

Royal Society submission to the House of Commons Science and Technology Committee Legacy report 2010-2015 Parliament

1. The Royal Society welcomes the opportunity to contribute to the House of Commons Science and Technology Committee legacy report.
2. The Royal Society is the National Academy of Science in the UK. It is a self-governing Fellowship of many of the world's most distinguished scientists. The Royal Society draws on the expertise of the Fellowship to provide independent and authoritative scientific advice to UK, European and international decision makers.
3. This submission confines itself to observations on aspects of the Commons Science and Technology Committee inquiries to which the Society has submitted evidence over the course of this parliament. Rather than analyse each of these reports in detail, it seeks to highlight key areas of progress and issues that are yet to be addressed within the Society's areas of expertise. We would be very happy to provide further information on request.
4. The inquiries covered in this response are:

Session 2010-12, 3rd report, *Scientific advice and evidence in emergencies*

Session 2010-12, 9th report, *Practical experiments in school science lessons and science field trips*

Session 2012-13, 4th report, *Building scientific capacity for development*

Session 2012-13, 8th report, *Bridging the valley of death: improving the commercialisation of research*

Session 2013-14, 6th report, *Women in Scientific Careers*

Session 2013-14, 8th report, *Communicating climate science*

Session 2013-14, 9th report, *Government horizon scanning*

Session 2014-15, 1st report, *Ensuring access to working antimicrobials*

5. The Commons Science and Technology Committee makes a vital contribution to the scrutiny of research policy and the use of science across government. The Committee's ability to shine a spotlight on important issues and hold government to account is invaluable and ultimately results in better policy and better use of research findings. For example the Committee's scrutiny of scientific advice structures within government ensures that these are kept under regular review and where necessary provides momentum to make improvements.
6. The Committee also provides helpful scrutiny of the activity of the whole scientific community and its interplay with government initiatives – ensuring the scientific community asks the questions of itself that it might not otherwise ask. For example, in its inquiry into women in scientific careers, the Committee was able to step back and take a broad look at the various initiatives across the

whole scientific community, something it is better placed to do than individuals in the sector. The breadth of its recommendations, stretching beyond government, are welcome.

7. The Committee can also play an important role in raising the profile of issues of concern to the scientific community – for example gathering evidence from across the community on the value of practicals in science education.
8. The Committee is particularly strong when it scrutinises issues which would otherwise receive little attention. In such situations its profile and the authority stemming from its evidence based approach can act as a driving force for action. We support the Committee's engagement with the scientific community to identify these areas and encourage it to seek those 'hidden' issues where its scrutiny can add value in this way.

Session 2010-12, 3rd report, *Scientific advice and evidence in emergencies*

9. This is an important issue that the Committee is very well-placed to examine. We would encourage the Committee to return to this issue over time to ensure learnings from recent emergencies are applied to improve future responses.

Session 2010-12, 9th report, *Practical experiments in school science lessons and science field trips*

10. The Royal Society originally provided oral and written evidence to this inquiry through SCORE – a partnership between the Association for Science Education, the Institute of Physics, the Royal Society, the Royal Society of Chemistry and the Society of Biology focused on strengthening education in the science of biology, chemistry and physics at 5-19. Below we outline progress in respect of the Committee's report, in so doing highlighting some ongoing concerns.

