



The **Association**  
for **Science Education**

*Promoting Excellence In Science Teaching and Learning*

## **ASE response to the GCSE Criteria consultation**

This document forms the response of the Association for Science Education to the QCDA consultation on GCSE criteria completed on 11th September 2009.

### **Introduction**

The Association for Science Education is the membership organisation for the science teaching profession. This response has been formulated in consultation with ASE's specialist committees and the divisions of Council, although the timing of the consultation has been unfortunate for obtaining the views of practising teachers, most of whom being away from their schools and unreachable during the consultation process.

ASE recognises the progress made in recent years towards the aim of providing a first class science curriculum for all and we expect new criteria to build on those successes. Currently there are many alternative routes to GCSE science, with opportunities for students to consider the impact of science on society and to develop a range of science skills. We have identified some weaknesses in current practice, particularly in the methods used to assess science skills and processes, and we expect new criteria to build on the progress made in developing new approaches to teaching and learning. There is currently a broad suite of science GCSE courses that cater for a diverse range of students and institutions, and it is also encouraging to note that there has been a 10% increase in A/S level uptake for the first cohort in 2008 whilst recent research from the University of York suggests an increase in A/S numbers from schools that have offered 21st Century Science. This diversity of science GCSE courses and subsequent qualifications must not be reduced through the introduction of courses that have a narrow range of aims, or assessment models that do not allow all students to demonstrate their enthusiasm for and understanding of science.

### **Principles**

ASE believes that a coherent and complementary suite of GCSE courses should be the cornerstone of the science curriculum in secondary schools in England. GCSE courses must build on, and show clearly defined progression routes from, the Key Stage 3 science curriculum. They must provide progression routes for students wishing to study science beyond compulsory schooling, and for students wishing to take up a career in science or STEM related areas. They must also provide for those students who do not follow a STEM related career but who, as future responsible citizens, will need to understand scientific principles and processes, the possibilities and indeed the limitations of science.

## Key messages

1. The revised criteria must retain the sound principles underlying the development of the 2006 GCSEs which arose from the Beyond 2000 report ie: that all students should be given opportunities to access a definitive body of knowledge, understanding and skills on the core ideas of science, and gain experience and understanding of the scientific approach to enquiry<sup>1</sup> so that they can function as scientifically literate citizens of the future and are equipped for further study or careers in science.
2. There is currently a broad suite of science GCSE courses that caters for a diverse range of students and institutions. This diversity must not be lost through the introduction of courses that have a narrow range of aims, or assessment models that prevent students from demonstrating their enthusiasm and understanding of science.
3. The revised criteria must build on the successes of the current provision, providing continuity for teachers who have experienced considerable change over recent years and have expended considerable time, resources and creative energy in developing approaches to deliver science GCSEs since 2006.
4. Recent reports from Ofqual (March 2009) and SCORE (July 2009) highlight significant issues around 'How Science Works', practical science, mathematics in science GCSE courses and the narrow ways in which they are assessed, which must be addressed through this examination of the criteria.
5. High quality practical work is central to the teaching, learning and doing of science and it is essential that all students should experience it. ASE is concerned that the draft criteria do not reflect the distinctive role of practical work and we feel that the opportunities for its effective assessment may be constrained.
6. The existing science GCSE courses have been criticised for the lack of consistency between awarding bodies in the use of terminology of measurement. While ASE groups have been working on providing teachers with guidelines to help with this confusion, clarification is required from QCDA on the expected terminology for use within the science GCSEs.
7. For science to be studied successfully at all levels, the necessary supporting mathematics must be included in courses as appropriate and the relationship between science and the appropriate maths must be evident in the GCSE assessment.

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<sup>1</sup> Currently known as "How Science Works"

## **Detailed response to the draft GCSE subject criteria**

### *The place of "How Science Works" in the criteria*

GCSE science courses should provide an understanding of scientific enquiry to help students make sense of how scientific knowledge is developed and verified. ASE believes that 'How Science Works' should be placed at the centre of the criteria to ensure that all specifications emphasise the importance of the skills and processes of science for both teaching and assessment. The list of scientific abilities in section 11 of the draft criteria should remain in section 11 but should also be included in section 10 as knowledge and understanding that should be explicitly taught. The 'How Science Works' statements should be moved to the top of the list of content, to emphasise the importance of this aspect of science.

### *The role of practical work*

Practical work is central to teaching, learning and doing science. It defines science as a unique way of thinking about the world. Learning in a practical context enables students to acquire the understanding, skills and ways of thinking that will be essential for their future study and their future engagement with science and hence for the future sustainability of our civilisation. Evidence suggests that there has been a reduction in the amount of practical work undertaken by students since the introduction of the science GCSEs in 2006. This is a worrying trend as the positive impact of effective practical work learning in science is widely recognised.

The GCSE science criteria must place much more emphasis on the role of effective practical work. They must reflect how practical work helps to:

- ? develop knowledge and understanding of science and the natural world,
- ? use apparatus and carry out standard procedures and
- ? develop an understanding of the scientific approach to enquiry.

This emphasis should be reflected with specific reference to the role of effective practical work in section 5 and more guidance must be provided on rigorous and different approaches by which practical science can be assessed, without reverting to the unimaginative and constraining Sc1 assessments of the past. ASE believes that the draft criteria assessment objectives are too vague and imprecise to ensure that specifications will be developed that will lead to effective teaching, learning and assessment of practical skills. As the lead partner in the DCSF funded Getting Practical (Improving Practical Work in Science) programme under STEM Action Programme 10, ASE would be prepared to work with QCDA in convening a working party drawn from the science community and awarding bodies to strengthen the assessment of practical science work in the specifications.

