



National  
**HE STEM**  
Programme

# HESTEMnews

SPRING/SUMMER 2011

[www.hestem.ac.uk](http://www.hestem.ac.uk)

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# Welcome...

**Over the course of the past year, the future of higher education within England and Wales has faced intense political and media scrutiny. Particular focus has been upon the changes to the funding model which have sparked intense debate and divided opinion. These changes will leave a legacy to the higher education landscape for many years to come: but we, as a sector, are now in a position to define what this legacy will be.**

While this is not the place to comment upon the funding models chosen, doing nothing was simply not an option. Further investment is required if our high-quality education is not only to be maintained, but to flourish in the global marketplace. With universities now declaring their fee plans from 2012 onwards, and future students potentially contributing a greater proportion towards the costs of their education, it is clear there will be a not unreasonable change in the expectations of students, and on the obligations placed upon universities.

Universities will be required to demonstrate their efforts to widen access and participation, and there will be greater scrutiny of teaching quality and of their role in preparing students for the transition to the workplace. There will also be a need for greater information to be made

available to inform student choice so universities themselves will need to ensure that they communicate effectively.

This makes it particularly timely to observe the synergies which now exist between the future priorities of HEIs and the work of the National **HE STEM** Programme, and to note how closely these align with those we worked to define over two years ago. Higher education must remain accessible to all so that those who have the desire and ability to do so are able to participate regardless of personal circumstances. However, we do not fully know what the implications of the changed fee regime might be for the decisions of students to engage with higher education study, and the higher education sector has a responsibility to communicate benefits and opportunities to potential cohorts of learner and encourage their participation. Widening access also includes part-time learners for whom the current system denies access to support for both tuition and living, and yet whose participation in higher education in the future is vital if the UK is to meet its 2020 target, defined in the 2006 Leitch report, of having 40% of adults qualified to Level 4 or above. When choosing higher education courses, students will increasingly utilise the enhanced information made available to explore learning, teaching and support mechanisms on offer, make judgements based upon perceived quality or innovative practices, and identify those programmes of study that will assist their effective transition to the workplace based upon the skills and knowledge they develop.

At the time of writing, the National **HE STEM** Programme has over 300 activities underway within more than 75 higher education institutions across England and Wales, meeting needs and priorities defined by those within the higher education STEM sector who engage directly with current and future cohorts of learner. With a large body of work

well underway, future responsibilities for the Programme over its remaining funded lifetime include ensuring all activities are properly evaluated, their learning captured and communicated more widely, and opportunities provided for others to adopt the ideas and approaches to leave an ongoing legacy. I would encourage you to take a look at our redesigned website as you may find ideas or approaches that will be of interest to you or your colleagues; if this is the case, please don't hesitate to get in contact with us to find out more.

Evaluation is worthy of special mention here as it is important to us all. Evaluation isn't something that should be undertaken only at the end of an activity, but an approach that should be embedded throughout to enable the collection of information and evidence to support any claims of success or impact that might reasonably be made. It will be important for the Programme to demonstrate the impact that its work has had upon the practices of those within the university sector, but is also important for universities themselves to demonstrate the impact of their work to both government and future generations of learner.

It is interesting to note that in some of the public discussions around the content of University Access Agreements, particularly by those outside the higher education sector, focus has been upon quantity of activity. Let us not forget the importance of being able to demonstrate the quality of our work. We know the impact of what we do, so let us collect the evidence to enable us to communicate this effectively to others.

With the summer months fast approaching, I would like to wish you all an enjoyable break. I know how very well deserved it is, particularly for my colleagues working within the National **HE STEM** Programme who have worked tirelessly and with determination to establish our activities. Real credit for what we have achieved to date is due to them. ■



# Programme Successes



Key successes of the National **HE STEM** Programme to date include:

- 5 new STEM Clubs clusters set up in Midlands and East Anglia at the universities of Wolverhampton, Staffordshire, Derby, Birmingham and East Anglia
- 10 employer engagement masterclasses offered to the sector across England and Wales
- 40 undergraduate STEM students from HEIs in the South-West took part in the 'Bath Taps into Science' festival in March as part of a 'STEM Communicators' project, and 60 undergraduate
- 43 regional projects now underway across the Programme to support the STEM higher level skills agenda
- 78 projects launched via the Royal Academy of Engineering, more than half of which involve employers in curriculum development
- 1000s of hits on the Maths Support Sessions website in Wales
- More than 8,000 students in England and Wales have now been involved with the

STEM ambassadors in the same region have now participated in employability activity

- Royal Society of Chemistry's Spectroscopy in a Suitcase (see p17 for more on this)
- Two new Chemistry Teacher Fellows have been appointed at the Universities of Leicester and Manchester
- HE Mathematics Curriculum Summit hosted by the Institute of Mathematics and its Applications, identifying priorities for mathematics in HE and launching a funding call to which one third of all HEIs in England and Wales who offer Mathematics have applied
- Choices Together, a project working with looked after children in the North East, has been greatly enhanced by a focus on STEM related subjects
- Publication of employability skills review report led by the North West spoke which can be downloaded from <http://www.hestem.ac.uk/resources>
- Guidance on evaluation of projects is now online at <http://www.hestem.ac.uk/evaluation%20>
- The Maths Busking project at the University of Manchester (see p17 for more details) has now been transferred to the University of Leeds

## HE STEM launches new website

May 2011 saw the launch of the redeveloped National **HE STEM** Programme website, [www.hestem.ac.uk](http://www.hestem.ac.uk)

[www.hestem.ac.uk](http://www.hestem.ac.uk) now comprises a publications library, and details of all National **HE STEM** Programme funded projects and upcoming events. Please do have a look and let us know what you think, and don't forget that you can also follow us on Twitter [@hestem](https://twitter.com/hestem).





# National **HE STEM** Programme Legacy Projects

## Legacy project for the North East - "Greening STEM"

This project integrates STEM and sustainable development: two major themes of relevance not only for the University of Bradford, but the HE sector and the UK economy. Science, Technology, Engineering and Mathematics will be a major driver of future economic regeneration development, job creation and high tech innovation, shaping the delivery of a low carbon future based on sustainable technologies and scientific innovation. Current connections between STEM and sustainability are however often weak and fragmented. Operationally STEM infrastructure is a major but poorly understood cost item which has the opportunity for substantial financial savings.

"Greening STEM" will bring together these initiatives into one holistic coherent approach and produce a major legacy for the National **HE STEM** Programme. Four major project activities have been identified and are under development:

- To translate the internationally renowned research activity of the Low Carbon Automotive Engineering team into the mechanical and automotive engineering curriculum. This will involve students designing and building low emission human powered transport on a competitive basis against students in other universities
- To develop and embed ethics and sustainability into the telecommunication and electrical engineering undergraduate curriculum
- To create core level 2 and 3 modules for computing and software engineering students with sustainability as a central theme
- The Big Green Laboratory project which will involve fundamental changes in chemistry pedagogy and curriculum (promoting the 12 principles of green chemistry) as well as the re-design of the lab facilities to promote sustainability in action. This work will be showcased at the forthcoming British Science Festival at Bradford in September.

