STEM Choices

A Resource Pack for Careers Education and Information, Advice and Guidance Practitioners

Science

Technology

Engineering

Maths

Enthusing Students
Equipping Professionals
Supporting Employers

Department for Education

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Department for Education initiative to promote subject choice and careers in Science, Technology, Engineering and Maths (STEM) delivered by the Centre for Science Education at Sheffield Hallam University and Babcock International Group

1 Introduction

The future prosperity of the UK is, to a large extent, dependent on young people choosing STEM-related subjects (science, technology, engineering, maths). For young people, STEM opens doors to a rich diversity of opportunities, which can improve the quality of people's everyday lives and find solutions to global challenges, such as sustainable economic development.

Recent research highlights the shortfall in the number of people choosing to study STEM subjects, as well as the need to double the supply of skilled workers in STEM–related jobs in the next seven to ten years. **An important aspect is the issue of gender and ethnicity imbalance in the supply. (See Section 4 Equality and Diversity)** Both females and some ethnic minority groups are greatly under–represented (see Sections 4 Equality and Diversity) in relation to the overall cohort taking STEM subjects and also to the numbers entering STEM–related jobs.

STEM skills are valued by employers across different sectors, with almost three quarters (72%) of firms employing STEM–skilled staff. In particular, STEM skills are vital to areas of future growth and employment including advanced manufacturing and low carbon industries. Yet 45% of employers are currently having difficulty recruiting STEM–skilled staff, with almost six in ten (59%) of firms expecting difficulty in the next three years.[1]

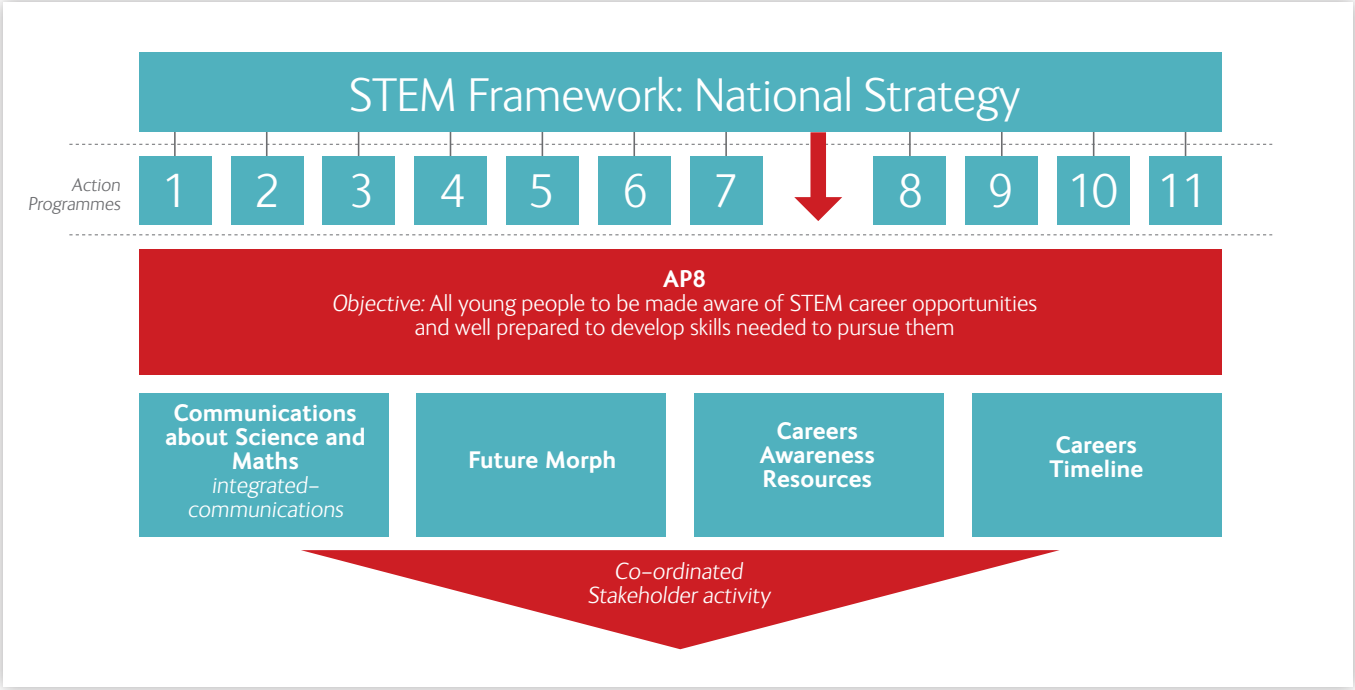
To tackle the decline we need to engage the interest and enthusiasm of young people, and demonstrate the relevance of STEM knowledge and skills to everyday life. **It is also vital that careers practitioners help young people to understand the importance of STEM subject choice and their impact on progression opportunities.** The Careers Professions Task Force report recommended that initial training and CPD should include a focus on LMI, ICT and STEM as critical to delivering high quality guidance.[2]

We also need to promote excitement about the UK's world–class science base in sectors including pharmaceuticals, aerospace, telecommunications, mobile phone technology, oil and gas exploration, along with the increasing demand for scientists, engineers and technicians. The Science for Careers Report of the Science and Society Expert Group, March 2010, has highlighted that there is also a great deal of 'hidden' science and technology in use in the high street, including supermarkets (e.g. food and drink, packaging, logistics, IT, finance), fashion (including textile technology, materials, computer aided design, dyes), and the built environment (e.g. construction engineering, materials sciences, environmental issues, energy). Tutors, teachers and advisers will be cautious about labour market messages proclaiming a growing demand. However, there is strong evidence of a future demand for STEM skills with an example being in the manufacturing sector.[3]

Employers value people with STEM qualifications and skills, not only for their specific knowledge and skills, but also for the transferrable skills of analysis, problem solving and creativity.

We are all living in a world struggling to deal with issues of **climate change and a rising population**, with associated demands on **water supply**, **food production and energy.** This challenging background means that **young people** can both **build strong futures** and **make a difference** by choosing STEM subjects and careers.

1. CBI/EDI Education and Skills Survey 2010
2. Towards a Strong Profession DfE 00550–2010
3. The EngineeringUK Report 2011 has identified that by 2017, 587,000 new workers will need to be recruited into the manufacturing sector.



The eleven Action Programmes of the National Strategy are part of a ten year plan to improve take-up and achievement in science and maths. They aim to:-

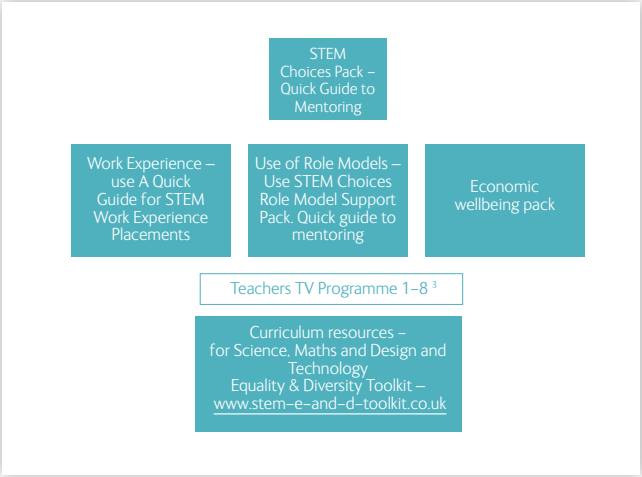
- Get the right people to become teachers and lecturers
- Encourage continuing professional development for teachers and engage teachers in technology and engineering
- Bring real–world context and applications of STEM into schools and colleges to enrich teaching
- Show young people the rich range of careers opportunities that STEM study opens up
- Get the STEM curriculum and infrastructure right including enhancing the quality of practical work

Action programme 8, the Careers Awareness strand, has included:-

- Communications with young people and parents to improve the take–up of science and maths subjects post–16[1]
- The Future Morph website for young people aged 11–18 to help engage them in studying science and maths by demonstrating the huge range of career opportunities available by pursuing these subjects
- A range of careers awareness resources for schools, teachers and careers education and IAG professionals to complement the public facing elements
- A Careers Awareness Timeline pilot designed to establish a more coherent structure for young people to learn about careers relating to science and maths. The project has been spearheaded by Kate Bellingham, the National STEM Careers Coordinator.

1. Educating the next generation of scientists – DfE – November 2010 – reported that 44 per cent of students had seen the adverts and the proportions of students likely to take Maths A level increased from 52 to 62 per cent and had changed the opinion of 41 per cent of parents about their child taking science or maths at A level.

The Careers Awareness project was run by the Centre for Science Education at Sheffield Hallam University, in partnership with Babcock, a leading provider of careers resources and consultancy. The project has produced a range of targeted online and printed resources to help teachers, tutors, employers and other stakeholders to support STEM careers awareness (see figure below). The design of the products recognises that careers information and guidance can help encourage young people to want to pursue science and maths and that "career learning and development is constructed through activity and in interactions with a variety of people (including career professionals, employers, teachers, parents and peers)."[2]



The resources can be downloaded from www.futuremorph.org, the online portal for STEM careers. See also the STEM Careers Awareness collection at www.nationalstemcentre.org.uk.

2. An Introduction to Career Learning and Development 11–19 (2011)

3. The Teachers TV programmes illustrate good practice as subject teachers and careers staff bridge the gap between the classroom and the workplace. Search for STEM Subject Choice & Careers to access the eight programmes.

The secondary curriculum itself provides a platform for using real–life applications to enhance teaching, engage the interest of young people and encourage initial career exploration. Interest and enjoyment of subjects, alongside whether young people consider themselves good at the subject are key factors in how young people form their career and subject identities. Embedding STEM careers into the curriculum is one of the routes open to raise awareness of students, and is strengthened by a partnership approach with career professionals. *"It is important to ensure that career routes and qualifications form an intrinsic part of all STEM courses ... this will require a partnership approach at the level of curriculum design from both careers professionals and teachers."* [1]

Maths – important for all members of a modern society ... for its use in the workplace, business and finance ... tools for understanding economics ...essential for participation in the knowledge economy

- applications and implications of maths
- work on problems and in contexts beyond the school (e.g. financial).

Science – discover how scientific ideas contribute to technological change – affecting industry, business ...

- applications and implications of science
- experience science in the workplace, where possible.

Design and technology – skills and understanding of economic, industrial and environmental issues...evaluate present and past D&T, and its uses and effects

ICT – understanding to apply skills purposefully in learning, everyday life and employment...economic implications of its use.

Seeing the career possibilities of STEM subjects can be a positive motivator for students. The 'STEM Careers Awareness Timeline' strand of Action Programme 8 conducted in partnership with CEI (Centre for Education and Industry) at the University of Warwick, iCeGS (International Centre for Guidance Studies) at the University of Derby, and Isinglass Consultancy, surveyed 4073 Year 7 and Year 9 students to assess their current interest in STEM subjects and willingness to engage in STEM careers. Some of the key findings include:–

Subject popularity and importance

- Maths and science were considered to be important subjects since they are needed to secure a good job. The percentage of young people who consider a career related to a STEM subject is comparatively high (with 59% contemplating future work linked with technology, 52% in science and 50% in mathematics; 38% would consider a career related to engineering).
- Boys were significantly more likely to choose engineering, ICT, maths and science in their top 3 subjects than girls.
- Higher socio economic status was associated with students being significantly more likely to choose science and design and technology in their top 3 subjects.
- Lower socio economic status was associated with students being significantly more likely to choose engineering and ICT in their top 3 subjects.
- Male students were significantly more likely to agree or strongly agree that engineering is important for adult life (75%) and to get a job (58%) than girls (58% and 37% respectively).

Considering a STEM career

- Students from the lower socio economic status schools were significantly more likely to consider an engineering related career than those from the higher socio economic status schools.
- The percentage of students considering careers related to engineering were generally lower than careers related to other STEM subjects, which **supports earlier conclusions that students perhaps lack understanding of engineering compared to other STEM subjects.**

The choices that young people make regarding their option choices and eventual career pathways are influenced by a variety of factors based on their personal histories and experiences, self–awareness and belief, and school–based support. By the time they reach Year 11 young people have often either consciously or instinctively introduced physical, emotional or cultural "boundaries" within which they will shape their choices. The main difference the survey found between reported attitudes of Year 7 and Year 9 students was a move away from science study during Key Stage 3 – particularly for girls, and an increasing awareness of sources of career related information and advice. The three waves of research completed by Babcock on behalf of Sheffield Hallam demonstrate the impact of planned interventions in increasing students' interest in STEM careers and on the attitudes of staff (an increase from 45% to 64% of students agreeing that STEM careers can be enjoyable between waves 1 and 2 and an increase in STEM themed problem solving days from 27% to 54%). There is a clear challenge to improve the quality of careers education, information and guidance overall with a wealth of evidence available now about what works.

There is also overall agreement that the messages we want to share with young people about STEM courses and careers are:–

- STEM qualifications lead to a wide range of opportunities at different levels and are valuable for non–STEM jobs. They keep options open.
- STEM qualifications can help to address key global challenges such as climate change.
- STEM qualifications are valued by employers – 40% of businesses prefer STEM degrees when recruiting graduates.
- STEM courses and careers are open to all and can help raise aspirations.
- STEM helps develop enterprise and employability skills – analytical capabilities, problem solving, creativity.
- Many STEM jobs need creativity and design skills in combination with mathematical and scientific abilities
- Good salaries are available and locations for work vary, often not a desk or a laboratory

1. STEM Careers Review November 2010.

What you can do and how the pack can help

There is a range of ways in which teachers, tutors and advisers can make a real difference to STEM careers awareness. See the key points outlined below and how the resource pack can support these tasks. Also see Section 9 for a signpost to other materials. You could also complete the development plan at the end of this section to identify priorities for your school/college across eight related strands of engagement with STEM Careers Awareness.

What you can do	How the pack can help all sections downloadable via www.futuremorph.org/careers_staff
• Review your own continuing professional development needs in relation to STEM careers awareness. Young people value careers practitioners who have expert knowledge to enable them to access opportunities that are in their interest.	See **Section 2:** Current & Future Trends See **Section 5**: Where's the Money? See signposts to Industry Focus Reports in Section 7
• Check your own knowledge and understanding of learning routes and progression possibilities for young people in STEM-related subjects. Ensure you are aware of a wide range of pathways for students of all abilities.	See **Section 3:** Learning Routes and Pathways
• Establish a shared understanding of the starting points and challenges in your area in relation to STEM take-up. Share general information about the perception of STEM subjects.	See **Section 2:** Current & Future Trends See **Section 4**: Equality and Diversity, See **Section 6:** STEM Careers Starters and Plenaries
• Collaborate with STEM departments in your school/college to raise the visibility of STEM subjects and careers. Provide subject and careers information and resources for young people and their parents and carers, e.g. posters, displays in each department	See **Section 8:** Organising STEM events See **Section 9:** Websites and Sources of Information
• Build your knowledge of local agencies and initiatives that can support STEM-related enrichment and enhancement activities in your school/college. Contribute to thematic learning projects or suspended timetable activities	See **Section 8:** Organising STEM Events See **Section 9:** Websites and Sources of Information See also STEM Directories Online www.stemnet.org.uk
• Motivate and engage young people by involving them in activities where they need to use their STEM knowledge, understanding and skills to face future challenges e.g. food security, water shortage, energy supply	See **Section 6:** STEM Careers Starters and Plenaries See signpost to Industry Focus report **Section 7** See **Section 8:** Organising STEM events
• Challenge stereotypes. Careers practitioners can help young people extend their 'horizons for action'. Often young women and black and minority ethnic students are under-represented in STEM courses and careers and may be held back by poor information and lack of positive role models.	See **Section 4:** Equality and Diversity Also see the Equality and Diversity Toolkit www.stem-e-and-d-toolkit.co.uk

How to use the tool:

- identify where you are on each of the aspects of school/college practice (A–H)
- identify the changes needed to make the transition from your current level to the next on each of the eight aspects
- identify the mechanisms or interventions to help you achieve change
- identify existing resources and sources of support for making the transition
- identify any gaps in the help available and how they can be plugged.
- identify senior staff and governors to oversee and facilitate developments

	Level 1	Level 2	Level 3	Level 4
A. Teaching and Learning	No explicit or planned reference to STEM contexts and careers in curriculum planning. Individual teachers might make occasional reference to STEM careers if opportunities arise.	Some STEM teachers make use of work related contexts to achieve greater student engagement in STEM subjects.	Widespread use of work related contexts to support curriculum planning and delivery by teachers across the STEM subjects.	Whole school/college approach to use of work related contexts to support curriculum planning and delivery across all the STEM subjects.
B. Student personal skills and capabilities	No verbal awareness of their own personal skills or capabilities. No planned acknowledgement of personal skills or capabilities within the curriculum. Teachers rarely make reference to personal skills.	Reasonable awareness of personal skills & capabilities development and is able to give examples. Teachers occasionally use associate language in ad–hoc way. Reference to skills is driven by individual teacher enthusiasm rather than whole school/college action.	Good awareness of personal skills and capabilities and can give examples and identify what made them worthwhile. Explicit progressive and inclusive provision is given to personal skills & capabilities in subject lessons. Whole school/college and curriculum activities by most staff.	Strong awareness of personal skills and capabilities and can give examples, identify worthy features and describe why they are useful. They work with other students to peer assess and coach others, and actively seek out opportunities to develop further. They experience personal skills & capabilities embedded into school/college and lesson activities by most staff; parents know about them.
C. Teacher Awareness of STEM careers	Low level of subject teacher awareness of STEM career pathways and use of STEM subjects in the workplace.	Some STEM teachers are aware of career pathways and use of STEM subjects in the workplace. Use is made of Future Morph and mathscareers.	Widespread knowledge and use of STEM subjects in the work place and career pathways. Teachers confident to answer front line enquiries from students and to help them make effective use of the wide range of web and hard copy STEM careers information.	Whole school/college approach to updating teachers on STEM applications and career pathways. Positive use of this knowledge to enthuse and engage students. Direct links to Future Morph, and mathscareers. Teachers actively support students' career exploration and refer them for further guidance.

D. Enhancement and enrichment	Rare use made of enhancement and enrichment activities. Individual STEM teachers might make use of occasional STEM visitors from industry.	Some use made of STEM enhancement and enrichment activities with some students, though this tends to be only with those already committed to STEM subjects.	Good use of STEM enhancement and enrichment activities with substantial numbers of students. High level of awareness amongst staff of the opportunities and benefits of this approach and of STEM Directories	Whole school/college approach to STEM enhancement and enrichment. Progressive programme for Key Stages 3, 4 and post–16. Support for students to reflect on learning and the connections to and implications for career choice.
E. Equality and diversity	No explicit plan to tackle limited and stereotypical views of STEM courses and careers.	Efforts made to tackle student and parents' stereotypical views of STEM courses and careers by some teachers through role models and curriculum materials. Some recognition of equality duties.	Good recognition of equality duties. Active use of role models and mentors to promote equality in STEM subjects and careers. Targets set to achieve representative participants in STEM enrichment activities. Strategy in place to deliver an inclusive STEM curriculum.	. Creative, whole school/college approach to equality duties that engage all students in successful experiences of, and progression, in STEM courses and ensure that all students are able to fully achieve their potential. Differentiated activities to engage under–represented student groups in STEM courses and activities.
F. Communication about STEM careers	No explicit efforts made to raise awareness of STEM careers by teachers or personal advisers.	Individual teachers try to raise awareness of STEM careers in class and with individual students in response to interest. Personal advisers run group work and provide information, advice and guidance on STEM opportunities in response to requests.	There are comprehensive efforts by STEM teachers through displays, visiting speakers, discussions, and information for individual students to raise awareness of STEM courses and careers. Personal advisers make positive efforts to broaden students' knowledge of STEM opportunities through group sessions, presentations at events, etc.	There is a whole school/college strategy for communication about STEM choice and careers with students and parents. This is evident in the careers library, schools/college intranet and displays, as well as newsletters and events. There is a widespread commitment to the social and economic benefits of STEM careers. Personal advisers contribute to this strategy
G. Leadership and management	No explicit lead on STEM choice and careers.	STEM faculty heads are aware of potential and make efforts to encourage students to progress in STEM subjects.	STEM faculty heads have started to define a strategy for encouraging students to explore STEM careers and develop interest in further STEM study through curriculum development and enrichment and enhancement activities. Some monitoring of student participation and achievement in STEM subjects to monitor effect.	Whole school/college STEM engagement and careers policy in place in partnership with other key agencies. Monitoring of effectiveness is undertaken by studying participation and achievement in STEM subjects and career choice.
H. Partnerships	No explicit links are in place with partners such as local universities, the all–age careers service and STEM enrichment providers to support STEM subject choice and careers.	Some individual teachers have links with partners to enhance delivery.	STEM Faculties have good links with key partners from higher education, Aimhigher and industry to enhance student learning. These are celebrated within the school/college and wider community.	The STEM careers policy is developed, delivered, reviewed and celebrated in close collaboration with key partners including Aimhigher, local universities and industry.

2 Current and Future Trends

1. A changing labour market

As the table below shows, the UK has changed from a predominantly manufacturing and agricultural–based economy to one that is increasingly service based:

	Manufacturing	Services
1950	9 million employees	9 million employees
1986	5.2 million employees	18 million employees
2006	3.3 million employees	25 million employees

One of the results of this is that the number of jobs in semi-skilled or unskilled work is declining. Employers are increasingly looking for people with higher level qualifications to fill clerical, technical and professional level work:

- In 1960, 8 million or 33% of the labour market was in unskilled or semi–skilled jobs.
- In 2006, 3.5 million or 12% of the labour market was in unskilled or semi–skilled jobs.
- In 2007, the Treasury forecast that by 2020 just 600,000 or 2% of the labour market would be in unskilled or semi–skilled jobs.

2. An ageing population

In the UK, the number of over 65s is predicted to increase from 8.5 million in 2000 to 12.3 million by 2025 and 15 million in 2050. This will place growing pressures on the health and medical services in particular. As a result, there will be *increasing demand for people with STEM skills*, with exciting opportunities in areas such as:

- *Biomedical engineering* – designing hip and knee replacement joints, heart bypass valves, breast implants
- *Bioinformatics and computational biology* – solving biological problems at a molecular level such as DNA sequencing in the treatment of cancer to target individual cells
- *Pharmaceutical research* – working to develop new drugs to combat the effects of cancer, tackling mental health issues, vaccines, insulin, antibiotics
- *Biotechnology* – using living cells (bacteria, yeast, stem cells) as well as biological substances (enzymes) in industrial processes like brewing and baking, and in research in agriculture and medicine.

