scottish science advisory council

Science Education:
Enhancing Support for Schools Through Collaboration

SCIENCE AND ENGINEERING DELIVERING THE FUTURE

DECEMBER 2011

The Scottish Science Advisory Council (SSAC) is Scotland's highest level science advisory body, providing independent advice and recommendations on science strategy, policy and priorities to the Scottish Government. It is a broadly-based group, including both practitioners and users of scientific innovation.

The terms of reference for the SSAC are to advise the Scottish Government's Chief Scientific Adviser on a broad range of scientific issues and science-related policies that will grow our economy and raise our quality of life and will further enhance Scotland as a science nation. To address the breadth of the remit of the SSAC the membership of the Council has been drawn from right across the science, business and academic communities and has a broad range of expertise and experience in science-related matters.

Further details about the SSAC, including a full list of members, can be found on its website: www.scottishscience.org.uk

Introduction

1. Innovative science, engineering and technology are recognised as essential components for driving forward Scotland's economy – both now and in the future – but they are also significant parts of Scotland's heritage and culture. Scotland has a world-wide reputation as a Science Nation and the Scottish Government's Purpose is to make Scotland a more successful country, with opportunities for all to flourish, through increasing sustainable economic growth. This will require a new generation of young scientists and engineers to drive forward new technologies and innovations but also a population that can better understand and appreciate science. A more scientifically informed and aware public will be better able to make important choices about the applications of science and the benefits of technological advances to all sections of our society.

2. The Scottish results in the *Trends in International Mathematics and Science Study* (TIMSS) report[1] published in December 2008 had highlighted failings in maths and science in Scotland's schools "*where Scotland was standing still while other nations pushed by and rose up the league tables*". In response the Scottish Government launched the Science and Engineering 21 – An Action Plan for Education.[2] It paved the way for stimulating ambition in the teaching and learning of science, engineering and technology, encouraging more young people to consider a career in science and engineering and raising public understanding of science. The Science and Engineering Education Advisory Group (SEEAG) was set up to ensure that a wide range of stakeholders had the opportunity to contribute to making the aspirations of the Action Plan a reality.

3. Through the SEEAG work, a sub-group of the SSAC was invited to undertake a piece of work to explore ways in which the links between schools, universities and business can be enhanced to support science education in Scotland. The ongoing implementation of the Curriculum for Excellence (CfE) brings opportunities to encourage greater collaborative working between industry, the teaching profession and the academic community. The CfE aims to raise standards of achievement, declutter the curriculum, teach topical information and encourage pupils to understand concepts as well as facts.

4. The CfE will firmly embed, from pre-school to upper secondary levels, an enquiry led approach to science learning that places a strong emphasis on methodology, process and practical experience in addition to establishing a sound base of scientific understanding and the capacity to engage in informed discussion. As stated in the CfE Science Experiences and Outcomes, this approach to science aims to engender:

1 http://www.scotland.gov.uk/News/Releases/2008/12/09163549
2 http://www.scotland.gov.uk/Topics/Education/Schools/curriculum/ACE/Science/Plan

"curiosity", "understanding of the big ideas in sciences" and "the skills of scientific enquiry and investigation using practical techniques". Parallel developments of an updated Higher place a similar emphasis on research-led activities.

5. While these developments are very welcome, increased emphasis on open-ended enquiry, conceptual understanding and the implications of advances in science will create a considerable challenge for teachers. Some teachers, even those science specialists, may lack the confidence to engage fully with the latest research topics or industrial applications – particularly when these may involve areas of science that have advanced significantly since their own time at university. Unless these challenges are overcome they will serve to undermine the impact and ultimately the success of the new curricular activities in science perhaps even reducing the number of young people taking STEM subjects. However, this creates a significant opportunity for both universities and industry in Scotland to assist through the provision of specialist support for science teaching across all levels.

6. Enhancing the links between schools, universities and industry, in order to achieve the goals of the CfE, seems to be a crucial step towards addressing one of the key issues for Scotland in the 21st century: how to equip our citizens with the knowledge to make informed decisions about the scientific challenges confronting our society.

Informing our thinking

7. In gathering evidence to support this workstream, SSAC organised a number of workshops and spoke to a range of organisations and individuals with an interest in this agenda including Education Scotland, teachers, industry representatives, SQA and other support organisations. This provided a strong basis for further consideration of the issues.

