

The Science Council

1. The Science Council is an umbrella organisation of nearly 40 learned societies and professional bodies in the UK drawn from across science and its applications: a list of member organisations is attached. In addition to providing a mechanism for the sector to work collectively, the Science Council develops and leads collaborative projects working with member bodies and the wider scientific community: examples include the Future Morph website¹ designed to provide information about career opportunities, and LMI analysis of the UK Science Workforce.²
2. The Science Council also works to advance the professional practice of science and since 2004 has awarded the professional qualification of Chartered Scientist (CSci). It is now leading an initiative that aims to raise the profile, aspirations and retention of technician and graduate scientists through professional registers at these levels (Registered Scientist and Registered Science Technician). Collectively our member bodies represent more than 400,000 individual members, including scientists, teachers and senior executives in industry, academia and the public sector.

The need for science skills

3. It is important to recognise that A levels sit within a wider qualification framework that includes vocational progression routes and that will also need to adjust to accommodate the move towards compulsory education or training up to age 18. For science there is a particular need to take account of the relationship between A levels and technical education routes, given their importance to the growth of the UK's economy.
4. Recent research undertaken for the Science Council shows that science skills have become increasingly important across all sectors of the UK economy and society, with 5.8 million people now employed in science-based roles: this is projected to increase to 7.1 million people by 2030.³ This research looked at the UK workforce in its entirety, thus enabling an understanding of the true size and scope of the science workforce across the whole economy, rather than limiting the research to considering only those working in a narrow band of so-called science sectors. The research highlighted the need for different skill levels and was able to show that within the science workforce as a whole 34% hold qualifications at QCF Level 4 or below, 32% are graduates and 26% post-graduates. In addition the Technician Council has identified that by 2020 the demand for highly skilled technicians will grow by at least 450,000.⁴
5. Individuals with science, technology, engineering and mathematics (STEM) qualifications provide value in employment across the economy, not just within academic and research sectors. These "hidden" aspects of the demand for individuals with STEM skills add to the difficulty of quantifying the numbers required, but all indications are that demand from all sectors is steady or increasing.
6. The economy and society will benefit from more individuals studying STEM subjects beyond 16, whether or not they plan to pursue STEM subjects at university and as careers and therefore it is a key concern for the Science Council that there is a mis-perception that STEM A levels are only important for those who wish to progress to science in higher education. The Science Council considers that as with humanities and social science A levels, the economy and society gain value from an increasing number of individuals achieving a science based A level and thus the ability to draw on science methodological and subject knowledge and skill into a broad range of employment sectors. It is acknowledged that HE is often very prescriptive about the subjects required to study STEM degree subjects and there is therefore a tendency to see STEM A levels simply as the necessary steps to a pathway to STEM careers via university.

¹ <http://www.futuremorph.org/>

² *The current and future UK science workforce* TBR, Sept. 2011 <http://www.sciencecouncil.org/content/science-workforce>

³ *Ibid.*

⁴ *Professional Technician: the future*, The Technician Council, 2012

Purpose of A levels

7. It is not possible for a single qualification route to adequately satisfy the needs of all stakeholders for level 3 qualifications. The purpose of A levels must be sufficiently focused and fit within a landscape of qualifications available which, as a whole, will allow more individuals to study high quality STEM qualifications post-16. For many science A levels, particularly the core subjects, preparation for higher education courses will be the primary purpose but it is important to remember that it is not the sole purpose.
8. Even where science subjects are not a stated entry requirement they can be of value for entry to non-STEM higher education courses, as acknowledged by the Russell Group in their advice regarding post-16 subject combinations.⁵ A significant proportion of students will choose to study science alongside other subjects without an expectation of progressing to a science degree.⁶ This is particularly common for subjects such as psychology which can be attractive to students who do not wish to continue studying biology, chemistry or physics but nevertheless means that they are continuing their study of science. This may be the final stage in their science education and equip them with increased scientific literacy and transferable skills such as statistical analysis, or it may inspire them to further science studies.
9. There is a tension between the need for A levels to enable universities to differentiate between the most able applicants and the potential to design innovative courses that attract a wider cohort of pupils and increase the take up of science. In recent years there has been significant government funding for initiatives aiming to widen participation in STEM higher education: if the new A levels are positioned only to stretch and challenge the most able, there is a risk that the gains of the widening participation work will have been very short term. The purpose for the new A levels will need to carefully articulate the desired balance between increasing uptake and challenging the most able in order to avoid a multi-tiered system where A levels from different awarding organisations fulfil different aims. Much of the rhetoric and concern with regard to the quality of A levels is led by those with research interests. While this is an important agenda, it is not the only purpose of A levels, and the government must not lose sight of the fact that we need more individuals to pursue science subjects post 16, not fewer.
10. Higher education is increasingly a global market and for our students to remain competitive A levels must also meet the entry requirements of international universities. Over time changes to the funding of higher education may well increase the importance of this and other progression routes for young people.