3. A STEM skills shortage

The CBI Education and Skills Survey of 2010 states that 45% of employers are currently having difficulty recruiting STEM staff, rising to almost 59% expecting difficulty in the next three years. **Almost one third of businesses are anticipating difficulty recruiting STEM graduates.**

The UK Commission for Employment and Skills – Working Futures 2007–2017 predicts an **increased demands for skilled technicians and association professionals** of 654,000 over the period 2007 to 2017. In its audit of Skills for Jobs[1] it reports the growing importance of technicians, especially in specialist STEM areas. A Cogent (Sector Skills Council) Report in 2008 similarly concluded that the current inflow of non–graduates is insufficient to meet replacement demand in processing and technician roles. This deficit will increase significantly in the period to 2017, which coincides with the known lowest point in 16 – 18 year olds in the general population. Matthew Harrison, Director, Education Programmes, Royal Academy of Engineering has pointed out that *"With our society evermore dependent on technology, we rely increasingly on the technicians who install and maintain the nation's technological infrastructure. Yet the contribution made by these people who can match knowledge of science with real practical skills goes unsung"*

1. *Skills for Jobs: Today and Tomorrow 2010*

Examples of growth areas for STEM opportunities include:

- *Nanotechnology* – the science of the very small enabling the development of light and immensely strong materials with varied applications including telecommunications, aviation, fuel cells
- *Space technology* – developing satellites for use in, for example, telecommunications, global positioning systems, military surveillance
- *Civil and water engineering* – needed to design and construct, for example, flood defences, improved irrigation systems, dams, desalinisation plants
- *Ubicomp technology* – designing and building micro-processors and low cost sensors into, for example, central heating systems, refrigerators, and security systems to enable use by remote control.

4. Climate change

The Climate Change Act 2008 sets a 2050 target of reducing UK carbon emissions by 80% compared to 1990 levels. The report calls for a whole range of measures including:

- carbon capture and storage
- a new generation of nuclear energy
- greater energy efficiency
- renewable sources of energy
- a second generation of biodiesel fuels

To meet the challenge of climate change, there is a need to *boost the number of people with STEM skills at all levels* in order to achieve these targets and meet the demand for skills that these technologies will create in areas including:

- *Renewable energy technology* – generating electricity from renewable sources such as wind, solar and tidal power
- *Clean coal technology* – building new coal-fired power stations where carbon emissions are reduced and stored underground
- *Nuclear engineering* – needed for the programme of decommissioning old plants and building new nuclear power stations over the next decades
- *Fuel cell technology* – fuel cells combine hydrogen and oxygen to produce water, electricity and heat – a potential alternative energy source that is cleaner and more efficient than using non-renewable fossil fuels.

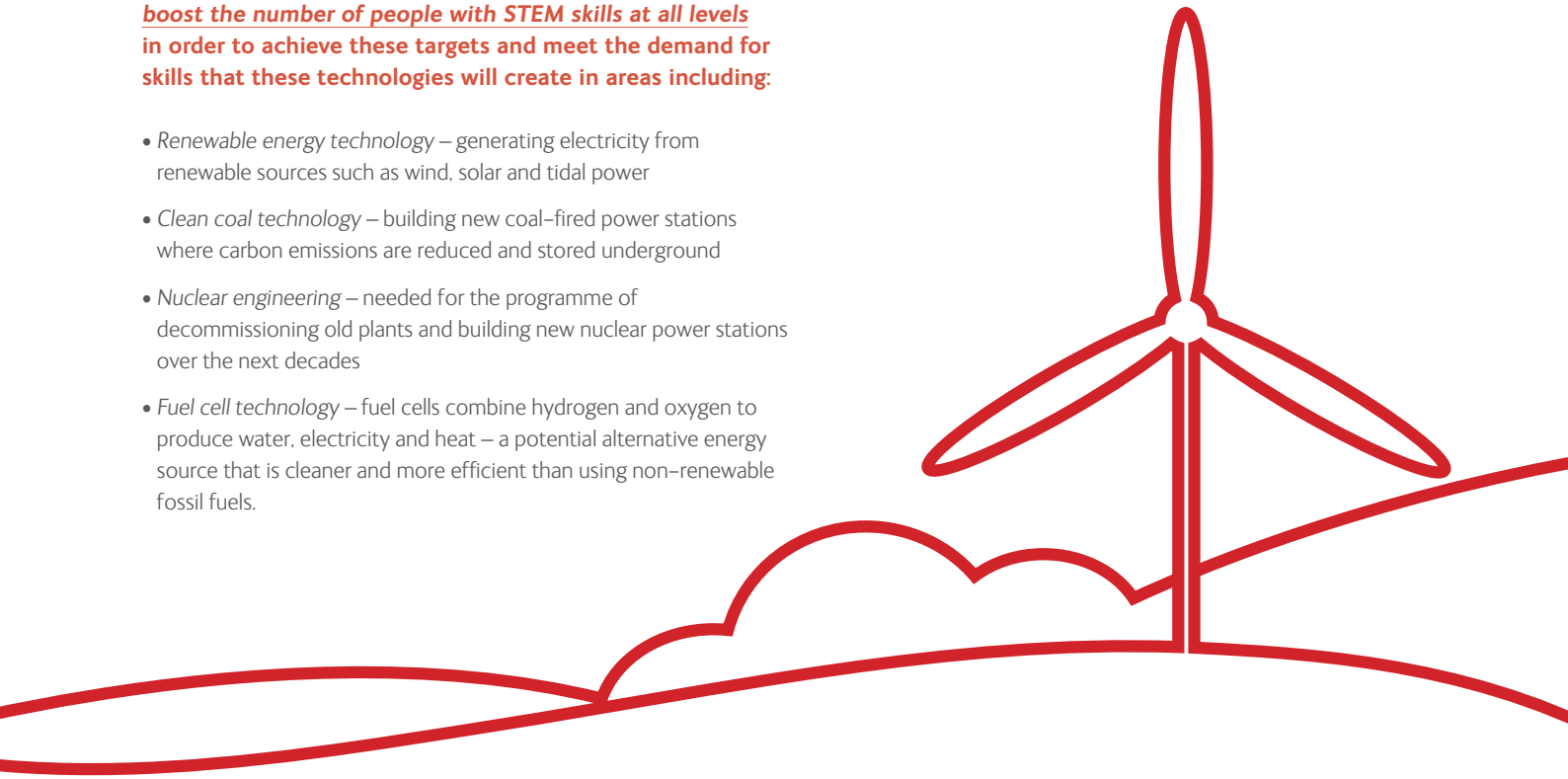
The International Perspective

The economic growth of the BRIC nations (Brazil, Russia, India and China) is challenging a two hundred year dominance by Europe and the USA. Predictions are that the Chinese economy will overtake the US economy by around 2025 and be twice as big in terms of Gross Domestic Product, by 2050[1]

China and India are the two most heavily populated countries in the world, with a combined total in 2008 of 2.4 billion people out of 6.6 billion (adding up to 36% of the total world population). These two countries with their large domestic markets will increasingly dominate the world economy.

For the UK to meet this global economic challenge, there is an ever greater need for people with STEM skills. "A strong supply of people with science, technology, engineering and maths skills is important to promote innovation, exploit new technologies, produce world class scientists and for the UK to compete internationally."[2]

1. *BRICs and Beyond – Goldman Sachs Global Economic Department – November 2007*
2. *Educating the next generation of scientists DfE November 2010*



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Learning Routes and Pathways

General Overview

Exciting opportunities are available for young people to develop their STEM Skills and unlock talent through a range of education and training routes supporting progression onto higher level learning and employment. At Key Stage 4, in addition to vocational science courses offered by BTEC or OCR[1], young people can undertake.

- Core science (single award) GCSE
- Core science plus additional science (double award) GCSE
- biology GCSE, chemistry GCSE, physics GCSE (triple science). Take-up of the individual sciences has increased by almost 150 per cent in the last five years with a rapid increase in the numbers offering triple science. However in June 2009 just under half of all schools still did not do so, with less availability in areas of highest deprivation. Young people studying triple science are more likely to continue study at A level and achieve higher grades having done so.

Other options available include:

- The Apprenticeship route – is being expanded and strengthened
- Diplomas – combining general learning with practical hands-on experience covering a broad employment sector
- GCE A level subjects – required for entry to STEM related higher education and valued by employers and universities as indicating academic rigour, numeracy and problems solving abilities. With competition so strong for university places and jobs students need to choose their subjects wisely.
- Vocational science courses offered post-16 at entry level through to level 3 of the national framework.[2]

1. The Ofsted Report on Guidance to Students Studying Science published in May 2010 found that very few students felt misdirected at the end of Key Stage 3. However, where students embarked on vocational pathways, it was usually because teachers believed that students would achieve higher grades as a result of this method of assessment and awareness of the career implications of choices do not inform the advice offered. It is important that advice and guidance is available on progression routes including any barriers to A level progression from vocational science courses pre-16.

2. The review by Professor Alison Wolf identified improvements in vocational education 14-19 in March 2011

Apprenticeships

Apprenticeships are increasingly recognised as the gold standard for work-based training. Young people can benefit from taking an Apprenticeship through gaining increased confidence, developing skills, gaining qualifications and funded training, and getting career development. There are three levels of Apprenticeship available for those aged 16 and over:

1. **Intermediate Level Apprenticeships (equivalent to five good GCSE passes)**
   These provide the skills needed by specific industries, and allow entry onto an Advanced Apprenticeship.
2. **Advanced Apprenticeship (equivalent to two A level passes)**
   To start this programme, applicants should ideally have five GCSEs (grade C or above) or have completed an Apprenticeship.
3. **Higher Apprenticeship**
   Higher Apprenticeships work towards work-based learning qualifications such as NVQ Level 4 and, in some cases, a knowledge-based qualification such as a Foundation Degree.

Examples of Apprenticeships available in the area of STEM skills are as follows:-

Engineering and Manufacturing Technologies

- Engineering Technology
- Food Manufacture
- Gas Industry
- Marine Industry
- Nuclear Decommissioning
- Rail Transport Operations

Construction, Planning and the Built Environment
- Building Services Engineering
- Electrical and Electronic Servicing

Information and Communication Technology
- IT Users
- IT and Telecoms Professionals

Business, Administration and Law
- Accounting
- Providing Financial Services

The following quote from an Apprentice illustrates some of the benefits: Rachel Hoyle completed an Advanced Apprenticeship in Aerospace Engineering, but said that as her schooling drew to a close *"I felt unsure of what the future held. I looked into Apprenticeships and other courses, and what clinched the Apprenticeship for me was the fact that I could go and begin a career, learning from people who are experts in their own right. I felt I could get involved in real work while applying my favourite subjects, like physics and maths, and continuing to learn."*

For more details and to find a full list of Apprenticeships visit www.apprenticeships.org.uk

For case studies of Apprentices access www.futuremorph.org

- Food and Drink – Food and Drink Manufacturing Apprenticeships
- Manufacturing – Chemical, Pharmaceutical, Petrochemical Manufacturing and Refining Industries Apprenticeships
- Transportation – Rail Transport Engineering Apprenticeship

For more details and to find a full list of Apprenticeships visit www.apprenticeships.org.uk

Diplomas

The Diploma is a qualification that:

- offers a mix of general learning, creative thinking and practical hands–on experience
- involves a research–based project and at least 10 days' work experience with an employer
- covers a broad employment sector and builds essential skills while keeping all learning routes open
- has been developed in partnership with employers and higher education institutions.

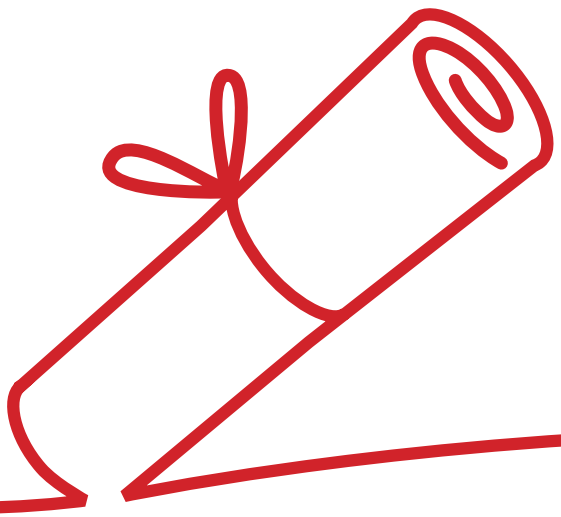
The Diploma is available at three levels:

- *Foundation Diploma* – is a level 1 qualification
- *Higher Diploma* – is a level 2 qualification
- *Advanced Diploma* – is a level 3 qualification

The Diplomas most closely relating to STEM are:

- Construction and the Built Environment
- Engineering
- Information Technology
- Business, Administration and Finance
- Manufacturing and Product Design
- Creative and Media
- Environment and Land Based Studies
- Society, Health and Development

Out of 3,069 young people who completed the two year Higher Diploma, in 2010, 871 studied engineering, making it one of the most popular.



STEM A Level subjects

In terms of numbers of students studying STEM A Levels, there has been an encouraging recent increase in numbers, but from a low base compared to many non-STEM subjects. The figures for STEM subjects illustrating recent trends are as follows:

Physics – an encouraging fourth consecutive increase in numbers to 30,976 in 2010, which is back to the level of 2001 (30,701)

Maths – a significant increase in numbers from 66,247 in 2001 to 77,001 in 2010 (A Level Further Maths has increased by 11.5% on 2009 to 11,682 students in 2010)

Chemistry – a small but sustained increase in numbers from 38,602 in 2001 to 44,051 in 2010

Biology – an increase in numbers from 52,647 in 2001 to 57,854 in 2010 and still considerably higher than the chemistry or physics numbers

Other Science subjects – significant growth in A Level entrants has occurred in the past twenty years in some science subjects. For example, in 2001, **psychology** had 31,740 entrants, with an increase to 54,940 entrants in 2010. **Sports studies** has also seen a strong growth from 16,716 in 2001 to 20,612 in 2010, but with a slight decrease on 2009 numbers. It is important for young people to be aware that to enter STEM-related degrees with A Level psychology or sports studies, **they will also need to take 2 'core' science A Levels as well.**

(Source: Joint Council for Qualifications, June 2010)

The SCORE Report (2009) Choosing the Right STEM Degree Course found that students wishing to gain entry to degrees in STEM would be best advised to attain A levels or equivalent in at least two science-related subjects. The report suggests that there can be flexibility in the third or fourth A level studied. Grades and subjects studied are critical determinants of entry emphasising the importance of effective information, advice and guidance to assist young people with this vital decision. For instance, in order to study a BSc in Chemistry, most universities will expect A Level in Chemistry and in at least one more science/maths A Level.

A useful tool to assist with guidance on subject choice can be found at www.futuremorph.org by searching for Choosing Subject combinations. Students should be encouraged to check acceptable or optimum A level combinations with UCAS or individual institutions. For instance, highly competitive institutions may only accept A levels such as Applied Science or Sports Studies as a fourth subject.

The Russell Group of universities have recently published a guide to entry requirements entitled Informed Choices in partnership with the Institute of Careers Guidance that identifies the importance of STEM A levels.

STEM degree subjects

Applications

With the exception of Engineering, there has been a percentage growth in applicants to STEM degree subjects from 2002 to 2007 – with Maths (57%) and Chemistry (27%) showing above the average growth for all subjects (16%). Subject trends in numbers of degree course applicants are as follows:

Physics – has seen a 9% growth from 2002 (5,236 applicants) to 2007 (5,715)

Maths – has seen a strong 57% growth from 2002 (7,251 applicants) to 2007 (11,374 applicants)

Chemistry – has seen an encouraging 27% growth from 2002 (6,195 applicants) to 2007 (7,865 applicants)

Biology – has seen a growth of 7% from 2002 (10,670 applicants) to 2007 (11,428 applicants)

Engineering – has seen a fall of 5% from 2002 (42,841 applicants) to 2007 (40,911 applicants)

(Source: UCAS Research Team, 2008 – for DIUS (Department for Innovation, Universities & Skills))

There is a very wide range of degree courses on offer in UK universities that require STEM qualifications for entry in 2010. UCAS identifies 4,815 different degree courses.

Acceptances onto STEM degree courses

The table below indicates the number of acceptances onto STEM degree courses, and illustrates the low base of STEM degree numbers compared to more popular subjects such as psychology and sports science. A five year trend indicates a varying amount of growth in acceptances onto STEM degree courses, as shown in the table below.

Although the number of STEM graduates is lower than for many other subject areas, there is a much better chance of STEM graduates entering employment within that sector. Conversely, the number of, for example, psychology or sports science graduates entering employment directly related to their degree subject are significantly lower, as those employment sectors are much smaller.

Degree subject	Number of acceptances in 2009	Number of acceptances in 2004
Physics	3,566	2,671
Maths	6,916	4,778
Chemistry	3,966	3,089
Biology	4,686	4,641
Mechanical engineering (the largest single engineering sub-discipline)	6,275	4,753
Psychology	15,385	12,484
Sports science	10,783	7,810

(Source: Universities and Colleges Admissions Service (UCAS) 2009)

The added value of a STEM degree is the flexibility that it brings in terms of employability. The CBI/EDI Education and skills survey, 2010 found that STEM skills are valued by employers across different sectors, with almost three quarters (72%) of firms employing STEM-skilled staff. Therefore, studying STEM subjects not only maximises career options in the STEM area, but also for careers not related to STEM.

4

Equality and Diversity

Introduction

It is widely understood that gender, ethnicity, social and economic background and disability can have a profound effect on young people's choice of subject and career. This may be a result of the limiting effects of an individual's own culture and background on academic self concept (I'm not good at science) or on career identity (that's not a job anyone I know does). Other factors relevant to STEM careers awareness are the lack of visibility of the breadth and dimension of STEM careers and stereotyped images and perceptions of people working in traditionally conceived STEM jobs.

The desirability of a more diverse STEM workforce is generally well–accepted on the grounds of maximising individual opportunity and meeting economic need.

This part of the pack explores some of the facts about under–representation in STEM courses and careers, offers tried and tested approaches to practice that can produce real and sustained impact and points to some of the sources of information to support change.

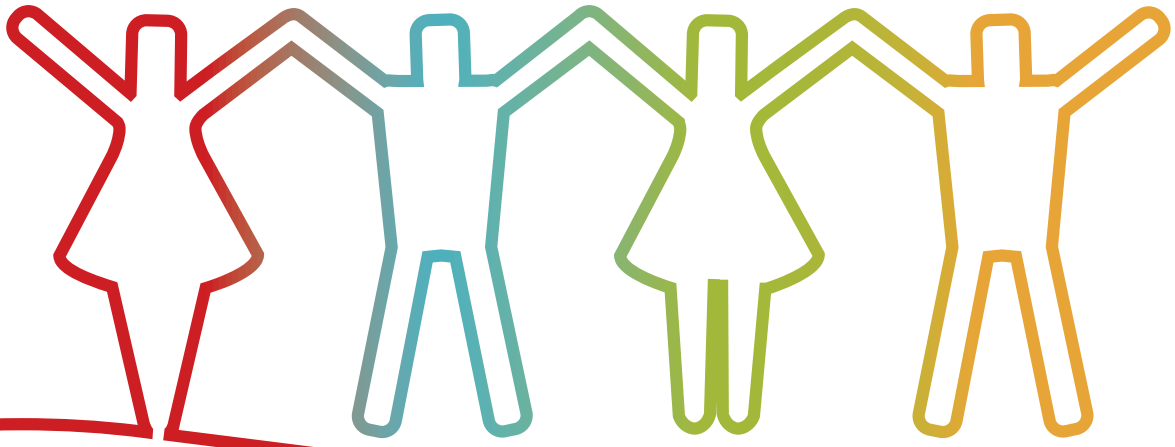
There are significant interactions between the various strands of equality that affect young people's progression and achievement in STEM. The STEM Subject Choice and Careers Online Equality and Diversity Toolkit helps practitioners reflect on practice in relation to STEM careers and signposts relevant case studies and resources. www.stem–e–and–d–toolkit.co.uk.

Some of the particular challenges we face on STEM subject choice and careers include:–

- The number of schools offering Triple Science has increased rapidly...'research shows that, compared with other pupils, pupils from more deprived backgrounds achieve relatively larger improvements in their future A level science and maths outcomes when offered Triple Science at GCSE ... However, Triple Science is less widely available in areas of higher deprivation, where it could potentially have the greatest impact on take–up and achievement.'[1]
- Only about 20% of those taking A level Physics or studying undergraduate physics courses are female.
- Approximately 1 in 14 of the general population attend higher education but only 1 in 20 of disabled people do so.
- Disabled people represent around 3.8% of the STEM sector as compared to 5.9% in other sectors.[2]
- Low aspirations, poor academic self concept and effort have a disproportionate effect on STEM achievement among working class White British and Black Caribbean boys.
- The UK is ranked worst in Europe for the number of female engineering professionals. Some engineering sub disciplines (aerospace and chemical, processing and engineering) are showing more sustained interest from young women.

The Equality Act 2010 promotes equality across a range of protected characteristics, and public bodies are expected to comply with the requirements. Schools/colleges are encouraged to move towards a single equality policy which should encompass the publication of data on a year by year basis. This could include information relevant to the STEM arena including take up of STEM subjects, breadth of participation in work experience and student destinations.

1. Educating the next generation of scientists – DfE November 2010
2. 2006 Labour Force Survey



Gender

The STEM workforce is not yet truly representative, with a significant gender imbalance in many areas.

Barriers to females choosing STEM subjects and careers

An example of work being carried out to understand the issues related to the gender imbalance in STEM subjects can be seen through initiatives led by the Institute of Physics. The under–representation of girls in post–16 physics was the rationale for the inclusion of a 'Girls in Physics' component in the Institute of Physics 'Stimulating Physics' project. This component was delivered by the UK Resource Centre for Women in Science, Engineering and Technology (UKRC) between February 2007 and July 2009. A substantial number of girls do well at Key Stage 4 but do not choose to study physics post–16. In 2005, only 14% of girls who were awarded an A* or A for GCSE Double Award Science or physics progressed to A level physics (Hollins et al., 2006). Whilst there has been a small year–on–year increase in the number of A level physics candidates between 2006 and 2008 (Institute of Physics, 2008), there has been little change in the proportion of girls that have taken the subject post–16. In 2008, 28,096 students sat physics A level and of these 21,941 (78%) were male (Institute of Physics, 2008).

Outcomes from the 'Stimulating Physics' project indicate that many physics teachers now recognise the barriers that girls face, and are convinced of the need to be proactive.