Progress in respect of the Committee's report

11. It is evident from the Committee's report and the government's response to this that there is consensus about the importance of practical work. However, the Committee's recommendation (recommendations 14–15) that students' practical skills should be formally assessed within formal examinations in A-level sciences has been rejected by Ofqual in favour of a pass/fail teacher assessment that will be reported alongside the graded performance in written examinations. Ofqual's decision to remove practical assessment from the examinations undermines the common agreement expressed in the Select Committee's report – and the government's response to this – that practical work is integral to the study of science; and it is baffling given Ofqual's synchronous ruling that practical skills should be compulsorily assessed within the new Geography GCSE examination.
12. Further, the Committee's report acknowledges that achieving real improvement in students' access to high-quality practical work requires ensuring:
 - a sufficient body and supply of confident, subject specialist teachers (recommendations 4–6);
 - a sufficient body and supply of laboratory technicians (recommendations 8);
 - teachers and technicians keep up to date with their science and maintain or develop practical skills (recommendations 4–6 and 8); and that
 - schools are properly resourced to undertake practical work (recommendations 7, 9 and 11).
13. It is clear that the changes needed to improve student's access to high-quality practical work will take time. However initial progress is not reassuring.
14. Despite indications being given that the science curriculum would be 'slimmed down' to enable broader approaches to teaching science and a greater focus on practical work (recommendation 16), the amount of content in the new National Curriculum has increased. This will mean that teachers have to cover more material in the same amount of time, are tempted to focus on facts

rather than presenting material in an interconnected and properly contextualised way, and ‘will mean less time for effective practical work to support students’ deep and lasting understanding’. Furthermore, these changes have been developed and implemented at great speed leaving inadequate time for the reflection and consultation which would be necessary to provide continuity in curricula.

15. Subject specialist teachers

The government has radically altered the landscape of initial teacher education (ITE), with greater responsibility being entrusted to schools. Following this restructuring, recruitment to initial teacher education courses in the sciences (excluding Teach First) has generally suffered. It may still be too early to assess the impact of the government’s recent reforms to ITE, but it is apparent that the targets for key strategic subjects such as computing, mathematics and physics will be missed this year,¹ as has often happened in previous years², particularly in physics, as table 1 shows.

Table 1. Recruitment to postgraduate initial teacher education courses in the sciences as a percentage of the required number of places (targets).			
	2011/12	2012/13	2013/14
Biology and general science	123%	93%	95%
Chemistry	121%	108%	127%
Physics ^a	94%	92%	72%

^a Physics includes entrants to physics and physics with mathematics programmes.
 Source: NCTL (provisional census data published in https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/300437/initial-teacher-training-trainee-number-census-2013-2014-commentary.pdf, figure 4).

16. Technicians

Although there are no accurate up-to-date disaggregated data on the numbers of science technicians in UK schools and colleges, the indications are that the shortfall of 4,000 technicians identified by the Royal Society and the Association for Science Education (ASE) back in 2002 has not been rectified. Last year, a report published by the Science Community Representing Education (SCORE) indicated that over a quarter of survey respondents in state-funded schools had inadequate technician support and that retention is weak because of poor working conditions.³

17. Professional development (PD) for teachers and technicians

Subject-specific professional development is essential for improving teaching and encouraging innovation. The Royal Society believes that recognition and promotion should be contingent on ongoing professional development and proven impact on practice. This requires both that the national infrastructure for PD in the sciences in England, the National Science Learning Centre and wider network of regional Science Learning Centres, are adequately and sustainably funded in the long term. It also requires teachers and technicians to demand and avail themselves of professional development opportunities.

18. Resourcing of practical work

SCORE’s recent detailed surveys of the resourcing of practical work in primary and secondary state-funded schools in England have shown that many lack the facilities and equipment they

¹ See <http://johnhowson.wordpress.com/2014/08/28/good-news-and-bad-news/>

² See <https://royalsociety.org/~media/education/policy/vision/reports/ev-7-vision-research-report-20140624.pdf>

³ See <http://www.score-education.org/media/11805/score%20resourcing%20secondary.pdf>

need to meet the minimum statutory requirements for practical work in science. Per pupil spending on practical science is very variable across secondary schools, indicating that there is insufficient government funding for practical science and that schools need to allocate more funding to this.

19. The Royal Society has recently published a *Vision for Science and Mathematics Education* which recognises that a long-term commitment is needed to address these problems and sets out a twenty-year vision for science and maths education.⁴

Session 2012-13, 4th report, *Building scientific capacity for development*

20. The Committee made several recommendations to the government. We focus in our comments on three themes highlighted by the committee. Considerable progress has been made in the first two, while further work may be required on the third.
 - a. the need for a specific commitment to capacity building and the role of science and engineering in development
 - b. the need for greater clarity in the funding arrangements available and evaluation of these.
 - c. The need to develop a sustainable approach to funding to ensure that capacity-building initiatives become self-sustaining over time.

