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24 June 2013

Dear Professor Smith,

Reform of Biology, Chemistry and Physics A-Levels

We are writing to you in your capacity as Chair of the panel of Awarding Organisation Responsible Officers.

In a letter dated 29 April (although not received until several days later), the CEOs of the Awarding Organisations (AOs) invited our societies to share our views (by May 16th) on the A-levels in our subjects and associated evidence.

In a meeting with the AO CEOs and Elizabeth Truss MP on 13 May, we explained that it would not be possible to contribute formally to the review within the timescale requested. However, we did discuss a number of concerns about the A-levels in our subjects. These concerns were identified through research and discussions with our communities, including experienced teachers, teacher trainers and the heads of university departments in each of our subjects. Since you were not present at that meeting we thought it would be helpful if we summarised the headlines for you.

Our recommendation was that the following should be addressed during the current cycle of reform:

- A coherent approach should be taken for biology, chemistry, physics and mathematics A-levels, owing to overlaps in content and the need for a consistency across the core sciences. Many students take at least two, often three, of these four subjects together, so independent and/or staggered reform of these subjects would be extremely problematic for students and teachers alike.
- Whilst coherence and consistency is important, we also recommend there should be subject-specific assessment objectives, rather than generic statements which are applied to all sciences.
- Recent reports¹ have identified serious concerns about the level of mathematics within biology, chemistry and physics A-levels and, particularly, how it is assessed. This issue is also related to the coherence between the subjects. It would not be acceptable, for example, for the level of mathematics in A-level biology, chemistry and physics to be restricted to what is covered at GCSE. As a specific example, there may be a need for calculus in physics.
- The SCORE Report (2012) recommends that mathematical requirements for each of the sciences should be reviewed to ensure the inclusion of underpinning areas of mathematics within that science.
- It is clear, both from our discussions and other evidence², that students entering HE courses do not have sufficient quantitative skills
- We all believe that practical work is a vital component of studying A-levels in the sciences; however, it is clear that the current assessment arrangements are not working for students, teachers, HE and employers. Many members of our communities (teachers and HE academics) have expressed serious concerns about the current approaches, particularly controlled assessments, triviality of content, mark allocations and grade boundaries. Other solutions are

¹ Mathematics within A-level Science 2010 Examinations, SCORE and Mind the Gap, Institute of Physics

² A Survey of the Mathematics Landscape within Bioscience Undergraduate and Postgraduate UK HE, The HE Academy

available but it is difficult to see them emerging within the current timescale of implementation in 2015.

- We would like to see a greater variety of question types, including more questions which require extended answers and multi-step calculations. Questions which allow students to show scientific and analytical approaches to problems should be encouraged, reducing reliance on signposted/scaffolded answers and marks awarded for mentioning only key words. Such assessments will require all markers to have detailed subject knowledge. Convenience and economy of marking should not be a barrier to quality of assessment. The effect of the keyword approach is two-fold – students who don't understand can get marks for matching key words; students that do understand may get penalised for deviating from the key words but producing better explanations.
- We cannot say with confidence that the content is appropriate given that GCSEs are being reformed in parallel. There is a danger either of overlap of content or gaps in topics that require a logical, sequential framework; such topics are common in the sciences. For example in biology, some of the topics – e.g. genomics – are covered in far more detail (and in a more up-to-date manner) in the proposed new GCSEs than currently appear in the A level criteria. We also have significant concerns that the reforms could exacerbate the already challenging GCSE-A-Level transition if not managed carefully.
- Measures should be put in place to ensure appropriate frequency of assessment of all content. This issue was identified in the SCORE research on mathematics content, but the same principle also applies to the scientific content. In general, our concerns are related more to assessment than content. The most frequent complaints from HE focus on what students are, or are not, able to do, rather than what they know; that is, the lack of skills (including quantitative, practical, problem-solving and extended writing) and ability to apply knowledge.
- However, there are some issues of content, including that:
 - A proportion of each specification is beyond the subject criteria and such material should be included only if students are able to answer meaningful questions on the topics.
 - Examples of applications and technology should be reviewed regularly to ensure that they are still relevant. Some chemistry specifications include examples of spectrometers which most HE academics would call "museum pieces".
- During the reform it is also important the views of other "user" groups are taken into consideration; for example, chemistry is a required A-level for medicine, physics is often required for engineering, and biology must provide access to a vast breadth of bioscience degree courses. We will be establishing advisory groups to support the reform process which will draw on our own subject communities but will also include representation from appropriate other subjects. These advisory groups will not only represent the relevant subjects, but also a range of stakeholders, e.g. teachers, HE, employers and education specialists. We hope and expect that the AOs and the Russell Group will be taking a similarly thorough approach.

We believe that it is not possible to address all these concerns adequately within the timeframe required for 2015 implementation, and hope that you and the AO Responsible Officers agree.

We would be very happy to work with the Russell Group, Ofqual and the AOs to take this opportunity to ensure that biology, chemistry and physics A-levels are the best they can be for students, universities and employers.

Yours sincerely,



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