Examples of recommendations for further development related to learning include:–

- Development of learning methods and materials that support personalised learning and embed gender equality.
- Training and development targeted at girls in the physics classroom to enable them to become more confident and assertive.
- Developing, piloting and evaluating learning activities to demonstrate the 'real world' benefits of studying physics

Recommendations relating to careers include:–

- Researching women in physics–related careers
- Strengthening the links between the physics curriculum and physics–related careers guidance
- Designing strategies for bringing the world of work into the learning of physics
- Designing strategies for bringing positive female role models from universities and industry into the learning of physics
- Designing gender–friendly industrial visits, work placements and employer involvement in the learning of physics. The 'Girls into Physics' action research programme (Institute of Physics, 2008), enabled 100 schools to participate to investigate methods to engage girls with physics. Key recommendations for teachers include:–

Learning & Teaching

- Talk to students to understand the context in your classroom
- Get students onside to work with you to change this – allow students to peer review
- Make sure students understand what physics is
- Discuss the nature, purpose and relevance of physics

Classroom Management

- Ensure interventions are appropriately timed
- Sharing good practice in school and beyond

Careers

- Careers advice should be integrated throughout the school
- Become aware of students' career aspirations
- Improve access to existing physics–related careers materials
- Links to careers should be highlighted throughout normal teaching

Progression

- Use appropriate role models at all stages of progression
- Link the physics covered to wider social relevance and interest

Workforce

- Specialist teachers can work with non–specialists to build their confidence and suggest strategies

School culture and ethos

- Use interventions that the whole school can see or get involved in

Some important messages to emerge from the findings include:–

Making it relevant:

- Integrating physics–related careers in (e.g. through direct references, set assignments, posters and display)
- Creating opportunities in lessons for students to explore the social relevance of physics (including the roles of physicists)
- Real life experiences with work experience and role models were also effective in 'bringing physics to life'

Students' lack of knowledge of careers is a problem and increasing their awareness of physics–related careers would enable them to make informed course choices. This approach relates to all the STEM subjects, and careers. Practitioners have a key role in ensuring young people have access to STEM careers knowledge.

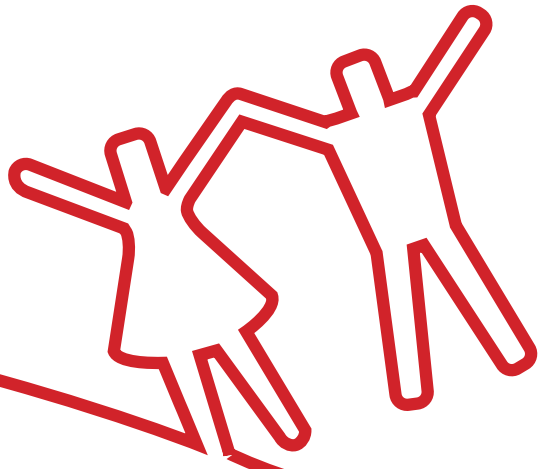
Gender imbalance in STEM careers

Encouraging the greater participation of young women in STEM makes good business sense since by not tapping the skills potential of females, employers are reducing the pool of possible recruits.

Fewer young women choosing STEM subjects leads to gender stereotyping in education with resultant occupational segregation in the workplace. Occupational segregation is one of the three main factors contributing to the gender pay gap alongside pay discrimination and unequal impact of caring.

Without more young women choosing the STEM route, occupational segregation will reinforce the current situation whereby 75% of working women are still found in just 5 occupational groups:

- Associate professional and technical (e.g. nurses)
- Administration and secretarial work
- Personal services (e.g caring for children or the elderly)
- Sales and customer service
- Non–skilled manual work.



Occupational segregation is illustrated by an analysis of successful completions in selected apprenticeship areas. See table below:-

The gender gap in Apprenticeships Completions (2006–07)[1]

Selected Sectors	Women as a % of completions
Retail and Commercial	67.5
Health, public services & care	88.6
Leisure, travel and tourism	48.4
Information & communication technology	23.6
Engineering and manufacturing	3.8
Construction, planning and built environment	0.9

The Gender Pay Gap

Pay rates in male–dominated sectors are higher than in those sectors where the majority of females work:

The national gender pay gap for full–time employees (as measured by the median hourly pay excluding overtime) was 12.6% in 2008. Traditionally, male professions appear to have a smaller gender pay gap than professions with higher proportions of women. (See UKRC Statistics Guide 2010). The message of overall better pay in the STEM area, combined with the exciting opportunities that are available, may encourage more girls to break this cycle of occupational segregation.

Mean annual pay (gross) – 2006	
Selected sectors	**Mean annual pay**
ICT Professionals	£39,228
Engineering Professionals	£34,839
Hairdressing and Beauty Salon Managers and Proprietors	£18,661
Healthcare and Related Personal Services	£12,108
Childcare and Related Personal Services	£9,405

1. LSC 2008. Secondary analysis by the UKRC – Women and men in science, engineering and technology: the UK statistics guide 2010

The Gender Pay Gap for Apprentices

The gender pay gap in the most recent government survey (2007) was 21% with an average weekly earnings for a male apprentice of £186 compared to an average weekly earning for a female apprentice of £147. Occupational segregation was illustrated in that the majority of apprentices in the two highest–paying sectors were male (i.e. engineering manufacturing, and electrotechnical), whereas the majority of apprentices in the three lowest–paying sectors were female (i.e. hairdressing, early years work, health & social care).

To provide greater balance in the gender apprentice earnings ratios, girls may benefit from the campaign to combat the skills shortages in STEM processing and technician roles through the expansion in Apprenticeship opportunities. Success for female apprentices in the STEM area can be exemplified by Katie Lester who is an electrical apprentice based at Tilbury Power Station, Essex. In 2009 she was named as the Institute of Engineering and Technology (IET) Young Woman Apprentice of the Year. This award recognises the very best young female engineers in the UK, highlighting Katie's own abilities as well as her example to others to enter the profession. Katie shows her desire to attract others to the industry by helping set up apprentice recruitment events at Tilbury. She says: *"I'm really chuffed to have won. Engineering is a brilliant career and I want to inspire others to consider it."* Katie is a young woman making a mark in the engineering world and contributing enormously to the fact that it can be a great career for women.

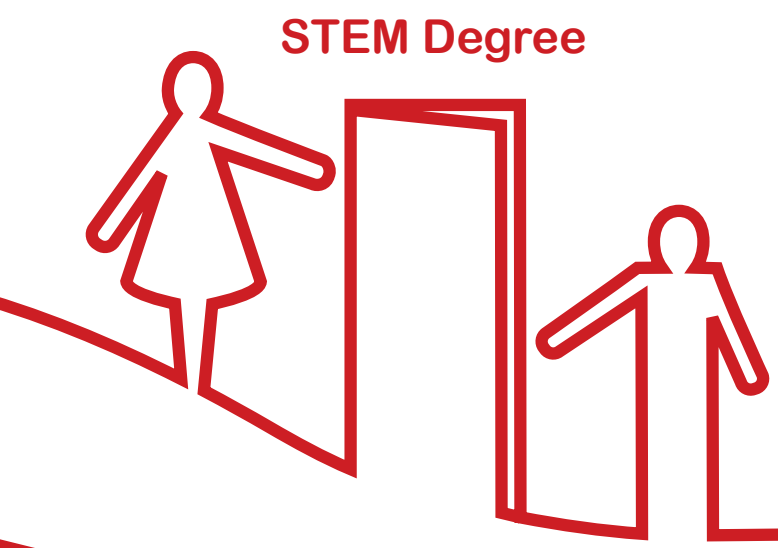
STEM Degrees

Only around a third of undergraduates in STEM disciplines are female, and although this position has improved over time, the gender gap is still considerable. The table below shows the ten year trend relating to the percentage of females taking STEM degree subjects (as a percentage of total number of students):–

% of female students by degree subject (as a % of total)

	2008/09	2003/04	1998/99
Biological sciences	64%	65%	60%
Computer science	19%	24%	22%
Engineering & technology	15%	14%	14%
Mathematical sciences	38%	38%	37%
Physical sciences	41%	40%	36%
Total proportion of female students in all subjects (STEM and non–STEM)	59%	59%	55%

Apart from the biological sciences and subjects allied to medicine, the percentage of females studying STEM degrees is significantly less than the percentage of males, with only a small increase over a ten year period. The main improvement has been in the physical sciences (primarily chemistry). The trend for engineering and technology degrees is the most stark, with females only making up 15% of student numbers – just a one percentage point increase in this low base in over ten years.



Ethnicity

For the purpose of consistency, the term ethnicity will be used rather than race, as ethnicity implies cultural, linguistic and religious aspects of identity as well as (sometimes but not always) visible differences.

Ethnic Minorities in SET Occupations – the statistics in this section refer to SET, which is defined as science, engineering and technology

The representation of ethnic minorities within SET occupations varies considerably. The highest level of employment is among the Chinese population (8.9% of their population) and the Indian population (7.2% of their population). The percentage of the White ethnic population in SET occupations represented just over 5% of their population.

The Black African population (4.0% of their population) and the Pakistani population (4.7% of their population), have rates lower than that of the White population, but the **most under represented groups in SET occupations are the Bangladeshi population (1.6% of their population) and the Black Caribbean population (2.3% of their population)**. **Table 1** illustrates the size of ethnic minority populations working in SET.

Ethnicity	Male	Female	Total
White	1,059,900	189,000	1,248,900
Black – Caribbean	4,700	700	5,400
Black– African	5,400	1,900	7,300
Indian	22,400	7,700	30,100
Pakistani	5,700	1,600	7,300
Bangladeshi	700	200	900
Chinese	5,200	1,600	6,800
Other	18,800	4,400	23,200
Total	**1,122,800**	**207,100**	**1,329,900**

Table 1: Employment in SET in the UK by ethnic group and gender (Labour Force Survey, March 2002 to August 2003 – A Report for the Royal Society, 2005)

Due to the small size of some of the ethnic minority populations, the number working in SET and, therefore, the **number of potential role models for young people is very small (e.g. the Bangladeshi population).**

The analysis reveals that men are much more likely to work in SET occupations than women. A ratio of men to women of approximately 5 to 1 is broadly maintained for all the ethnic groups, including the White population. The highest rates of participation for women are among the Chinese population (4.9% of their population) and the Indian population (3.6% of their population). The lowest rate of employment in SET occupations is among Bangladeshi women, at 0.4% of all those employed.

Disproportionality (disproportionate representation of a given population group) within SET occupations is highlighted by the *Jones and Elias' Royal Society Report, 2005*, which states:

"The two main disadvantaged groups in terms of participation in SET are the Bangladeshi population, where the problem appears to be most apparent among women, and the Black Caribbean population, where the problem of under–representation is greatest among males. ***Members of these ethnic groups are significantly less likely to work in a SET occupation than their White counterparts".***

Ethnic Minority Participation in STEM subjects

Attainment levels at GCSE are relevant to the study of STEM subjects as they have an influence on the likelihood of students staying on to study post–16. A study looking at ethnic minority students performance in public examinations at age 16 (DCSF, 2008) found that, at KS4, the mean score for Black Caribbean students is significantly lower than White British, but the mean score for Pakistani students is only just below the White British mean. The mean scores for Bangladeshi and Black African students do not differ significantly from the mean for White British students, while Indian students are substantially ahead of their White British counterparts at KS4.

The Royal Society (Jones and Elias) Report, 2005, analysed ethnic minority representation in SET at A level. **Table 2 below** illustrates the percentage of students awarded one or more A levels in a SET–related subject (defined as biology, chemistry, physics, mathematics and ICT) and one or more A level of some kind. This shows that Black African, Indian and Chinese students are very well represented in the SET A level cohort, while Black Caribbean and Bangladeshi students are poorly represented:

Ethnicity	% SET A level	% 1 or more A level of some kind
White	19	38
Black – Caribbean	9	28
Black – African	28	48
Indian	37	51
Pakistani	16	31
Bangladeshi	11	19
Chinese	39	52
Other	18	32

Table 2: Young people awarded at least one A level in SET and one or more A level of some kind, by ethnic group

When looking at the numbers of students choosing three or more SET A levels, there is an even more dramatic picture of over representation among Chinese and Indian ethnic minorities. 15% of Chinese students and 11% of Indian students are awarded three or more SET A levels compared to just over 4% of White students. The most pronounced under representation is amongst Black Caribbean students with less than 1% of this group being awarded three or more SET A levels.

In relation to higher education and the numbers from ethnic minority groups entering SET degrees, a similar pattern emerges. Compared to the White population, the Chinese and Indian populations have the highest proportions passing a degree in a SET–related subject. 7.8% of the Chinese population and 5.1% of the Indian population hold SET related degrees, compared to 3% of the White population. Bangladeshi students (1.5%) and the Black Caribbean population (1.4%) hold the lowest percentage of SET related degrees. **See Table 3 below.**

Ethnicity	% holding SET-related degree (within their population)
White	3.0
Black – Caribbean	1.4
Black – African	3.6
Indian	5.1
Pakistani	3.3
Bangladeshi	1.5
Chinese	7.8
Other	5.0

Table 3: Population aged 21+ holding SET–related degrees, by ethnic group (Labour Force Survey, 2002–03 – A Report for the Royal Society, 2005)
** SET–related degree subjects are defined as biological sciences, physical/environmental sciences, mathematical sciences and computing, engineering, technology*

Taking the findings presented to the Royal Society overall regarding participation in SET among ethnic minority groups, the Report concluded that:

"Among Asian groups, Indian and Chinese people are over–represented compared to the White UK population. In contrast, Bangladeshi people are under–represented in SET, both in terms of occupations and educational attainment. ***The problem is more acute among Bangladeshi women.*** *Among the Black ethnic minority population, while Black African people are over–represented in SET compared to the White UK population, this is not the case among* ***Black Caribbean people.*** *In this instance the* ***problem of under–representation is worse among males.***

Ethnic minority students and STEM subject choice and careers

Studies have suggested that there are a number of stereotypes associated with STEM careers. An example is a strong association between science careers and masculinity. A survey of secondary students found that 50% of students saw scientists as middle–aged men in white coats. Mathematicians are usually imagined as middle–aged white men (Mendick et al 2008) while engineering is described by Foskett and Hemsley–Brown as an 'invisible' career, which when imagined at all is often seen as dirty, physical work.

Investigating the attitudes of Bangladeshi girls towards choosing STEM, Smart and Rahman (2008) found that their subject choice at GCSE and A level was influenced by:

- Career ambitions
- Interest in and enjoyment of the subject
- Self–perceived ability
- Perceived difficulty of the subject
- The options on offer in the school/college
- Previous experience of studying the subject
- The assessment method

STEM subjects were seen as of use for a limited number of careers – biology and chemistry perceived as good for medical careers, and maths because of links with accountancy and finance; however, this also had the effect of narrowing their appeal. Girls and teachers indicated that girls might choose not to study STEM subjects because they had no interest in medicine, accountancy or finance. **Therefore it is important to portray STEM subjects as having worth in themselves, as well as for particular careers.** Girls often see the only reason for taking science was to become a scientist, and this perception limited the likelihood of girls studying STEM subjects.

Girls tended to see physics and chemistry especially as male subjects. According to Smart and Rahman, very few girls aspired to careers in engineering, technology or sciences that were not medically related, due both to **a lack of information about the breadth of careers open to those studying STEM subjects and also the perceptions of these careers requiring stereotypical 'masculine' characteristics**. Other studies suggest young people are more positive about science when they can see how it related to everyday life and is relevant (Osborne, Simon and Collins 2003, Jenkins 2006)

Springate et al (2008) found that ethnic minority A level and undergraduate students' choices were influenced by a variety of factors:-

- High–influence factors: enjoyment, future ambitions, perception of careers with a physics or chemistry degree and the relevance of the study of these subjects to life
- Medium–influence factors: the way physics and chemistry are taught, teachers of these subjects, images of scientists and the work they do, and family influences
- Low–influence factors: the difficulty of physics and chemistry, role models, careers advisers and peers

Key factors in encouraging ethnic minority students to continue with STEM were a passion for physics/chemistry and **positive perceptions about the relevance of subjects and careers related to them** (Springate et al, 2008).

The report emphasised the importance of challenging stereotypes. For example, some teachers were unaware of the destinations of previous students, and this may have contributed to some of their stereotyped ideas about the aspirations of Bangladeshi girls, which focused on law, medicine and teaching. While these were the most frequent aspirations among the girls spoken to, the girls discussed a wide range of different careers and teachers did not seem to have appreciated this diversity. **Mentors from STEM occupations could help to break down some of the stereotypes around STEM careers, and challenge some of the perceived barriers.**

With the exception of medicine, aspirations in STEM careers were very limited, and knowledge about careers in this sector was patchy. Girls in this research said that they would be free to pursue a STEM career, and were hopeful that the under–representation of Bangladeshi girls in this area would be challenged: however, because they tended to associate these careers with boys, and with masculine characteristics, they did not see themselves as the kind of person who would have a STEM career.

The report concluded that girls and their parents had limited access to information about careers in non–medical sciences, technology, engineering and mathematics. **Provision of information about these careers, and mentors with experience in STEM could help girls make informed choices.** For some girls, work experience was a factor in shaping their aspirations, but many had undertaken gender–traditional work experience. Monitoring of the gender balance of work experience placements and consideration of ways to challenge gender stereotypical placements would be helpful.

Moving on up? Ethnic minority women and work (R. Bhavnani 2006) commented on the influence of schools/colleges and careers advice:

- Over 4 in 10 Black Caribbean, and around 3 in 10 Pakistani and Bangladeshi girls say their **careers advice has not opened their eyes to a wide range of careers,** suggesting that young people have been given advice about a narrow range of careers
- **5 out of 10 Bangladeshi and Pakistani girls do not know the rates of pay for the jobs they are likely to get.** Given that Pakistani and Bangladeshi women have higher pay gaps than white British women in the labour market (Platt, 2006), it is vitally important that they know this information when making career choices
- Opportunities for flexible working are important when considering future employment. 5 or 6 out of 10 girls and boys across ethnic groups consider flexible employment to be important to them in the future
- An overt commitment to diversity and equality of opportunity from employers is important to this generation, along with opportunities to gain qualifications, training and employment

Role models and support programmes to encourage greater Ethnic Minority representation in STEM

Barriers and challenges exist which need to be overcome if there is to be a better representation of ethnic minority groups in STEM subjects and careers. A resource to help with this is the STEM Subject Choice and Careers Project's 'Equality and Diversity Toolkit' developed by The Centre for Science Education, Sheffield Hallam University. www.stem- e-and-d-toolkit.co.uk highlights truly inclusive STEM careers materials. Inspirational role models, mentors, ambassadors, and curriculum activities will help to encourage a new generation of young people to embrace the exciting opportunities opening up in the STEM area in the forthcoming decades – and at the same time help to close the occupational segregation issues through accessing well paid STEM opportunities. Historical role models (as in the Bessie Coleman example below) can be inspirational. Support programmes using Islamic history and the advancement of science/maths also provide good material – e.g. Museum of the History of Science, Oxford – www.mhs.ox.ac.uk/scienceislam_education/resources.php

1. Example role model – Bessie Coleman (1892-1926)

also faced barriers and challenges – but this did not stop her becoming the first African-American to become an airline pilot – her case study is inspirational (www.bessiecoleman.com):-

- Popularly known as "Queen Bess" she was also the first American of any ethnic background or gender to hold an international pilot licence
- Despite having to study in a poor, one-room school Bess established herself as an outstanding maths student
- Bess took French language classes and travelled to Paris where she was instructed to fly a biplane
- On June 15th, 1921, Bess become the first African-American woman in the world to earn an aviation pilot's licence, which she achieved through the Federation Aeornautique Internationale
- In 1922 she completed an advanced course in aviation
- Her pioneering achievements served as an inspiration for a generation of African-American men and women
- Lieutenant William J. Powell (who served in a segregated unit during World War 1 and promoted the cause of black aviation) said – "Because of Bessie Coleman...we have overcome the barriers within ourselves and dared to dream".

2. London Engineering Project (LEP) – Royal Academy of Engineering (Lead organisation)

In 2005 HEFCE (Higher Education Funding Council) awarded funds for the first phase of the London Engineering Project, including a specific programme for Afro-Caribbean boys and Bangladeshi and Pakistani girls, to widen participation in engineering at higher education level. Key elements of the project include:-

- to engage with 9 – 19 year old students in secondary schools/colleges and primary schools
- to use face to face and other targeted marketing to promote engineering higher education courses to students in the target groups
- to demonstrate real and achievable engineering career destinations

Project strands include:-

- STEM enrichment in schools
- raising awareness of teachers and school/college management teams
- mentoring students
- development of gender inclusive and culturally relevant learning opportunities

With the residential courses, in-school STEM enrichment days, and after-school engineering clubs, thousands of LEP students have been able to experience first-hand the fascinating world of engineering. STEM activities can be used as an integral part of the delivery of the curriculum making links between and within subjects. For more information, contact:- www.thelep.org.uk/contact-us

The HEFC is funding a three year programme which includes building on the success and experience of the London Engineering Project, More Maths Grads, Stimulating Physics and Chemistry for our Future. This HE STEM Programme will be developed by the University of Birmingham and channelled through six regional centres – Midlands, North East, North West, South East, South West and Wales.

3. REACH – example role model project

REACH is a project group led by members of the Black community in London designed to raise the aspirations and achievement among Black boys and young Black men, enabling them to achieve their potential. The group was commissioned to complete an independent report to Government, and key findings included:–

- the need for more Black male role models and more positive images of Black men – a survey conducted by mentoring and life skills training organisation c–a–n–i, found that up to 97% of 12 to 16 year olds (of 400 young Londoners surveyed) **seek positive influences from everyday, hard-working citizens, rather than famous people**
- the powerful influence of the media in reinforcing existing negative stereotypes of Black boys – often the only positive images of successful Black men were those of sportsmen and rap artists, but Black boys needed a greater diversity of images and portrayals, showing that Black men can be successful in a wide range of fields including STEM

In 2008, **20 national role models were named** who are working with hundreds of young Black boys across the country to broaden their horizons by showing them what they can aspire to and improve their self–image, self–confidence and self–esteem.

For information on the REACH programme contact: www.direct.gov.uk/reach

REACH Role Model

Obi Nwofor, Project Manager, London Underground

Obi moved to the UK from Nigeria in 1992, aged 16. His first jobs were sweeping streets for Haringey Council and cleaning at a tube station. He decided he had to get an education – the only way not to remain 'voiceless'.

Obi told the REACH panel that he is struck now by the lack of visible Black role models for him to look up to during this time. His determination and drive led to a Bachelors and a Masters degree and ultimately a position as a senior manager with London Underground. The irony of having swept stations for the same company years earlier is not lost on him!

*He continues to educate himself and is currently undertaking a Railway Engineering Masters degree. Obi says: **"I want to share my modest experiences to guide and enrich the lives of others so that my own child may inherit a better world than that I grew up in."***

4. STEM Ambassadors

The STEM Ambassadors Programme, co–ordinated by STEMNET, is a network of 19,000 people with STEM working knowledge across the UK who work with schools/colleges to run workshops, activities, give talks, and mentor students. STEMNET aims to recruit 8,000 more STEM Ambassadors by 2011.

Young people enjoy meeting 'real life' scientists to see the many different areas of science that people work in – and that scientists are certainly not always men with white coats and crazy hair! STEM Ambassadors are great at delivering 'real life' messages in schools/colleges, and they are a FREE resource for teachers to utilise.

STEM Ambassador Case Study

Ranna Patel, Bioprocess engineer

Ranna Patel did a doctorate in Biochemical Engineering at University College London which broke new ground in the development of processes to make antibiotics, vaccines and monoclonal antibodies. Monoclonal antibodies are similar to the antibodies created by our own body's immune system, and are providing the latest breakthroughs in the treatment of cancer and other diseases.