The need for a specific commitment to capacity building and the role of science and engineering in development

21. The Society had raised a concern in our submission to the inquiry that DFID had made no explicit recognition of the role of higher education for development. This is an area in which DFID has since made considerable progress, ably championed by the current Chief Scientific Adviser, Chris Whitty.
22. As mentioned in the government's response to the Committee, the £15 million Africa Scientific Capacity Building Initiative with the Royal Society put excellence of science at the heart of the programme. Conversations are in train for establishing a possible successor programme for sub-Saharan Africa which will continue to include steps to assist science communities in low and middle-income countries, increasing their capabilities of undertaking cutting-edge research and providing quality education.
23. There are also indications that DFID increasingly recognises the importance of tertiary education in this context. Earlier this year, DFID undertook an internal review of "The Role of Higher Education for Development". Although the outcome has not been publicised, the Society hopes that DFID will strengthen its support for capacity strengthening activities.

The need for greater clarity in the funding arrangements available and evaluation of these

24. The Committee recognised "the international role of DFID to facilitate the exchange of best practice in evaluating and monitoring research programmes". In our own DFID-funded programme we have committed substantial resource for an accompanying evaluation project. The strong emphasis on evaluation and monitoring in our and other programmes is a clear indication that DFID is taking this matter very seriously.

The need to develop a sustainable approach to funding to ensure that capacity-building initiatives become self-sustaining over time.

⁴ See <https://royalsociety.org/~media/education/policy/vision/reports/vision-full-report-20140625.pdf>

25. The Society supports the government response to the Committee that “promoting a sustainable approach to funding is important to embed a culture of scientific capacity building within developing countries.” In reality, one of the biggest problems for organisations engaged in capacity strengthening and dependent on donor organisations is the discrepancy between long-term planning and short to mid-term funding. DFID should consider options for long-term partnerships to run and develop capacity strengthening programmes in a time-frame that can realistically result in real and positive impact at an organisational/institutional level.

Session 2012-13, 8th report, *Bridging the valley of death: improving the commercialisation of research*

26. This report covered a broad and complex area. Many of the macro datasets that could provide insights are yet to be published. As a result it is difficult to offer concrete indications of progress. Below we outline detail of government progress and issues which remain unresolved.
27. The last few years have seen the introduction and adaptation of several government schemes aimed at addressing close to market development issues and there is a general impression that the situation is improving. However there is concern that this emphasis on downstream pull-through risks eroding funding for creative new ideas. The greater challenge to facilitate the whole pathway - taking breakthroughs in the lab and seeing them transferred to innovation and products – has not been tackled.

Government progress on issues raised by the Committee

28. **Investing in technology companies** (recommendations 2-5)
The Bank for Business has expanded considerably since the report was published and is attempting to support SMEs across sectors, although it is too early to tell if it is functioning optimally. Innovate UK (formerly the Technology Strategy Board) has increased its focus in 2014-15 on SMEs with the potential for high growth.
29. **The need for physical infrastructure.** (recommendations 7-8)
The introduction of the Catapult centres has largely answered the report’s recommendations on this point. On the whole, they are seen to be serving this purpose, although it is early days and there might be room for improvements. There has been some discussion about introducing new Catapult centres and about more bottom-up approaches to establishing new centres. The Royal Society has emphasised previously the importance of the centres being adequately resourced and resources not being spread too thinly. Funds should not be redirected away from other parts of the research and innovation system to achieve this.
30. **Small companies** (recommendation 9)
Uptake of the R&D tax credit by small companies has improved since the introduction of the SME scheme and policy measures introduced on 1 April 2012 (increase of the SME enhancement rate and the removal of a minimum expenditure requirement). The government has since taken steps to further incentivise SME uptake for example the rate of R&D tax credit was increased for loss making SMEs in Budget 2014⁵.

