

Vision

for science and
mathematics education

SUMMARY

VISION FOR SCIENCE AND MATHEMATICS EDUCATION COMMITTEE

The following Committee was set up to steer the Vision project. Vision Committee members acted in an individual and not a representative capacity, and declared any potential conflicts of interest. Members contributed to the project on the basis of their own expertise and good judgement.

Chair

Sir Martin Taylor FRS

Vice-Chair

Professor Dame Julia Higgins FRS FREng

Members

Professor Jim Al-Khalili OBE

Linda-May Bingham

Professor Sarah-Jayne Blakemore

Professor Sally Brown OBE FRSE

The Rt Hon Charles Clarke

Professor Raymond Dolan FRS

Professor Dame Athene Donald FRS

Michael Gernon
(until December 2012)

Sir John Holman FRSC
(from May 2012)

Sir Tim Hunt FRS

Dr Ian Jones

Dame Alison Peacock
(from December 2012)

Professor David Phillips CBE FRSC

Joan Sjøvoll
(deceased, January 2013)

David Swinscoe
(from December 2012)

Professor Lord Robert Winston Hon.
FREng FMedSci

Professor Alison Wolf CBE
(from December 2012)

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Summary*

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**The full report can be viewed online at
royalsociety.org/vision**

Science and mathematics education for 2030

Science and mathematics are at the heart of modern life. They are essential to understanding the world and provide the foundations for economic prosperity.

The UK is a world leader in science and engineering. To maintain and capitalise on this position, the UK needs to strengthen its science, technology, engineering and mathematics (STEM) education.

Our Vision aims to raise the general level of mathematical and scientific knowledge and confidence in the population. Scientific discovery and technological innovation can provide solutions to challenges such as scarcity of food and water, energy supply and security and climate change, but they also raise social and ethical dilemmas. All citizens need the skills and knowledge to be able to make informed decisions about how society handles these issues.

In addition, our Vision seeks to link people's learning and skills to the current and future needs of the economy. Science and technology open doors to jobs in many sectors where the analytical and problem-solving skills acquired by studying mathematics and science are greatly prized. These skills are vital if the UK is to remain competitive internationally and to ensure that people are productively employed throughout their lives.

There is excellent practice in primary and secondary schools across the UK's four nations. Our Vision for science and mathematics education from 5–18 years of age offers a way to build on these foundations.

Firstly, in order to ensure young people have a broad and balanced education through to age 18, baccalaureate-style frameworks should be introduced. Inspirational science and mathematics curricula should be placed at the heart of these, and should emphasise practical work and problem-solving. The new frameworks should incorporate subjects in the arts, humanities and social sciences and place equal value on vocational learning.

Secondly, education systems need to provide stability for the curriculum and its assessment in order to support excellent teaching and enable innovation. To achieve this, new, independent, expert bodies that draw on the wider STEM professional community need to be created in England and Wales to determine curricula and assessment in STEM subjects. Existing infrastructures in Northern Ireland and Scotland should be similarly supported.

Thirdly, many more inspiring teachers will be needed. For this to happen, a sustained effort is required to recognise their professionalism and raise their status. To keep up-to-date and maintain a passion for their subject, teachers need time and resources to undertake subject-specific professional development, with this being linked to career progression.

In order to realise our Vision, we envisage a significant role for the science, technology, engineering and mathematics professional community including:

- playing a leading role in the proposed independent expert curriculum and assessment bodies;
- championing more and better quality educational research;
- supporting excellence in teaching science and mathematics;
- embracing teachers as an integral part of the community; and
- providing regular opportunities for professional development.

Our Vision takes the long view but recognises that there is both urgency and great opportunity for Governments to act now.

There is a persistent dearth of young people taking science, technology, engineering and mathematics qualifications after the age of 16 across the UK. Employers report that the skills and numbers of students leaving education do not fully match their needs. And estimates suggest that one million new science, engineering and technology professionals – including technicians – will be required in the UK by 2020.¹

This is an exciting and important time in education as countries world-wide recognise the importance of high-level skills and their impact on economic growth, well-being and prosperity. Digital technologies, cross-disciplinary skills and the age of big data will all have a significant impact in the classroom and on teachers. Mathematics and science must be placed at the heart of education systems. This will help to underpin the future prosperity of the UK, ensure the UK maintains a globally competitive science and engineering base and support the development of a more informed and equitable society.

¹ Royal Academy of Engineering 2012 *Jobs and growth: the importance of engineering skills in the economy*. London: Royal Academy of Engineering.

Our Vision and recommendations

OUR VISION

All young people study mathematics and science up to the age of 18.