*Ranna's research contributed to making these life–saving treatments faster, safer and cheaper. Ranna says of her job: "It's challenging and I get to use my knowledge of science and technology to make a direct difference to society. **Meeting an engineer at my school was enough to make me realise it was the career I wanted to pursue** – I want to do that for the next generation."*

Ranna is pictured here inside a giant bubble – her career as a process engineer has included making washing–up liquid and glycerine, both of which are ingredients of bubble solutions.

The local STEM Ambassador Management Contract Holder will organise an Ambassador to visit schools/colleges and support STEM–related activities or events. For more information contact:–

www.stemnet.org.uk/content/ambassadors

Improving Equality and Diversity Practice

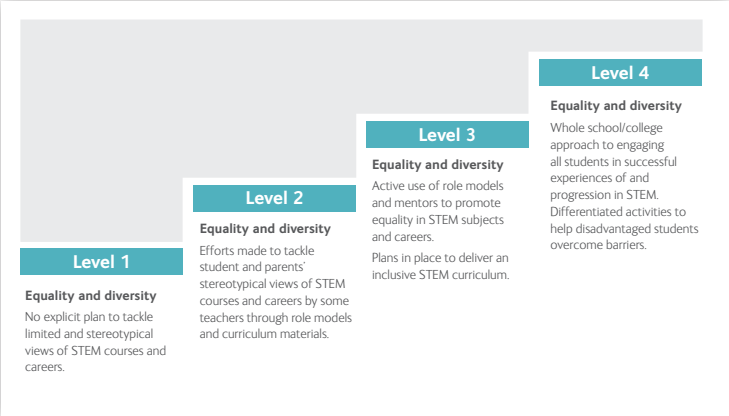
In order to measure the effectiveness of work in relation to promoting equality and diversity in STEM, the following element of the development framework sets out four different levels of performance and provides a ladder of progression.

Level 1 – low level impact

Level 2 – some awareness and use of STEM activities

Level 3 – widespread knowledge and use of STEM activities

Level 4 – whole school/college approach to supporting STEM activities



Top Tips for Supporting Equality and Diversity through STEM Careers Advice

1. Assess your starting points

What evidence is available about participation in STEM courses and careers? What are the perceptions and needs of young people and what feedback do they offer about STEM courses and careers? This can help identify the priorities for your development plan. Particular issues may include numbers progressing to A level Science or Maths, students' attitudes to STEM, participation in work experience or breadth of student destinations.

2. Promotional Material

Be aware you do not know the whole picture and ensure you are up to date on the networks, sources of information and organisations that can help your equality and diversity practice. It is also important to build a team within your own learning community.

3. Help to create a positive image

Use the wide range of available materials to promote awareness of the breadth of STEM careers and the range of people employed. Ensure literature and posters have positive images that reflect your learning community. Make use of available resources such as those from the UK Resource Centre, Royal Society of Chemistry or Institute of Physics (see list in Section 9). It is important to use inclusive language.

4. Open up possibilities

Ensure that you present all of the options. STEM careers are not just open to those studying A levels and a degree. Careers advice should emphasise the potential of a science or engineering career for all including Apprenticeships and vocational pathways. Celebrate success in student achievement.

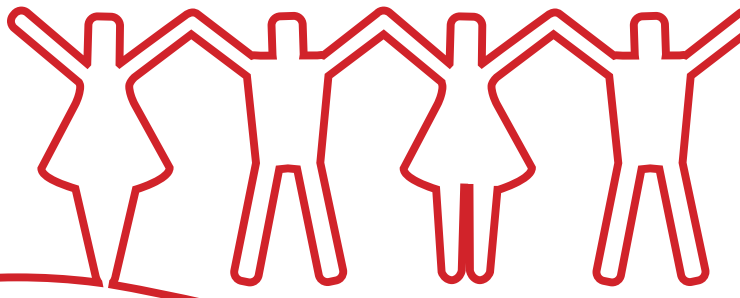
5. Engage your local employers and higher education

Visits

Well organised visits with adequate preparation and debriefing can help widen students' perspectives. It is worth considering sending proportionate numbers of boys and girls to events where practicable. Ensure that the hosts are encouraging and not going to reinforce stereotypes. A panel of speakers can help to balance views rather than relying on a single perspective.

Work experience

Research shows that entry into non–traditional careers is often initiated by a positive work experience. See the A Quick Guide to STEM Work Experience Placement for practical suggestions. A number of professional institutions and training organisations are keen to provide suitable work experience for instance NHS Careers.



6. Plan accessible enhancement activities

STEM enhancement and enrichment activities provide valuable opportunities for problem–based learning and investigating the practical applications of STEM. Examples include after school science and engineering clubs. They can motivate and build the confidence of young people who may be struggling with STEM. They can also enable young people to explore hands on activities in a safe environment (see Section 8). It is important to run activities that appeal to both girls and boys and to ensure the provision is accessible to all (including the time of day that clubs take place and the location).

7. Engage the parents/carers of students

Parents and families have a key influence on young people's choice of careers and courses. There are a variety of ways in which you can engage with parents on STEM careers awareness. These include running a STEM Careers evening (see the example programme in the appendix), running a celebration event involving parents following a STEM enhancement activity and providing information to parents on national events and activities (such as the annual Big Bang Fair) and sources of information (eg. www.futuremorph.org).

8. Measure impact

Review the priorities for development and benchmark your progress.

The Equality and Diversity Tool Kit signposts users to sources of information and advice. Some of the key examples include:-

www.skill.org.uk/page.aspx?c=10&p=106#work

SKILL offers access to leaflets for disabled people, including 'Finding Work' and other education related items

www.shaw–trust.org.uk/home

The Shaw Trust's website has information for individuals with disabilities, employers and others supporting people to live independently

www.iop.org/publications/iop/2008/page_42867.html

The Institute of Physics website provides an 'Access for All' publication offering "support and practical advice to university physics departments in meeting responsibilities towards disabled students"

www.generatinggenius.org.uk/

Generating Genius uses Science, hands–on Engineering, apprentice style competition to mentor boys from underprivileged backgrounds into higher education. It uses residential summer schools based in a number of top British Universities to nurture talented students into Science and Engineering. The boys start at age 11 /12 and attend each summer for the next 5 years, doing top level hands–on science, technology and engineering.

Windsor Fellowship –

www.windsor–fellowship.org

Windsor Fellowship is a charitable organisation that encourages innovative educational programmes, including the REACH project to raise the aspirations and achievement among Black boys and young Black men. Visit the home page and click on REACH National Role Models Programme and Pre–19 Programmes

Stephen Lawrence Charitable Trust –

www.stephenlawrence.org.uk

A trust set up to use Stephen's dream of becoming an architect an inspiration for other young people. Offers bursaries and scholarships to the Architectural Association for BME students interested in architecture. There is also a mentoring scheme available for aspiring architecture students

Museum of the History of Science, Oxford –

www.mhs.ox.ac.uk

MHS offers teaching sessions for schools, on–line resources and a web version of their scientific collections database. Click on the link above to access Science and Islam: Resources – for lesson ideas for science and mathematics and the influence of Islam, at KS3 and above

Construction Skills –

www.cskills.org

Sector Skills Council for the Construction Industry has a team of trained diversity advisers who will provide one–to–one support for Black and Asian candidates and their parents

Architects for Change –

www.architecture.com

The Royal Institute of British Architects (RIBA) have an Equality & Diversity Forum which promotes improved equality of opportunity and diversity in the architectural profession, and can sometimes help with role models, resources or other support

National Centre for Excellence in the Teaching of Mathematics (NCETM) –

www.ncetm.org.uk/resources/9309

NCETM provides and signposts high quality resources to teachers through an extensive on–line resource portal. The link above enables access to the 'Learning Maths Outside the Classroom' initiative which illustrates innovative projects used with ethnic minority students in schools/colleges across the country.

5

Where's the Money?

It is important to dispel the myth that financial rewards for STEM graduates are poor. There has been a rapid rise in the number of students studying for a degree in the UK, but there is significant variation in the value of different degree subjects. STEM graduates fare considerably better than the average graduate, both in terms of enjoying higher annual earnings and in finding a graduate-level job.

Economic benefit from taking a STEM degree subject

Key findings from research have shown that over a working life:

- The average graduate will earn around 23% more than his/her equivalent holding two or more A levels
- Chemistry and physics graduates will earn on average over 30% more during their working lifetimes than A level holders
- The figure of 30% compares with between 13 and 16% for graduates in subjects including psychology, biological sciences and history

Higher education body Universities UK reported (report carried out by PricewaterhouseCoopers, 2005) that the graduate earnings premium for engineering graduates over a working lifetime to be £219,971, and for maths graduates to be £241,749, whereas an arts graduate can expect only an additional £34,494. The table below shows the additional lifetime earnings for STEM subjects compared with all degrees:

Subject	Additional Lifetime Earnings
Engineering	£219,971
Chemistry	£186,307
Physics	£188,249
Maths	£241,749
Biological Sciences	£109,845
Psychology	£100,479
All degrees	£160,061
Arts degrees	£34,494

(Source: The Economic Benefit of Higher Education Qualifications produced for The Royal Society of Chemistry and the Institute of Physics by PricewaterhouseCoopers LLP, January 2005)

Another earnings indicator for STEM graduates is the earnings they command in the labour market. A number of studies suggest that returns for the physical sciences, maths, and engineering are higher than average. The table below shows the average annual salaries by subject for First Degree students who graduated in 2002/03 and who were younger than 25 upon graduation, and were in full-time jobs three and and half years after graduation:

Subject of Study	Average Annual Salary
Biology	£19,401
Sports Science	£20,552
Psychology	£19,285
Chemistry	£22,530
Physics	£24,252
Maths	£24,693
Engineering	£25,298

(Source: Longitudinal Destinations of Leavers from HE, 2008)

Recent evidence has suggested that around one third of graduates fail to get a graduate-level job (McIntosh, 2005; Chevalier and Lindley, 2007). For STEM graduates, however, the difficulties in getting good pay and a graduate-level job are much less of a problem. The tables below show the top paid degree subjects, compared to the bottom, for men and women respectively. In each case, the wage premium shown is relative to the average earnings of an arts graduate. There is a substantial variation in the earnings of graduates with different degree subjects. For instance, men with electrical engineering degrees earn in excess of 40% more than the average arts graduate. The figures suggest that employers place a higher value on graduates offering a technical or mathematically-based degree. Graduates with weaker numeracy skills tend to fare worse than their more numerate peers.

The wage premium for some degree subjects (compared to an arts degree) for men

Subject	Mark-up from average arts graduate earnings	Rank
Accountancy	42.15%	1
Electrical engineering	40.73%	2
Maths and computing	37.23%	3
Mechanical engineering	33.71%	4
Social sciences	14.20%	21
History	11.69%	22
English	10.84%	23
Sociology	10.83%	24

The wage premium for some degree subjects (compared to an arts degree) for women

Subject	Mark-up from average arts graduate earnings	Rank
Accountancy	37.12%	1
Medicine and related	27.52%	2
Law	23.97%	3
Education	22.40%	4
Psychology	1.98%	21
Biology	1.60%	22
History	0.95%	23
Politics	– 0.91%	24

(Source: Sloane P J and O'Leary N C, 2004)

STEM salaries for non-graduate entrants

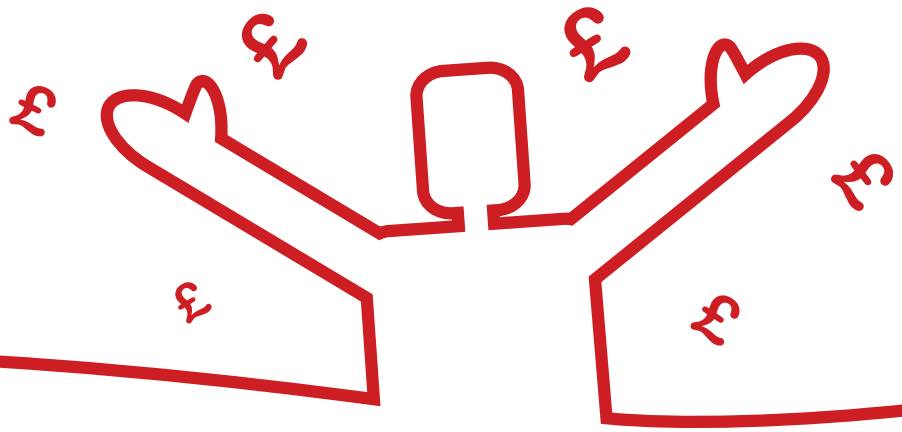
For non–graduate entrants into STEM–related occupations, the financial rewards are also above the average. The table below gives some examples by occupational sector:

Occupational sector	Average annual salary
Engineering technicians	£30,930
Electrical trades	£28,029
Science & technology associate professionals (e.g. lab technician)	£27,285
Telecommunications engineers	£27,134
All sectors	£26,020

(Source: Annual Survey of Hours & Earnings, Office for National Statistics, 2008)

Note

Advice and guidance on the economic benefits of STEM and higher education needs to take into account changes in the tuition fees.



6 STEM Careers Starters and Plenaries

These activities will be available for download from the National STEM Centre careers collection (www.nationalstemcentre.org.uk) and from www.futuremorph.org

1. STEM Quiz

Overview

These ten questions can be presented as a powerpoint quiz to explore the importance of Science and Maths and challenge some typical myths and preconceptions.

Teachers' Notes on Preparation and Delivery

There are a range of different ways in which you can help young people to log their answers including standing in different points of the room based on their answer or issuing red, yellow or green cards that the students can show in response to the three options.

The answers for the questions are as follows:–

1. C
2. A
3. C
4. Maths followed by engineering. Pay not everything but need to take account of the employability rates from different degrees. Universities have to collect information on student destinations www.hesa.ac.uk which can include salary.
5. A – 59%) expect to have difficulty finding STEM–skilled people in the next 3 years. With 72% of firms employing STEM skilled staff. CBI Education and Skills Survey 2010
6. C – 2010 UCAS figures 4815 different titles of degree. Degrees are classified into subject groups that include the full range of pure sciences and maths, applied sciences and all fields of engineering. These are further broken down into subject lines eg. for engineering (Electrical , Mechanical, Civil, Aerospace), In addition there are a broad range of combinations such as Chemical Engineering with Management, Physics with finance and Maths and neuroscience, law, languages etc.
7. See www.nationalstemcentre.org.uk for further information on STEM business and industry in each region.
8. A
9. A
10. C

1. STEM Quiz

Activity Sheet

1. Between 2002 and 2009 applications for higher education grew by 12%, however applications for STEM Courses only grew by ?%

   A) 6% B) 3% C) less than 1%

2. How many of the following sectors have a growing demand for skilled staff?

   Nuclear energy, Renewable energy, Biomedical engineering, Nanotechnology, Computer games design, Space technology
   A) 4+ B) 3-4 C) 1-2

3. What percentage of engineering graduates are women?

   A) 50% B) 25% C) less than 10%

4. In a study conducted by Price Waterhouse Coopers in 2005, which degree gave the highest life term earning premium?

   A) Maths B) Chemistry C) Engineering

5. What percentage of firms recruiting staff with STEM skills report difficulties?

   A) 59% B) 25% C) less than 10%

6. How many different degree courses in UK universities require STEM subjects as entry qualifications?

   A) 1-2,000 B) 2-3,000 C) 3-5,000

7. Name five of the main STEM related industries or sectors in our region.

8. Which of the following jobs is predicted to have the fastest growth in the UK in the next 5 years?

   A) Engineer B) Graphic designer C) Social worker

9. Which of the following STEM jobs has the highest annual salary?

   A) Actuary B) Marine engineer C) Entomologist

10. In 2020 which of the following will be commonplace? 1) Self-adjusting intelligent clothes 2) Glass walls that darken or turn into TVs 3) 3d bio-printing of human organs 4) Light-emitting paints 5) Energy from carbon dioxide-absorbing algae.

    A) none of the above B) 2 & 4 C) all of the above

2. Who, what, where and how?

Overview

There are a wide range of high quality resources that show people at work in STEM related jobs. These include cartoon images, film clips, photographs and posters. Ask groups of students to identify the job role of the person, (who they are) what tasks they may do on an average day, where they might work and how they use STEM knowledge and skills.

- Who is the person and what job are they doing?
- Where do they work?
- Why are STEM subjects important in their work?

Teachers' Notes

Easily available images of STEM related jobs include the Future Finder characters on Future Morph, the Leading Light photographs and films of STEM ambassadors, film clips on http://icould.com. www.careersbox.co.uk. Encourage students to explore the sources of information for finding out more about the jobs featured.

2. Who, what, where and how?

Activity Sheet

Job	Source	Who, what, where and why
Formulation Scientist	Science and Maths Future Morph Poster	Sonia works as a formulation scientist. She studied A levels in Biology, Chemistry and Maths before studying Pharmacy at university. You can find out more through www.abpischools.org.uk
Chemical Engineer	Science and Maths Future Morph Poster	Luis is a Chemical Engineer working with poor communities to ensure technologies support development. You can find out more at http://practicalaction.org or www.whynotchemeng.com
Lighting Engineer	Science and Maths Future Morph Poster and film clip www.futuremorph.org/scienceandmaths	Will is a lighting engineer.
Environmentalist	Science and Maths Future Morph Poster and film clip www.futuremorph.org/scienceandmaths	Jo is an environmentalist
Traffic Control Engineer	Science and Maths Future Morph Poster	Kamleh is a traffic control engineer. She was interested in art and design, maths and physics and uses those subjects in her job. Find out more from the Ambassadors section of www.thelep.org.uk
Geologist	Science and Maths Future Morph Poster and www.centrica.co.uk	Katie is a geologist working with a leading energy company.
Naval Architect	Science and Maths Future Morph Poster	Andy works with QinetiQ on technology based services to the defence and security industry.
Humanitarian Engineer	Science and Maths Future Morph Poster and film clip www.futuremorph.org/scienceandmaths	Andrew is an engineer using his skills and knowledge to support developing countries.

3. Pairs - Matching the job title and the tasks

Overview

The focus of this game is new STEM jobs in three growth sectors: computer technology, healthcare and biotechnology.

Teachers' Notes

The pack has nine job title cards and eight corresponding job description cards. Players lay the cards face down at random on the desk in a 6x3 grid. Players take it in turns to turn over two cards. The aim is to find a job title and matching definition. The winner is the player with the most pairs.

An alternative activity would be a set of cards with cards with the names and descriptions of different areas of engineering (civil, mechanical, electronic, aeronautical drawing on www.tomorrowsengineers.org.uk) .

3. Pairs - Matching the job title and the tasks

Activity Sheet

Games programmer	Computer technician	Computer hardware engineer
Health records clerk	Plastic surgeon	Biomedical engineer
Tissue engineer	Nanomaterials scientist	Renewable energy process engineer

Responsible for making the games work. Can further specialise in gameplay, artificial intelligence or AI, physics, online, graphics rendering, engine development, middleware tools development, etc.	Responsible for installing, repairing and maintaining computer equipment. Need to have an extensive knowledge of computer hardware and software and be good at trouble-shooting and communication.	Responsible for infrastructure construction (computer chips, fibre, cable, satellites, etc.) Need extensive knowledge of electronics and computing, and understanding of what consumers want.
Responsible for managing information that clinical staff need to look after patients. One of many different careers in the growing field of health informatics	Responsible for repairing and reconstructing abnormalities of the skin and other parts of the body. Need to work with the patient to achieve an appropriate aesthetic result combined with healthy function and form	Responsible for designing equipment to monitor, diagnose, treat and rehabilitate patients. Need knowledge of physical sciences, materials and manufacturing to contribute to the diagnosis and treatment of patients' needs.
Responsible for producing replacement tissue parts for clinical use. Applies the principles of engineering and life sciences in developing biological replacements for diseased/injured tissues.	Responsible for designing and improving production processes for new nanomaterials. Need to be self-motivated and able to work well with a multidisciplinary team of scientists	Responsible for developing economic industrial processes to make energy from waste and biofuels. Need a background in chemical and biochemical processes and engineering; and how to scale up processes from the laboratory into the processing plant

4. A Science and Innovation Timeline

Overview

Inventions using Science and Maths span a huge range of sectors including health, the environment, communications, entertainment and business. Students are asked to match the events and developments with the correct decade and if possible year.

Teachers' Notes on Preparation and Delivery

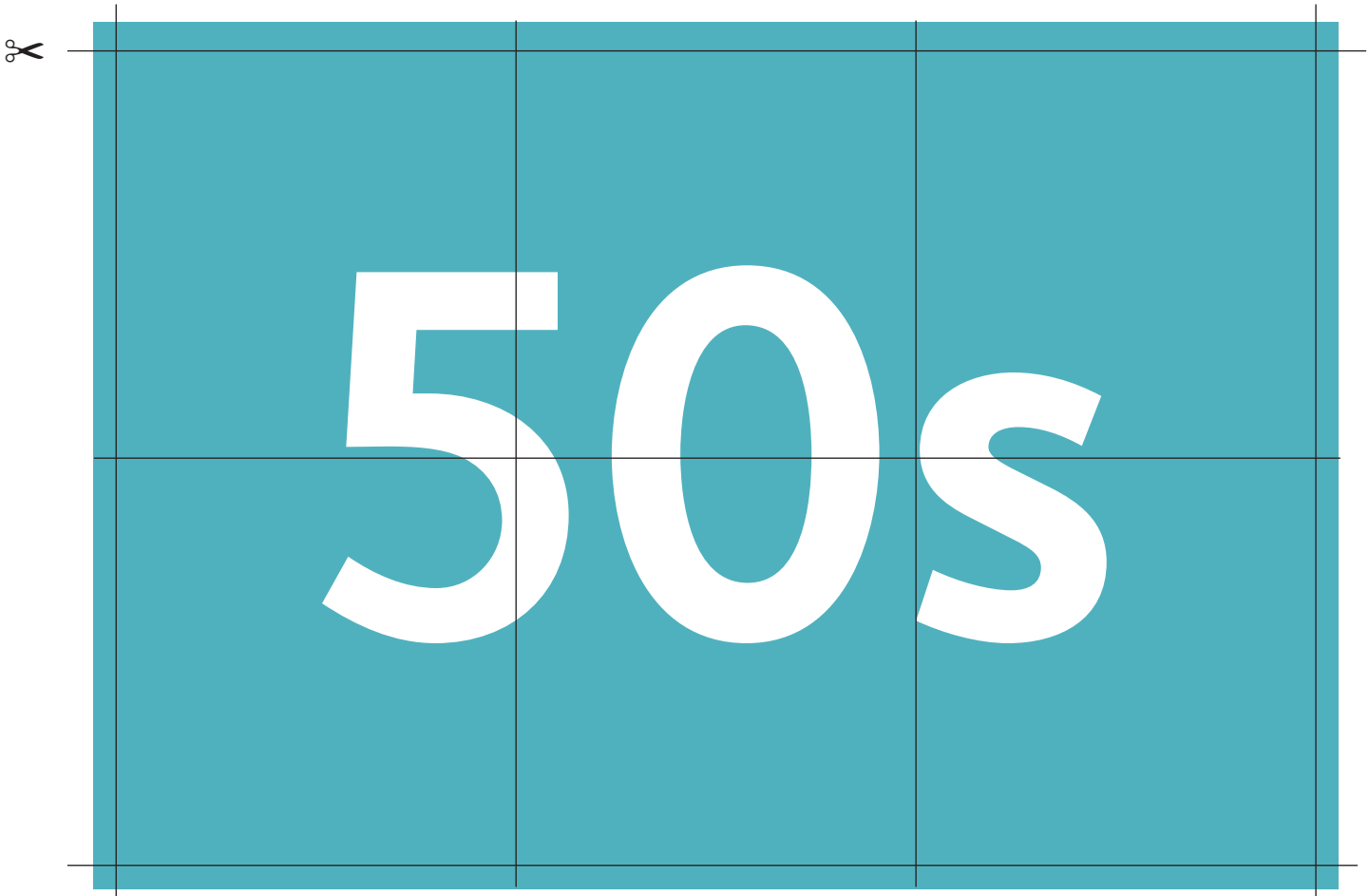
Ask students to read out the card with the event or development and think about which decade it happened in. See if they can put the developments in order within the decade. Give students blank cards and ask them to write one development they would like to see in the future with an estimated date. Discuss with them what careers/jobs they think would be needed to achieve the developments that have been suggested. What subjects/courses would help?