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https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293820/TIIN_6178_increasing_the_payable_credit_to_loss_makers.pdf

31. While the R&D tax credit is popular and uptake has increased, it is not clear whether R&D tax credits necessarily lead companies to perform R&D that they would not have done otherwise. However, R&D tax credits are now an established part of the fiscal environment in which companies operate.
32. We are aware that Innovate UK's focus on SMEs and its strategic areas can make it difficult for medium-sized companies to access the demonstrator funding needed to grow their business. Helping medium-sized companies to grow would allow them to invest more in research and potentially acquire smaller companies. At the same time we are aware of concern that Innovate UK's focus is shifting towards big companies, so the picture here is not clear. It is important to ensure that its resources are not spread too thinly to be effective.
33. **Intellectual property and technology transfer** (recommendation 16)
It is our understanding that Innovate UK is aware of issues with the need for proof-of-concept funding (for example oversubscription of SMART awards) and have increased funding for some relevant programmes.
34. **UK Innovation Ecosystem** (recommendation 18)
Catapult centres continue to be supported and the programme is currently under review by Dr Hermann Hauser⁶.
35. **Government procurement** (recommendation 27)
Efforts continue to expand support through the SBRI, and Innovate UK plans to take the lead in championing the scheme across government. We are aware that procurement initiatives have had some success in helping small companies to become medium-sized companies, for example in IT.

Issues raised during the Committee's inquiry which remain unresolved

36. **Investing in technology companies** (2-5)
Access to finance remains an issue for companies facing the Valley of Death. Latest figures indicate that lending to SMEs through the Bank of England's "Funding for Lending" scheme is falling⁷. We understand that taxation arrangements around founder equity are still a problem and there continue to be issues with a lack of patient capital. Venture capital and the business bank might not be able to tackle these more structural issues with business investment. Venture Capital fund structures are not typically designed to allow for a long-term or fluid timeframe and tend to be looking for a relatively quick return, therefore they are not ideally suited to technology investments. There may be value in exploring novel routes for investment such as crowd funding.
37. Further, and linked to recommendation (1), the fact the businesses are bought up before they have grown limits the potential opportunities for investors. (4) Although training staff to understand science companies is useful, it cannot tackle structural disincentives to invest in science companies.
38. **The need for physical infrastructure** (recommendation 7)
There is some concern that Catapult centres operating a subscription model might exclude newer, smaller companies.

⁶ <https://www.gov.uk/government/consultations/medium-term-strategy-for-catapult-centres-hauser-review-call-for-feedback>

⁷ <http://www.bankofengland.co.uk/markets/Pages/FLS/extensiondata.aspx>

39. **Taxation and regulation** (recommendation 11)

The issue of commercial VAT rates being applied to buildings in which more than 5% research is commercial has not been addressed. This has proven to be a significant barrier for organisations like the Francis Crick Institute and Universities that want to help very early stage spinouts. The Royal Society supports calls for this to be addressed.

40. **Intellectual property and technology transfer** (recommendation 15)

The issue about HEIF allocation was raised again during oral evidence for the Business, Innovation and Skills Committee's inquiry into business—university collaboration in 2014, suggesting that this is still an issue. In its response, government did not agree to the Committee's proposed review after three years, but a future review may prove valuable. The benefits of business-university collaborations to all partners go far beyond income from intellectual property and spin-outs, although these can be important. Such benefits could be increased through even greater collaboration and openness.

41. We are aware that the mismatch between the value placed on a new piece of knowledge by researchers and by industry at different stages in its development can lead to problems with IP valuation and, ultimately, commercialisation.

42. **UK Innovation Ecosystem** (recommendations 19)

Concerns remain about how well Catapult centres are linked into their local areas, particularly as sub-national structures have gone through a period of change.

Session 2013-14, 6th report, *Women in Scientific Careers*

43. Since the publication of this report the government has supported the launch of the 'Your Life' campaign. This joins a number of other initiatives in this area which are welcome, however we are concerned about the piecemeal approach and we hope that Your Life as it moves forward will rectify this. The development of an overarching strategy involving all partners may be beneficial.