**Legacy project for the North West - Developing STEM up-skilling services for the process industries in the NW – widening HE provision and income generation**

The Manchester Metropolitan University legacy project will focus on developing a systematic approach to the identification of workforce up-skilling needs in the process industries that align with key areas of strength in MMU’s STEM provision; in order to determine the suite of services most appropriate to employer and employee needs in the region. This will involve the development of direct flexible delivery incorporating new distance learning provisions (building on HLSP and Working Higher experiences) and working with local FECs and other professional training services providers delivering HE accredited training. The MMU Legacy Project will focus on developing a systematic approach to the identification of workforce up-skilling needs in the process industries that align with key areas of strength in MMU’s STEM provision; in order to determine the suite of services most appropriate to employer and employee needs in the region. This will involve the development of direct flexible delivery incorporating new distance learning provisions (building on HLSP and Working Higher experiences) and working with local FECs (with whom Associate College Agreements have been signed – see below) and other professional training services providers delivering HE accredited training. The outcomes will not only address an identified need for Level 3-4 workforce up-skilling in the region; but also embed a new way of working with Further Education providers to ensure more effective transition into the HE sector for workers who traditionally do not engage with universities.

**Legacy project for the Midlands and East Anglia - “EPS Grand Challenge”**

Aimed primarily at 3rd year MEng/MSci undergraduate students and graduates from all Schools in the College of Engineering and Physical Sciences at the University of Birmingham, EPS Grand Challenge is a 4-week activity to enhance employability skills running from Monday 11th July to Friday 5th August and ending with dinner and an award ceremony. Students will work in a team on a real challenge set by a company with an interest in STEM graduates, which could be about communication, the economy, new technologies, transport or infrastructure, involving team building exercises, peer review and assessment.

Over the course of the four weeks, in parallel with this project, participants will enjoy sessions on:

- Communication skills
- Team working and team building
- Personal development, reflection, personality analysis
- Commercial awareness
- Research and information-gathering skills
- Project management, planning and reporting
- Creative thinking
- Environmental sustainability
- Corporate responsibility and professional ethics
- Intellectual property
- Employee rights and confidentiality

Regional Director Kamel Hawwash says: “The Birmingham EPS Grand Challenge is a fantastic opportunity for students to tackle an identified commercial problem, learn new skills and prove themselves, ready for their graduate job applications. Participants will learn and develop the skills they’ll need throughout their careers, and these include people skills, technical/project skills and commercial awareness.”

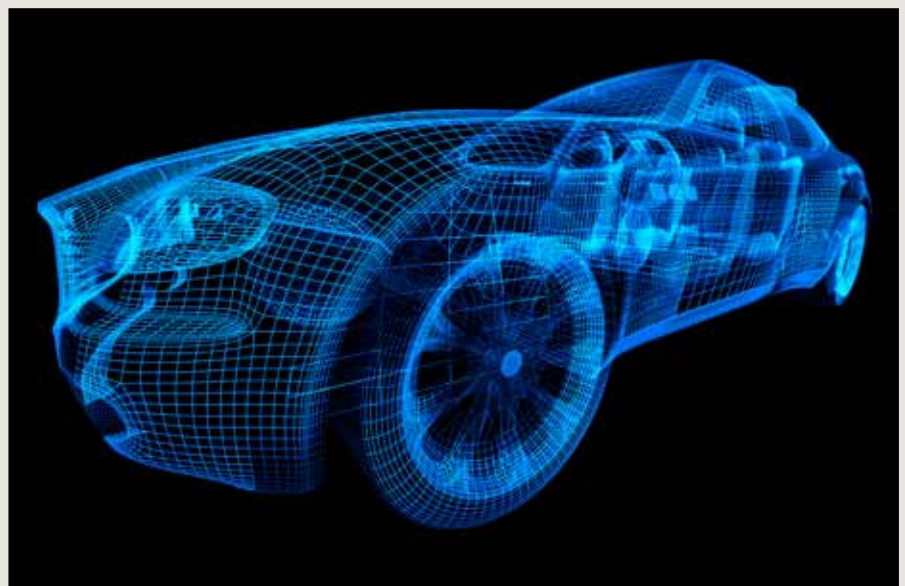
**Legacy project for London and the South East - Graduate skills development for the energy industry: STEM conversion courses – filling the void and keeping the lights on**

The projected shortfall of qualified engineers required for the Energy Industry to 2020 is well documented and of considerable concern at all levels of the industry and government. The UK currently does not have the capacity to supply these graduates through the conventional route of dedicated Electrical Engineering degrees, and companies routinely employ other STEM graduates to make up the shortfall, recognising that they will require significant upskilling once employed. This particular legacy project will provide a mechanism whereby current undergraduates in a range of STEM disciplines, in addition to Electrical Engineering, will be provided with access to dedicated work packages to develop the range of specialist skills and knowledge which the Energy Industry requires. These will be offered through their university departments as part of their ‘options’ within the latter part of their degree, which will not only alert undergraduates to career opportunities in the Energy Industry and their own suitability for these careers, but also provide appropriate training to increase their attractiveness to employers and thus, overall employability. These work packages will also be made available online to the workforce currently employed as a means of upskilling all and not just those who already have a STEM degree.

*Each regional spoke has established a substantial project that will form a legacy for the National HE STEM Programme within its institution, with the work undertaken collectively addressing the graduate skills and workforce development strategies of the Programme.*

## Legacy project for the South West - Strengthening, extending and embedding employer engagement across the undergraduate STEM curriculum

This project will build upon and extend existing good practice within the University of Bath, and more widely throughout the SW region, in relation to embedding employer engagement across the undergraduate STEM curriculum. Working with employers, academic staff and students, it will increase the provision of 'real world' experiential learning for STEM students by increasing both the number and range of employers offering opportunities for STEM students to undertake placements and employer-defined collaborative projects within their programme of study and the number of students taking up these opportunities. The project will also extend the range of ways in which employer engagement is embedded within the undergraduate curriculum, including the development of an innovative model of employer-led problem-based learning for undergraduate STEM students.



Through interaction and collaboration with national experts, the project will develop institution-wide mechanisms and resources to evaluate placements, to support placement students, and to increase equality of access for students to these experiential learning opportunities. It will improve the learning experience of placement students by enhancing departmental support practices, including developing specific skills training for students applying for placements and innovative online support resources for students while on placement and on their return to University. It will also identify and extend effective practice by improving access to placement opportunities for STEM students with disabilities, developing ways of supporting them appropriately throughout such placements and enhancing their employability skills.

## Legacy project for Wales - Fast track level 4 progression pathway in mathematics and engineering science for students with appropriate experience and skills

This project will develop a fast track flexible progression pathway at level 4 in mathematics and engineering science for experienced people within or potentially within the workforce. The pilot will be hosted by Swansea Metropolitan University and Glyndwr

or Bangor University in North Wales from September 2011. Part time formal learning and assessment will be offered over 42 weeks, totalling 250 contact tuition hours. The pathway will be worth 120 credits, of which 60 will be gained from formal learning, providing intensive development in mathematics and engineering science, and 60 via APEL which will recognise existing skills and knowledge. The progression pathway will enable students with the appropriate qualifications to fast track to level 5 studies in engineering. Although it is likely that most students will continue to complete their degrees by part-time study, students who successfully complete the fast-track level 4 course may choose to switch to full-time study at level 5. Following the pilot any HEI in England and Wales may choose to offer the progression pathway and/or accept students who have successfully completed the level 4 course for direct entry to level 5 of an engineering degree.