8. The workstream activity began in earnest with a Science Education workshop held on the 14 December 2010 at the University of Glasgow. Invited representatives from industry, universities and schools set the scene for later discussion by considering the question of how they could work better together to support science education in Scotland. The aim of the event was to identify the drivers, barriers and challenges for better engagement and the delivery of excellence in science education in Scotland. The event identified a number of emerging themes and issues and subsequent work by the SSAC, over the period from January through to November 2011, sought to develop and consider these themes in more detail. A list of the key meetings and activities over this period is contained in Annex A.

9. In addition, over the same period, there have been a number of pertinent reviews which have provided further context to the SSAC work; firstly, the Donaldson Review '*Teaching Scotland's Future*'[3], published in December 2010 which considered the future of teaching and more recently, the McCormac Review '*Advancing Professionalism in Teaching*'[4] which reviewed teachers pay and conditions in light of Curriculum for Excellence. Also, given that CfE is recognised to be such a change to the way in which pupils will learn, SSAC found that a number of organisations had established sub-Committees to consider the impact of CfE for them, such as the Deans of Science and Engineering in Scotland and the CBI Scotland Business Education Coalition.

Resulting themes

10. In drawing together and distilling all of the evidence, it was clear that a number of issues recurred throughout all of the discussions and workshops. SSAC identified four key themes to focus on which present opportunities for better engagement with partners in industry and academia to support teaching outcomes in science and beyond into science and engineering careers.

11. These are:

- Co-ordination of existing Science, Technology, Engineering and Maths (STEM) activities
- Importance of science-specific Continuing Professional Development (CPD) for science teachers
- Support for curriculum development and support for teachers in implementing the new curriculum
- Appropriate careers advice for pupils

12. Each of these themes is considered in more detail below.

Co-ordination of existing STEM activities

13. One of the main findings under this theme was the plethora of supporting activity that is currently ongoing – all with the aim of supporting STEM education in schools. Activity ranges from direct engagement between individual companies and/or universities with local schools through to national school engagement programmes and competitions.

[3] http://scotland.gov.uk/Publications/2011/01/13092132/0
[4] http://www.scotland.gov.uk/Publications/2011/09/13091327/0

14. A good example of the latter is the SCI-FUN Roadshow,[5] run by the University of Edinburgh and supported by the Scottish Government, which actively seeks to take the experience of a science centre to early secondary school pupils and public science festivals across Scotland. SCI-FUN currently engages with 10,000 pupils in 50-60 schools across Scotland each year through a unique combination of hands-on exhibits and interactive presentations. It aims to encourage more young people to consider STEM-based career and to appreciate the role of science in their everyday lives. Thanks to their position within the University of Edinburgh they have direct access to the most contemporary research, which allows great support for the topical science strand of CfE.

SCI-FUN demonstrating the carbon capture and storage interactive at the Hebridean Science Festival

15. There is also clearly an appetite from industry to work with schools to promote and encourage the uptake of STEM subjects amongst pupils. The importance of STEM skills to industry is not surprising given that a recent report by the Science Council[6] estimated that some 5.8 million people, or 20% of the workforce, are employed in science-based roles. The report also predicts that the total figure is set to increase to 7.1 million by 2030 increasing the need for good quality STEM graduates at a time when the number of young people (15-19 yr old cohort) is decreasing by 13% over the next ten years[7].

5 http://www.scifun.ed.ac.uk/main.html
6 Science Council, "The current and future UK science workforce", September 2011 http://www.sciencecouncil.org/content/science-workforce
7 National Records of Scotland, Projected Population of Scotland, 26 October 2011

16. At a national level, there are high profile industry-backed initiatives, such as the Scottish Council for Development and Industry (SCDI) Young Scientist and Engineers Clubs and the STEM Ambassador and STEM clubs networks[8] which aim to enable young people to make links between what they learn at school and the world of work and an understanding of the types of careers open to them if they study STEM subjects.

17. Other organisations such as Science Connects and the Institute of Physics (IoP) also provide activities aimed at building links between industry and education to encourage more young people to consider the career opportunities available to them in science, technology, engineering and maths.

