Summary

- The skills that the UK needs will change over time. A broad curriculum including STEM to 18 is the best way to equip young people with the range of skills that they will need in the future.
- More young people must be encouraged to consider STEM careers and develop into the specialists that the UK needs.
- Lack of diversity in STEM jobs is a huge waste of potential talent. Evidence-based approaches informed by an understanding of what barriers prevent underrepresented groups from accessing and progressing in STEM will be important to ensure that everyone can access a STEM career.
- STEM curricula must include open-ended, creative experimentation and problem-solving as these skills are sought after by employers. The Royal Society Partnership grants support schools and colleges to give students this opportunity, but this approach should be embedded in all schools.
- We must ensure that we equip those choosing to pursue a STEM career with the breadth of skills that they will need to succeed.
- As well as giving every UK citizen the opportunity to pursue a STEM career, the UK must be able to draw on the world’s brightest and best to maintain the UK’s position as a world leader.

Introduction

1. The Royal Society is the UK’s national academy of science. It is a self-governing Fellowship of many of the world’s most distinguished scientists working in academia, charities, industry and public service. Its fundamental purpose is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity. Within this its strategic priorities include providing scientific advice for policy, and education and public engagement.

2. The UK’s gap in science, technology, engineering and mathematics (STEM) skills is not static and sectors have very differing needs. This response provides an insight into a range of Society activities targeted at addressing different aspects of this gap. These include measures to increase the diversity of those accessing STEM careers, increase the number of young people inspired to consider STEM careers and ensure that those pursuing STEM research careers are equipped with the breadth of skills that allow them to effectively communicate or commercialise their research. Evaluation is provided where available.

The STEM skills gap

3. There is currently a shortage of STEM skilled school-leavers and graduates, holding back potential growth in the economy and a wide appreciation of science. 39% of UK firms have difficulties recruiting staff with skills in STEM\(^1\). Restrictions on the movement of skilled people may exacerbate this. In attempting to address this shortage, it is important to consider not just the skills that the UK needs now, but the skills it will need in the future when the young people who are currently in schools and colleges reach the workplace.

4. For example, new technologies such as machine learning are set to change the nature of work. We know that to thrive in an environment in which machine learning is a key tool for daily activities, data literacy skills will be increasingly important.

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\(^1\) CBI/Pearson (2014) Gateway to growth:CBI/Pearson education and skills survey 2014
5. It is also likely that the UK’s STEM skills needs will change over people’s working lifetimes. Initiatives to address specific skills gaps are important. A broad curriculum to 18 will best equip young people with the range of skills that they will need and enable them to adapt to changing skills needs and opportunities throughout their lifetime.

6. A skills gap can also exist amongst those pursuing STEM careers who are not equipped with the skills that they need to succeed. The Council for Science and Technology recently wrote to the Prime Minister to outline the importance of entrepreneurship education to help scientists and engineers turn new ideas into innovative business that can increase productivity, support economic growth and create jobs. They have set an aspiration for one-quarter of all STEM undergraduates to take formal, credit-bearing entrepreneurship education at some point during their course. This currently stands at 4.5% of STEM undergraduates.

Increasing the diversity of those choosing to pursue STEM careers

7. Any lack of diversity within STEM careers represents a huge waste of new talent that the UK should be accessing to reach its full potential.

8. The Society is working with the Education Endowment Foundation to better understand why children from economically disadvantaged backgrounds appear to perform less well in science than other pupils. This work is looking at the causes of any gaps in participation and attainment and will identify promising approaches (e.g. pedagogies or interventions) that could boost science attainment and progression among students.

9. Various groups are underrepresented in STEM at different levels. Women, those from Black or Black British backgrounds and people with disabilities are drastically underrepresented at senior levels. A similar evidence-based approach is being used to investigate this.