This project will therefore provide engineering based businesses with the skilled workforce they need in order to benefit from rapidly changing technology in a number of sectors including automotive manufacturing; advanced materials including metals and polymer composites; aerospace; and the energy industry.



# Institute of Physics Integrated Sciences programme



Integrated Sciences is an interdisciplinary sciences degree developed by the IoP with the University of Leicester and London South Bank University in order to offer a greater diversity of students access to physics, provide a recognised interdisciplinary science degree programme, offer an alternative route into physics, engage with the needs of employers and link skills to the job market.

The IoP will continue to work with the Universities of Leicester and London South Bank and are currently working with a third university who wish to launch an IoP approved Integrated Sciences degree. The structure of the degree has been revised to allow more flexibility and to build on individual universities' strengths and effective good practice will be shared with other physics departments nationally.

## Outcomes to date

- In September 2007, the University of Leicester launched their degree programme. Leicester's problem-based learning model has proved particularly successful
- Requisite key skills for graduates of the Programmes were established in line with the QAA benchmark recommendations for physics degrees
- As a direct result of Integrated Sciences, the Institute has developed a new level of accreditation called 'recognition status' for physics-based degree courses

## Royal Society of Chemistry context and problem based learning

Context and problem based learning (C/PBL) is a teaching methodology which is rapidly gaining popularity in teaching science subjects at HE level. As its name suggests, the approach is based around getting students to examine real-world problems and scenarios that will not only develop their understanding of the topic, but show them how their knowledge can be applied in a practical manner. By delivering material in this way, students also develop their problem-solving, teamwork and communication skills, in addition to enhanced independence.

The RSC has a number of C/PBL resources which are freely

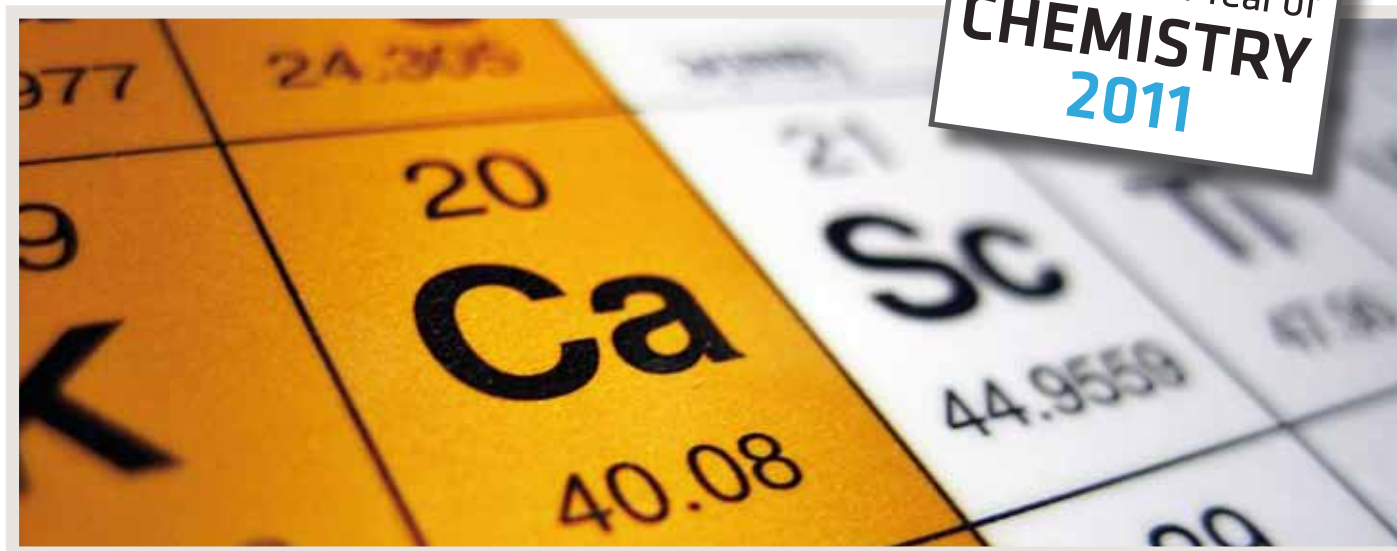
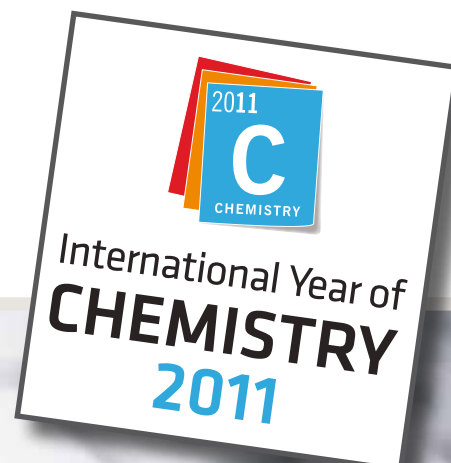
available from the RSC's website at [www.rsc.org/cpbl](http://www.rsc.org/cpbl). To increase the number of C/PBL practitioners and to support those already engaged in C/PBL, the RSC aims to augment this collection by commissioning the development of a series of new resources for delivery at undergraduate level. These will be based around the themes outlined in the RSC's Roadmap: Chemistry for Tomorrow's World, which represent key societal challenges that will be faced by scientists of the future, such as energy production, water quality and the supply of raw materials. Workshops will also take place throughout the 2011-12 academic year to provide lecturers and teaching staff with



the opportunity to learn more about a C/PBL approach to teaching and learning, and how to implement it within their courses.

The RSC are looking for HEIs who are interested in trialling the new resources early in 2012: if you wish to participate in a trial, or would like more information, please contact the RSC at [hestem@rsc.org](mailto:hestem@rsc.org)

# International Year of Chemistry



This year is the International year of Chemistry (IYC) with activities taking place across the world to celebrate chemistry and increase the public appreciation of this vital subject. Raising the profile of STEM disciplines among potential students is key to safeguarding the supply of qualified scientists in the future and, as such, is an important part of IYC and National **HE STEM** Programme initiatives alike. As the National **HE STEM** Programme seeks to promote STEM subjects to a wider variety of learners, and to make degrees in these subjects both more attractive to students and more relevant to industry, the IYC comes at the perfect time.

Among the many events and activities taking place, two flagship IYC projects are underway that highlight the importance of chemistry in relation to one of our most essential resources: water.

## The Global Experiment – Water: A Chemical Solution

The global experiment sees school students around the world participating in a shared data gathering project based around water. Supported by the RSC, and devised by the International Union of Pure and Applied Chemistry (IUPAC)

and UNESCO, the project aims to meet the IYC aims of inspiring students' interest in chemistry whilst bringing attention to a topical scientific issue that is one of the most significant global challenges facing future scientists.

Water is obviously a critical resource and this, combined with its ubiquity, presents an ideal means to bring students together across the globe. Throughout 2011 students will be carrying out simple experiments looking at different aspects of water, with their results being combined to yield a worldwide dataset. The experiments investigate water quality, where students will determine the pH (acidity) and salinity (salt content) of local water samples. The 22nd of June was the International Global Experiment day when participating schools conducted their experiments and collected their data.