18. Lab in a Lorry in Scotland is a partnership between the IoP, OPITO, the Scottish Government, the Dulverton Trust, the Rank Prize Funds, Society of Petroleum Engineers (SPE) and the Schlumberger Foundation. It is an interactive mobile science lab staffed by volunteer practising scientists and engineers. The aim is to give young people aged 11-14 the opportunity to do experimental science in the way it actually happens; exploratory, accidental, informed by curiosity and intuition, but also guided by the experience and insight of practicing scientists. A similar initiative, the GeoBus, is an outreach project developed by the University of St Andrews with support from industry. Its aim is to support the teaching of Earth Sciences and provide a link between industry, HEIs and schools. It is planned to launch in January 2012.

19. It is heartening to note that there are also many individual businesses across Scotland that undertake a variety of engagement activities with local schools as part of their corporate and social responsibility. This could involve providing opportunities for work experience for pupils, CPD opportunities for teachers and awareness raising about the breadth of STEM careers. For example, amongst other things, SELEX Galileo UK have sponsored 'Rampaging Chariots' as a vehicle for exposing children to a hands-on STEM project with its effect being traced through cohorts of students from primary to graduate. A case study looking at the activities of one organisation is provided in Box 1.

[8] http://www.stemscotland.com/seas.html

Box 1

CASE STUDY – THALES UK

Stuart Sharkie, Engineering Manager, Optronics and Land, Thales

Over the last 5 years Thales in Glasgow has significantly increased its schools involvement covering an ongoing spectrum of activities. These activities are initiated by Thales, schools directly, STEM Ambassadors or organisations such as EDT and SCDI Young Engineers. These result in schools visiting Thales or staff going out to schools to support a wide range of activities including Young Engineers clubs, EDT competitions and career events. Staff are encouraged to become STEM ambassadors with STEMNET. Two activities give the best scope to encourage pupils into science and engineering. These are school visits to Thales' Glasgow facility and supporting the annual SCDI Young Engineers clubs Celebration of Science and Engineering. These aim to involve a spectrum of staff including apprentices, graduates and more mature staff. Enthusiasm is the most important factor and involving female staff is key in seeking to help address the imbalance in the number of women in engineering.

Factory Visits

In support of National Science and Engineering Week (NESW), Thales has developed visits that meet EDT best practice. Schools from Glasgow and surrounding areas are invited to send 15 – 20 pupils each, with 2 to 4 schools involved each day. 4 NSEW days were held in 2011. Pupils get direct exposure to a high technology facility and hands on experience demonstrating practical applications of science and technology. Pupil experiences include using an image intensifier and a thermal imager to demonstrate sensors for use from the brightest day, to starlight or total darkness; firing a laser range finder having seen an original optical one from early 20th century; comparing an 1920s periscope to what goes into the most modern periscopes and masts; and how the latest technology is used to protect the modern day soldier. This close up exposure and use of products helps the pupils understand and be inspired to become engineers and scientists. Visits are not restricted to NSEW week and in 2011, around 300 pupils from across Scotland have visited Thales in Glasgow (3 Highland schools and 17 from across the West).

Celebration of Science and Engineering

Run each year at Glasgow Science Centre, this is a gathering of over 600 school pupils from across Scotland. Having taken a while to discover its existence Thales has been pleased to support it for the last 3 years through the 3 minute challenge. Two of our graduate engineers take along an optical alignment challenge to be completed by pupils of all ages (see photo).

The challenge can be adapted to be more complex for older pupils. In 2011, Thales increased their involvement by adding a demonstration of thermal imaging giving pupils a chance to have their picture taken sitting beside a thermal picture of themselves.

20. Higher and Further Education Institutions also recognise the benefit of engaging directly with schools and there appears to be a wealth of activity in this area too. A recent report by Universities Scotland '*Together at the Heart of Scottish Education*'[9] presents a range of ways in which universities engage with schools across Scotland. At a national level, the Researchers in Residence scheme organises researcher placements in host secondary schools and colleges, although from January next year, the Research Councils UK (RCUK) will no longer be funding the scheme. A case study looking at the schools engagement activity of one of our universities in the area of computing science is provided in Box 2.

Box 2

CASE STUDY – UNIVERSITY OF GLASGOW COMPUTING SCIENCE

Dr Quintin Cutts, Senior Lecturer, School of Computing Science, University of Glasgow

The School of Computing Science at the University of Glasgow have set up valuable links with a number of schools locally and nationally. These were initiated through an EPSRC-funded Partnerships in Public Engagement project, CS Inside. The original objective was to develop workshops for teachers or visiting academics to present in school lesson time. Each workshop opened up some computational aspect of the technology all around the pupils, e.g. phones, the web, games. Literally, it is the computer science inside that is being exposed.

