverse range of scientists and science and engineering, for example to reflect the contribution of Islam, female scientists and scientists from ethnic minorities. SCORE would also like to see the inclusion of 'science stories' as well as individuals, such as the discovery of DNA and the digital revolution, the internet, and advanced materials; it would also be useful to highlight to schools the ways in which they could use local examples. This would also be a good opportunity to introduce the idea of serendipity in science. It provides an important way of showing that completely counterintuitive results arise from unexpected observations and are amenable to analysis through the scientific method and may lead to important new discoveries.

## **Working scientifically**

24. The National Curriculum for the sciences must include statements that encourage teaching and learning about 'how we know' and 'how we find out' as well as 'what we know'. The nature and methods of science is the way in which scientists solve scientific problems and create knowledge. The current term 'working scientifically' does not fully

express this and we strongly advise that this part of the National Curriculum is referred to as 'working and thinking scientifically'. It may also be worth highlighting that these ideas will be developed further in later key stages as 'nature and methods of science'; at primary, it is important to encourage pupils to ask good questions and think about how they might answer them.

25. In order to make the aims of this part of the curriculum explicit, SCORE would like to see a paragraph, similar to that for spoken language, at the start of the document that succinctly captures why its inclusion is critical. We would propose the following:

*As learners progress in the key stages they should become increasingly autonomous in their decision making; systematic and accurate in collecting and analysing data; and able to express their ideas scientifically using scientific language and enquiry. Some examples include progressing from simple tangible ideas to complex, more abstract ideas; and from testing ideas using evidence to understanding the nature of evidence, and if it can be trusted<sup>1</sup>.*

26. Working and thinking scientifically must be made explicit in the Programme of Study otherwise there is a danger that these ideas that are fundamental to scientific understanding will not be taught. While we agree that the nature and methods of science should be embedded within the three sciences rather than a stand-alone strand, we are concerned that the current structure gives the message this part of the curriculum is a tag on rather than fundamental cross-cutting ideas. We would strongly advise the 'working scientifically' statements are placed at the beginning of each year rather than the end.

### **Implications for schools**

27. While there are areas of the new curriculum that may require specific support in terms of CPD, such as evolution, SCORE would like to see the introduction of the new Programme of Study as an opportunity for all teachers, and particularly primary teachers who often do not have a background in science, to improve their subject knowledge and pedagogical subject knowledge. It is important that funding and support are available for them to do so.
28. SCORE recommends that where particular equipment is required to deliver the Programme of Study, for example data loggers, there is a mechanism in place to ensure schools have access to the equipment (either through explicit funding or loan arrangements). SCORE is currently investigating the differing levels of resourcing science in primary schools and will be able to provide evidence of this to the Department in 2013.

### **Process for moving forward**

29. SCORE recommends that the Department shapes the next stage of the review based on lessons learnt developing this draft programme of study. SCORE recommends the following:

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<sup>1</sup> ASE/Millgate House Education publication *It's not fair - or is it?* 2011

- a. The review should be conducted in a way that allows ongoing transparency of process and personnel. SCORE would like to continue to be involved in commenting on drafts of both statements and guidance notes before the publication of the full consultation draft.
- b. Any further development of the National Curriculum should be informed by a range of individuals with appropriate expertise in the sciences and science education. They should be selected through a transparent process, with individuals chosen to represent a range of knowledge, experience and qualifications in science curricula and pedagogy.
- c. SCORE member organisations have an important role to play in this Review. Any Programme of Study for the sciences should have the support of these organisations prior to publication.
- d. The work should be adequately funded so that the selection of those who work on it can be made purely on merit rather than being restricted to those whose circumstances allow them to work unpaid.
- e. The process for commenting on the Programmes of Study should be well defined and the lines of communication between the Department of Education, the individuals involved in the drafting process and the various subject communities should be explicit.