Jenifer Burden
Director, National STEM Centre
York, England
Organisational overview

- National Science Learning Centre
- Regional Science Learning Centres
- National STEM Centre
- Operations Teams
• National network of Science Learning Centres
  • Established 2004
  • 10 centres – national and nine regions
  • Professional development for teachers of science and related subjects.

National Science Learning Centre
Regional Science Learning Centres
National STEM Centre
Operations Teams
• Established 2008
• Funded by Gatsby Charitable Foundation
• Activity to support teaching of STEM subjects, predominantly through online infrastructure
• Home to the largest collection of teaching and learning resources for science and mathematics in the UK
• Also home to the ESA funded ESERO-UK
Why ‘STEM’?

Snapshot of science education in England

Recent curriculum changes for science

Students’ attitudes and progression

STEM in schools

Work of the National STEM Centre
Why ‘STEM’?
STEM skills are in short supply....

- Around 58 per cent of net new jobs predicted to appear in the economy between 2007 and 2017 will require employees with STEM skills.
  
  UK Commission for Employment and Skills 2010

- 66% of employers report difficulties recruiting STEM skilled staff, with particular concern at graduate and post graduate level.

  Confederation of British Industry; Education and skills survey of 350 employers 2009
.... but the picture is complex
The broader argument

... improving education in math and science is about producing engineers and researchers and scientists and innovators who are going to help transform our economy and our lives for the better.

But it’s also about something more. It’s about expanding opportunity for all Americans in a world where education is the key to success. It’s about an informed citizenry in an era where many of the problems we face as a nation are, at root, scientific problems.
Snapshot of science education in England
## Education compulsory to age 16

<table>
<thead>
<tr>
<th>Age range</th>
<th>Key stage</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-5</td>
<td>EYFS*</td>
<td>Most children begin formal education aged 4 years</td>
</tr>
<tr>
<td>5-7</td>
<td>KS1</td>
<td>Summative teacher assessments in English, and maths</td>
</tr>
<tr>
<td>7-11</td>
<td>KS2</td>
<td>Summative national tests and teacher assessments in English and maths</td>
</tr>
</tbody>
</table>
| 11-14     | KS3       | Ongoing teacher assessments  
Summative teacher assessments in English, maths and science and other foundation subjects |
| 14-15     | KS4       | Minority of children take GCSEs** |
| 15-16     |           | Most children take GCSEs and/or vocational qualifications  
Minority take international qualifications |

*Early Years Foundation Stage  
**General Certificate of Secondary Education
# STEM education

<table>
<thead>
<tr>
<th>Subject</th>
<th>Compulsory to ...</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>Age 16</td>
<td>Together with English these are core subjects. Almost all students take a GCSE qualification in these subjects.</td>
</tr>
<tr>
<td>Mathematics</td>
<td>Age 16</td>
<td>Completion of national curriculum requirements is compulsory, but not external qualification.</td>
</tr>
<tr>
<td>Information technology</td>
<td>Age 16</td>
<td>Students are entitled to have access to design &amp; technology until age 16, but study is not compulsory.</td>
</tr>
<tr>
<td>Design &amp; technology</td>
<td>Age 14</td>
<td>Not a national curriculum subject; some students follow courses of study leading to vocational qualifications</td>
</tr>
<tr>
<td>Engineering</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Age 16-18

- General qualifications (A-levels) 40%
- Vocational qualifications 28%
- Apprenticeships 2%
- NEETs* 9%

*NEET – not in education, employment or training’
Vocational qualifications – technical routes

- A bleak and confusing landscape

- Progression to higher levels of vocational qualifications is poor

- Need to look at models across Europe, e.g. Netherlands (60% vocational routes), French BTS (Brevet de Technicien Superieur) or the German Techniker

Hilary Steedman, Centre for Economic Performance, London School of Economics and Political Science
1993

- Less than 50% of 16-18 year olds were in full time education
- 16% in a job with some form of training
- 13% NEET

2008

- Approximately 60% of 16-18 year olds were in full time education
- 9% in a job with some form of training
- Little change in NEET figures

More choice in qualifications – less in work-related training routes
Some recent science curriculum changes
Beyond 2000 (Millar and Osborne)

- ‘The science curriculum from 5 to 16 should be seen primarily as a course to enhance general ‘scientific literacy’.’