The original focus was on the pupils and their awareness and understanding of computing science, known to be extremely weak. However, early on, the project realised that computing teachers across Scotland tended to be very poorly supported. Whilst the provision of materials is undoubtedly useful, the project soon discovered that providing the opportunity for computing teachers to meet, discuss issues, learn new ideas and techniques, was very highly valued. Our school visits programme became more of a localised CPD programme putting on regular evening events for teachers – with participants coming from as far away as Inverness and Fort William just for the evening.

The initial project was funded until 2009 but it has led to the development of a new final year Honours module called Computing Science in the Classroom. This course is modelled on the template provided by the Undergraduate Ambassadors Scheme (www.uas.ac.uk). With appropriate orientation, students spend 10 half-days in a local school, acting variously as classroom assistant, teacher, one-to-one tutor, or ambassador for university life or the discipline generally. The clear link with CS Inside is that they have to present at least one workshop from the collection, and create and present one new workshop in the same style. In this way, the collection of resources is steadily increasing. An equally important link is that local teachers are still being supported in their teaching, with the help of the student ambassador who can bring fresh ideas and enthusiasm to the classroom.

[9] http://www.universities-scotland.ac.uk/index.php?page=publications

21. Looking beyond Scotland, Imperial College London has developed a Reach-out Lab,[10] a new concept linking Public Engagement and Outreach initiatives. It is a nexus for a range of schools outreach and public engagement activity in STEM and aims to educate school children from age 6 – 18 and help them learn about STEM subjects through experimental work. In particular, it introduces mathematics in all subjects in an engaging way. Also associated with this outreach work is a serious long term evaluation of the impact on children and teachers as well as on the university students who come in to teach or demonstrate. This will provide valuable evidence as to the effectiveness of this type of outreach activity. In general, all projects should make efforts to effectively evaluate the impact of their activity on pupil learning – particularly given the increasing financial restraints being faced.

22. Other organisations are also involved in outreach activity with schools. Scotland's four science centres – Our Dynamic Earth, Glasgow Science Centre, Satrosphere and Sensation – offer a range of outreach programmes, interactive workshops and exhibitions to support schools activities.[11] There are many other notable examples of outreach such as the Edinburgh International Science Festival and its touring road shows (Generation Science) which reach over a quarter of primary schools and some 56,000 pupils. There are many other initiatives supported by professional bodies such as the Institution of Engineering and Technology (IET) and charities such as the EDT[12] who run Go4SET, EES and the Year in Industry schemes.

23. The range and breadth of activity supporting STEM in schools is welcome and often of a very high standard. However, it does seem that there are too many small scale initiatives meaning that the landscape for individual schools can appear very crowded. There seems to be a lack of a central co-ordinated approach to the support of STEM in schools and there is no central recording of the breadth of existing activity nor any assessment of what constitutes good practice in the area of school/industry/academia liaison. Industry representatives have commented that they can often find it difficult to engage effectively with individual schools as there are no formal mechanisms that exist to support this type of activity. Often it seems that great things can happen on a small scale but all too frequently only benefit those schools that are already engaged and rely on the same people from industry and universities giving their time. The challenge is to replicate good practice across the country so that more schools can benefit.

Recommendation 1: SSAC consider that it is essential to capture and map the breadth of existing schools' engagement with industry, professional institutions, learned societies and academia with a view to developing good practice guidance (including guidance on the evaluation of the impact of the activities) and examples – as well as co-ordinating and publicising opportunities.

10 http://www3.imperial.ac.uk/outreach/reachoutlab
11 www.hmie.gov.uk/documents/publication/ScienceCentresFT.pdf
12 http://www.etrust.org.uk/

Importance of Science-specific CPD for science teachers

24. The importance of Continuing Professional Development (CPD) for science teachers has been consistently highlighted throughout all discussions. It is important that science teachers are able to access good quality CPD opportunities in STEM throughout their career. This is of particular importance in science subjects given the pace of scientific discovery and the necessarily changing nature of the subjects. Teachers, particularly in secondary schools, need to have the opportunity to keep pace with recent major STEM developments. Teachers in primary schools may need to have support to develop their own scientific knowledge and understanding as well as understanding children's learning in science.