These results will then be collated through the IYC data collection website to create a global map of all the submitted data. This huge project will thus show students the power of joint enterprise; allowing them to see the significance of their contribution and the importance of international collaboration in science.

More information, as well as details of the experiments themselves, can be found on the RSC website [www.rsc.org/globalexperiment](http://www.rsc.org/globalexperiment) and on the IYC website [www.chemistry2011.org](http://www.chemistry2011.org)

## Our Children on Water

The unifying and emotive nature of water has brought about a second project with this subject at its heart. Based upon a RSC project in South Africa looking at children's experiences of water, the project aims to capture students' thoughts and feelings about water in the form of artwork. Working with the title 'Water: Refreshment or Responsibility?', students in schools and art studios across Africa and Europe have produced work depicting their own experiences and also highlighting the role of chemists in producing safe and clean drinking water. A selection of 40 of these pieces has been brought together to create a unique European exhibition which is currently on tour. The exhibition will visit major European cities, running until November this year. An online display of the exhibition pieces is also available.

More information is available on the RSC's IYC website [www.rsc.org/iyc](http://www.rsc.org/iyc)

# The hybrid part-time MEng degree scheme – an innovative approach to HE provision in nuclear and chemical engineering



Continued skills shortages in the nuclear and chemical engineering fields are being exacerbated by the paucity of part-time MEng provision in these disciplines. These growth sectors in engineering business are often forced to wait for graduates to study four years, full-time, before they can join the industries which are in desperate need of their skills.

Lancaster is central to a geographical region that is home to a significant number of industrial engineering businesses, many of which are in the nuclear and chemical sectors. HE provision of these disciplines is significantly under strength across the UK, with Lancaster, for example, offering the only Nuclear Engineering MEng in the UK, and the Institution of Chemical Engineers reporting significant shortages in HE course provision, far outstripping employer demand. Forecast growth in these sectors, as a result of decarbonising the electricity supply, will coincide with widespread changes in the way students' education is funded which is liable to lead to increased demand for part time and flexible provision.

***“The hybrid part-time MEng is highly complementary to Lancaster’s strategy for Engineering: at MSc level, Lancaster’s Engineering Department has already pioneered two highly successful, industry-based schemes for the nuclear sector which are available exclusively part-time.”***

***Professor Malcolm Joyce,  
Head of Department of  
Engineering, Lancaster  
University***

In collaboration with a wide number of organisations and professional bodies which include Sellafield Ltd., BAE Systems plc., Centrica plc., the Royal Academy of Engineering, the Institute of Engineering and Technology, the Institution of Mechanical Engineers, the Nuclear Institute, the Institute of Chemical Engineers, the Institute

of Materials, the National Skills Academy for Nuclear, and Cogent, Lancaster University has therefore secured funding from the National **HE STEM** Programme to create a hybrid part-time MEng award, which will establish an innovative approach to MEng HE provision in nuclear and chemical engineering and a mode of delivery combining the traditional full-time student experience with the experiential benefits of part-time provision, and also collate the priorities of both industry and professional bodies and bring this expertise to bear upon the design of this new mode of study.

This innovative award is based upon consultation with industry, PEIs, HEIs and students and will involve the rationalisation of the third and fourth years of the existing full time provision at Lancaster which will enable students in industry with prerequisite qualifications to register for part-time study over 4 years, graduating with an MEng (Hons).

# Higher level skills for **HE STEM** students: mathematical modelling and problem solving

Through the National **HE STEM** Programme, four universities - Leeds, Manchester, Keele and West of England – are collaborating to address a problem of increasing concern in Higher Education: the need to equip students with the skills of setting up mathematical models and applying mathematics to find solutions to real problems. These skills are essential to many STEM degree programmes and are highly valued by employers.

The significance of these skills has long been recognised in science and engineering. In 2006, Dr Alan Stevens, of the Mathematics Modelling Group, Rolls-Royce, remarked that

**“...the ability to solve physical problems using mathematical modelling and mathematics are invaluable attributes for new graduates entering an engineering industry.”**



Recent findings from research into the country's mathematical needs, published on 14 June 2011 by the Advisory Committee for Mathematics Education (ACME), confirm that the ability to apply mathematics and to communicate mathematical ideas are skills highly valued by employers. However, the research also suggests that these skills are often perceived as lacking in new graduates from STEM degree courses.

When trying to understand issues relating to the transition from university to the workplace, it helps to review what has happened at the transition from school/college to university. In the 1990s, Higher Education experienced a well documented and well evidenced mathematics problem in which many first year students on mathematics - related degree courses lacked fluency in basic pure mathematics techniques. This problem received considerable attention leading to changes to the curriculum for A Level Mathematics. These changes, together with national support to promote the study of A level Mathematics and enable more students to take AS/A level Further Mathematics, have led to significant increases in the uptake of A level Mathematics and Further Mathematics. As a result, many university departments now recognise that fluency in mathematical techniques has improved. Unfortunately, universities now report that, despite this increase in technical fluency, the ability of new undergraduates to apply mathematics to solve problems (as opposed to answering standard exam questions) has declined.

## **Why has problem solving using mathematics suddenly emerged as a problem in HE?**

Over the past 20 years both A level Mathematics and A level Physics have undergone substantial curriculum change such that sixth formers now experience far less mathematical problem solving in both applied mathematics and physics than was previously the case. Specifically, A level physics has become far less

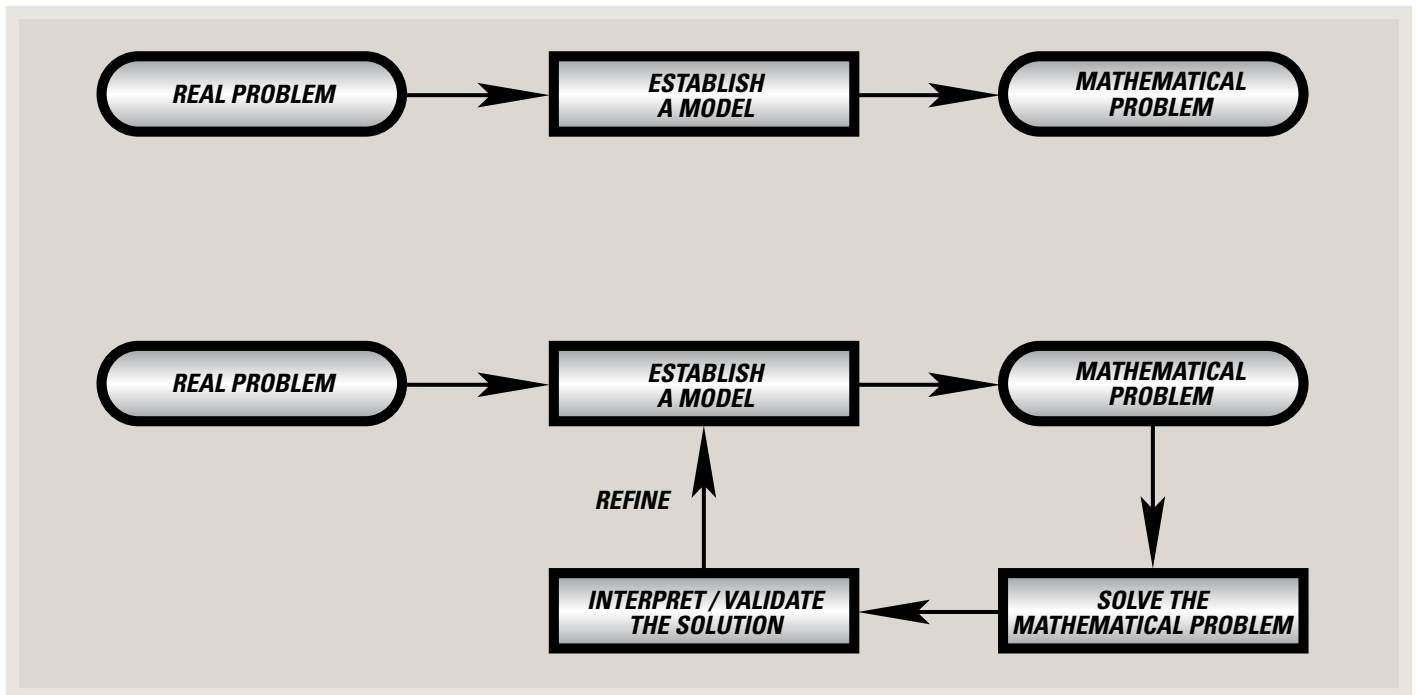
mathematical with the problem solving element of 'core physics' being substantially diminished, whilst the applied mathematics content within A level mathematics has been reduced by 33%.

