

Department for Education: National Curriculum Review - Call for Evidence**Response by the Wellcome Trust**

April 2011

SUMMARY

1. Given the remit of the Wellcome Trust, our response is directed primarily at science education, however some comments are relevant to all areas of education. The key messages of this submission are:
 - Subject content for the new National Curriculum should not be dictated by a call for evidence alone. We recommend that subject specific expert groups are established to provide specialist advice on content for the National Curriculum. This would enable key stakeholders to be accountable for the performance of the system.
 - We agree that the National Curriculum should be slimmed down but careful attention must be given to how subject content is presented so that the context of what is taught is not lost in place of facts alone. Each subject should display an appropriate balance between information (what we know), skills (how we do things) and concepts (what we understand).
 - The design of the new National Curriculum should be intrinsically linked to assessment. Careful thought must be put into developing and carrying out appropriate means of assessing young people's progress and achievement that follows, not drives, the National Curriculum.
 - The implementation of the new National Curriculum needs to be informed and carefully managed so that teachers can translate its vision into practice and can integrate the reforms into the wider school curriculum. We recommend that the curriculum be piloted before full-scale implementation.

INTRODUCTION

2. The Wellcome Trust is committed to science education and works to support ways to develop the science skills and knowledge necessary for young people to live and work in an ever more scientific age. We recently launched our Education Strategy¹ for 2010-2020 which places "science 5-14" as a key priority area in our remit. We are, therefore, pleased to respond to the National Curriculum Review.
3. We have been actively involved in debates on the National Curriculum, in particular facilitating a symposium in 2010 on the National Curriculum for science. The report of this meeting² sets out five key messages for consideration in the development of a new curriculum. We have enclosed a copy of this report for your information.
4. This review seems to have two distinct areas of focus, the first being the general principles of the National Curriculum and the second being subject content. We are concerned that the nature of subject content in the new National Curriculum will be dictated by this call for evidence alone. We therefore urge the Department for Education (DfE) to go further than this and set up expert groups for specific subjects. Engaging STEM experts from higher education and other sectors would enable them to accept accountability for the success of a new system.

¹ Wellcome Trust Education Strategy 2010–2020 (2010) "Inspiring Science Education: Extraordinary Opportunities"
http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_publishing_group/documents/web_document/wtx064002.pdf

² Wellcome Trust (2010) Summary report of the seminar "Leading Debate: 21 Years of the National Curriculum for Science"
http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtx063344.pdf

The Trust would be happy to provide suggestions of membership for STEM subject expert groups.

5. We note that the Call for Evidence distinguished between the “National Curriculum” and the “wider school curriculum”, and we welcome this approach. The National Curriculum does not exist in isolation and therefore the incorporation of a new version into the wider school curriculum will need to be carefully managed.
6. Where possible we have answered the specific questions in the consultation document, however in some circumstances we have given a broader view.

Section C: General views on the National Curriculum

6a) What do you think are the key strengths of the current National Curriculum?

7. The National Curriculum has been successful in many aspects. Generally, it has raised standards in maintained schools since its inception in 1989 and has improved the consistency and transferability of education in England.
8. The existing curriculum has strengths and so care should be taken to ensure that these are not lost. For example, it has seen the establishment of science as a core element of learning and a national entitlement to science education for all young people. We welcome the re-assertion of science as a core subject for all up to age 16 within the proposed new National Curriculum.
9. In embedding science as a core element of education, it has ensured that young people study all major scientific disciplines. This must be strengthened further so that all students have an understanding of science necessary for the world today and that those who have the desire to pursue a career in science have the opportunity and ability to do so. There should be no move back to the system that prevailed before the introduction of the NC, whereby students could drop individual science subjects (often physics in the case of girls) before the age of 16.

6b) What do you think are the key things that should be done to improve the current National Curriculum?

10. Over many years the existing National Curriculum has been subjected to multiple piecemeal changes that have contributed to it being over-prescriptive and inflexible. We would like to see a commitment to an agreed long-term (at least 10 years) vision for the National Curriculum that policy makers, teachers and other stakeholders could work towards.
11. Engaging teachers in the review of the National Curriculum is vital. Teaching professionals have reported a lack of direct engagement with the existing National Curriculum. This has ultimately undermined teacher confidence to innovate, leaving them as deliverers of the National Curriculum rather than as developers of a rich and varied science education.
12. To accompany the launch of a new National Curriculum it will be crucial to encourage and support teachers through guidance, teacher training and ongoing CPD. This will promote confidence and understanding of how best to apply the curriculum, and provide ongoing stability for the teaching profession. Through enabling teachers with training and more freedom to teach to the best of their abilities they will be empowered to be creative and innovative in their approaches to teaching in realisation of a new National Curriculum.
13. Key to the successful delivery of the new National Curriculum is implementation. Careful thought is needed on how to engage the appropriate stakeholders to ensure that the translation of the reforms into practice is done in the most effective way. We provide more detail on this point in Section J.