25. The introduction of CfE also highlights this as it means that teachers will have greater responsibility and control over how the curriculum is delivered and it introduces a greater focus on inter-disciplinary teaching of STEM. This new development means that teachers will need access to supportive CPD which allows them to develop inter-disciplinary, contemporary and relevant teaching examples.

26. A wide range of national and local organisations provide CPD for teachers. Although much of the CPD on offer is generic in nature, it is interesting to note that 52% of secondary teachers (surveyed as part of the Donaldson report) wanted more opportunities to develop subject-specific knowledge and practice.[13] While the Donaldson report does not make any recommendations with regard to subject-specific CPD, SSAC consider that for teachers of STEM subjects the opportunity to update their subject knowledge and skills is particularly important.

27. In practice, there is an array of activities that are counted as CPD, beyond formal training courses, such as mentoring/coaching, shadowing, good practice visits, networking, online study and peer observation.[14] The Scottish Schools Education Research Centre (SSERC) provides an ongoing programme of CPD in the sciences in line with CfE which are highly-valued but can only reach a restricted number of teachers. A range of other organisations, such as the Institute of Physics (IoP) and Scotland's science centres, also provide varying forms of science-related CPD to teachers.

28. There are also online resources available to teachers, such as GLOW. GLOW is an intranet facility for Scottish schools which provides a range of online tools aimed at enhancing learning experiences. This includes community networks that allow practitioners to share best practice.

13 'Teaching Scotland's Future – Report of a review of teacher education in Scotland', Donaldson, December 2010
14 'Teaching Scotland's Future – Report of a review of teacher education in Scotland', Donaldson, December 2010

29. It seems fair to conclude that there is a reasonable amount of existing CPD material available to teachers and schools from a wide range of sources. However, it appears that there is a lack of overall coherence in what is offered and insufficient central co-ordination of existing material and/or activity to allow teachers to access and use it effectively. It also seems difficult for schools and teachers to be able to judge the relative quality of the various CPD offerings.

30. Education Scotland should have a role in providing a 'one-stop shop' for CPD, perhaps, by developing a portal approach and quality-control via user-led feedback. Education Scotland work closely with every Scottish local authority as well as key organisations such as the Scottish Centre for Studies in School Administration (SCSSA) and the SQA. Through the Education Scotland website, teachers can access information on how the tools on GLOW can assist with CPD and the *CPDFind* facility can be used to identify CPD appropriate activities.[15]

31. It seems that tools such as the GLOW network and *CPDFind* are a valuable resource to teachers but that they are currently under-utilised. However, these tools should provide a valuable basis on which to build. SSAC understand that GLOW is currently under review and will be updated in 2012.

32. It should be possible to streamline and rationalise the existing information into something that is more user friendly. As part of their wider work, SEEAG undertook a valuable CPD mapping exercise, which demonstrated the wide range of provision currently available. However, it is recognised that, over time, this mapping exercise will require updating and it would be valuable for this activity to be carried on a continuous basis.

Recommendation 2: SSAC consider that it would be valuable to capture and map the breadth of science-related CPD available to teachers on an ongoing basis.

Recommendation 3: SSAC consider that CPDFind should be developed further to include the full range of science-related CPD opportunities available (including those available via industry) and more actively promoted to teachers as the 'one-stop shop' to find CPD. There is currently a function to 'endorse' certain courses and consideration could be given to expanding this function in order to provide an approximate 'quality marking' for others who may be considering undertaking the CPD.

[15] http://www.cpdscotland.org.uk/index.asp

33. CPD is a further area in which greater interaction between industry and academia and schools could provide mutual benefits. Building these links provides an external stimulus and support for developing new ideas, particularly in the context of CfE. It also can also help teachers to better understand modern careers in science-related fields. The McCormac Review notes the "*benefits from interaction between schools and the private sector and would encourage schools and authorities to continue to develop links with local and national companies*".[16]

34. One example is the Institute of Physics (IoP) Teacher network in Scotland. They organise and coordinate local CPD events, and help to forge better links between school sectors, and between schools and Higher Education. They also act as a source of information about local initiatives and activities and generally provide help and advice in response to requests.

Recommendation 4: SSAC consider that there should be a greater role for industry and academia in developing and contributing to science-specific CPD for science teachers.