- ‘To speak of scientific literacy is simply to speak of science education itself.’ (DeBoer, 2000).

- ‘[Scientific literacy] stands for what the general public ought to know about science.’ (Durant, 1993).


Twenty First Century Science

- Whilst a grounding in scientific literacy can be argued as appropriate for all students, those aspiring to further scientific study, and/or a science-based career, also require more specialised training.

- The pilot project for Twenty First Century Science was major influence on national curriculum from 2006 – an increase in ideas about the nature of science (known as ‘How Science Works’).
Bananas as good as drugs for treating HIV, say scientists
Twenty First Century Science

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- Increase in post-16 progression for Twenty First Century Science schools:
  - Sample of 155 schools (35.7% of schools originally contacted)
  - Average increase for progression of over 30% for in all three sciences

- In broader implementation of the national curriculum an unsatisfactory specification of curriculum for the nature of science, with poor implementation of assessment for nature of science

- Future for teaching of nature of science?
Recent new government, new priorities

1. Science and mathematics education remain high on the agenda

2. Reduced spending

3. More autonomy to schools and colleges:
   For example, Teaching Schools, Academies, Free Schools

4. Ongoing curriculum review

5. International comparisons of achievement

Watching:
Developments in provision of careers guidance
Recognition of importance for technical routes
National Curriculum Review

- To embody rigour and high standards and create coherence in what is taught in schools
- To ensure all children have the opportunity to acquire a core of essential knowledge in the key subject disciplines
- Beyond that core, to allow teachers the freedom to use their professionalism and expertise to help all children realise their potential

(Department for Education, 2010)
Support for non-specialist teachers

Over 17,000 primary schools in England - total workforce 189,315

(Royal Society, 2010)
What do young people think of science?
Horizontal axis: Human Development Index
Vertical axis: Measurement of positive attitudes towards studying science

Svein Sjoberg, University of Oslo
[Research in England by Professor Edgar Jenkins & Nick Nelson at University of Leeds]
TIMSS 2007

England 1999 to 2007:

- Proportion of 15 year-olds with a high positive attitude:
  science 76% to 55%
  mathematics 65% to 40%

- ‘Pupils are doing well in science (and maths) but with relatively low levels of enjoyment.’

Trends in International Mathematics and Science Study 2007
<table>
<thead>
<tr>
<th>% of students agreeing with statements:</th>
<th>OECD average</th>
<th>UK</th>
<th>USA</th>
<th>Germany</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal value of science</td>
<td>63</td>
<td>64</td>
<td>72</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>Career in science</td>
<td>29</td>
<td>25</td>
<td>36</td>
<td>26</td>
<td>21</td>
</tr>
</tbody>
</table>
Attitudes to science: 800 students aged 14

- Two-thirds of students think science has positive influence on society.

- 25% of students think that it would be good to have a job as a scientist, but almost 33% indicate that they definitely do not want a job as a scientist.

- 80-85% of students believe it is important for the country to have well qualified scientists – though most do not want a job involving science themselves.

A-level entries – science subjects

- Biology
- Chemistry
- Physics
A-level entries – mathematics
Separate sciences at GCSE

Biology
Chemistry
Physics

GCSE Entries (end KS4 pupils)
Gender imbalance remains for physical sciences

- GCSEs: around 650,000 candidates for science, maths, English

- A-level (2010):
  - Mathematics: 77,001 (40.6% female)
  - Biology: 57,854 (58.8% female)
  - Chemistry: 44,051 (47.8% female)
  - Physics: 30,976 (21.5% female)

See Institute of Physics research, ‘Girls in Physics’ National STEM Centre eLibrary
Science Aspirations and Career Choice: Age 10–14

The Science Aspirations and Career Choice: Age 10–14 project is a five-year longitudinal study, funded by the Economic and Social Research Council (ESRC) as part of their Targeted Initiative on Science and Mathematics Education (TISME). The project started in 2009 and is based at King’s College London. One of the main objectives of the project is to investigate some of the factors influencing the educational choices made by children in this age group. Particular interest focuses on the influence of peers, parents and schools, and on the role gender, class and ethnicity play in shaping these choices.