Consequently many students now entering HE to study applied mathematics, physics or engineering have studied at most one module of Newtonian mechanics. For example, at the University of Leeds, 45% of first year physicists in 2010 had at most one module of mechanics. Further evidence for the decline in the take-up of mechanics and the finding that *"UK engineering, science and industry prize highly the skills of mathematical modelling and problem solving grounded in Newton's mechanics"* can be found in the 2009 report 'Newton's Mechanics: Who Needs It?' (Mike Savage and Charlie Stripp, Maths, Stats & OR Network 2009)

[www.mathstore.ac.uk/mechanicsreport](http://www.mathstore.ac.uk/mechanicsreport)

Since Newtonian mechanics has long been seen as an ideal vehicle for developing students' mathematical modelling and problem solving skills and since at least two modules are generally considered necessary for students in schools and colleges to meet sufficient content and have sufficient practice in mathematical problem solving, it is hardly surprising that HE is now faced with the task of equipping many new STEM undergraduates with the basic skills in mathematical modelling that are needed for science, engineering and industry.

While the optimal solution will involve change to the pre-university curriculum, until that happens, it is imperative that universities act in order that students can become quickly equipped with the skills and abilities they need to progress within their undergraduate STEM programmes. The approach currently being taken forward by the four universities, as part of this National **HE STEM** Programme project, involves introducing the two modelling skills 'setting up a model' and 'multi-stage modelling' into the



university curriculum for those STEM undergraduates who need them, in a way that is most suitable to their needs. There are several ways of introducing modelling that are particularly appropriate for engineering, mathematics and physics students, of which Newtonian mechanics is only one. The approach adopted within this work allows the six departments involved to implement tailored approaches based upon a common core.

**So what will the proposed curriculum developments be?**

At the University of Leeds, for first year physics students modelling and problem solving skills will be developed through innovative and engaging problem based learning focused around Newtonian mechanics. Within Mechanical Engineering four level 1 modules are being adapted and coordinated to promote and develop mathematical modelling skills. The vehicle for offering modelling opportunities will be the 'Design and Build' challenges that students undertake and an exciting aspect of this work is that students will build their designs and will be able to test the predictions of the models. In the School of Civil Engineering a new intervention will be embedded in the level 1 undergraduate curriculum. Group workshop sessions using a new set of materials will be integrated into the

first year design project which will be used to develop students modelling and problem solving skills.

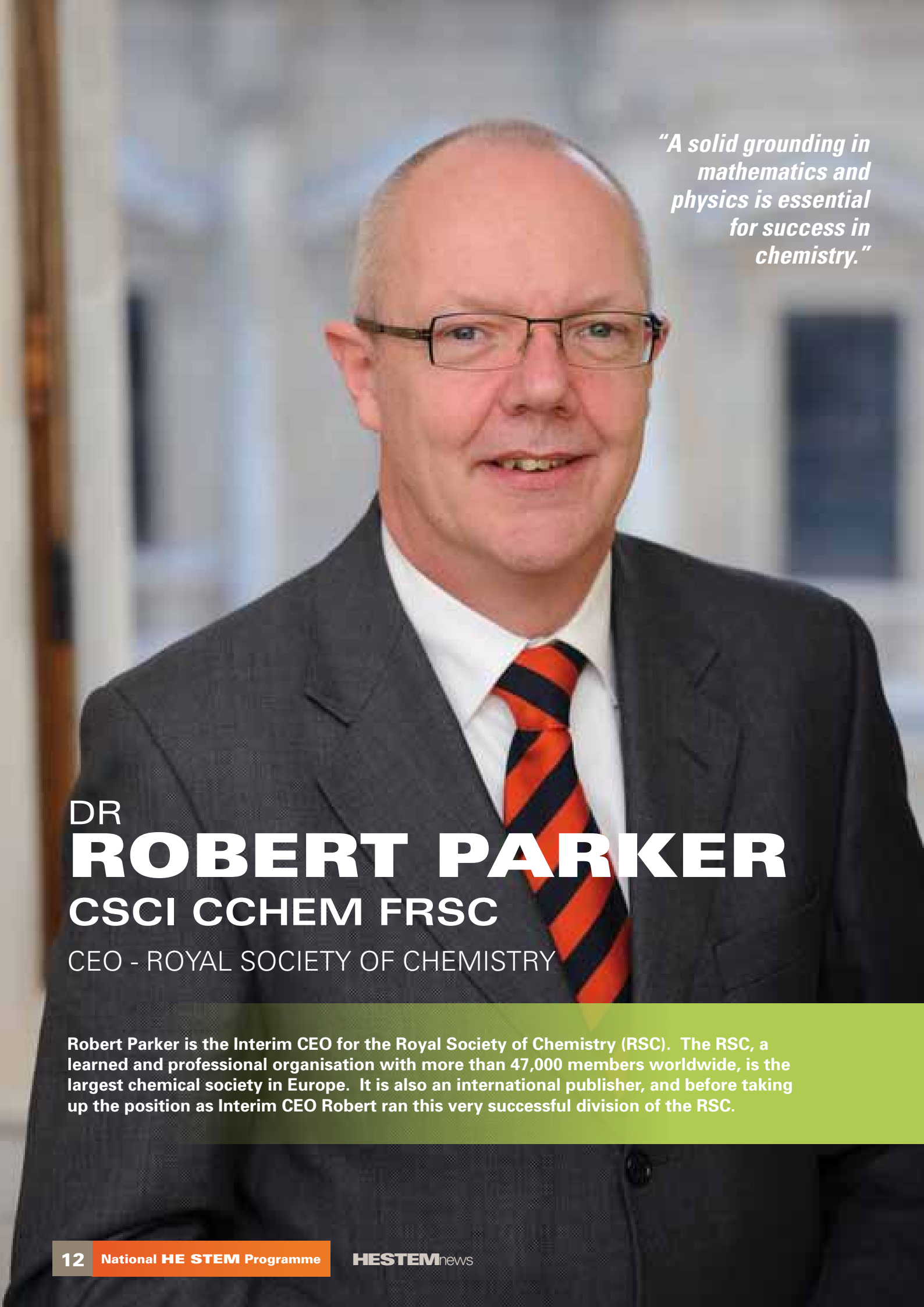
At the University of Manchester, two projects, based upon introductory mathematical modelling, will be included with the Mathematical Workshop, a first year unit undertaken by all single honours mathematics students, and will constitute two-thirds of the unit. Within the School of Mathematics and Computing at Keele University a new level one module will be delivered to first year single honours mathematics students and as an elective to all students within the science faculty. This module will introduce computer skills and model building methodology to derive equations whose behaviour will then be analysed. At the University of the West of England a new level one engineering mathematics module will be delivered to students on degree programmes in Civil Engineering, Building Services and River and Coastal Engineering. The module will be designed to develop mathematical modelling skills and an understanding of how mathematical models relate to problems encountered in the engineering workplace.