35. The Teachers' Agreement of 2001 included a requirement for teachers to continue and develop their skills throughout their careers and a contractual 35 hours of CPD was allocated per annum. In some countries, e.g. Finland and Singapore, there is a requirement for teachers to do more hours of CPD. The Donaldson review notes that most CPD is provided by local authorities. However, the provision of centrally delivered courses is decreasing as local authorities devolve more CPD to individual schools whilst encouraging them to work in networks or clusters. There is also a danger that funding is being cut in this area, just when it is needed most to support the roll-out of CfE in schools. This would be a short-sighted move as teachers will need support to implement the CfE effectively.

36. In fact, it may be that for subject-specific CPD training that there would be considerable value in identifying priorities for CPD in science and co-coordinating a programme of activity across Scotland that could be delivered at a time when all science teachers could attend and receive the same refresh of their knowledge and skills. This would require investment but the potential benefits of distance learning could be explored in order to reduce the cost of delivery.

Recommendation 5: SSAC recommend that consideration be given to providing centrally coordinated science-specific CPD across Scotland, at a time when it would be convenient for most teachers to attend. The potential benefits of distance learning could also be explored in order to reduce the overall costs.

[16] http://www.scotland.gov.uk/About/reviewofteacheremployment/ReviewReport

Support for Curriculum Development

37. Curriculum development is the most important area where opportunities exist for valuable input from universities and industry at all levels. Feedback from discussions has indicated that many teachers would welcome additional support through, for example, the development of exemplar learning material in the sciences to inspire and support the new teaching methodologies being promoted under CfE. There has been concern expressed that the current 'Experiences and Outcomes' framework doesn't offer enough discipline-specific materials to develop sufficient detail.

38. There is already some useful material that is being produced in this area. The Royal Society of Edinburgh (RSE) in collaboration with the Royal Society of Chemistry (RSC) has exemplified a subset of the learning experiences and outcomes for chemistry.[17] Following a positive reaction from teachers, a second project is now underway between the RSE and the BCS Academy of Computing Sciences to develop an exemplification for Computing and Information Science elements of the CfE. STEM-ED Scotland, supported by the Deans of Science and Engineering in Scotland, have also been particularly active in supporting curriculum development. Another example of where external organisations can be helpful in supporting pupil learning and developing the curriculum can be found in Box 3.

Box 3

CASE STUDY – SEPA CITIZEN SCIENCE

"Citizen Science" is a project aiming to let young people see the relevance of science in the real world. It is a good example of where engagement with wider partners supports learning by creating modules that can fit with the aims of CfE. Young people were engaged in measuring environmental data and this was then used to develop an understanding of flooding and adaption to climate change. Local rivers are being used as a source to promote inter-disciplinary learning. It is currently being piloted in eight schools ranging from Glasgow to Peebles.

SEPA also has a Kids section on its website which provides information on a range of topical subjects such as climate change, flooding and waste.

The picture above is used with the kind permission of Abernethy Primary School, Abernethy and Education Scotland.

[17] http://www.rsc.org/Education/Teachers/Resources/InvestigateChemistry.asp

39. Education Scotland has published support material on how schools are implementing the science outcomes of CfE.[18] In addition, it has also recently launched the STEM Central website[19] which is intended to be an ongoing, developing resource for teachers. The website provides tools for topical learning journeys with suggestions for experiences and outcomes, learning intentions, success criteria and possible evidence. Learner journeys offer opportunities to advance learning through relevant contexts (for example, electric transport) and actively extend thinking beyond simply learning diagrams. The first four STEM Central examples illustrate how strong Scottish engineering contexts, such as clean water, eco housing and renewable energy, can be used to lead learning in the sciences, technologies and mathematics. GLOW, the online community for Scottish schools, can be accessed via STEM Central and the STEM Central in Motion Glow Group will, in common with GLOW National and local groups, provide opportunities for teachers to share good practice and collaborate.

40. Again it seems that there is a range of information available to support curriculum development but that it is currently being provided by a wide range of sources and efforts could be made to better centrally coordinate and signpost to improve the impact of existing material. Throughout discussions, SSAC has found general agreement amongst stakeholders that some of the existing mechanisms are not being utilised as effectively as they could be and there is scope to do more.