7a) What are the key ways in which the National Curriculum can be slimmed down?

14. We support the move to provide a National Curriculum that is not overly prescriptive and gives teachers the freedom to innovate in their approach to teaching and raise standards. However, as mentioned above, we believe that content of the National Curriculum should not be dictated by a call for evidence alone.
15. We are also concerned about the emphasis on knowledge, and warn the review panel against steering the National Curriculum to encompass information and facts alone, which leads to

regurgitation in testing situations. If the interpretation of 'scientific knowledge' is one that excludes scientific *skills*, the curriculum will fail to meet the demands of the workplace and society in the 21st century. It is not enough for scientists and citizens of the future to possess scientific knowledge; they also need to understand the method by which that knowledge is obtained.

16. All young people should have a core entitlement to a broad and balanced science education, covering the big ideas and principles of science³. The pinnacle of science is in the development of theories, therefore young people must not only be able to explain what they know or observe, but how they know this and why it matters⁴.
17. There needs to be an overview and understanding of the ideas that are being developed from 5 to 16 and beyond and an understanding that it is 'questions' which drive science. A body of core knowledge should be clearly defined but not over-prescribed. The scientific knowledge encapsulated in a National Curriculum should include a balance of information (what we know), skills (how we do things) and concepts (what we understand).
18. Content knowledge refers to the understanding of factual knowledge, concepts, laws and theories. However, different types of knowledge such as procedural and epistemic knowledge, as well as an appreciation of the place of science in society are required as part of a balanced science education⁵. Procedural knowledge describes ideas about evidence and its interpretation; concepts such as reliability and validity, measurement, error and calibration. Epistemic knowledge describes understanding of what knowledge is; how knowledge is acquired; and how we know what we know. Furthermore, science education should present itself in the context of society. By simply teaching science as a list of facts and body of knowledge we would fail at showing young people its significance.
19. The science curriculum should enable young people to gain knowledge and capabilities in all these aspects of the subject as well as ensuring that they experience science through practical activities and in diverse settings beyond the classroom. Practical work should be intrinsic to the curriculum and be used not only to develop a pupil's understanding of scientific enquiry and practical skills but also to further a pupil's scientific knowledge and understanding⁶.

Section D: English, mathematics, science and physical education

11a) *Science. What knowledge do you regard as essential to include in the Programme(s) of Study for science? Please also set out why this is essential and at what age or key stage.*

11b) *Considering your response to the above, should the Programme(s) of Study for science be set out on a year by year basis or as it currently is, for each key stage?*

Do you believe that the Programme(s) of Study for science should identify separate requirements for biology, chemistry and physics: at Key Stage 1, 2, 3 and 4?

20. The Trust is not in a position to dictate what should go into a programme of study for science education. However, we have a keen interest in supporting the development of a curriculum that will engage young people in science so that they have the necessary literacy for an increasingly scientific society and, where possible, inspire them to become the scientists of tomorrow. We have therefore provided some general points regarding the ethos of an improved science curriculum in this section.
21. Children's early years are key to shaping society's attitudes towards science. Some studies have shown that children's attitudes towards science declines in the latter years of primary school⁷. To avoid this, primary science education should be rewarding, enjoyable and

³ Harlen et al. (2010) "Principles and big ideas of science education" <http://dl.dropbox.com/u/901220/principles-and-big-ideas-of-science-education.pdf>

⁴ Osborne (2010) "Arguing to Learn in Science: The Role of Collaborative, Critical Discourse" <http://www.sciencemag.org/content/328/5977/463.full>

⁵ Cooper (2008) The Roles of Substantive and Procedural Understanding in Open-Ended Science Investigations <http://www.springerlink.com/content/m8ru5752703j3162/?p=95f3a72c3520424baacc52ce829feecd&pi=10>

⁶ SCORE (2010) "Practical work in science project" <http://www.score-education.org/policy/wider-learning-experience/practical-work-in-science>

⁷ The Wellcome Trust (2005). "Primary Horizons: starting out in science" http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtx026628.pdf

engaging. It should include a greater emphasis on the use of creative and innovative approaches, open-ended investigation and cross-curricular work, to help bring science to life and develop transferable skills. The best way to develop children's scientific literacy is to make science more relevant to their everyday lives. We argue that high quality primary science education should engage and inspire young people, encouraging them to continue to study science subjects at GCSE and beyond.