10. As well as encouraging people into STEM careers it is also important to keep people in those careers, or to support them to make transitions with STEM, for example developing skills in one sector and taking them elsewhere. Many factors may influence this. Given that women are predominantly carers, concerns over the ability to balance caring responsibilities and a STEM career may play a role. Underrepresentation may take place at various points along a STEM career pathway, for example whilst gender is fairly balanced across science, engineering and technology subjects at university, only 18.5% of professors in these disciplines are female. The Society provides funding for those who require flexible working through the Dorothy Hodgkin Fellowship programme. Additionally all Royal Society Fellowship programmes have in built flexibility to allow researchers to take career breaks. Projects such as the Royal Society’s Parent Carer Scientist campaign set out to illustrate the opportunities that a STEM career offers, raising the visibility of people combining a career in science with a family life. This project reached 3.5 million people in the first month post launch and events have taken place at universities across the UK.

11. The Society is also developing a series of career case studies showcasing examples of scientists who have moved between academia and industry and other sectors during their careers. Titled ‘Changing Expectations’ the aim of the project is to advance a conversation about how scientists should be encouraged, incentivised and supported to move between sectors as well as demonstrating the versatility of a science education. These will be published in 2017.

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2 Council for Science and Technology (2016) Improving entrepreneurship education
3 BIS (2016) Entrepreneurship modules: student numbers, August 2014 to July 2015 academic year
5 Equality Challenge Unit, Equality in higher education: statistical report 2015
Supporting employers to better articulate their STEM skills needs and the career opportunities these present - *Making education your business*

12. Many school leavers and graduates find themselves without the skills and knowledge they need to progress in their careers. We know that business relationships with schools and colleges can play a crucial role in supporting STEM education. Business support for STEM teaching can help equip young people to take advantage of the opportunities ahead of them, help meet employers’ needs for skills and knowledge and help the UK keep pace with international competitors.7

13. The Royal Society and CBI have jointly developed *Making education your business: a practical guide to supporting STEM teaching in schools and colleges*. The aim of this guide is to support more employers, of all sizes and sectors, to work with teachers to help encourage and enthuse future generations about the value of STEM. It sets out five simple steps, describing the practicalities of setting up a programme, giving key advice at each stage to ensure that the programme supports inspirational STEM teaching. It also includes case studies that highlight the key features of successful, mutually beneficial, education schemes.

Giving students an opportunity to experiment and problem-solve - Royal Society Partnership Grants

14. Key to addressing the STEM skills gap will be encouraging more young people to consider studying STEM subjects. The Society’s Partnership Grants scheme aims to do just that by supporting UK schools or colleges to partner with STEM professionals to offer their students the opportunity to carry out STEM projects.

15. These projects give students the opportunity to experiment and investigate themselves, so fostering their curiosity and wonder and giving them confidence and a feeling of ownership of the scientific process. This helps increase their ‘science capital’ which is shown to increase aspirations to study STEM subjects8.

16. The scheme also creates long-term interactions between teachers and STEM professionals. This builds the subject expertise and confidence of teachers, which can impact on a large number of students over their years of teaching. Given that most young people attribute their decision to pursue STEM subjects to an inspirational teacher, working with teachers is an effective way to encourage more young people to study STEM.

17. The scheme offers up to £3,000 each to 40 successful UK schools and colleges each year to run a project with students aged 5 to 18, usually purchasing equipment that is used with students across the whole school. The students also take part in a scientific conference to discuss their findings. Since 2000, when the grants began in their current form, over 900 grants (approximately equal primary and secondary) have been awarded, totalling over £1.68 million. Many schools have continued their projects beyond the end of the initial grant.

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8 The concept of science capital encapsulates both cultural capital – having had the opportunity to engage with science – and social capital – knowing and recognising people who in, or are interested in science. A clear relationship has been found between a student’s level of science capital and their future aspirations in STEM subjects. Science capital can be quantified to inform new approaches to increase engagement in STEM. See Kings College London Enterprising Science Project http://www.kcl.ac.uk/sspp/departments/education/research/cppr/Research/currentpro/Enterprising-Science/index.aspx [accessed 26 April 2016]
Written evidence submitted by The Royal Society (GAP0081)

reaching much higher numbers of students. Schools also often share the projects within their schools and local area, reaching more people indirectly.