Redevelopment process

11. Greater university involvement in the development of A level courses is welcome, as they are key users, and as a connection to ongoing advances in the field of science they will have much to contribute. However, higher education is a diverse sector offering a very wide range of courses; in 2010 UK universities were offering 4,815 different degree titles which required STEM qualifications for entry; a further point to be made is that progression to higher education is not always a case of pursuing further study of the same subject.⁷ By way of an example, biology A level could lead to a biology degree but equally degrees in nutrition, biochemistry, zoology, ecology, countryside management, immunology, marine science, palaeontology, sport science, pharmacology, physiology and many other courses.
12. In addition, for many pupils science will be a subsidiary subject, one which they choose not to pursue beyond AS level but which may assist them in progressing to study of other subjects or which they have chosen purely to pursue an interest: a similar case is often made to encourage those studying predominantly science subjects to include a humanities subject to give them a more rounded education.
13. The Science Council does not believe that a single grouping of higher education institutions could represent all strands of science, all types of courses and all potential progression routes. As such, a

⁵ *Informed Choices*, Russell Group, March 2012

⁶ *Transfer to STEM Higher Education*, State of the Nation, Royal Society, February 2011

⁷ *Choosing the right STEM degree course*, University of Warwick commissioned by SCORE, Dec 2009

process for the design of A levels led by a sub-set of universities would fail to adequately represent the stakeholders and the Science Council would not support this methodology.

14. The SCORE partnership has proposed that broadly based national subject committees, which would include university representatives as well as representatives from schools and employers and other users, should be established to set subject criteria and review sample assessment material with the potential to act as 'guardians' for individual subjects.⁸ The SCORE partners, with the exception of the Royal Society, are members of the Science Council and the wider Science Council membership is broadly supportive of this proposed model.
15. The Science Council believes that this more broadly based methodology should be explored further. For the national subject committees to be effective there would need to be a number of safeguarding provisions. Most importantly the committees would need to be independent from the awarding organisations and transparent in their working; we would note that the financial interest of the awarding organisations has driven undesirable behaviour and the committee structure must remove that possibility in the future.
16. The membership of the national science committees would need to include broader representation than from the corresponding single science disciplines. The science subjects are interconnected: key concepts learnt in one branch of science, or mathematics, are required for understanding of other branches. For example, to understand the structure of DNA biology students will need to apply their understanding of molecular bonding acquired through studying chemistry. Each subject committee will therefore need to draw on the other disciplines.
17. A further argument for breadth of representation within the subject committees is the range of progression options available from each A level and thus the range of 'users'. This has been described previously and an important example would be the requirement for the national biology committee to incorporate representation from the medical schools; however, it is also quite likely that they would also wish to input to the development of chemistry A level as well as mathematics. Further examples would be the engineering and geoscience communities. Physics A level is a gateway to engineering courses and careers, and accordingly the content must provide for progression to engineering as well as physics. A significant proportion of students progress to geoscience degrees having encountered geology through A level geography, therefore geoscience representation on the geography subject committee would also be pertinent. The overlapping of representation, and carefully managed alignment and coordination across committees will be necessary to ensure that the terminology used and progression of concept understanding marries up across science subjects and with mathematics. Without this linkage, it is unlikely that a new A level system – one that is fit for purpose in the 21st century – could be developed.
18. A further concern would be that the range of interests that should rightly be engaged in the development of new A levels could easily lead to large and unwieldy committees. It will therefore be important for the convenors for the subjects committees to have strong stakeholder engagement credentials and the ability to draw creatively and effectively from experience of a range of methodologies to engage and hear stakeholders. The processes for approval of the steps leading to development and the final qualifications are likely to be challenging and would need to be clearly defined. There are also significant time and resource commitments associated with this work, as such funding support will be required.

Structure of A levels and assessment

19. Attainment targets have been driving behaviour in secondary education, reducing the value of assessment as a tool for learning through reflection, recognising strengths and areas for improvement. There are concerns that the balance between assessment for accountability and assessment for educational purposes has tipped too far in favour of accountability. Reforms must seek to redress this balance.
20. Science subjects are cumulative in nature; each stage of learning builds on previously acquired knowledge and skills. Some science disciplines have reported that the modularity of A levels has meant that universities are unable to rely on students entering university with an understanding of key concepts. There are advantages to a degree of modularity which allows some tailoring of content to

⁸ <http://www.score-education.org/media/10256/final%20score%20position%20on%20a-level%20reform.pdf>

student interests; it would be beneficial to retain some element of this particularly to assist engagement of both genders through different topics.