22. The transition between primary and secondary education requires seamless continuity in the National Curriculum to ensure that all children are at the appropriate level to learn increasingly complex concepts. This is discussed further in Section I.
23. Looking further to Key Stages 3 and 4, we welcome the government's vision to give all young people the opportunity to undertake triple science at GCSE. This vision should build on recent developments in science GCSEs, where the introduction of new GCSEs in 2006 has seen an increased number of courses that meet the needs of all students and have increased the uptake of science subjects at A-level⁸.
24. School science, at all levels, should incorporate relevant ways of presenting itself in terms of the diversity of career paths that follow from science qualifications. Not simply for those who may become tomorrow's scientists, mathematicians or engineers but to inform all young people on how and when they can progress through their education and into future training or employment.

Section F: Supporting and recognising progress

Views on supporting progress of all pupils. Are there credible alternatives to attainment targets that would better support and recognise all pupils' progress, irrespective of their attainment and background, and how to address the needs of all pupils through the National Curriculum?

25. The design of the new National Curriculum should be intrinsically linked to assessment. Careful thought must be put into developing and carrying out appropriate means of assessing young people's progress and achievement that follows, not drives, the National Curriculum.
26. It is crucial that the processes of designing the curriculum and its associated assessment are carried out in parallel, especially regarding external assessment at the end of Key Stage 4. There is abundant evidence that the most powerful influence on what gets taught is what appears in external tests. In the past, responsibility for the processes of curriculum development and assessment development has been located in different parts of the Department, and with different NDPBs, and the result has been, in some cases, incoherence between curriculum and assessment. Now that both processes are under the control of the Department, we hope the same mistake will not be made again.
27. Appropriate assessment should be designed to support learning, improve achievement and promote progression. Different forms of assessment – including both formative and summative – should inform students, parents and teachers of young peoples' attainment and progress. It should not be used as an overall measure of system performance due to the distorting influence on learning outcomes.
28. Further work is needed to create a framework to measure system performance separately from pupil assessment. We believe that one element of performance improvement and accountability of schools should include robust local governance of schools⁹. As part of this, careful thought must go into the training and recruitment to governing bodies to ensure appropriate experience and full understanding of the role of governing body members.

Section G: International comparisons

27a) Please give examples of any jurisdictions that could usefully be examined to inform the new National Curriculum. Please also briefly describe the reasons for the examples given.

⁸ Ofsted (2010) "Successful science" <http://www.ofsted.gov.uk/content/download/11931/138792/file/Successful%20science.pdf>

⁹ Report of the Science and Learning Expert Group (2010) "Science and Mathematics Secondary Education for the 21st Century" <http://interactive.bis.gov.uk/scienceandsociety/site/learning/files/2010/02/Science-and-Learning-Expert-Group-Report-Annexes-31.pdf>

27b) Considering your response to question 27a above, what features of their national curricula or wider education systems are most significant in explaining their success?

28) Please use this space for any other comments you would like to make about the issues covered in this section.

29. While we recognise the need to compare our education system in an international setting and we advocate an evidence based approach to developing policy, caution is required in its interpretation because broader societal factors influence educational attainment in different countries.

Section H: How children learn

29) What research evidence on how children learn provides the most useful insights into how particular knowledge should best be sequenced within the National Curriculum Programmes of Study?

30. As highlighted in our education strategy and the recent 'Brain waves' report by the Royal Society¹⁰, areas of neuroscience research looking into the biological processes of how children learn could inform educational practice in the future. Although this research is still in its infancy we support the recommendations of the Royal Society report and urge DfE to monitor developments in this field. Claims that particular activities improve learning by stimulating brain activity need to be examined more systematically by educators, scientists and policy makers working together. We therefore particularly support the suggestion to provide better cross sector links between researchers and the education system.
31. While scientific evidence should inform future development of education, teachers are best placed to understand, on an individual level, how best young people in their classes learn. As mentioned previously, engagement with teachers and experts on development of the National Curriculum is therefore essential to understand what should be taught at different stages. We must trust that our teachers know best the abilities of children to learn at appropriate levels.

Section I: Transition

30) What are the most important factors to consider in developing the National Curriculum for Key Stage 1 to ensure a smooth transition from the Early Years Foundation Stage?

31) What are the most important factors to consider in developing the National Curriculum for Key Stage 3 to ensure a smooth transition from Key Stage 2?