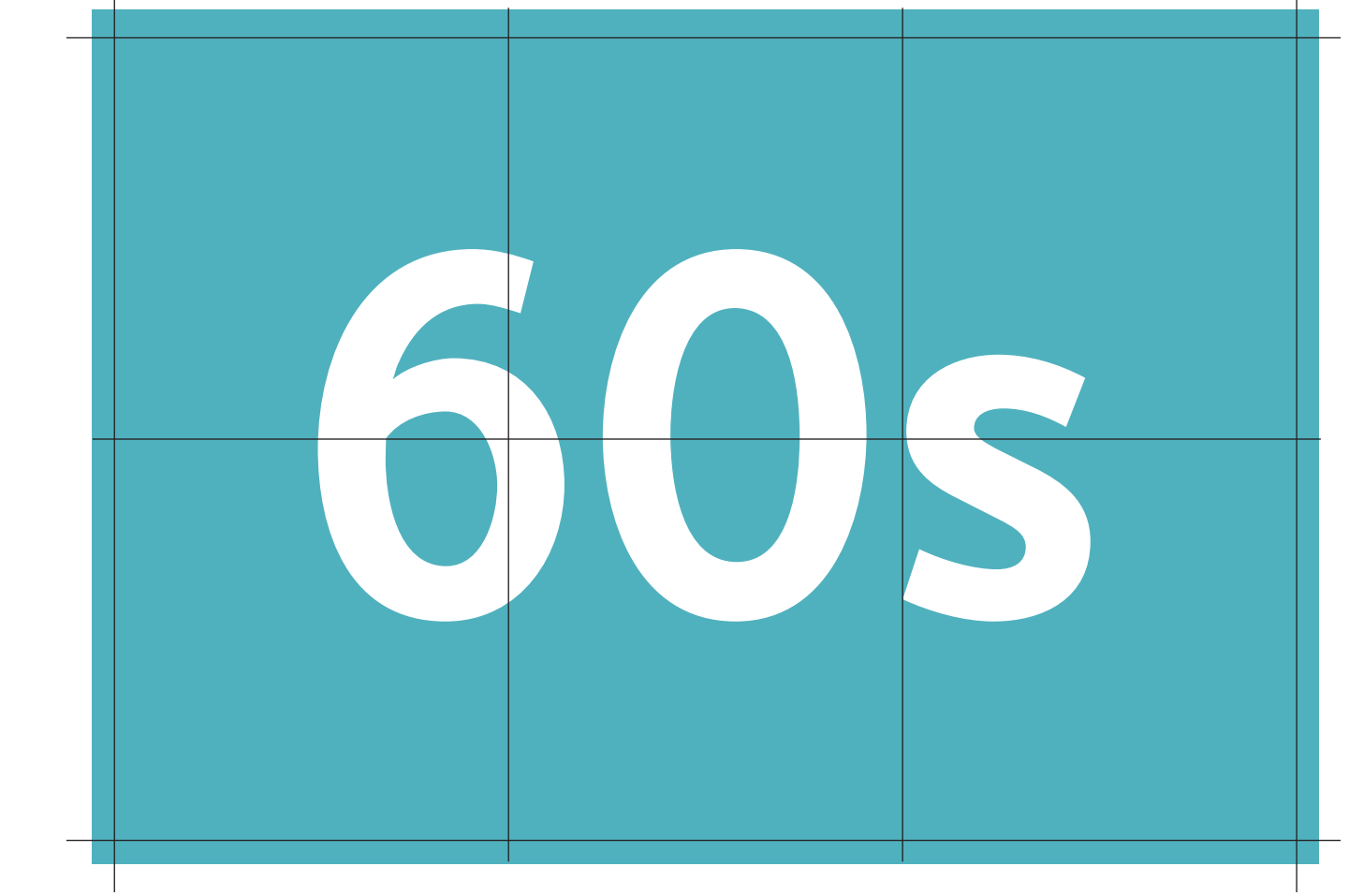
This could be followed up by Café Sci debating forum where a guest scientist talks for 10–15 minutes followed by conversations that allow participants to discuss their views about scientific issues relevant to everyday life. (www.juniorcafesci.org.uk)

A selection of STEM related events, discoveries and developments

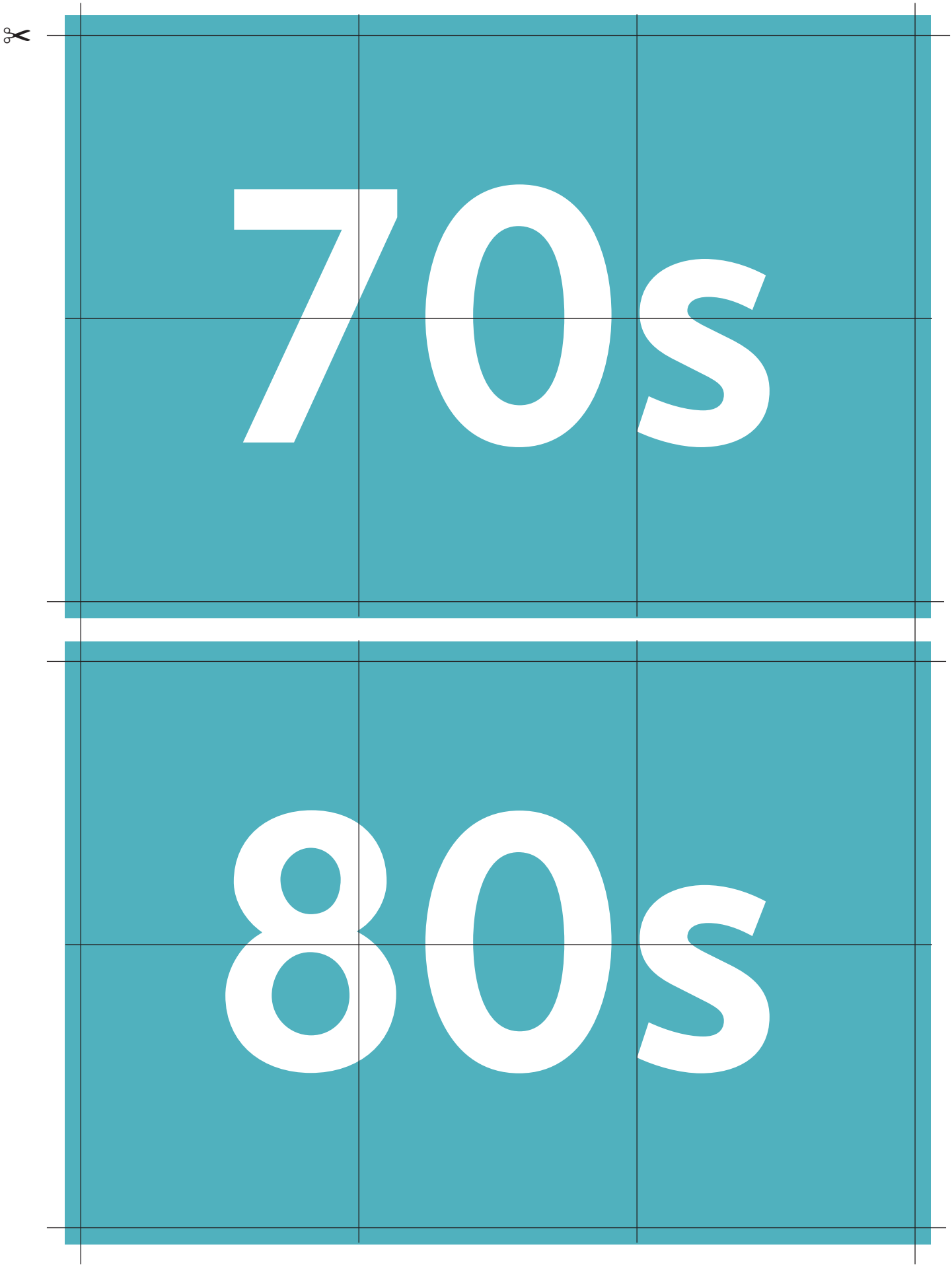
Start of concern about greenhouse gases emissions and levels of carbon dioxide in the atmosphere. 1957	Development of first contraceptive pill. 1954	First email sent. 1972
First computer game devised entitled Spacewar. 1962	First oral polio vaccine developed. 1962	Helen Sharman becomes the first Briton in Space. 1991
Pontiac car manufacturers develop bumpers that absorb the energy of a collision. 1967	First use of lasers in surgery. 1985	First mobile phone call made. 1973
Materials scientists develop synthetic skin. 1986	Apple's iPhone goes on sale with touch screen, media player, camera and web-browser. 2007	Launch of the instant colour camera. 1972
Tim Berners-Lee invents the World Wide Web. 1989	Colour television pictures transmitted for first time. 1951	Three blind patients receive the world's first bionic eyes which convert light into electrical impulses. 2000
Bar codes scanned using lasers are placed on shopping products for the first time. 1974	Report of 90% drop in number of large fish in the sea since 1950. 2003	Invention of disposable contact lenses. 1987

DECADE cards

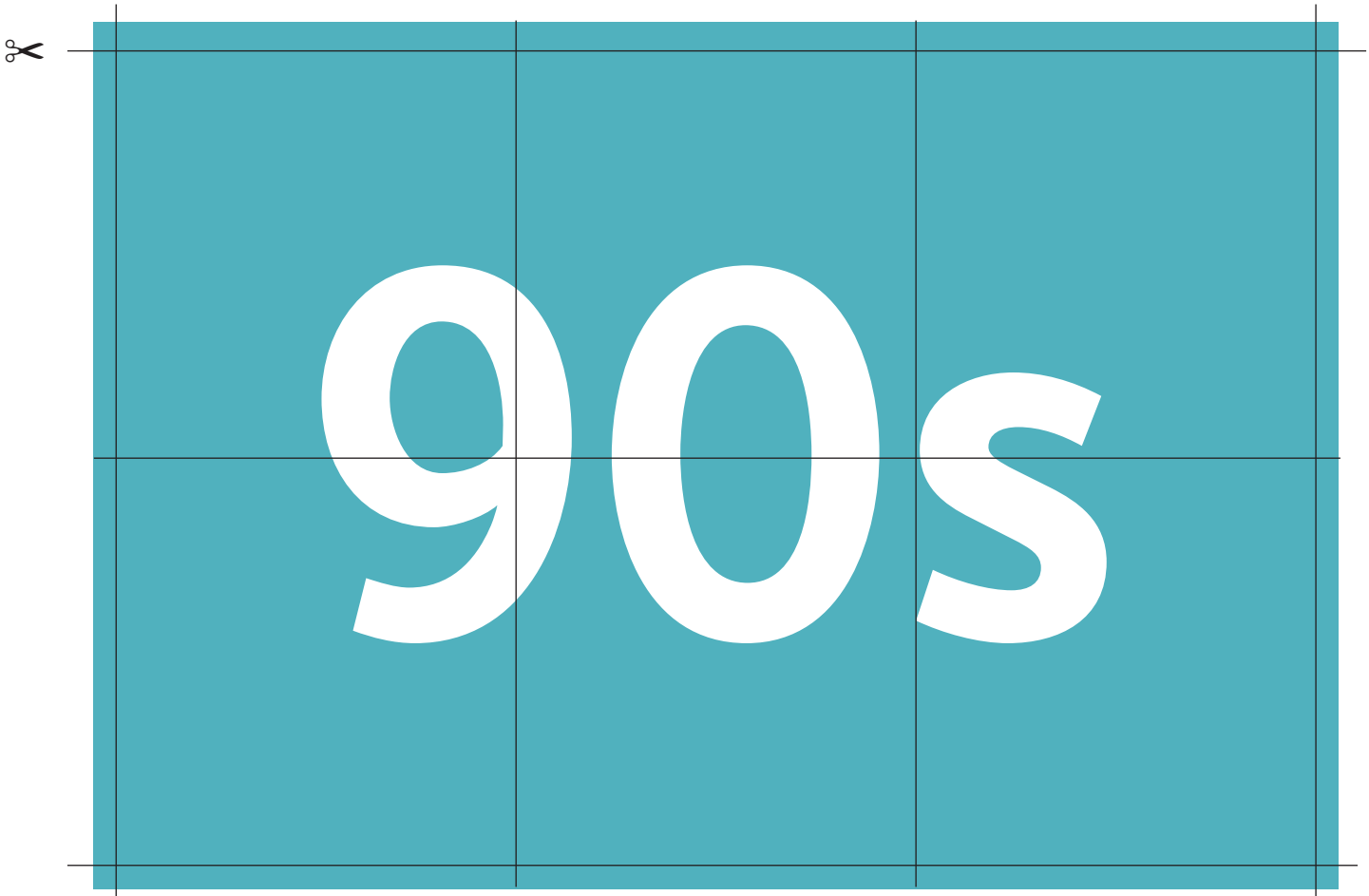


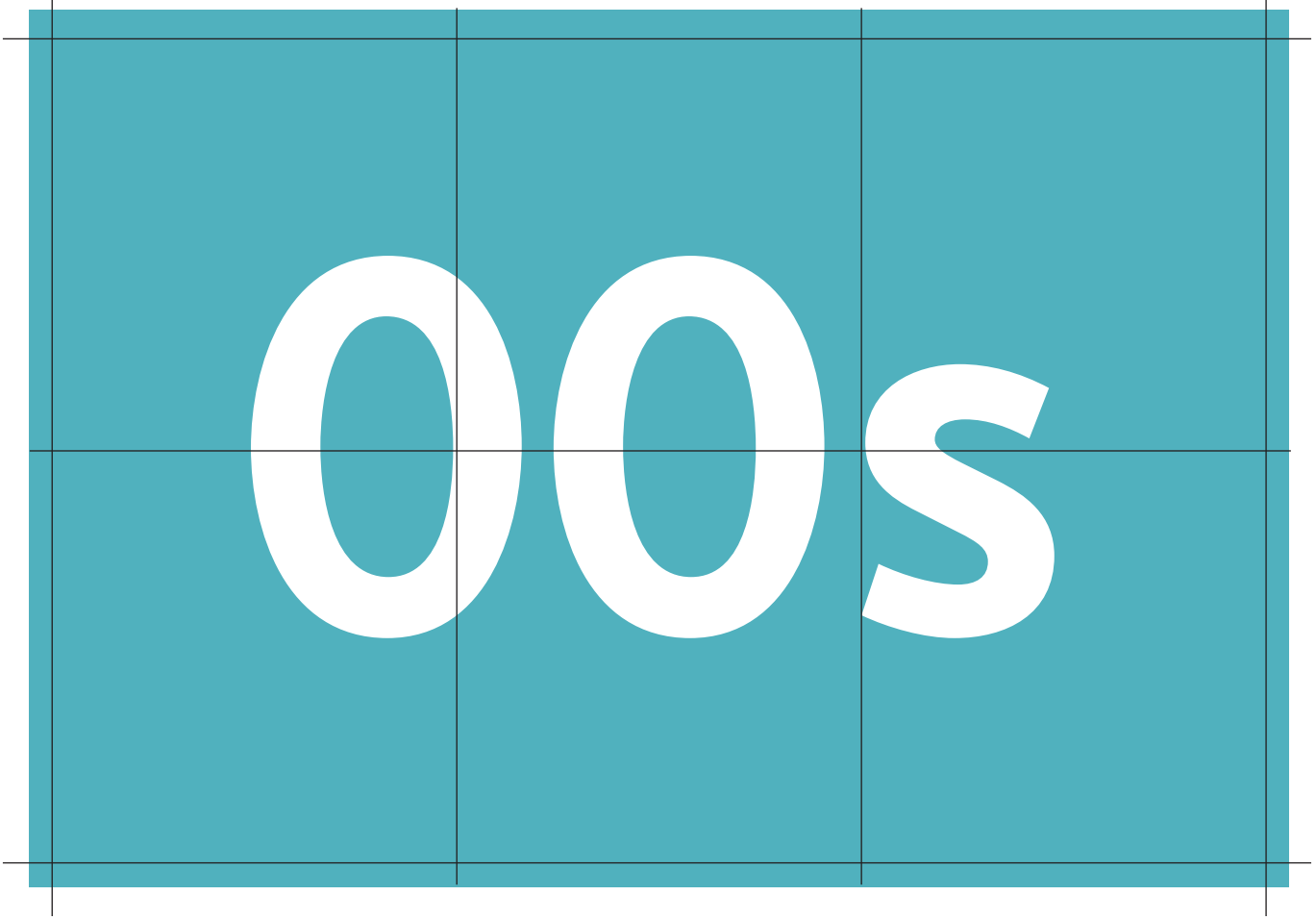


DECADE cards



DECADE cards





Years

1951	1954	1957
1962	1962	1967
1972	1972	1973
1974	1985	1986
1987	1989	1991
2000	2003	2007

A selection of STEM related events, discoveries and developments

Start of concern about greenhouse gases emissions and levels of carbon dioxide in the atmosphere.	Development of first contraceptive pill.	First email sent.
First computer game devised entitled Spacewar.	First oral polio vaccine developed.	Helen Sharman becomes the first Briton in Space.
Pontiac car manufacturers develop bumpers that absorb the energy of a collision.	First use of lasers in surgery.	First mobile phone call made.
Materials scientists develop synthetic skin.	Apple's iPhone goes on sale with touch screen, media player, camera and web-browser.	Launch of the instant colour camera.
Tim Berners-Lee invents the World Wide Web.	Colour television pictures transmitted for first time.	Three blind patients receive the world's first bionic eyes which convert light into electrical impulses.
Bar codes scanned using lasers are placed on shopping products for the first time.	Report of 90% drop in number of large fish in the sea since 1950.	Invention of disposable contact lenses.

5. What's my line – careers using maths?

Overview

This activity explores how Maths is used in a ten different jobs and work places.

Teachers' Notes on Preparation and Delivery

A powerpoint presentation lets you reveal statements about the job one at a time. Students guess what the job is when they've seen sufficient clues. Get students to explain their reasoning.

Key points for debrief:–

- Numeracy is a core skill in most jobs and for personal money management.
- Numeracy is essential for running your own business.
- There are high paid jobs using maths and statistics in finance and management.
- High level maths is needed in a large number of jobs including engineering, architecture, computer games design.

5. What's my line – careers using maths?

Activity Sheet 1

1. Margaret is a health specialist
2. She has her own private practice but she could work for the NHS
3. Salaries range from around £21,000 to over £75,000 a year
4. Margaret uses maths to maintain her own accounts, tax records and pension plan
5. Doing her degree, she needed a background in maths to understand the action of lenses on changing the angles at which light travels (refraction) and other basic measurements; but now she is qualified she does not use maths a huge amount in her day-to-day job
6. She carries out eye tests as well as prescribing contact lenses and glasses
7. She examines the eyes to detect signs of injury, disease, abnormality and defects in vision
8. Margaret is an optometrist

1. Justin is a kind of financial analyst
2. He has a first degree in maths and a Master's degree in his specialism
3. Salaries range from around £20,000 to over £100,000 a year
4. He needs to be good at problem solving using a range of both mathematical and non-mathematical techniques
5. He could work in many different employment sectors but he chose transport as air transport interests him a lot
6. Justin recently worked on a predictive model for an airline company to help it make higher profits by increasing its seat share and market share
7. He uses statistics, algorithms and mathematical modelling on computers to help make better decisions about problems that organisations face
8. Justin is an operational researcher

1. Matthew works in insurance
2. He could have chosen to work in pensions, consultancy or investment
3. He did a maths degree and then studied part-time for his professional qualifications
4. Salaries range from around £30,000 to over £170,000 a year
5. He is responsible for managing, advising and evaluating financial risks
6. He uses mathematical and statistical skills and computer programs to build models
7. He applies statistical and financial theories to assess the financial costs and probability of certain events occurring
8. Matthew is an actuary

1. Steve has always been interested in maps
2. He works mainly out in the field and the rest of the time in the office
3. Salaries range from around £20,000 to over £70,000 a year
4. Steve uses maths to take measurements and draw accurate maps using computer software
5. As well as maths skills, he needs personal skills to work with colleagues and deal with clients
6. He maps features of the landscape, man-made objects and boundaries
7. He collects land measurements and data to make site plans and reports for building and engineering projects
8. Steve is a geomatic or land surveyor

1. Hilary is an academic
2. She works in a university
3. Salaries range from around £28,000 to over £60,000 a year
4. She is responsible for her own work and is not closely supervised by others
5. Hilary does her thinking about work anywhere and at anytime – during the day, in the evenings and at weekends
6. For her PhD, she chose a topic based on her interest in prime numbers
7. She combines research (inventing the new maths of the future) with teaching (explaining maths to students)
8. Hilary is a mathematician

1. Guang works in a design-related field
2. He didn't get much careers help at school but did his own research carefully
3. Salaries range from around £17,000 to over £60,000 a year
4. He uses computer software in the design process
5. Guang does not use maths much in the artistic phase of the design process; but then he uses a lot of geometry and measurement to help realise his designs
6. He draws plans to scale in two or three dimensions and creates structures with interesting shapes and angles
7. He designs buildings and the spaces in and around them in response to a client's vision
8. Guang is an architect

5. What's my line – careers using maths?

Activity Sheet 2

1. Rohit's job is in the financial sector 2. He works in the family business 3. Salaries range from around £20,000 to over £100,000 a year 4. He has to keep up-to-date with new products and services which might be of interest to his clients 5. He works from his office at home but also meets clients in their offices and homes 6. Rohit uses probability, algebra, geometry, statistics and graphing 7. He analyses the financial affairs of individuals and businesses and then recommends to them how they can achieve their future financial goals and make the best use of their money 8. Rohit is a financial adviser	1. Amita works in the financial services sector 2. She works for a small company so gets more varied tasks than she would probably get if she worked for a large company and had to specialise in one area 3. Salaries range from £14,000 to over £35,000 a year 4. She works with spreadsheets, databases and word processing software 5. Amita started the job straight after school with GCSE qualifications and then studied part-time for the professional qualifications that will help her to progress 6. She uses maths to maintain and check financial records 7. She collects, checks and analyses financial information such as invoices, payments and receipts 8. Amita is an accounting technician
1. Steve is a graduate working in a branch of the leisure industry 2. He thinks it's great to turn his hobby into a career 3. Salaries range from around £19,000 to over £60,000 a year 4. He works in a studio as part of a team 5. His work is concerned with probability and statistics 6. He needs to know principles of algebra, geometry and calculus to be successful in using the software that he uses in his job 7. He devises, designs and produces computer games 8. Steve is a computer games designer	1. Paul has very good practical hand skills 2. He started as an Apprentice 3. Salaries range from around £20,000 to over £35,000 a year 4. He works in the manufacture of machinery but other people who do this job could work in a wide range of sectors including transport, healthcare and the production of materials 5. He needs to know how to use algebraic, trigonometric and statistical methods and to be able to use elementary calculus techniques 6. He reads and creates technical drawings 7. He designs, builds, operates and services plant machinery and parts 8. Paul is a mechanical engineering technician

6. STEM in the News – the Science and Maths Behind the Headlines

Overview

This activity identifies stories from the media that shows innovative use of Science, Technology, Engineering and Maths. Recent examples that could be used include:–

- The use of satellite monitoring of moisture levels in different parts of Pakistan to help target aid most effectively.
- The development and testing of a solar energy plane able to store energy and fly at night
- Specialist clothing using nanotechnology that can detect slight changes in the body of the wearer that indicate health problems.
- Development of medication specially designed for the individual patient.