21. A common core of assessed content would help to facilitate progression of learning and the interlinking between subjects, however, each subject must retain sufficient flexibility for awarding organisations to develop differentiated courses.
22. The Science Council supports the retention of the AS level qualification as an appropriate exit point for those not wishing to continue with a subject and a useful indication of progress for students, teachers and even admissions tutors. The AS level also acts as a mechanism to encourage breadth of study allowing students to consider studying subjects for which they may not wish to commit to a full A level. This can facilitate wider take up of science subjects and, in particular, allow greater numbers to study mathematics for longer.
23. However, with the current move towards a greater emphasis on post-16 mathematics it is unclear how alternative mathematics qualifications will align with the current structure of AS and A levels.
24. The Science Council agrees that the current number of opportunities for re-sitting impacts on teaching time and hinders student attitude and performance. It would be beneficial to remove the January re-sit and move to a system where assessment takes place only in the summer term.
25. Assessment strongly influences teaching and for assessment to be effective it must be developed alongside the content and use a range of assessment methods. Practical skills are of utmost importance for science subjects and, therefore, must be included in the assessment.
26. Valuable learning does not always require external assessment. This is illustrated by the Extended Project Qualification, which provides opportunity for inter-disciplinary learning and develops transferable skills in areas such as research, communication, time management and critical thinking.

Comparability of standards

27. One of the most serious issues has been the lack of comparability between subjects with regard to grading; there is already evidence that perceived ability influences subject choice.⁹ Higher Education funding is currently linked to grades with unlimited places available for AAB students, this raises the importance of gaining grades of this level. If comparability between subjects is not enforced there is a risk that this funding policy will drive subject choice. Consistency of assessment and comparability is essential and must be monitored.

Implementation of reform

28. The Science Council has serious concerns with regard to the proposed timetable for reform, which it believes is unrealistic if worthwhile reform is to be achieved. The proposed timetable indicates that awarding organisations would require subject criteria agreed by early 2013 in order to meet the September 2014 target for first teaching. There are serious risks to rushing the development of new A levels, particularly for science subjects. The individual science subjects are interconnected with concepts and skills spanning subjects as such the new qualifications will need to align across subjects but also with mathematics, which acts as a tool and a language for science. For these reasons it is important that the core science subjects, biology, chemistry and physics, are developed in parallel with mathematics. Other science subjects could conceivably be developed at a later stage. Since the process for reform has not yet been established, and all key user organisations will require time and resources to prepare, this proposed timetable is unachievable. It is unclear how this programme of reform for A levels will relate to pre-16 qualifications and it will be important that the content and structure of A levels and GCSE, or equivalent qualifications, complement each other to provide appropriate progression. There are therefore several strands of education policy and reform that will need to work hand in hand.
29. Credible and durable reform cannot be rushed. The UK witnessed the catastrophic drop in A level mathematics entries that followed the implementation of Curriculum 2000 when in 2002 alone entries dropped by 18.5%.¹⁰ Over £500 million of Government funds and considerable stakeholder input were expended on the Diploma development process, another example of poorly managed reform

⁹ *Subject Choice in STEM*, review of UK literature, EPPI-Centre for Wellcome Trust, Oct. 2010

¹⁰ <http://www.acme-uk.org/news/news-items-repository/2009/10/rises-in-a-level-mathematics>

that must not be repeated.¹¹ However, a delay to September 2015 for first teaching may be achievable.

30. In recent years government policy has recognised the economic importance of science and mathematics and the risks to the economy and society of rushed and poorly managed reform for the qualifications that provide the main gateway to further study of these subjects are great. The consequences of rushed changes could be highly detrimental for the skills base of the UK economy.

We would be happy to discuss further any of the issues outlined above.

The Science Council
September 2012

¹¹ Freedom of Information request: Ref 2012/0008389

Member Bodies of the Science Council
September 2012



1. Association for Clinical Biochemistry*
2. Association of Neurophysiological Scientists*
3. Association for Science Education**/ ***
4. British Academy of Audiology
5. British Association of Sport and Exercise Science
6. British Computer Society*
7. British Psychological Society*
8. British Society of Soil Scientists*
9. Chartered Institution of Water and Environmental Management*
10. College of Podiatry
11. Energy Institute*
12. Geological Society of London*
13. Institute of Biomedical Science*/ **
14. Institute of Brewing and Distilling*
15. Institute of Clinical Research*
16. Institute of Corrosion*
17. Institute of Food Science and Technology*/ **
18. Institute of Marine Engineering, Science and Technology*
19. Institute of Materials, Minerals and Mining*
20. Institute of Mathematics and its Applications*
21. Institute of Measurement and Control
22. Institute of Physics and Engineering in Medicine*/ **
23. Institute of Physics
24. Institute of Science and Technology**
25. Institution of Chemical Engineers*/ **
26. Institution of Environmental Sciences*
27. London Mathematical Society
28. Mineralogical Society*
29. Nuclear Institute*
30. Oil and Colour Chemists' Association*
31. Physiological Society
32. Royal Astronomical Society
33. Royal Meteorological Society
34. Royal Society of Chemistry*/ **
35. Royal Statistical Society*
36. Society for Cardiological Science and Technology
37. Society for General Microbiology
38. Society of Biology*/ **
39. Society of Dyers & Colourists

* Licensed to award Chartered Scientist (CSci)

** Licensed to award Registered Scientist (RSci) and Registered Science Technician (RSciTech)

*** Licensed to award Chartered Science Teacher (CSciTeach)