As part of this work, it is important that the impact of these curriculum enhancements that will run from autumn 2011 are fully evaluated and understood. It is for this reason

that the School of Education at the University of Manchester will undertake a programme of educational research to support the activities within each department, and will explore the direct impact the interventions have had upon student modelling and problem solving skills. This will also enable evidence based refinements to be made, much as would happen within the modelling and problem solving process! Longer-term sustainability remains a key driver, and since the interventions now being developed will be naturally embedded within the curriculum of each department they will continue to be a core part of the course for years to come, thereby ensuring sustainability.

The four universities will also be involved in outreach work with local schools and colleges, helping sixth formers studying A level mathematics to develop their mathematical modelling and problem solving skills, and helping them and their teachers to understand the importance of these skills in STEM degree courses. This work will be facilitated through links with the Further Mathematics Support Programme.

Results from this national **HE STEM** Programme project will be communicated widely as they emerge. In the meantime, if you would like to know more, Professor Mike Savage from the University of Leeds would be delighted for you to get in

A portrait of Dr Robert Parker, a middle-aged man with glasses, wearing a dark suit, white shirt, and a red and black striped tie. He is smiling slightly and looking towards the camera. The background is a blurred indoor setting with white walls and a window.

*"A solid grounding in  
mathematics and  
physics is essential  
for success in  
chemistry."*

DR  
**ROBERT PARKER**  
CSCI CCHEM FRSC  
CEO - ROYAL SOCIETY OF CHEMISTRY

Robert Parker is the Interim CEO for the Royal Society of Chemistry (RSC). The RSC, a learned and professional organisation with more than 47,000 members worldwide, is the largest chemical society in Europe. It is also an international publisher, and before taking up the position as Interim CEO Robert ran this very successful division of the RSC.

As a professional body and National **HE STEM** Programme partner, the Royal Society of Chemistry (RSC) is committed to raising the profile of chemistry among the next generation. The scientists of tomorrow will be instrumental in solving the problems and challenges faced by society. Ensuring a supply of well-equipped science graduates, both now and in the future, is therefore a guiding principle for both the RSC and the National **HE STEM** Programme. Within the National **HE STEM** Programme, the RSC's Spectroscopy in a Suitcase project looks specifically at engaging school students and raising their awareness of chemistry degrees and careers. The context and problem-based learning resources produced by the RSC will also enhance undergraduate teaching to improve the quality and employability of chemistry graduates. In this interview, the RSC's CEO, Robert Parker, gives us his views on the role that chemistry has to play in education and research, and on the future of science.

The RSC has a portfolio of 31 high-quality journals, publishes around 90 books each year, and has a suite of databases, current awareness products, magazines, etc., all in chemical science and related areas. The RSC's electronic content platform contains more than one million journal articles, book chapters and database records, the oldest dating back to 1841 when the Society began publishing. More than 90% of RSC's published articles and more than 90% of its publishing revenues originate outside the UK.

Robert has a PhD in chemistry and is a Chartered Scientist, Chartered Chemist and Fellow of the Royal Society of Chemistry. He has worked for the RSC for more than 25 years. He is also a husband, father and biker and is currently Immediate Past Chair of the Association of Learned and Professional Society Publishers (ALPSP) which is the international trade association for not-for-profit scholarly publishers and those who work with them.

### How does Chemistry interact with the other STEM disciplines?

Chemistry is a core science, but it cannot stand alone. A solid grounding in mathematics and physics is essential

for success in chemistry. Divisions between subject areas, which were probably always falsely drawn, are also being eroded by the very significant growth in interdisciplinary research. The whole area of materials science, which incorporates chemistry, physics, engineering and biology, is a great example of the development of interdisciplinary areas.

**Are there too many people currently taking PhDs in Chemistry?** *[A number of recent commentaries such as the editorial in Nature on 21st April 2011 have suggested there are too many PhD students coming through the system for the number of academic jobs available]*

Personally I don't believe there are too many people taking PhDs in chemistry. It would be wrong to assume that the only point in gaining a PhD would be to follow an academic career (although that is, of course, a legitimate outcome!) Many people study for a PhD as a result of being enthused by project work undertaken as undergraduates and feeling that they would like to experience more of the same or similar. Some will leave university to work in industries using or related to chemical sciences. Some will follow careers in teaching, where having teachers with highly developed practical skills can be a real bonus. For others, having completed a PhD, they can be sure that they should seek a career elsewhere, either in a field which uses their scientific knowledge or one which uses the transferable skills they have gained as a result of their study and research. Those skills include but are not limited to numeracy (which should never be underestimated as a skill), problem-solving ability, self-motivation, presentation skills, project management skills and developing analytical thinking. Such skills can be very well applied in any number of roles. It is good and important to have scientifically literate people represented in many different walks of life. The RSC employs 30 graduates a year in roles in science policy and publishing, and about 20 of these usually have a PhD.

### Why have an International Year of Chemistry?

There is a huge amount to celebrate about chemistry and its achievements

and having an International Year of Chemistry assigned by the United Nations is a great way to do this. The activities during the year will highlight the contribution chemistry has made and continues to make in solving global issues and making the world a better place to live. Also, with a focus on celebrating the centenary of the award of the chemistry Nobel Prize to Marie Curie, it provides an opportunity to celebrate the contribution that women have made to chemistry.

At RSC our main goals for the IYC are to:

- Increase the public appreciation of chemistry in meeting world needs
- Encourage interest in chemistry among young people
- Generate enthusiasm for the creative future of chemistry

and we have a great programme of activities to help achieve these goals.

### What areas of science are you most excited about?

Many areas of chemistry excite me, but I feel that those which are really seeking to deal with global challenges come first for their relevance to us all. The RSC has worked on a roadmap for the chemical sciences - Chemistry for Tomorrow's World - and the specific challenges there are those which require urgent attention from the chemical science community around the world.

### How do you think the world of science will look in 25 years time?

I believe there will be a massive influence on the chemical sciences from the enormous growth in research output from China, India and Brazil particularly. The world map of chemistry in 2026 will look very different. My fervent hope is that there will have been an era of fantastic global collaboration on the issues raised in the last question and that if not solved, we will be very well on the way to solving those and any others that have come up in the meantime. Chemistry has a great contribution to make to sustaining our world and improving our lives.