Create new baccalaureate-style frameworks that encompass vocational and academic learning across a broad range of subjects to age 18.

RECOMMENDATIONS

- Develop rigorous new post-16 courses and qualifications in mathematics, science, engineering and technology to engage students who are studying non-STEM subjects at school or who are training in the workplace, ensuring these meet the changing needs of employers.
- Increase the amount of time and money invested in practical and problem-solving work in science and mathematics education for 5–18 year olds, through access to adequately resourced laboratories and well-trained teachers.
- Extend the age at which students leave formal education or training to 18 in Northern Ireland, Scotland and Wales.

OUR VISION

Curricula and their assessment are stabilised and support excellent teaching and learning.

Use the expertise and independence of the STEM professional bodies, under strong overarching bodies, to stabilise the curriculum and assessment, providing quality and coherence in 5–18 science and mathematics education.

RECOMMENDATIONS

- Establish new, independent, expert bodies in England and Wales, and enhance existing structures in Northern Ireland and Scotland, to provide stability in curriculum and assessment and allow teachers space to innovate in their teaching.
- Commit to invest in these bodies long-term to enable STEM experts, including employers, to contribute their knowledge and experience.

OUR VISION

Teachers have high professional status and there is a strong supply of science and mathematics specialists.

Widen access to science and mathematics teaching and enhance their appeal to prospective entrants and returners by expanding the STEM professional community's role in recognising professionalism in teaching.

RECOMMENDATIONS

- Require all school and college teachers to work towards a suitable teaching qualification to ensure they are experts in teaching as well as in their specialist subject.
- Retain STEM technicians in schools and colleges on permanent and well-paid contracts.
- Make subject-specific professional development a core requirement for teachers and technicians and link this to career progression.
- Invest over the long term in national infrastructures which provide access to subject-specific professional development for all STEM teachers and technicians.
- Ensure that every primary school has, or has access to, at least one subject specialist teacher in both science and mathematics and that all post-primary science and mathematics lessons are taught by suitably qualified subject specialists.
- Train and reward teachers to engage fully with digital technologies to improve students' experience of, and attainment in, science and mathematics.

OUR VISION

Students understand the significance of STEM through better careers awareness and guidance.

Maintain investment in large-scale, national programmes and events, delivered locally, which provide students with STEM role models and help teachers and families to develop better engagement with academia and industry.

RECOMMENDATIONS

- Build careers awareness from primary school onwards by giving children exposure to role models, such as professional scientists, engineers and technologists.
- Make careers information, advice and guidance from early secondary onwards an essential part of the school/college week.
- Increase parents' understanding of how STEM offers many and varied employment opportunities for all children, regardless of their social or economic status.

OUR VISION

The success of students, teachers and education systems is judged through appropriate and broadly based assessment and accountability measures.

Ensure teachers have an increased role in assessing student achievement in public qualifications. Judge the health of the school and college systems through broader measures including ones that reflect the features of high quality STEM education.

RECOMMENDATIONS

- Entrust teachers with increased responsibility for assessing students' achievements.
- Place practical work and problem-solving at the heart of good assessment of science and mathematics.
- Use a wider set of measures than examination performance to make more informed judgements about the quality of a school or college.
- Measure the quality of science and mathematics provision in schools and colleges through specific STEM-related indicators, such as tracking the number and diversity of students taking STEM qualifications to 16 and post-16.
- Require all school and college governing bodies to have at least one member with STEM subject expertise.
- Increase the emphasis in school and college inspections on identifying and sharing good practice.

OUR VISION

Education policy and practice are better informed by evidence.

Enhance collaboration and communication between science and mathematics education researchers, scientists and mathematicians, teaching professionals, policy-makers and the public.

RECOMMENDATIONS

- Establish agreed standards for educational research to ensure good practice and to give users confidence in its results.
- Invest in education research and test and evaluate new programmes prior to rolling them out nationally.
- Encourage professional and learned STEM bodies to embrace teachers and STEM education researchers in their networks.



The Royal Society is a self-governing Fellowship of many of the world's most distinguished scientists drawn from all areas of science, engineering, and medicine. The Society's fundamental purpose, as it has been since its foundation in 1660, is to recognise, promote, and support excellence in science and to encourage the development and use of science for the benefit of humanity.

The Society's strategic priorities emphasise its commitment to the highest quality science, to curiosity-driven research, and to the development and use of science for the benefit of society.

These priorities are:

- Promoting science and its benefits
- Recognising excellence in science
- Supporting outstanding science
- Providing scientific advice for policy
- Fostering international and global cooperation
- Education and public engagement

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