44. In its report, the Committee called on the National Academies and others to emphasise both male and female role models who have successfully combined a STEM career with family life. The Society is producing case studies on a number of scientists who received a Dorothy Hodgkin Fellowship and have now reached the professoriate. These case studies will join a bank of case studies which include videos from our Inspiring Scientists project, promoting scientists from minority ethnic backgrounds active in UK science today, as well as videos from our 'I wasn't a Scientist' project which will highlight 'unusual' or non-traditional career paths to a scientific career and include a scientist who took a 10 year career break to raise her children. The case studies will be promoted through the Society's new diversity hub and will be used in publications and work with partners to address the lack of accessible and relatable role models in science and engineering from protected groups.

45. As outlined in the Society's original submission to the Committee, we would encourage the government to look wider than women when working to improve diversity in the scientific workforce and consider other underrepresented groups in science.

Session 2013-14, 8th report, *Communicating climate science*

46. Due to its recent publication, there has been limited time for progress to be made on the Committee's recommendations. However the Society can comment on two pieces of relevant work

47. Recommendation 14 called on the government to work with the learned societies and national academies to develop a source of information on climate science that is discrete from policy delivery, comprehensible to the general public and responsive to both current development and uncertainties in the science. The Society has since met with DECC to discuss planned work on climate science and is developing opportunities to work together in future.
48. Just prior to publication of this report, the Royal Society published *Climate Change: Evidence and Causes*, a public-facing document jointly with the US National Academy of Science. This has been widely shared including in the UK Parliament, at the World summit of legislators hosted by GLOBE International in June 2014 and with individual stakeholders. Anecdotally we understand that this document is providing a useful reference for organisations working on climate change policy. The Society is developing further work in this area including providing this information in formats tailored to the needs of different audiences. We will keep the Committee informed.

Session 2013-14, 9th report, *Government horizon scanning*

49. Given the recent publication of this report it is relatively premature to draw conclusions, however below we outline progress to date.
50. The Society welcomes the Committee's call for improved transparency and dissemination of government horizon scanning outputs (recommendations 9, 10 and 11). Promising steps have been taken towards this with information increasingly being shared through the Communities of Interest on Emerging Technologies and external experts more commonly involved. However there remains scope for this process to be more open.
51. The Society agrees that government horizon scanning must be open to challenge (recommendation 12). The Society is represented on one of five Communities of Interest (on Emerging Technologies) and is invited to Heads of Horizon Scanning meetings. This contact has been mutually beneficial. Specifically the Royal Society has:
 - d. Peer reviewed a paper on emerging technologies in January 2014
 - e. Attended the Strategic Foresight Symposium in February 2014
 - f. Attended a workshop on the Internet of Things in March 2014
 - g. Helped to peer review a document on quantum technologies in March 2014
 - h. Peer reviewed departmental slides on emerging technologies in July 2014
 - i. Attended the Emerging Technologies workshop in August 2014
52. However the Society is not represented at the four other Communities of Interest or the Horizon Scanning Oversight Group (GOSH) as was recommended by the Committee. In their response to the Committee, the government undertook to invite external members to attend as the subject and situation requires. We would welcome opportunities for engagement with GOSH and believe we may have valuable expertise to offer the Communities of Interest in emerging economies, supply and demand of resources and demographic change.

Session 2014-15, 1st report, *Ensuring access to working antimicrobials*

53. The Society welcomed the Committee's recommendation that the High Level Steering Group for the antimicrobials strategy should be expanded to include voices from learned societies and industry. The review announced in July to be chaired Jim O'Neil⁸ is welcome and its remit

⁸ <https://www.gov.uk/government/news/prime-minister-warns-of-global-threat-of-antibiotic-resistance>

suggests that it will address many of the issues raised by the Committee.

54. The recommendations of the G8+5 statement on antimicrobial resistance complement those of the Committee, although naturally taking a more international focus.

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