# HE STEM Engagement conferences in Wales

Held at Cardiff University in March and Glyndŵr University in May, these conferences attracted delegates from Careers Wales companies, the British Science Association, the Association of Science Education, the Higher Education Funding Council of Wales, Reaching Wider Partnerships, the South West Wales Regional Learning Partnership, the sigma network, the Women's Engineering Society, Techniquet, See Science, the National Science Academy for Wales and Scottish Power, in addition to representatives from schools, HEI and FE college academic departments.

The topics addressed included workforce upskilling, employer engagement, improving graduate skills, outreach and widening participation, the Royal Society of Chemistry's project: 'Spectroscopy in a Suitcase' (see page 17 for more about this!) – and the MSOR Network's HE Mathematics curriculum workshop.

Attendees were also informed of opportunities to engage with the National **HE STEM** Programme in relation to the forthcoming Practice Transfer Adopter Scheme; small scale project opportunities in employer engagement, employability skills and curriculum enhancement; student transition projects including Maths Support and Teacher Fellows; and diversity and gender issues in outreach



projects working in partnership with Engineering Education Scheme Wales.

About 50% of delegates completed feedback forms at each conference and overall the feedback was very positive:

- 88% of delegates at Cardiff and 90% at Glyndŵr responded that they now knew more about the **HE STEM** Programme.

- 88% of delegates at Cardiff and 92% at Glyndŵr responded that they were now more likely to engage with the **HE STEM** Programme.

*'Well organised with a variety of presentations. Great opportunity to network and share good practice.'*

## Comments from delegates included:

*'Valuable insight into future activities'.*

*'Really informative and raised awareness of initiatives. Clearer on some opportunities.'*

*'Great opportunity to network! I feel quite inspired by some of the projects work and presentations.'*

# AS-Level Revision Day Conference at the University of Glamorgan



On April 12th and 13th April 2011, a group of 500 keen young AS-Level maths students attended the one day maths revision conferences, hosted by the Division of Mathematics at the University of Glamorgan. Both conference days followed a similar format, with revision lectures in the morning and talks on careers and effective exam preparation in the

afternoon. The two days form part of the Division's annual revision conference week. A grand total of 1,000 maths students from numerous schools and colleges throughout the region benefited from the week's programme.

Dr Mark Jones, Senior Lecturer in Mathematics and the Division's Outreach Coordinator, organizes the conferences on a regular basis. Having attended the National **HE STEM** Programme's Maths Strand pilot project roll out event, organized by the National **HE STEM** Programme's Wales spoke at Cardiff University last year, Mark invited Makhan Singh from the Institute of Mathematics and its Applications to speak at the conference.

In his presentation, Makhan gave a highly motivational maths careers talk to all students and teachers at the conference showcasing the More Maths Grads pilot project activity and the new National **HE STEM** Maths outputs. He highlighted the all-new Maths Careers website and sign-posted the freely downloadable resources now available.

The remaining afternoon talk, which formed the keynote address, was given by Emrys Read, Chief Examiner, WJEC. In his presentation, he highlighted some of the common mistakes and pitfalls students can fall into and how best to avoid losing marks needlessly.

Teachers in attendance at the AS-Level days were also given a talk from Mark Griffiths, Head of Mathematics at Glamorgan, on "What is Happening in Mathematics". His talk focused on some of the many developments in higher education at the present time and also highlighted the Division's Outreach portfolio.

The Revision Conference Week forms the last of seven outreach events which Glamorgan Maths Division runs throughout the academic year. The Division very much hopes to see a good many of these young people again in the future, either at one of their forthcoming outreach events, or perhaps during their Maths Degree induction week's programme of activities.



***"Very helpful, not only in answering questions for exams, but also in helping me with career choices within maths. The speakers were interesting and answered questions clearly, making sure we understood."***

***(student)***



# The Big Bang Fair 2011

The Big Bang Fair is now the UK's largest STEM fair for young people. This year it was held at London Excel between the 10th and 12th March with nearly 30,000 registered attendees. With the support of the National **HE STEM** Programme, the Maths Zone was the largest it has ever been, aptly named the 'x plus why factor'. HEI maths departments from across the country pulled together to provide a wide range of engaging activities. In the future Programme funding will also enable ideas and equipment to be shared with other institutions, ensuring

that the good work continues and expands in the years to come.

Professor Peter McOwan from QMUL, a key partner in the pilot project More Maths Grads, demonstrated the mathematics of card tricks with the help of QMUL students - showing young people how you can successfully amaze your friends every time if you rely on the power of maths! Meanwhile Tony Croft and Steve Joiner from Loughborough deftly removed any fear of trigonometry by showing how it can be used to programme robots to follow a pre-set course. The IMA contribution included mathematical puzzles; the foam cube challenge; the Harmonograph, an elegant but simple device using two pendulums which produced patterns of startling complexity, and a demonstration of the principles of projectile mechanics as applied not only to marbles but also a jumping dog!

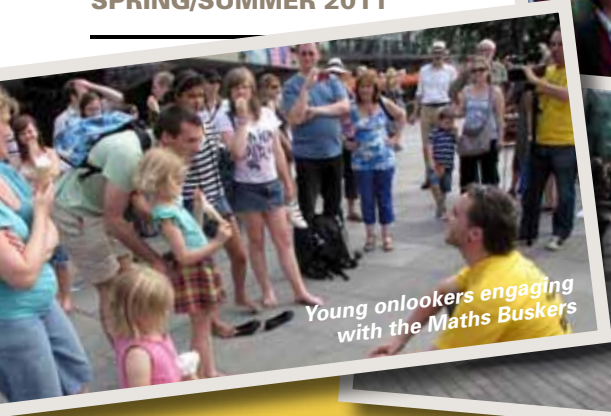
Chris Budd and his team of students from the University of Bath presented a variety of activities on the theme of Living in a Complex World, fascinating their audience with the chaotic antics of a double pendulum. (As a consequence of his participation, Chris has now also written a guide to organising a substantial exhibition which is available to download from the National **HE STEM** Programme website.)

Perhaps the most eye catching contribution was the trebuchet, a medieval energy weapon provided by Paul Hewson of Plymouth University. It stood out from across the room and attracted pupils of all ages. It was also an excellent device for introducing maths – starting with questions about its use and the thickness of medieval castle walls and then moving onto conversion of energy and the counterintuitive maths which shows that the ball would travel the same horizontal distance on the moon!

In addition to the activities on the main floor, the mathematics community contributed workshops and theatre shows including 'Surprising Geometry', a Royal Institution Masterclass taster delivered by Sara Santos and Matt Parker and 'The Geometry of the Industrial Revolution' by Chris Sangwin from the University of Birmingham. Rob Eastaway demonstrated the mathematical background to Gameshows while Steve Humble introduced the Randomness of Maths. Finally, Chris Budd supported his activities on the main floor with more extraordinary revelations on complexity.

Sincere thanks are also due to a small army of students from the University of Greenwich who helped to deliver the activities with unflagging enthusiasm. A Maths team effort all round!