Teachers' Notes on Preparation and Delivery

Ask students to think who is involved in the variety of headlines and how they are using STEM knowledge and skills to address the particular problems.

As a follow–up activity ask students themselves to bring in clips they have found interesting.

7. Matching the statistics

Overview

This activity encourages young people to explore some of the issues associated with equality and diversity in STEM careers and progression.

Teachers' Notes on Preparation and Delivery

Give each group a set of statistics cards and a set of statements that match with the statistics. Ask students to explain their reasoning behind their choice. Discuss with them what the underlying reasons for the statistics might be and whether greater progress is needed and what might help achieve this? You could add some relevant statistics from your own school/college.

Answers

1. 21%
2. 1 in 3
3. 7%
4. 57%
5. 99%
6. 68%

7. Matching the statistics

Activity Sheet

1. The pay gap between young men and young women on apprenticeship schemes.	2. Numbers of girls doing Physics A level.	3. Percentage of professional engineers who are women.
4. Percentage of Biology A level students who are girls.	5. Percentage of successful completions of construction apprenticeships by young men.	6. Percentage of undergraduate students on medicine and related courses who are women.

21%	1 in 3	7%
57%	99%	68%

8. Spot the Celebrity Scientist and Mathematician

Overview

This activity presents a range of science communicators or celebrities:–

1. Robert Winston
2. Liz Bonnin
3. Maggie Aderin–Pocock
4. David Attenborough
5. Brian Cox
6. Alice Roberts

Teachers' Notes on Preparation and Delivery

Ask students to discuss the role of a science communicator. A powerpoint presentation is available that allows the celebrity faces to be revealed gradually so that the group can guess their identity.

8. Spot the Celebrity Scientist and Mathematician

Activity Sheet

9. Top Trumps Activity

Overview

This activity provides 56 different cards relating to professional and technician level jobs that are STEM related.

Teachers' Notes on Preparation and Delivery

'Top Careers in STEM' is a card game for two or more players. There are 56 cards relating to professional, associate professional and technician–level jobs that are STEM–related. The statistics for five criteria are printed on each card. The aim is to win all the cards by beating the specific details of your opponents' cards.

At the start of the game, the cards are dealt equally or as equally as possible. The cards are held face up and the player to the dealer's left begins play. (An alternative way of starting before the players examine their cards is for them to agree upon a category that will determine who starts the game – the way this works is that everyone consults the top card in their pile, and the player whose card has the best statistics in the agreed category starts the first round). The cards contain certain facts and figures such as average (mean) salary, numbers in this job in the UK, etc. The starting player calls out one of these categories that they feel will win, i.e. have the higher value and then lays the card face up before everyone. The remaining players announce the statistics for the category on their cards so that everyone gets to know the careers and labour market information for the STEM sector. The player who has the highest figure wins and takes all the cards placing them at the bottom of their pack. Then it is their turn to call the next figure/fact. If, however, more than one player has a higher ranking that matches (i.e. it's a draw) then the original caller calls again and the cards are left in the middle until someone wins and they then take all of the cards. The game continues until one player holds all of the cards. If the players run out of time, the winner may be decided on the basis of who holds the most cards at that point.

The data on the cards was compiled from the following sources:

1. ASHE 2010 http://www.statistics.gov.uk/downloads/theme_labour/ASHE–2010/tab14–7a.xls
2. Jobfile (Babcock Lifeskills, 2010)
3. Rose, M. (2007) 'Why so fed up and footloose in IT? Spelling out the associations between occupation and overall job satisfaction'. Industrial Relations Journal 38:4, 356–384

Job Title	
Job band	**1=low – 5=high. Highest wins** **3= technician/supervisory** **4= associate professional/managerial** **5= professional/senior managerial**
Numbers (male and female)	**Highest wins**
Numbers (female)	**Highest wins**
Average annual salary	**Highest wins**
Job satisfaction ranking	**Highest ranking wins, e.g. 6 is higher than 9**

Production, works and maintenance managers

Job band	4/5
Numbers (male and female)	421,000
Numbers (female)	67,000
Average annual salary	49,499
Job satisfaction ranking	6

Managers in construction

Job band	4/5
Numbers (male and female)	103,000
Numbers (female)	6,000
Average annual salary	52,678
Job satisfaction ranking	6

Managers in mining and energy

Job band	4/5
Numbers (male and female)	10,000
Numbers (female)	uncertain
Average annual salary	68,595
Job satisfaction ranking	6

Information and communication technology

Job band	4/5
Numbers (male and female)	171,000
Numbers (female)	32,000
Average annual salary	51,592
Job satisfaction ranking	9

Chemists

Job band	5
Numbers (male and female)	16,000
Numbers (female)	uncertain
Average annual salary	36,623
Job satisfaction ranking	34

Biological scientists and biochemists

Job band	5
Numbers (male and female)	64,000
Numbers (female)	32,000
Average annual salary	36,152
Job satisfaction ranking	34

Physicists, geologists and meteorologists

Job band	5
Numbers (male and female)	13,000
Numbers (female)	uncertain
Average annual salary	46,643
Job satisfaction ranking	34

Hospital and health service managers

Job band	3/4
Numbers (male and female)	56,000
Numbers (female)	37,000
Average annual salary	47,633
Job satisfaction ranking	3

Pharmacy managers

Job band	5
Numbers (male and female)	7,000
Numbers (female)	uncertain
Average annual salary	37,830
Job satisfaction ranking	3

Healthcare practice managers

Job band	3/4
Numbers (male and female)	12,000
Numbers (female)	10,000
Average annual salary	28,612
Job satisfaction ranking	3

Social services managers

Job band	4/5
Numbers (male and female)	17,000
Numbers (female)	11,000
Average annual salary	37,630
Job satisfaction ranking	3

Residential and day care managers

Job band	4/5
Numbers (male and female)	47,000
Numbers (female)	36,000
Average annual salary	29,638
Job satisfaction ranking	3

Farm managers

Job band	4/5
Numbers (male and female)	13,000
Numbers (female)	uncertain
Average annual salary	29,759
Job satisfaction ranking	37

Civil engineers

Job band	4/5
Numbers (male and female)	54,000
Numbers (female)	uncertain
Average annual salary	37,862
Job satisfaction ranking	53

Mechanical engineers

Job band	4/5
Numbers (male and female)	39,000
Numbers (female)	uncertain
Average annual salary	40,223
Job satisfaction ranking	53

Electrical engineers

Job band	4/5
Numbers (male and female)	25,000
Numbers (female)	uncertain
Average annual salary	44,151
Job satisfaction ranking	53

Electronics engineers

Job band	4/5
Numbers (male and female)	7,000
Numbers (female)	uncertain
Average annual salary	44,530
Job satisfaction ranking	53

Chemical engineers

Job band	4/5
Numbers (male and female)	uncertain
Numbers (female)	uncertain
Average annual salary	44,450
Job satisfaction ranking	53

Design and development engineers

Job band	4/5
Numbers (male and female)	67,000
Numbers (female)	uncertain
Average annual salary	36,276
Job satisfaction ranking	53

Production and process engineers

Job band	4/5
Numbers (male and female)	37,000
Numbers (female)	uncertain
Average annual salary	36,391
Job satisfaction ranking	53

Planning and quality control engineers

Job band	4/5
Numbers (male and female)	38,000
Numbers (female)	8,000
Average annual salary	34,185
Job satisfaction ranking	53

IT strategy and planning professionals

Job band	4/5
Numbers (male and female)	89,000
Numbers (female)	13,000
Average annual salary	48,512
Job satisfaction ranking	66

Software professionals

Job band	4/5
Numbers (male and female)	279,000
Numbers (female)	44,000
Average annual salary	38,625
Job satisfaction ranking	66

Medical practitioners

Job band	5
Numbers (male and female)	154,000
Numbers (female)	66,000
Average annual salary	76,000
Job satisfaction ranking	13

Psychologists

Job band	5
Numbers (male and female)	24,000
Numbers (female)	17,000
Average annual salary	38,250
Job satisfaction ranking	13

Pharmacists/ pharmacologists

Job band	5
Numbers (male and female)	25,000
Numbers (female)	18,000
Average annual salary	36,022
Job satisfaction ranking	13

Opthalmic opticians

Job band	5
Numbers (male and female)	6,000
Numbers (female)	uncertain
Average annual salary	32,535
Job satisfaction ranking	13

Dental practitioners

Job band	5
Numbers (male and female)	9,000
Numbers (female)	uncertain
Average annual salary	39,719
Job satisfaction ranking	13

Veterinarians

Job band	5
Numbers (male and female)	8,000
Numbers (female)	uncertain
Average annual salary	35,819
Job satisfaction ranking	13

Scientific researchers

Job band	5
Numbers (male and female)	31,000
Numbers (female)	14,000
Average annual salary	35,646
Job satisfaction ranking	48

Chartered and certified accountants

Job band	4/5
Numbers (male and female)	76,000
Numbers (female)	36,000
Average annual salary	38,212
Job satisfaction ranking	29

Management consultants, actuaries, economists and statisticians

Job band	4/5
Numbers (male and female)	112,000
Numbers (female)	43,000
Average annual salary	47,478
Job satisfaction ranking	29

Architects

Job band	5
Numbers (male and female)	29.000
Numbers (female)	7,000
Average annual salary	42,373
Job satisfaction ranking	28

Town planners

Job band	5
Numbers (male and female)	10,000
Numbers (female)	uncertain
Average annual salary	35,781
Job satisfaction ranking	28

Quantity surveyors

Job band	4/5
Numbers (male and female)	30,000
Numbers (female)	uncertain
Average annual salary	37,449
Job satisfaction ranking	28

Laboratory technician

Job band	3/4/5
Numbers (male and female)	55,000
Numbers (female)	28,000
Average annual salary	21,607
Job satisfaction ranking	69

Electrical/electronics technicians

Job band	3/4
Numbers (male and female)	12,000
Numbers (female)	uncertain
Average annual salary	31,538
Job satisfaction ranking	69

Engineering technicians

Job band	3/4
Numbers (male and female)	74,000
Numbers (female)	5,000
Average annual salary	32,690
Job satisfaction ranking	69

Building and civil engineering technicians

Job band	3/4
Numbers (male and female)	11,000
Numbers (female)	uncertain
Average annual salary	26,537
Job satisfaction ranking	69

Architectural technologists and town planning

Job band	3/4
Numbers (male and female)	15,000
Numbers (female)	uncertain
Average annual salary	27,010
Job satisfaction ranking	74

Draughts persons

Job band	3/4
Numbers (male and female)	31,000
Numbers (female)	uncertain
Average annual salary	27,129
Job satisfaction ranking	74

IT operations technicians

Job band	3/4
Numbers (male and female)	105,000
Numbers (female)	28,000
Average annual salary	31,536
Job satisfaction ranking	63

IT user support technicians

Job band	3/4
Numbers (male and female)	68,000
Numbers (female)	19,000
Average annual salary	26,174
Job satisfaction ranking	63

Nurses

Job band	3/4/5
Numbers (male and female)	604,000
Numbers (female)	534,000
Average annual salary	25,800
Job satisfaction ranking	18

Midwives

Job band	3/4/5
Numbers (male and female)	uncertain
Numbers (female)	40,000
Average annual salary	29,554
Job satisfaction ranking	18

Paramedics

Job band	2/3
Numbers (male and female)	13,000
Numbers (female)	uncertain
Average annual salary	37,432
Job satisfaction ranking	18

Medical radiographers

Job band	5
Numbers (male and female)	25,000
Numbers (female)	19,000
Average annual salary	31,502
Job satisfaction ranking	18

Pharmaceutical dispensers

Job band	3/4
Numbers (male and female)	29,000
Numbers (female)	27,000
Average annual salary	14,919
Job satisfaction ranking	18

Medical and dental technicians

Job band	3/4
Numbers (male and female)	29,000
Numbers (female)	16,000
Average annual salary	26,028
Job satisfaction ranking	18

Physiotherapists

Job band	5
Numbers (male and female)	36,000
Numbers (female)	29,000
Average annual salary	26,308
Job satisfaction ranking	17

Occupational therapists

Job band	5
Numbers (male and female)	23,000
Numbers (female)	20,000
Average annual salary	25,575
Job satisfaction ranking	17

Speech and language therapists

Job band	5
Numbers (male and female)	uncertain
Numbers (female)	7,000
Average annual salary	25,956
Job satisfaction ranking	17

Aircraft pilots and flight engineers

Job band	3/4/5
Numbers (male and female)	14,000
Numbers (female)	uncertain
Average annual salary	68,582
Job satisfaction ranking	32

Finance and investment analysts/advisers

Job band	4/5
Numbers (male and female)	70,000
Numbers (female)	29,000
Average annual salary	47,742
Job satisfaction ranking	42

Financial and accounting technicians

Job band	3
Numbers (male and female)	22,000
Numbers (female)	9,000
Average annual salary	40,501
Job satisfaction ranking	42

Conservation and environmental protection officers

Job band	5
Numbers (male and female)	22,000
Numbers (female)	8,000
Average annual salary	27,134
Job satisfaction ranking	33

Job band	
Numbers (male and female)	
Numbers (female)	
Average annual salary	
Job satisfaction ranking	

Job band	
Numbers (male and female)	
Numbers (female)	
Average annual salary	
Job satisfaction ranking	

Job band	
Numbers (male and female)	
Numbers (female)	
Average annual salary	
Job satisfaction ranking	

Job band	
Numbers (male and female)	
Numbers (female)	
Average annual salary	
Job satisfaction ranking	

7 Industry Focus

Sector Reports have been produced to help careers practitioners to develop an up to date picture of new and changing occupational areas. It is important that when young people are considering their futures that they are aware of the growth of opportunities within industries related to the STEM sector – **and that even at a time of economic slowdown, STEM industries have skills shortages and a high recruitment demand.**

A series of Industry Focus Reports have been produced to illustrate some of the **exciting opportunities available in industries which young people may not always be aware of.** These industries represent a significant element of the 21st Century employment infrastructure. There are some new, emerging industries but all are based on the traditional strength of UK workforce skills and innovation. Each region in England can illustrate the growth in STEM–related industries, as shown below, and the Industry Reports provide an insight into the opportunities available:–

North West

- Many of the region's most high–profile employers are STEM–related and there are increasing numbers of smaller STEM–related employers in new sectors including nuclear decommissioning and nano–materials.

- The region is also home to a number of research–intensive STEM facilities such as Daresbury Science & Innovation Campus, the Northwest Genetics Knowledge Park and the Dalton Nuclear Institute.

Yorkshire & the Humber

- The heart of the UK's energy sector, with a new Nuclear Advanced Manufacturing Research Centre being developed in the region which is due for completion by November 2011.

- Priority sectors include Advanced Engineering and Materials, such as the National Metals Technology Centre, and Healthcare Technologies including Meddserve.

North East

- The region's dominance in the biotechnology sector is significant – the number of biotech companies in the region has doubled in three years

- The sector accounts for 58% of the UK's petrochemical industry and 35% of its pharmaceutical output. Example employers include SABIC UK Petrochemicals, and GlaxoSmithKline.

East Midlands

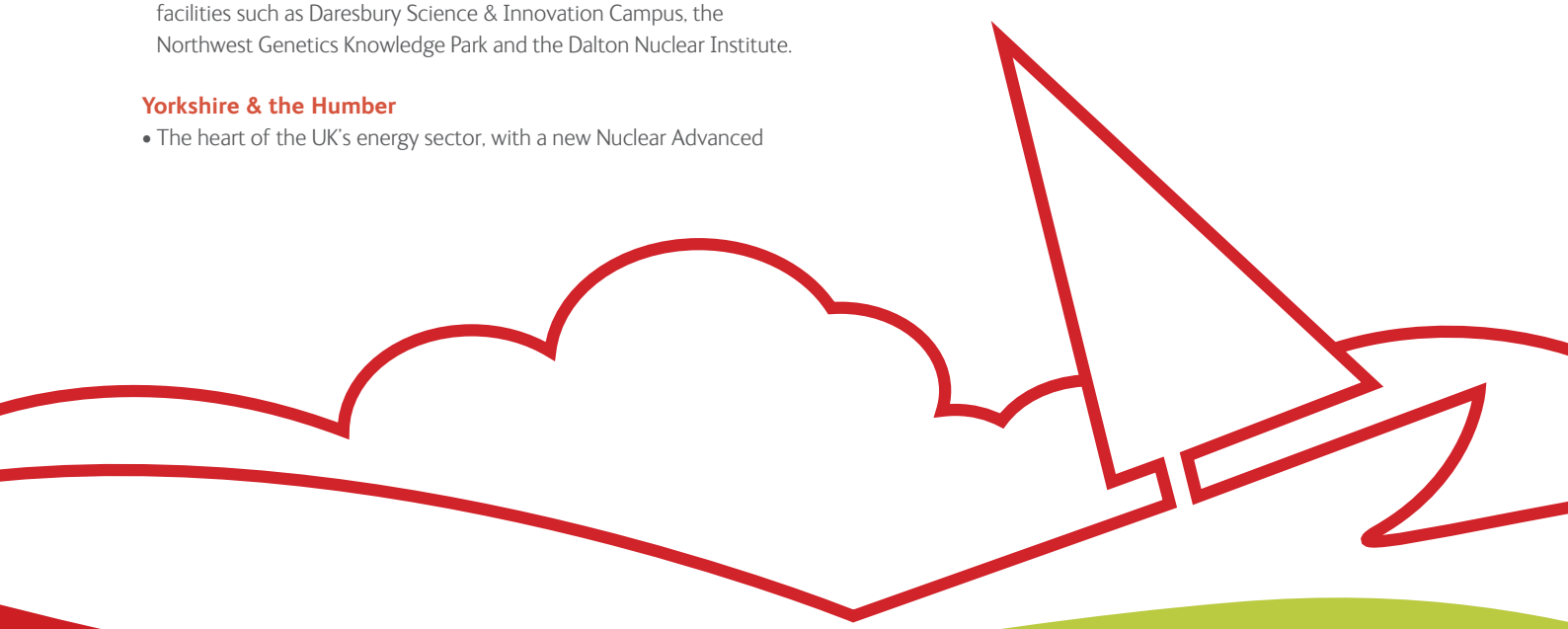
- Within Europe, the region has one of the highest concentrations of aerospace companies, accounting for 15% of the UK aerospace industry. The National Space Centre, based in Leicester, helps to promote careers across the space industry.

- In the pharmaceutical sector, BioCity Nottingham is the UK's largest bioscience innovation centre.

West Midlands

- The West Midlands has the highest proportion of manufacturing companies of any UK region employing 15% of all people employed.

- The region still hosts world–leading automotive companies, such as Jaguar, Land Rover, and Aston Martin, but these have now also been joined by global food and drinks companies and a huge upsurge in new media and digital companies.



East of England

- The region is home to a range of research–intensive STEM facilities, including the Cambridge Science Park, Institute for Food Research, Genome Analysis Centre, and the St. John Innovation Centre.

- The East of England's pharmaceuticals and chemical sectors are the highest–scoring sectors of the regional economy.

London

- London has many businesses that are leaders in their field, such as Heathrow Airport which is regarded as the hub of the aviation world, flying customers to over 180 destinations.

- The biomedical sector is well represented, including employers such as The Biomedical Research Education Trust, Henderson Biomedical, and AstraZeneca.

South West

- Environmental technologies contribute £1,300 million to the regional economy, with the potential to produce another 39,000 jobs, and £670 million. Example employers include Wave Hub, and Solarcentury.

- The second largest sector in the South West is advanced engineering, with aerospace as the largest sub–sector including companies such as Airbus, GE Aviation, and BAE Systems.

South East

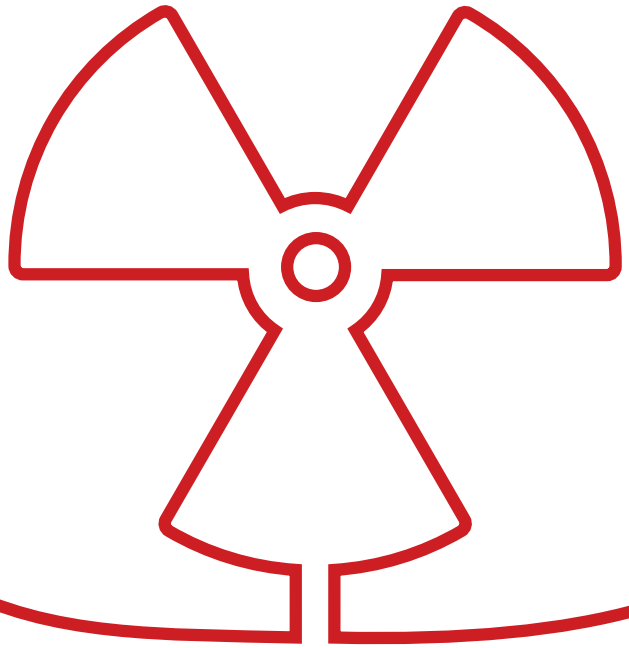
- The biomedical sector is well represented including such organisations as the Medical Research Council, GE Healthcare, Johnson & Johnson, and Wyeth Research.