### *Language of science*

One common criticism of existing science GCSE courses has been the lack of consistency between awarding bodies in the use of terminology of measurement. ASE and the Nuffield Curriculum Centre have convened a series of meetings with awarding bodies over the use of such terminology. This has resulted in the production of guidance for awarding bodies, publishers and others to help to make this aspect of science teaching and assessment more effective. ASE would be

pleased to work with QCDA and others to promote consistency and understanding in this area.

#### *Distinctive nature of different draft criteria*

Each set of criteria contains broadly similar aims and learning outcomes. The differences can be subtle making it difficult to interpret the meaning behind the differences. For example the first learning outcome in the science criteria is to 'develop their knowledge and understanding of the material, physical and living worlds'. The first learning outcome for the additional science criteria is to 'develop their knowledge and understanding of science'. Where criteria intend to convey the same meaning, the same wording should be adopted.

The intended audience and purpose of each set of criteria must be made clearer. The GCSE Science criteria should cover the programme of study at KS4 and be appropriate for all pupils, providing an understanding of the main processes and principles of science and equipping them to become responsible citizens. Additional Science should be appropriate for all pupils and provide greater depth of understanding and experience of scientific skills, processes and concepts. GCSE Science plus GCSE Additional Science together provide a progression route to further study of science at AS/A2 level and will be the science curriculum choice for the majority of students.

Additional Applied Science together with Science should be for those students interested in a career in science, and together these will provide a progression route to further study post 16. Currently the content statements in the draft Additional Applied Science criteria are very specific in a number of areas of chemistry but less prescriptive about biology and physics. There should be a single more generic chemistry statement to balance with the statements on biology and physics, leaving awarding bodies the freedom to include other content areas appropriate to the interests of young people and the changing needs of society and the labour market.

The draft criteria for chemistry, biology and physics as separate subjects should not specify content in addition to that covered by science and additional science criteria. This will allow awarding bodies the flexibility to develop distinctly different specifications for these subjects. The purpose and target audience for such courses should be made clearer as alternatives to Science plus Additional Science, as routes to a scientific career or to further study.

In further defining the characteristics of the different science criteria, the different purposes and emphases of the practical work assessed alongside the written assessments should be clarified between Science, Additional Science and Additional Applied Science GCSEs.

#### *Assessment principles and objectives*

The controlled assessment component of each of the draft criteria must build on the Assessing Pupils Progress (APP) approach developed in KS3 science. It should also include successful elements of existing GCSE assessment such as the extended research and writing that students undertake in 21<sup>st</sup> Century Science courses. Whilst recognising the importance of teachers assessing the various skills listed in the consultation questionnaire, there are additional skills that would be more effectively assessed by controlled assessments rather than external assessment. The weighting of 25% controlled assessment in five of the draft criteria could be increased without

loss of rigour to emphasize the unique importance of practical work to the understanding of science.

ASE believes that the assessment objectives should be clarified further, and an indication given of how each objective is to be assessed – by external and/or controlled assessment.

### **Specific issues**

#### *Coherence of biology, chemistry and physics draft criteria*

The criteria for the three subjects should be brought into line, avoiding minor differences in the phrasing of common components. Single subject physics criteria also specify significant additional content that does not appear in Science or Additional Science criteria, unlike the single subject chemistry and biology criteria.

#### *Content in the Science and Additional Science criteria*

There should be a review of the knowledge and understanding specified in the Science and Additional Science criteria. Science should contain the complete programme of study (the subject of radiation has been omitted, for example). Some content currently included in Science should be transferred to Additional Science. ASE considers it important that human impact on the environment should be included in science as this is central to the problems that confront society now and for the foreseeable future.

#### *Fieldwork*

Fieldwork is a specialist aspect of practical work in science providing a unique set of skills and processes that should not be limited to the measurement of environmental change.

#### *The role of ICT*

ICT is central to the acquisition and communication of scientific knowledge. It has a unique role to play in school science as a means of providing students with authentic data. ICT is also specified in the programme of study as a means of collecting primary and secondary data. ASE believes that the use of ICT should be specified in each of the criteria.

#### *The role of mathematics*

Following the SCORE report (July 2009) on the first application of the current criteria, it is clear that the awarding bodies need further guidance on the inclusion of appropriate mathematics in their various specifications. This is particularly problematical in biology, where if appropriate mathematical content is not included at GCSE, the impression of biology as a mathematics-free science will prevail and students will be under prepared for further study.

#### *Recommendations to improve the criteria and GCSE assessment*

The concept of a 'toolkit' for awarding bodies to provide guidance on aspects of the specification development should be explored as it is a welcome feature of the diploma development with which ASE is involved. This could include further guidance on the mathematics, IT, assessment strategies, practical work and

terminology to be used in science specifications. ASE would be happy to contribute to production of such a toolkit.

ASE believes that the specification production process could be improved if the awarding bodies were to convene a review board comprising ASE and other science organisations, reflecting the approach taken in creating the science diploma which has involved a wide range of science organisations.

Reflecting the importance and vulnerability of practical work, ASE recommends that QCDA should secure its role in the new GCSE specifications by convening a working group to supervise its assessment. This should draw on the expertise of ASE and the consortium partners of Getting Practical project mentioned earlier in this document.

The Association for Science Education is committed to the pursuit of excellence in the teaching and learning of science and is happy to take part in consultations of this nature, and to help in the development of improvements to the curriculum and its assessment.