Young onlookers engaging with the Maths Buskers



Maths Busking in Manchester City Centre



Maths Busking in Birmingham's Bullring

# Maths busking

Although many initiatives aim to improve the public image of mathematics, it still suffers from a general perception as dull and unpopular. However unless mathematicians are fundamentally

Buskers habitually encounter the same disinterested public with whom mathematicians are familiar! The primary focus of Maths Busking is thus to develop engaging, innately entertaining mathematics routines

*"...it almost crosses over a bit with magic. I suppose some magic is maths based and stuff and it's just showing people that, you know, maths can be fun..."*

different from other human beings, there must be some way of appreciating the beauty and the joy of mathematics and its relationship to the physical world before undertaking serious study of maths.

that capture the audience whatever their mathematical background. When people walk away from seeing Maths Busking, they should have a better appreciation of mathematics, feel that they engaged with the subject, and have ways to explore their mathematical interest further.

The routines developed capture the audience through entertainment and require only curiosity and the basics of numeracy to understand. Maths Busking focuses heavily on the training of the Maths Buskers, not only for the sake of the busking quality, but also so that the trainees will continue to interact with the public long after the initial events. (It is vital that the mathematics community interacts and communicates with the general population and aims to explain what mathematics is and why it is so important !) From informal consultation with the mathematics promotion community (including the Maths Prom list) Maths Buskers work to create a culture amongst mathematics specialists of regularly going out and 'informally' communicating mathematics. Busking is a provenly excellent means to communicate mathematics, and being trained for busking is a creative way of developing communication skills transferable to other areas like teaching, lecturing and any situation facing a (potentially difficult) audience.

**As a result of funding from the National HE STEM Programme, nineteen Maths Busking performance days took place in 2010. To find out more, visit <http://mathsbusking.com>**

## SIAS IN SOLIHULL

Leicester University recently paid a visit to Lyndon School and Humanities College in Solihull, to demonstrate their £15,000 Spectroscopy in a Suitcase kit to a group of year 7 students. The students were given a wide range of substances to scan, including plastic bottles, fabrics and bank notes. They were then asked to check their results against standard spectra in order to identify the chemical make-up of their sample.

Run by the National **HE STEM** Programme's partner, the Royal Society of Chemistry, **Spectroscopy in a Suitcase** is aimed at widening participation in Chemistry in Schools across England and is designed to get the students thinking about how chemistry is used in the working world. Although initially aimed at A-level students, SIAS has been developed recently for secondary school visits for Key Stage 3 and 4 pupils.

For more information and to book a visit for your school or club please contact the **National HE STEM Programme team** at the Royal Society of Chemistry, [hestem@rsc.org.uk](mailto:hestem@rsc.org.uk)



Year 7 Students, Lyndon School

# Nuclear Island: new build experience for science and engineering students

A unique and exciting opportunity for students to develop and apply their skills to a scaled down new build construction project, Nuclear Island represents an ambitious partnership between Imperial College London, Constructionarium, Cogent Sector Skills Council, Engineering Construction Industry Training Board (ECITB)

and Construction Skills with funding from the National **HE STEM** Programme and the Royal Academy of Engineering. The pilot week in June saw 25 engineering students from Imperial College London construct a scaled down nuclear core reactor, in a simulated highly secure environment at the Constructionarium facility at Bircham Newton in Norfolk. Students' ability to respond to a potential disaster was tested to maximum effect on the final day of construction with an unforeseen safety breach.

Nuclear Island will also offer a new build undergraduate module for science and engineering students across the country in which nuclear safety culture will play an essential role, embedding critical safety behaviours from day one.

**Cogent CEO Joanna Woolf says:**

"the prospect of replacing the current fleet of nuclear power stations represents a multibillion pound private sector investment, but one which is dependent on a highly skilled workforce. Cogent's research shows that the industry will require a thousand new recruits every year to ensure that power generation meets projected demand to 2025 and beyond.

"This new initiative aims to become an integral part of a number of UK undergraduate courses, attracting and exposing students from civil and nuclear engineering to the New Build sector. This learning experience will also be levelled to meet the needs of apprentices, post-graduate students and employee continuing professional development. It will support the delivery of essential nuclear skills for the proposed New Build programme."

The summer/autumn issue of **HE STEM** news will carry a fuller report on the progress of Nuclear Island.

***"This new initiative aims to become an integral part of a number of UK undergraduate courses"***





## New BEng in Biomedical Engineering

From September 2012, King's College London is offering a new BEng in Biomedical Engineering. The programme is one of the first of its kind in the UK, with a focus on the application of engineering and physics into healthcare related research and industry. Biomedical engineers integrate biology and medicine with engineering to solve problems related to living systems.

The practice of medicine is being transformed by application to the human body of insights from electrical, mechanical and chemical engineering, mathematics, and physics; and this programme will offer a foundation in mathematics, engineering and science in the context of a specialised Biomedical Engineering curriculum.



## P1 Marine Foundation undergraduate awards

P1 Marine Foundation has launched a national Awards scheme to recognise and reward undergraduate projects across the UK which present outstanding project proposals specifically designed to have a positive and sustainable impact on the marine environment. Undergraduate students from universities across the UK are eligible to apply and the deadline for submission is **31st July 2011**. Full details are available from [staseer@p1marinefoundation.org.uk](mailto:staseer@p1marinefoundation.org.uk)



## Putting STEM on the map

The Hidden Science map, which is linked to the 'News' section of [www.hestem.ac.uk](http://www.hestem.ac.uk), aims to tempt all of Britain's scientists, engineers, technologists and mathematicians out of hiding to show how much science is taking place across the UK. To add your own 'pin' or for more information, follow @hiddensciemap on Twitter or visit [www.hiddensciemap.org](http://www.hiddensciemap.org)

## The Leaders' award: encouraging the STEM leaders of the future

The Leaders' award for STEM raises school student awareness about the vast range of careers available to them within STEM related industries by encouraging students to act as "STEM reporters" and interview professionals from various STEM related fields. To find out more, please visit [www.leadersward.com](http://www.leadersward.com)



## Expertise Wales

Expertise Wales is a web-based portal supported by the Department for Economy & Transport in the Welsh Assembly Government which facilitates businesses working with all Universities and Colleges in Wales by providing a central gateway to experts, facilities, specialist centres and services. General advice is also available on problem solving, research and development, specialist equipment and services, access to graduate skills, how to work with a university and how to secure funding.



## £44,000 programme adds value to Maths

A new programme to widen access to Further Mathematics at GCE AS/A2 Levels in Wales has been endorsed by Education Minister Leighton Andrews. Supported by a total of £440,000 from the Welsh Assembly Government over a three year period, the programme is being delivered by the Wales Institute of Mathematical and Computational Sciences (WIMCS) based at Swansea University.

Leighton Andrews said: "It's encouraging that over 50 schools have already joined the programme...Through the online resources and a range of other support, this programme will provide opportunities for more young people in Wales to pursue studies in Further Mathematics".



## Engineering to have its own Nobel-style international prize

As part of its Plan for Growth, the UK Government has announced exciting plans to create a Nobel-style international prize for engineering. This prestigious award, which has been welcomed by the Royal Academy of Engineering, will form part of the Government's vision to promote engineering as an aspirational profession for young people and to help create excitement about the future of British manufacturing.