18. A recent evaluation of the scheme found that young people taking part reported pride and satisfaction at being part of the scientific process, experienced a boost in confidence and had positive perceptions of scientists and engineers with a feeling of ‘it could be me’. This addresses an issue that was identified by the ASPIRES report\(^9\) that young people like science and think it is important but perceive it as ‘not for me’. Teachers have noted that students taking part increase their transferable skills, particularly communication skills, teamwork and problem solving.

19. Early findings from an analysis of the British Science Association CREST awards (which are very similar in principle to the Society’s Partnership Grants) indicated that taking part in the Silver CREST award leads to a small increase in attainment and progression in science, with an indication that this increase is greater for students from disadvantaged backgrounds, improving social mobility\(^10\). The Education Endowment Foundation is currently conducting further research.

20. This scheme is by its nature restricted in its reach to the schools that take part. However, the engagement with teachers and relationships built with STEM professionals provide a longer-lasting impact.

21. Greater leadership, support and recognition for teachers to build links with STEM professionals and carry out STEM projects in schools and colleges could encourage more to undertake these activities outside of a specific scheme, so enabling many more young people to develop skills in undertaking experimental work and problem-solving and see where science can take them.

**Ensuring those pursuing a STEM research career are equipped with the skills to succeed**

22. It is also important to ensure that those who have chosen to pursue STEM research careers are equipped with the skills to succeed and become the next generation of research leaders, both in academia and industry. Future research leaders are expected to be not only strong in research but also develop skills to be excellent leaders, communicators and managers, able to demonstrate the ‘impact’ of their research to funders and the public. The Society undertakes a number of activities to enable researchers to develop these skills.

23. The Society provides a suite of training activities to our research fellows. These include mentoring, courses in media and communication skills, grant writing, engaging the public and innovation and the business of science which is run in partnership with the Imperial College Business School that helps researchers understand what it means to be an effective leader, the relationship between science and industry and what it means to be a scientific entrepreneur. We delivered this course to 93 researchers in 2016/17 including researchers supported by the MRC, BBSRC and Wellcome. We are currently evaluating this course alongside the other training that the Society offers.

24. Recognising that academia and industry research can benefit from a greater sharing of skills, the Society’s Industry Fellowship scheme aims to enhance knowledge transfer in science and technology between industry and academia by supporting researchers based in each sector to work collaboratively with each other. In 2016/17 the Society supported ten Industry Fellowships.

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\(^9\) Kings College London (2013) ASPIRES: young people’s science and career aspirations, age 10-14  

\(^10\) EMHConnect (2013) CREST Awards and Employability Skills A project for the British Science Association
25. The Society is establishing a way to systematically track our former research fellows to better identify and understand the career pathways, destinations and choices of these researchers. This will help us to understand the changing research landscape and in turn inform the training provision and support offered to our research fellows.

26. The Royal Society’s Fellowship programmes, including its flagship University Research Fellowship, aim to help attract and retain the most talented UK and international researchers to UK research. This contributes to the strength and breadth of the UK’s research base which in turn both helps train people within the UK, and provides the UK with greater resilience to adapt to future skills needs.

**Accessing the global talent pool as well as growing the UK’s brightest and best**

27. For some STEM roles, for example in engineering, there are systemic skills shortages that have existed for a long time. It is important to train more home workers for these roles and action is being taken to do so, some of which is outlined above. But this can take decades — from inspiring young people through to postgraduate education. Removing the option of recruitment from overseas before the skills gap can be filled with home workers could exacerbate the shortage in the short term and make it more difficult for UK firms to focus on training home workers in the long term. It is therefore important that, alongside these initiatives the UK can recruit workers from overseas with the skills that the UK needs if they cannot be filled by home workers. Science is a global endeavour and to maintain the UK’s position as a world leader, attracting the brightest and best, from wherever they are found, will always be important.

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