32) What are the most important factors to consider in developing the National Curriculum for Key Stage 4 to ensure the effective operation of GCSE and other public examinations?

32. There is a need to strengthen the curriculum and pedagogical continuity that young people experience as they move through 5-16 education. Our belief in the importance of this crucial area of transition is set out as a priority area in the Trust's Education Strategy focusing on 5-14 science education:

"To reinvigorate the teaching of science in primary schools, improving the expertise of teachers and strengthening the continuity of science education within and between phases".

33. Continuity and clarity in the National Curriculum is essential for a smooth transition throughout school education. To ensure this, the National Curriculum must be looked at in its entirety rather than in Key Stages, so that the big picture of what young people should be aiming to achieve at the latter stages is made attainable.
34. As noted previously, many reports have revealed a decline in attitudes towards science at the latter stages of primary school, which has a knock-on effect in secondary school¹¹. Effective teaching throughout the Key Stages, but especially in late Key Stage 2 and early Key Stage 3, is therefore especially important to maintain enthusiasm for science subjects at this critical point in learning.

¹⁰ Royal Society (2011). "Brain waves module 2: Neuroscience implications for education and lifelong learning". http://royalsociety.org/uploadedFiles/Royal_Society/Policy_and_Influence/Module_2_Neuroscience_Education_Full_Report.pdf

¹¹ Wellcome Trust (2005) "Primary Horizons: starting out in science". http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_peda/documents/web_document/wtx026628.pdf

Section J: Implementation

34) *What are the particular issues that need to be considered in phasing the introduction of the new National Curriculum in the way proposed, with Programmes of Study in some subjects introduced in 2013 and the rest a year later?*

35) *What other arrangements, if any, need to be considered in implementing the new National Curriculum, and how they should be addressed?*

35. As noted earlier, the success of a new reformed National Curriculum is dependent on its appropriate implementation. This must be carefully planned to ensure that all parties involved (including curriculum developers, awarding bodies, examination designers, teachers, inspectors, parents and pupils) are involved in its development and understand how it should be applied in practice.
36. We believe that a new National Curriculum should be piloted and all methods of its implementation rigorously evaluated before being refined and rolled out nationally. This would ensure that the ability to transfer the new reforms into practice in the classroom and assessment structures is effective and would provide long-term stability.
37. Of particular importance will be the need to support teachers in delivering a curriculum that is less prescriptive than its current form. Since the introduction of the National Curriculum teachers have had to deal with moving goal posts and changes to the system. Many teachers only have experience in the current regime. They are used to a system loaded with detailed programmes of study, frameworks, text books and bureaucracy. These teachers may not have the skills, expertise or vision to apply an innovative approach to their teaching as part of the revised National Curriculum. High-quality ongoing professional development, as well as revision of initial teacher training, will be essential to support teachers in this transition period.
38. In addition, perceptions of the National Curriculum as a rigid system have increased and the plethora of bureaucracy associated with it has constrained teaching. A new slimmed down curriculum needs to be accompanied with a new positive attitude towards it. This will only be achieved if it draws on teacher opinion and expertise, and should in turn promote interest in and credibility of the new system.
39. For those teaching STEM subjects, it is important that teachers throughout 5-16 education have the necessary subject-specific knowledge and expertise. This is particularly important for primary teachers, where many studies have identified these attributes as important influencers on pupil response's to science during primary and early secondary education¹².
40. To strengthen the teaching of science in both primary and secondary schools there is a clear demand to increase the levels of science teaching expertise in schools. For example, in the 17,640 maintained primary schools in England, only 3% and 2% of teachers are science and mathematics specialists respectively¹³, demonstrating that there are insufficient numbers for each primary school to have access to a specialist. The recruitment and retention of excellent science and mathematics graduates into teaching is therefore essential to increase standards in these subjects and provide the system with more able and innovative teachers.

The Wellcome Trust is a global charitable foundation dedicated to achieving extraordinary improvements in human and animal health. We support the brightest minds in biomedical research and the medical humanities. Our breadth of support includes public engagement, education and the application of research to improve health. We are independent of both political and commercial interests.

¹² Tymms, P. & Gallagher, S. (1995) Primary Science: an exploration of differential classroom success. *Research in Science & Technological Education*, 13 (2), 155 – 162; Osborne, J. F., & Collins, S. (2001). Pupils' views of the role and value of the science curriculum: a focus-group study. *International Journal of Science Education*, 23(5), 441-468;

¹³ The Royal Society (2010). "State of the Nation – Science and Mathematics Education 5-14". <http://royalsociety.org/WorkArea/DownloadAsset.aspx?id=4294971776>