Learning about careers in science

A second component of the project is to work with teachers and other experts on an intervention that is helping us develop strategies for teaching about science-based careers in Key Stage 3.
‘STEM’ in schools
At age 14-16, students may spend 40 percent plus of the formal curriculum studying:

- mathematics
- sciences
- design & technology
- ICT & computing
STEM is a useful term to describe a group of disciplines with related economic importance.

It is *not* a prescription for particular approaches to pedagogy.

*At the heart of STEM is strong subject teaching.*

Alongside this teachers have a range of strategies to support young people in making the connection between subjects, and the rich range of opportunities they can lead to.

These strategies will include cross-subject working, but subject learning is not lost.

STEM subjects also offer the opportunity to develop competencies that are of value to students regardless of their future progression routes.
Areas of work at the National STEM Centre
Strategic embedding of STEM in schools

1. An ethos driven by senior leadership
2. Appropriate curriculum routes
3. Continuing professional development for teachers to support strong subject teaching
4. Enhancement and enrichment opportunities for students
5. Innovative use of the school environment
6. Access to well-informed careers-related learning for students
Timeline project

- A research approach to raising awareness and engagement with STEM subjects
- 28 pilot schools across English regions
- Mentor support for pilot schools
- School self-review and action planning for STEM
- Pupil attitude surveys (before and after)

Centre for Education and Industry (CEI) at the University of Warwick
International Centre for Guidance Studies (iCeGS) at the University of Derby
Isinglass Consultancy
How to use the STEM Manager

The STEM Manager helps your school develop an integrated approach to STEM. No two schools are alike, so please adapt the model to fit your school's needs.

Click here for guidance on how to use the STEM Manager.

Five steps to STEM

Acknowledgements
Wave Machine

Subject(s): Science, Physics, Age: 11-16, 16-18 | Type: Video | Publication Year: 2012 to date

In this video, produced by the National STEM Centre and the Institute of Physics, Atom Snaith describes a simple but effective wave machine. Aimed at teachers, this video explains how to make the wave machine using adhesive tape, jelly babies and wooden skewers. He explains how it can be used to illustrate transverse wave motion in a visual and engaging manner.

Health and Safety
Any use of a resource that includes a practical activity must include a risk assessment. Please note that collections may contain舊STEM resources, which were developed at a much earlier date. Since that time there have been significant changes in the rules and guidance affecting laboratory practical work. Further information is provided in our health and safety guidance.

URL: http://stem.org.uk

Downloads
This video is not available for download.

Files

CPD links
- Fire science to life: CSI Forensics
  Science Learning Centre London - Online CPD
- Astrophysics: impact award
  Science Learning Centre London - University of London Observatory, MIT, HEP
- Technicians supporting triple science: impact award
  Science Learning Centre London
- Working as a science technician: an introduction to the role impact awards available
  Science Learning Centre South West
- Science in informal settings
  Science Learning Centre East Midlands
- Learning outside the classroom: science in informal settings
  Science Learning Centre East Midlands
Triple Science Chemistry

Group leader(s): James de Winter
Group type: Open

In this area is a quality assured collection of the most useful resources for use in delivering the extension units of the new GCSE chemistry specifications. The first tranch are materials sourced from a leahers of chemistry in maintained schools. Overtime, it will build into an extensive collection of material directly relevant to the teaching of the extension units within GCSE chemistry.

How can you get involved? If you want the team to post resources on a specific area of the chemistry curriculum you are struggling with, let us know by posting a comment to this community or e-mail the Group Leader. If you have expertise of how you might use the materials we have posted, comment on them or upload better links of your own.

Qualitative Analysis (1 reply)
Created on 10th April 2012 08:38 by James

In this topic are resources to help you teach aspects of Tripe Science Chemistry that cover content around Qualitative Analysis.

James replied 49 days ago:

Collected here are some of the resources produced by advisors, teachers and consultants for the previous triple science support program (courses pre 2011). Without there may have been some changes to the specifications since then we felt that these are well worth sharing here.

View
Looking forward
‘The most important factor in a student’s experience of a subject area is their teacher.’

*How the world’s best-performing schools come out on top*
(McKinsey and Company 2007)
“Coming together is a beginning; keeping together is progress; working together is success.”

Henry Ford
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