- Over £50 million of funding has been secured for the development of an International Space Innovation Centre, based at Harwell, Oxfordshire. The European Space Agency have also decided to locate at Harwell, so that over the next four years around 1,000 new jobs will be created in the space industry alone.

The National STEM Centre www.nationalstemcentre.org.uk includes information on the STEM business and industry in each region with links to Sector Skills Council websites for further information.

The Industry Focus Reports can be accessed via:–
www.futuremorph.org/careers_staff/careersinformationresourcepack

- The UK Space Industry
- The UK Nuclear Power Industry
- The UK Renewable Energy Industry
- The UK Maritime Industry
- The UK Pharmaceutical Industry
- The UK Food Science & Technology Industry
- UK Built Environment Industry



8 Organising STEM Events

There is a wealth of resources available to support schools/colleges running STEM enhancement and enrichment activities.

This section provides examples of schemes and activities provided by organisations that aim to enhance and enrich the curriculum. The activities aim to offer a fun and stimulating opportunity for students to see the relevance of their studies to the world of work and to involve industry in its widest sense. The links offer a gateway to the wide range of activities and materials that can be used with different age ranges and within differing curriculum contexts.

Schools and colleges also run STEM careers days. Example programmes are provided in Section 10.

STEMNET (Science, Technology, Engineering and Maths Network) – STEM Online Directories –
www.stemnet.org.uk

STEM Online Directories are a free resource aimed at helping teachers to pinpoint which activities and events provided by organisations across the UK will enhance and enrich their school/college curriculum. There are 3 volumes – Science; Engineering & Technology; and Maths.

STEM Clubs –
www.iop.org/education/teacher/extra_resources/stem/page_41714.html

The Institute has produced a physics activity pack suitable for supporting the development of a STEM Club.

BAE Systems Schools Roadshow –
www.baesystems.com/education

The BAE Systems Education Programme includes a range of features such as work experience, in-school Roadshow activity, and Ambassador support

Enterprising Science (supported by BP) –
www.enterprisingscience.com

Includes the high-impact, one day Trading Challenge roadshow for 14 – 19 year old students.

British Science Association –
www.britishscienceassociation.org/web/news/

Programme of science, engineering and technology events and activities across the UK.

The Big Bang –
www.thebigbangfair.co.uk

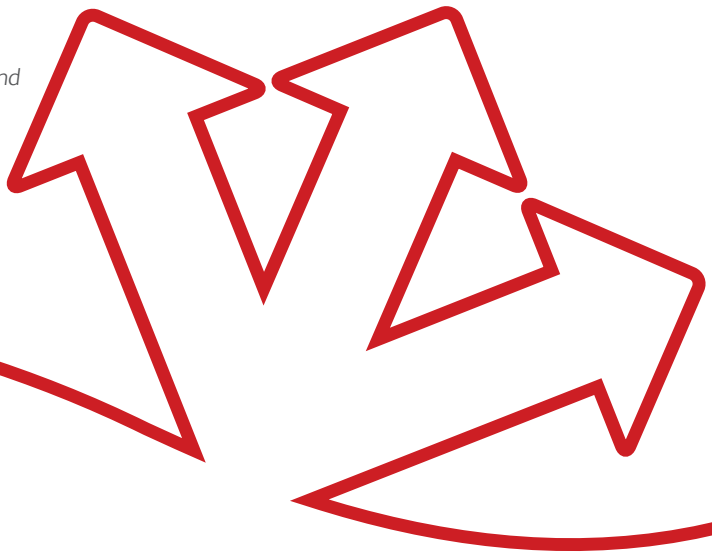
Free event led by EngineeringUK and developed in partnership with organisations from business & industry, government and the STEM community.

Greenpower F24 –
www.greenpower.co.uk/racing/formula24.php

Enables schools/colleges to compete in building electric cars which culminates in a race.

The Industrial Trust –
www.industrialtrust.org.uk

The Trust is the leading national provider of out of school/college and in-company educational experiences to inspire and motivate young people to choose a STEM career.



The Institute of Physics –
www.stimulatingphysics.org/the-pilot-careers-and-enterprise.htm

A new enterprise activity for schools, the Ashfield Music Festival, was designed as a mechanism to broaden the perceptions of Year 9–10 students and to highlight the range of careers opened up by A level physics. Working in teams, students design all aspects of the main stage for a music festival.

The Smallpeice Trust –
www.smallpeicetrust.org.uk

An independent charity providing exciting programmes to promote engineering careers to young people through in-school STEM sessions, and residential engineering courses.

Young Engineers –
www.youngeng.org/

This charity facilitates national competitions covering ages 7 to 19, and a free national club network providing resources, advice and activities.

Links for accessing STEM presenters and networks

Royal Society of Chemistry –
www.rsc.org/Education/Teachers/Outreach/Outreach.asp

Click on downloadable files for the RSC list of recommended presenters suitable for pre sixth form students and over 16s.

Science Live -
www.sciencelive.net/

Professional science and engineering communicators and committed enthusiasts. Co-ordinated by the British Science Association, supported by the Institute of Physics.

UK Resource Centre for Women in SET –
http://theukrc.org

This site includes an Online Catalogue listing hundreds of useful groups, organisations and networks. The GetSET Women database can be used to search for female role models.

STEM enrichment and enhancement activities can have a powerful effect on young people's learning and career development and foster their enjoyment of, and engagement and identification with, STEM related activity. Maximum value can be drawn through building in opportunities for students to reflect on their learning and explore the connections to and implications for their personal career decisions.

9 Websites and Source of Information

This section offers a gateway to accessing key information relating to STEM subject choice, career pathways, and resources. The content is not intended to be exhaustive, but aims to save you time by pinpointing sites that will provide the most stimulating and relevant STEM information.

General:

National STEM Centre –
www.nationalstemcentre.org.uk

Houses the national STEM careers collection and a wealth of other resources including regional contacts and support for STEM learning.
- *STEM business and industry in the region – what are the region's major STEM sectors?*
- *Major employers – which businesses are the main STEM employers in the region?*
- *Looking forward – what are the potential STEM skill shortages for the region?*
- *STEM education support – who can I contact in the region?*

The Centre for Science Education (CSE) –
www.shu.ac.uk/research/cse/

CSE is a research and business development unit specialising in the STEM subjects. CSE creates, manages and delivers resources, projects and initiatives to support teachers and students at all levels of education.

CRAC: The Career Development Organisation –
www.icould.com

Their site provides access to the career experiences of real people through their stories. It includes many inspiring examples of STEM careers at a variety of levels, and through the stories describes the pathways of people who used their STEM courses as a springboard into other opportunities.

Science Council Careers website –
www.futuremorph.org

The online portal for STEM careers including links to a list of relevant websites as a download. The site explores the world of STEM through case studies, job profiles, videos and lesson plans and has sections for different ages of young people, for advisers and for parents and teachers.

STEMNET –
www.stemnet.org.uk

The Science, Technology, Engineering and Mathematics Network helps schools/colleges to understand the range of STEM Enhancement & Enrichment opportunities available to them.

STEM Directories –
www.stemdirectories.org.uk

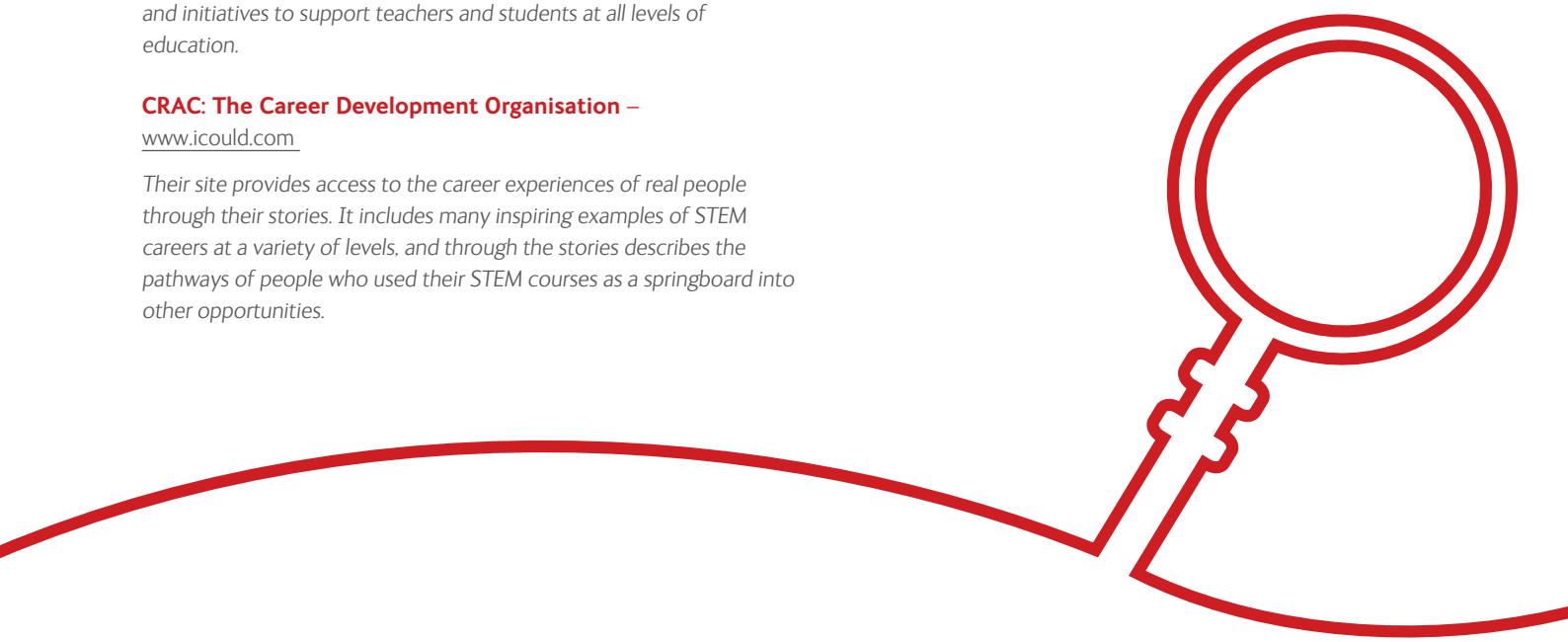
Site to download the STEM Online Directories (for enhancement and enrichment of the curriculum).

NOISE (New Outlooks in Science & Engineering) –
www.epsrc.ac.uk/noise

Includes exciting experiments to try at home and interesting blogs by young scientists, to great articles and details about 'cool' careers in science and engineering.

STEM Equality and Diversity Toolkit –
www.stem-e-and-d-toolkit.co.uk

An interactive toolkit to help to promote STEM careers to people with a range of backgrounds and needs.



UK Resource Centre for Women in SET –
www.theukrc.org

National programme that can provide statistics and material relating to increasing the number of females in science, engineering, technology and the built environment.

WISE (Women into Science, Engineering and Construction) –
www.wisecampaign.org.uk

WISE works with industry and education to inspire girls and attract them into STEM studies and careers. Advises on a range of intitiatives, from running an outreach day to advising on new careers literature, challenging stereotypes in innovative and effective ways.

The UK Commission for Employment and Skills
www.ukces.org.uk

The website has a research portal to Employment and Labour Market Information and Sector data including the Working Futures 2007–2017 produced by the Institute of Employment Research at the University of Warwick in collaboration with Cambridge Econometrics (CE). You can register for a monthly e–briefing on key developments in employment and skills.

To help in finding the right science course in higher education, view –
www.science–engineering.net

This site offers a free University Information Service for science, engineering, and technology.

National Guidance Research Forum (NGRF) –
www.guidance–research.org

A comprehensive site for exploring labour market information, including an LMI Future Trends section. Managed by the University of Warwick Institute for Employment Research (IER) together with Deirdre Hughes (DMH Associates) and the International Centre for Guidance Studies at the University of Derby (iCeGS).

Science:

Society of Biology –
www.societyofbiology.org

The SoB aim to encourage a passion for biology in students, and help teachers with resources such as the BioEd e–newsletter and free online lesson plans.

Royal Society of Chemistry –
www.rsc.org

The RSC provides a range of careers materials for use by school students and teachers as well as a range of chemistry enhancement and enrichment activities for all ages.

Institute of Physics –
www.iop.org/careers

The IOP provides a range of support for teachers, sutdents and working physicists and offers a large number of free resources related to studying physics and careers from physics. See the website for further information including access to the "Exploring physics, uncovering choice", a pack of materials to encourage teachers and advisers to work together in providing a consistent approach to careers advice and guidance.

The Association for Science Education –
www.ase.org.uk

The school science site is packed with free online resources for both teachers and students, showing the applications of the science learnt at school from age 5 to 19.

Technology and Engineering:

EngineeringUK –
www.engineeringuk.com

The purpose of EngineeringUK is to promote the vital contribution that engineers, and engineering and technology, make to our society. Through initiatives such as The Big Bang, Tomorrow's Engineers and the Communications Hub, accurate and engaging information about engineering is communicated.

Tomorrow's Engineers –
www.tomorrowsengineers.org.uk/resources

Contains extensive links to careers resources including the 'What Is Engineering?' leaflets with posters and linked lesson activities.

The Design and Technology Association –
www.data.org.uk

The Design and Technology Association offer curriculum support through DfE funded projects such as CAD/CAM in schools, Electronics in schools (with support from the Institution of Engineering and Technology) and Food in schools.

Engineering Council –
http://www.engc.org.uk/engineering–gateways/contact–us

Use the Engineering Council website to access an updated list of engineering institutions that have websites which include careers information and careers resources.

Maths:

Maths Careers –
www.mathscareers.org.uk

The Maths careers site presents opportunities using maths in six main areas – sport, science and engineering, entertainment, business and money, health and society, the environment and a general 'I love Maths' section. Has sections for teachers, advisers as well as young people.

Sector Skills Councils (SSCs) and Industry Focus websites and resources

Cogent –
www.cogent–ssc.com

Cogent host an interactive 'Careers Pathways' site for the Chemical, Pharmaceuticals, Nuclear, Petroleum, and Plastics & Rubber (Polymers) industries. Includes case studies and salary information.

Improve –
www.improve-skills.co.uk/careers

The careers site for the food and drink industry. Includes entry qualifications, employment trends, case studies and access to a virtual careers adviser.

SEMTA -
www.semta.org.uk

The SSC for science, engineering and manufacturing technologies. Eight different industry focused sections with information on funding, training information and skills: Aerospace, Automotive, Electrical, Electronics, Marine, Mechanical, Metals and Science & Bioscience.

Technology and Engineering:

e-skills –
www.e-skills.com

e-skills aims to transform attitudes, inspire interest and prepare young people with the technology-related knowledge and skills employers need. The site provides information on career opportunities and the skills required for a career in IT and Telecommunications.

Summitskills –
www.summitskills.org.uk

Summitskills is the SSC for the Building Services Engineering sector. Includes the dedicated 'Good Day' careers website.

Classroom websites and resources

General:

British Gas –
www.generationgreen.co.uk

Fun online student activities including building an energy efficient house or fixing the online interactive house that is wasting a lot of energy.

Careersbox –
www.careersbox.co.uk

Over 100 short career, learning and training film clips, including STEM related employment situations. Case study film showing real people doing real jobs. Careersbox are digital media innovators in the CEIAG world.

NPower Education Programme –
http://education/npower.com

The 'Brighter Futures' website includes a STEM section with challenging activities.

WISE (Women into Science Engineering and Construction) –
www.wisecampaign.org.uk

WISE works creatively with industry and education, offering colourful and innovative tools and approaches to support them in encouraging girls into non-traditional STEM careers. Included in this site is a link to STEMgirls, supported by WISE and the British Science Association, where professionals working in STEM careers will answer questions.

Working in ... booklets –
www.babcock-lifeskills.co.uk

Attractive high quality careers information booklets that include Science; Manufacturing; Hospitals; Construction & the Built Environment; Transport & Logistics; Food & Drink; Maths; Computers & IT. Each booklet contains a sector overview and real life case studies.

Science:

The Association of the British Pharmaceutical Industry –
www.abpischools.org.uk

The ABPI Resources for Schools website provides curriculum related resources for use by teachers and their students. ABPI also host a 'Careers' website for information on careers in the pharmaceutical industry.

BP –
www.bp.com/bpes/cft

Carbon footprint toolkit containing interactive CD-Rom, lesson plans, 3D animations, starter activities, how to calculate your school's carbon footprint.

The Geological Society –
www.geolsoc.org.uk

Contains material relevant to teachers and students, including 'The Rock Cycle', a school-specific teaching resource for KS3.

Making the Modern World –
www.makingthemodernworld.org.uk

Powerful stories about science and invention from the eighteenth century to today, using the web and dynamic multimedia techniques.

NHS Careers –
www.nhscareers.nhs.uk

The information service for careers in the NHS in England. Includes an 'Explore by Career' section.

National Space Centre –
www.spacecentre.co.uk

Use this site to access information about the Space Academy school visits, learning resources, and Curriculum Focused Programmes for key stage 3 to key stage 5 students.

Planet SciCast –
http://scicast.org.uk

The SciCast team will take mini movies of science demonstrations from schools and enter them into their competition. Short films, real science!

Planet Science –
www.planet-science.com

Offering young scientists of school age the inspiration and excitement that will support their study of science at school and beyond. Planet Science is there to support classrooms, curriculum and teachers by exciting interest and unleashing a passion in science.

Science Learning Centres –
www.sciencelearningcentres.org.uk

Provide quality continuous professional development for everyone involved in science education, with a network of 9 regional centres and 1 National Centre providing innovative and inspiring courses.

Science and Maths –
www.futuremorph.org/scienceandmaths/

Contains inspirational case studies including sports technologist, cosmetics specialist, and digital designer.

Science Upd8 –
www.upd8.org.uk

Provides short downloadable, easy to use science classroom activities based on up to the minute science in the news and popular culture with a growing STEM careers section.

The Vega Science Trust, Science Career Videos –
www.vega.org.uk/video/series/10

These videos show a day in the life of a young scientist, giving insights into the lives of young people at the cutting edge of British science and engineering – these are the people who are making things happen.

Technology and Engineering:

BLOODHOUND Education Programme –
www.bloodhoundssc.com

The BLOODHOUND SSC (Super Sonic Car) engineering adventure enables schools to access teaching and learning materials to research, design, build and test the car.

BT –
www.connected–earth.com/Learningresources

From telephone to telegraph to wireless to computer, including good animations such as showing which bit does what inside a mobile phone. Teaching resources to show how communication shapes the world.

Tomorrow's Engineers –
www.tomorrowsengineers.org.uk

A site that provides information about engineering careers, access to teaching resources and links to over 50 other relevant organisations.

e–skills UK in schools –
www.e–skills.com

e–skills have created BigAmbition, a site designed to inspire 14–19 year olds by demonstrating the wide range of IT career options, and how to get into them. The site features interactive tools and video profiles of IT professionals – go to:
www.bigambition.co.uk

The Design and Technology Association
www.data.org.uk

Hosts curriculum resources that integrate careers work into Design and Technology.

Maths:

The Association of Teachers of Mathematics (ATM) –
www.atm.org.uk

ATM aim to provide teachers with the resources to help them develop their maths teaching in creative and broad–thinking ways. FREE resources are provided on their website for teachers to download or use online in the classroom.

Maths Careers –
www.mathscareers.org.uk/teachers.cfm

This link will provide access to exciting classroom resources that emphasise the transferable skills that maths provides for students, whatever jobs they eventually enter. Also includes enrichment activities such as after school STEM clubs.

Further Maths Network –
www.fmnetwork.org.uk

Information and resources to encourage access to Further Maths, including advice on progression to university courses in STEM subjects..

10 Appendices

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Grow your future: jobs with biology

Biology is the science that deals with the life processes and habits of all living things, from single cells to whole organisms. It studies how they interact with each other and with their environment and includes the study of plants (botany), humans (physiology and anatomy) and animals (zoology), genetics and microbiology. Studying biology gives you the skills and opportunities to advance human knowledge and understanding, including saving threatened species, studying microbes, growing organic plants for food and curing diseases.

There are many routes available after GCSEs. These include taking biology to A level, Diploma courses (in subjects such as environmental and land based studies) and relevant apprenticeships in areas such as health.

Taking science will open up a variety of career options for your future and provide you with skills that will make you very employable. Here is a list of some of the many jobs that skills and qualifications in biology and other STEM subjects can lead you to.

- Acupuncturist
- Adult Nurse
- Agricultural Scientist
- Alexander Technique Teacher
- Anaesthetist
- Animal Physiotherapist
- Arboriculturist
- Aromatherapist
- Bacteriologist
- Biochemist
- Biologist
- Biomedical Scientist
- Biotechnologist
- Botanist
- Children's Nurse
- Chiropractor
- Clinical Engineer
- Clinical Physiologist
- Clinical Research Associate
- Clinical Scientist
- Consumer Scientist
- Countryside/Conservation Officer
- Dental Hygienist
- Dental Therapist
- Dentist
- Dietician
- District Nurse
- Doctor
- Ecologist
- Entomologist
- Environmental Scientist
- Farm Manager
- Fish Farmer
- Forensic Scientist
- Forest Officer
- General Practitioner
- Geneticist (Clinical Laboratory Specialist)
- Health Promotion Education Specialist
- Health Visitor
- Herbalist
- Homeopath
- Immunologist
- Landscaper
- Marine Biologist
- Microbiologist
- Midwife
- Naturopath
- Nutritional Therapist
- Occupational Health Nurse
- Occupational Therapist
- Oceanographer
- Orthoptist
- Osteopath
- Pathologist
- Pharmacologist
- Physiotherapist
- Podiatrist/Chiropodist
- Psychiatrist
- School Nurse
- Sport & Exercise Scientist
- Sports Therapist
- Surgeon
- Toxicologist
- Veterinary Pathologist
- Veterinary Scientist
- Veterinary Surgeon
- Zoologist

For further information

General sites

For more information about careers with maths and science go to www.futuremorph.org. Future Morph links to useful websites for other organisations who will be able to help.

Other General Sites

www.futuremorph.org/scienceandmaths
www.apprenticeships.org.uk
www.sectorcareersinfo.co.uk
www.lantra.co.uk

Biology related sites

Society of Biology – www.societyofbiology.org
Biochemical Society – www.biochemistry.org
British Pharmacological Society – www.careersinpharmacology.org
Society of Experimental Biology – www.sebiology.org
Society of General Microbiology – www.biocareers.org.uk
British Ecological Society – www.britishecologicalsociety.org

Expand your horizons: jobs with chemistry

Chemistry examines materials in terms of their structure, their physical and chemical properties, how they interact and what role they play in the living world.

There are many routes available after GCSEs. These include taking chemistry to A level, Diploma courses (in subjects such as environmental and land based studies) and relevant apprenticeships in areas such as engineering and health.

Taking chemistry and other STEM subjects will open up a variety of career options and provide you with skills that will make you very employable. Here is a list of some of the many jobs that skills and qualifications in chemistry and other STEM subjects can lead you to.

- Agricultural Scientist
- Anaesthetist
- Analytical Chemist
- Bacteriologist
- Biochemist
- Biomedical Scientist
- Biotechnologist
- Chemical Engineer
- Chemist
- Clinical Physiologist
- Clinical Research Associate
- Clinical Scientist
- Cosmetic Scientist
- Dentist
- Dietician
- Doctor
- Education Laboratory Technician
- Environmental Health Practitioner
- Food Scientist/Technologist
- Forensic Scientist
- General Practitioner
- Leather Technologist
- Marine Biologist
- Materials Engineer/Scientist
- Microbiologist
- Pathologist
- Pharmacist
- Pharmacologist
- Polymer Technologist
- Psychiatrist
- Research Scientist
- Surgeon
- Technical Brewer
- Textile Dyeing Technician
- Textile Technologist
- Toxicologist
- Veterinary Pathologist
- Veterinary Scientist
- Veterinary Surgeon
- Zoologist

For further information

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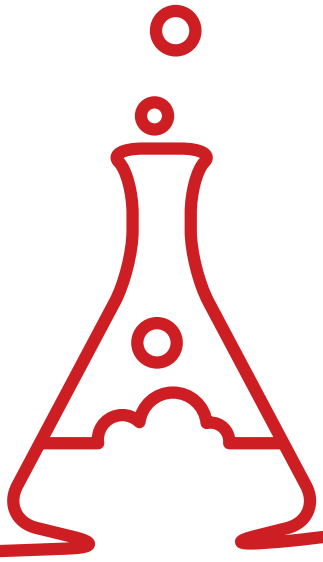
For more information about careers with science and maths go to www.futuremorph.org. Future Morph links to useful websites for other organisations who will be able to help.

Other General Sites

www.futuremorph.org/scienceandmaths
www.apprenticeships.org.uk
www.sectorcareersinfo.co.uk
www.cogent-careers.com
www.improve-skills.co.uk/careers
www.prospect4u.co.uk
www.skillsforhealth.org.uk
www.nhscareers.nhs.uk

Chemistry related sites

Royal Society of Chemistry – www.rsc.org/education
Association of the British Pharmaceutical Industry – http://careers.abpi.org.uk



Set the controls for your future: jobs with design and technology

In design and technology students combine practical and technological skills with creative thinking to design and make products and systems that meet human needs. The subject uses current technologies and considers the impact of future technological developments.

There are many routes available after GCSEs. These include taking design and technology to A level, Diploma courses (in subjects such as manufacturing & product design, and engineering) and relevant apprenticeships in areas such as engineering and construction.

Taking design and technology and other STEM subjects will open up a variety of career options and provide you with skills that will make you very employable. Here is a list of some of the many jobs that skills and qualifications in design and technology and other STEM subjects can lead you to.

- Aerospace Engineer
- Aerospace Engineering Technician
- Architect
- Architectural Technician/ Technologist
- Auto Electrician
- Blacksmith
- Broadcast Engineer
- Building Services Engineer
- CAD Draughtsperson
- Chemical Engineer
- Civil Engineer
- Civil Engineering Technician
- Clinical Engineer
- Computer Hardware Engineer
- Computer Service Technician
- Construction Plant Mechanic
- Design Engineer
- Electrical Engineer
- Electronic Engineering Technician
- Electronics Engineer
- Engineering Maintenance Technician
- Ergonomist
- Foundry Patternmaker
- Furniture Maker
- Land–based Engineer
- Land–based Service Technician
- Manufacturing Engineer
- Marine Crafts Person
- Marine Engineer
- Mechanical Engineer
- Mechanical Engineering Technician
- Merchant Navy Engineering Officer
- Mining Engineer
- Model Maker
- Motor Vehicle Body Repairer/ Refinisher/Builder
- Motor Vehicle Technician
- Naval Architect
- Nuclear Engineer
- Polymer Technologist
- Refrigeration Technician
- Special Effects Technician
- Telecommunications Technician
- Toolmaker
- Vehicle Breakdown Engineer
- Watch & Clock Repairer
- Welder

For further information

General sites

For more information about careers with design and technology go to www.futuremorph.org. Future Morph links to useful websites for other organisations who will be able to help.

Other General Sites

www.futuremorph.org/scienceandmaths
www.apprenticeships.org.uk
www.tomorrowsengineers.org.uk
www.sectorcareersinfo.co.uk
www.semta.org.uk
www.e–skills.com/careers
www.summitskills.org.uk/careers
www.skillset.org/careers

Design & Technology related sites

The Design and Technology Association – www.data.org.uk
Institution of Engineering and Technology – www.theiet.org
EngineeringUK – www.engineeringuk.com

Shape your prospects: jobs with maths

Maths is part of just about everything; from calculation, measurement and the study of shapes and the motion of objects, to the science of patterns, for example, in numbers, space or computing. Maths is a vital skill in many fields including engineering, science, medicine, business and social sciences.

There are many routes available after GCSEs. These include taking maths to A level, Diploma courses (in subjects such as engineering, environmental and land based studies) and relevant apprenticeships in areas such as construction and engineering.

Taking maths and other STEM subjects will open up a variety of career options providing you with skills that will make you very employable. Mathematical careers include those which need an advanced knowledge of mathematics, as well as those which require an ability with figures. Here is a list of some of the many jobs that skills and qualifications in maths and other STEM subjects can lead you to.

- Acoustician
- Actuary
- Aerospace Engineer
- Astronomer
- Broadcast Engineer
- Building Control Surveyor
- Building Services Engineer
- Chemical Engineer
- Civil Engineer
- Civil Engineering Technician
- Computer Hardware Engineer
- Design Engineer
- Digital Forensic Analyst
- Electrical Engineer
- Electronics Engineer
- Engineering/Land Surveyor
- Estimator
- Geophysicist
- Land–based Engineer
- Marine Engineer
- Mathematician
- Mechanical Engineer
- Medical Physicist
- Merchant Navy Engineering Officer
- Mining Engineer
- Naval Architect
- Nuclear Engineer
- Oil and Gas Engineer
- Operational Researcher
- Physicist
- Production Engineer
- Statistician
- Stock Market Dealer/Trader
- Systems Analyst

For further information

General sites

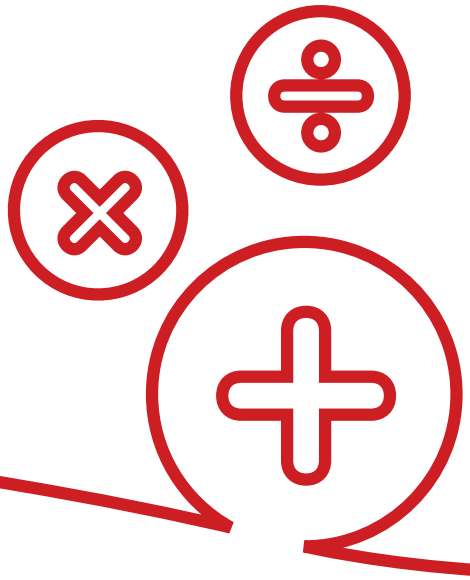
For more information about careers with maths and science go to www.futuremorph.org. Future Morph links to useful websites for other organisations who will be able to help.

Other General Sites

www.futuremorph.org/scienceandmaths
www.tomorrowsengineers.org.uk
www.apprenticeships.org.uk
www.sectorcareersinfo.co.uk

Maths related sites

Maths Careers – www.mathscareers.org.uk
Institute of Mathematics and its Applications – www.ima.org.uk
London Mathematical Society – www.lms.ac.uk
Royal Statistical Society – www.rss.org.uk



Launch your life : jobs with physics

Physics is the science of matter and its motion, as well as space and time. It deals with concepts such as force, energy, mass, and charge, and helps us understand how the world around us behaves.

There are many routes available after GCSEs. These include taking physics to A level, Diploma courses (in subjects such as engineering, science and environmental and land based studies) and relevant apprenticeships in areas such as engineering and construction.

Taking physics will open up a variety of career options for your future and provide you with skills that will make you very employable. Here is a list of some of the many jobs that skills and qualifications in physics and other STEM subjects can lead you to.

- Acoustician
- Aerospace Engineer
- Astronaut
- Astronomer
- Broadcast Engineer
- Building Services Engineer
- Chemical Engineer
- Civil Engineer
- Clinical Engineer
- Clinical Scientist
- Computer Hardware Engineer
- Design Engineer
- Dispensing Optician
- Electrical Engineer
- Electronics Engineer
- Geophysicist
- Hydrologist
- Land–based Engineer
- Marine Engineer
- Materials Scientist/Engineer
- Mechanical Engineer
- Medical Physicist
- Merchant Navy Engineering Officer
- Metallurgist
- Meteorologist
- Mining Engineer
- Naval Architect
- Nuclear Engineer
- Oceanographer
- Oil and Gas Engineer
- Optometrist
- Physicist
- Production Engineer
- Refrigeration & Air Conditioning Engineer

For further information

General sites

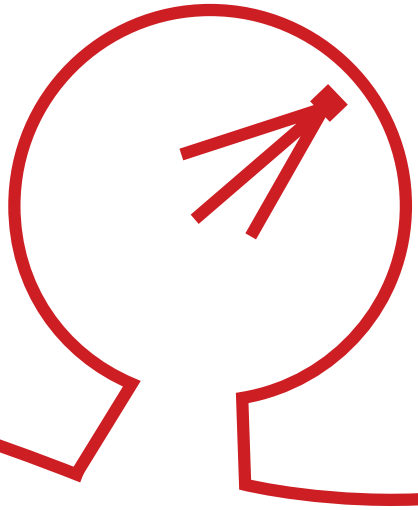
For more information about careers with science and maths go to www.futuremorph.org. Future Morph links to useful websites for other organisations who will be able to help.

Other General Sites

www.tomorrowsengineers.org.uk
www.futuremorph.org/scienceandmaths
www.apprenticeships.org.uk
www.sectorcareersinfo.co.uk
www.semta.org.uk
www.euskills.co.uk/careers

Physics related sites

Institute of Physics – www.physics.org/careers, www.iop.org/careers
Royal Astronomical Society – www.ras.org.uk
Royal Meteorological Society – www.rmets.org



A STEM careers day

You have been asked to lead a STEM careers off–curriculum day for a whole year group (pre–GCSE) within your school/college for next term. (You may be the Careers Coordinator or you may just be supporting them). This needs to be an event that can help to inform the students about the wide range of careers that STEM subjects can lead to – but you also want to try and enthuse the students about taking STEM subjects beyond 16 – and you want them to have a good time on the day. You have a limited budget (£350 maximum) for the day.

The STEM careers day is an opportunity for STEM subject teachers to begin to work together across the curriculum and to begin to draw in the careers staff. The event will begin to build on new partnerships outside the school/college and will support STEM careers work over the next year.

You are required to produce a plan for the day – along with supporting notes on how you will achieve the aims and an action plan.

A series of questions / prompts will take you through the task.

You can choose which year group and the time within the school calendar to meet your own priorities. (We are aware that school calendars can be outside a teacher's control.)

1. The theme/s for the day

a) Do you want to identify a particular topic or theme? This could link to the location of your school/college – is it rural, urban, city based? What industries are within the region? Do you want to show STEM subjects working together? Are you a specialist school/college – could you focus on the specialism?

b) Do you want to strengthen or develop particular areas of the curriculum? Are there issues that could be tackled as part of the day e.g. not enough girls choosing physics, engaging student groups who need motivating.

c) Are you engaged in any STEM or business related projects that you could link to e.g. Enterprise, Bloodhound.

2. Begin to think of potential activities and content

a) Do you want something to give the 'wow' factor for the day? How will you do this? Could it be by something entertaining – circus, theatre.

b) Bringing real local people in to meet the students is popular, useful and free. See the Teacher TV programme (Careers). However it does take a bit of organising to be effective and inclusive. Do you know where you can find local STEM Ambassadors from? This is generally a first call. However you may well need a back up plan and there are other schemes. Do you have any known contacts / friends / family working or studying in STEM that could be invited? Support staff in school/college – nurse, technicians can be role models. Students are another set of role models to draw on – undergraduates (past students?) or sixth formers?

c) Examine the STEM Directories to find local and national schemes of enrichment activities.

d) If you have an after school/college STEM club you may have access to activities you can draw on – or do some research e.g. making bathbombs, building bridges with straws or KNEX, designing a seat with newspaper and sellotape. Then you can add a careers element.

e) What other partnerships are in place with the school/college that could be drawn on?

f) Can you build in a Personal Learning and Thinking Skills element to the day?

g) There are some organisations that may be able to offer support free of charge – the Armed Forces (engineering), public services like – fire brigade (fire safety), police (forensic science).

3. How will you ensure it is inclusive?

a) Some STEM activities naturally appeal to more boys than girls. How will you ensure all girls as well as all boys have full access to the activities? (Balance the rocket building with making bathbombs.)

b) Have you planned a range of activities that will appeal to a broad range of student achievement and learning styles.

c) How will you ensure all activities are accessible for all students?

d) How will you ensure that your role models and visitors are not stereotypical? You don't want the girls to be put off because all role models are men. You want to show that STEM careers appeal to a diverse range of people.

4. The framework to make it more than a 'fun day'. Think long term...

a) While it is obviously important that the day should be fun, there is a need to ensure the aim of the day is not forgotten. So a workbook for the day will enable the students to reflect afterwards and put their own career thinking into words.

b) Could there be a competition and prizes? Will there be a display afterwards for parents' evening? Could you produce something for the school/college newsletter or website afterward?

c) How will you encourage ongoing career exploration by students via structured web searches and the careers library?

5. The logistics

a) How many are in the year group and how many groups will you have?

b) What spaces and rooms in the school/college (or outside) will you need to be available?

c) How will you divide the groups up? In tutor groups / separate boys and girls for some activities?

d) Can you share out tasks – will you get some administrative support in the school/college?

By the end of the time be ready to share your plan with the group and be quizzed on your reasoning.

Prompts	Supporting Decision Notes
1. The theme/s and the AIM for the day	
2. Potential activities and content	
3. How will you ensure it is inclusive?	
4. The framework to make it more than a 'fun day'. Think long term...	
5. The logistics	

A STEM careers evening

STEM

Science, Technology, Engineering and Mathematics

STEM Evening

at

Rosebery School

Wednesday 10th November 2010

6.00pm – 8.00pm

STEM Evening Exhibitors

Hall

Atkins

Robert Shephard – Engineering in fluid mixing technology

WISE (Women into Science and Engineering)

Brooklands Museum

Roy Rowden - Retired Aeronautical Engineer

Thales

Room M2

PPA Energy with Claire Wilkinson STEM Ambassador and colleague Sarah Carter

Room M3

Neil Gilchrist STEM AMBASSADOR - Chartered Electrical Engineer

6th Form Area

MERU (Medical Engineering Resource Unit)

Mike Edwards - Retired Tax Director (Reuters) and accountancy professional

ECITB (Engineering Construction Industry Training Board)

Air Products Plc – Advanced Controls, Global Operations

Nescot College - Advice and Guidance, Biomedical Sciences and Osteopathy

BAE Systems

Judith McCarron STEM Ambassador

Ergonomics

Claire Nix – Education and Training

Timothy Graham –STEM Ambassador talking about careers in maths and physics

Richard May - Engineer – analysis software, offshore industry, racing teams etc

Natalie Cropp - geotechnical/environmental engineering

NHS – Epsom Hospital

Nicola Broomer – Architect

University of Surrey

Steve Pitman - Scientist working in oil exploration

Couper Building

Lab Room C1

Former students now qualified as a vet, doctor and a diagnostic radiographer.

Mrs Trimmer - computer programmer.

Lab Room C2

Jeff Day STEM Ambassador - IT Security Consultant – British Telecom

Lab Room C3

Presentations

Lab Room C4

Logica - Space business staff - Iain Brown and Karen Hutchins

Lab Room C5

Thermofisher Research and Development Scientists – Dr Saima N. Nayab PhD and Dr Glyn Ball

Lab Room C6

Careers information leaflets

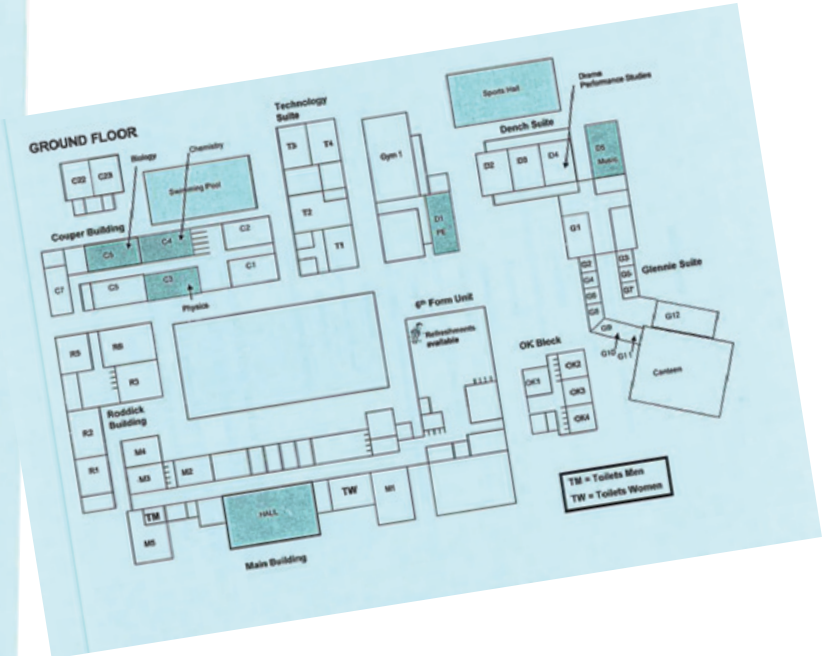
Lab Room C7

Laptops and Website exploration

We hope you have found the Rosebery STEM evening beneficial and the activities fun and educational.

It would be very much appreciated if you would please take a couple of minutes to fill in an evaluation form before you leave.

Thank you for your support.



Helsby High School STEM Themed Food Week

Managed by Liz Cullen, SSAT Lead Practitioner

Objectives for the Event

- To make students aware of the amount of Science and Technology which goes into something as basic, but important, as the food which we eat.
- To make students aware of the wide variety of STEM careers available.
- To encourage students to consider a STEM career
- To encourage students to consider studying STEM subjects at a higher level
- To make students aware of the importance of the transferable skills which STEM subjects develop.
- To make students aware of cross curricular links and of skills which can be transferred to enhance STEM subjects.
- To support the school's work as a Leading Edge School in terms of the community awareness aspect of the Curriculum Dimensions.
- To provide an exciting and memorable week!

Main Elements of the Event

- Linked to Science and Engineering Week
- Used the theme of "Food"
- Involve as many departments as possible and as many year groups as possible with activities in lessons throughout the week, for example activities on food ethics in RE, on food rationing in WW2 in history, on food and energy in physics and on how to make ice cream in chemistry.
- Interactive Careers Day for Year 10
- Visiting speakers and a brewery visit
- Charity events in aid of the World Food Programme
- Displays throughout the school and a quiz

Careers Day

- Joint initiative with the Work Related Learning Coordinator
- Focus on jobs in any area relating to "Food"
- Interactive, in the form of "speed dating"
- Used as many contacts as possible; local employers, colleges, universities, staff contacts, educational consultants, STEMPOINT, Science Ambassadors.

Charity Event

- Sixth form students heavily involved in the organisation
- Sponsor a sixth form student to live off a bowl of rice for 24 hours
- On line quiz on the world food programme
- Guess the number of grains of rice in the jar

Displays

- Timeline of technological developments in food production in main corridor
- "Fascinating Food Facts" throughout the school
- Food information posters in the canteen
- Display of fiction and non fiction books related to food in the library

Helsby High School Science and Engineering Week Quiz

Names(Max3):	Form:

Time Line (Look in the breakout space)

1. How many thousand years ago did the Egyptians start making bread using yeast?	
2. In which country was the fishing reel invented?	
3. How many hundred years ago was alcohol first distilled in China?	
4. Which group of people were the first to produced distilled water in 800 AD?	
5. Name the British inventor who designed the steel plough in 1837?	
6. In what year was pasteurisation invented?	
7. In which country was ginger ale first created?	
8. In what year were plastic bottles first used for soft drinks?	

Fascinating Facts (Look out around school)

9. How can you tell if an egg is fresh when you put it into a glass of water?	
10. Which vitamin helps prevent night blindness?	
11. The emperor of which country apparently discovered tea?	
12. What is the scientific name for the part of a potato plant that we dig up and eat?	
13. In what year did the first McDonald's restaurant open in this country?	
14. What is the additional ingredient that the ancient Mayans used to spice up their hot chocolate?	
15. What poisonous substance does marzipan contain?	

General Knowledge (Go find out or guess!)

16. How much fat is there in a single 'Pringle'?	
17. Bassetts originally launched the 'Jelly Baby' to mark the end of something, what was it and what were they first called?	
18. Who invented coca–cola?	
19. What chemicals are mixed with the food in your gut to digest them?	
20. What is your appendix for?	
21. Is a banana a herb, a fruit or a vegetable?	
22. Is a tomato a herb, a fruit or a vegetable?	
23. Where does the word sandwich come from?	
24. Which is the most expensive spice?	
25. What is the most popular food in the world?	

Answers: *1. 6000 2. China 3. 1400 4. Arabs 5. John Deere 6. 1871 7. Ireland 8. 1970 9. It floats 10. Vitamin A 11. China 12. Tuber 13. 1974 14. Chillies (and corn) 15. Cyanide*

CPD Session on STEM Careers

Aims and Objects

- Capture students' interest and imagination
- Use stimulating contexts to develop an appreciation
    - of the applications of science
    - that science–based jobs are really exciting
    - that scientists make an important contribution to society
    - that scientists use the skills they are developing
    - that scientists work in multidisciplinary teams
    - of the many different careers and jobs involving science
    - of the subjects and qualifications required to progress in science

Activity One

- Watch the 'Science Teachers' TV programme
- http://www.teachers.tv/video/31980
- Identify which key messages the teacher addresses.
- How does she address those messages.
- Be prepared to discuss your ideas.

Activity Two

- Choose a science topic you all teach or are familiar with.
- Look back at the key messages slide again and discuss
    - which activities you would keep
    - which activities you would adapt or enhance
    - which activities you would replace to enable you to introduce the key messages appropriately into the scheme of work for that topic
- Develop an outline exemplar scheme of work for your topic to present and evaluate.

Useful Resources

http://www.futuremorph.org

http://www.nhscareers.nhs.uk

Department for Education

Department for Education initiative to promote subject choice and careers in Science, Technology, Engineering and Maths (STEM) delivered by the Centre for Science Education at Sheffield Hallam University and Babcock International Group