Recommendation 6: SSAC consider there may be a need to have a central resource to develop, evaluate and disseminate through appropriate fora a range of exemplar materials developed in conjunction with schools. These can draw on a variety of sources (including academia and industry) and can then be accessed by science teachers as a resource as they implement CfE.

Recommendation 7: STEM Central is a welcome development providing additional resource for teachers. However, it is currently very engineering focused. SSAC recommend that it would helpful for Education Scotland to consider expanding the focus of STEM Central to cover the wider STEM agenda and for STEM Central to become the entry portal to Education Scotland science material as the name suggests.

[18] http://www.ltscotland.org.uk/learningteachingandassessment/curriculumareas/sciences/
[19] http://www.ltscotland.org.uk/stemcentral/index.asp

Appropriate Careers Advice for Pupils

41. Young people need to be inspired to become the world-leading scientists and engineers of the future. This relies on a better understanding of the importance of science and engineering to the careers of today but also the careers of tomorrow. This is important because research[20] has shown that young people in developed nations recognise the contribution that science and technology make to society and acknowledge their importance now and in the future, yet few view the study of science and technology as leading to interesting, and potentially lucrative,[21] careers.

42. It is also important to educate pupils (and their parents or carers) about the diverse range of career options that are available through STEM and to emphasise that there can be a number of different routes into STEM-based careers, beyond the traditional academic route. For example, technical apprenticeships require good Higher grades to get in and provide a clear route from school to chartered engineer status. These could be a better option for many but are often not seen as attractive routes into STEM careers. The Scottish Government highlighted in its recent consultation paper on the reform of the post 16 education in Scotland – '*Putting Learners at the Centre*'[22] – its support for developing a wider range of progression and articulation opportunities, including higher level technical and graduate apprenticeships, such as the Engineers of the Future programme.[23]

43. The STEM Transitions Programme is hoping to achieve more in this area. Led by SEMTA Scotland, the Sector Skills Council, along with the SQA, Forth Valley College and other partners including industry and Skills Development Scotland are in the process of developing and trialling a Life Sciences Transitions Programme. The aim of the programme is to highlight the various qualification routes into STEM further study and careers and enhance knowledge of STEM careers through integrating work experience in the relevant sector with study programmes (either via Skills for Work or Science Baccalaureate). The programme is currently being trialled with Skills for Work level qualifications through Forth Valley College.

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20 http://www.gla.ac.uk/departments/stem/projects/the%20rose%20survey%20in%20scotland/
21 http://www.universitiesuk.ac.uk/Publications/Pages/Publication-257.aspx
22 http://scotland.gov.uk/Publications/2011/09/15103949/0
23 http://www.ineosopportunities.co.uk/Working_Here/Engineer_of_the_Future_Programme.aspx

44. Industry has commented when teachers visit their operations, they often get most value from the opportunity to see the different routes that staff have taken to get into particular roles beyond the traditional academic route. It would be particularly valuable if careers advisers and guidance teachers had more opportunities to gain this type of exposure.

Recommendation 8: SSAC consider that there should be a greater role for industry in educating teachers, particularly career advisers and guidance teachers, and parents/carers about the wealth and diversity of STEM-related careers.

45. However, in order for pupils to become enthused about STEM careers and choose to progress their future careers in the field of science and engineering, they need to have the necessary building blocks through appropriate school qualifications in science. SSAC believe that qualifications in STEM subjects open up the widest possible options for future careers (not just those in science). The recent 'Informed Choices' leaflet[24] produced by the Russell Group universities supported this view by demonstrating the relative value of taking STEM subjects at A-level to allow access to a wider range of the more competitive and selective courses. Other subjects may only help to get into a more limited range of courses. Annex C provides tables showing entrants to Higher Education in Scottish Higher Education Institutions and colleges by level, subject and gender for the last three years.

46. Following a previous decline in the number of pupils taking sciences at Higher, Scottish Qualification Authority (SQA) figures now show rising numbers of entries in the sciences. Between 2009 and 2011, there have been increases in entries in Higher and Advanced Higher Physics, Chemistry and Biology. Annex D provides tables showing the Higher and Advanced Higher entries and course awards for 2011. However, effort is needed to maintain this upward trend and ensure that momentum is not lost during the transition to CfE and with the decreasing numbers in the future senior phase cohort.

[24] http://www.russellgroup.ac.uk/informed-choices.aspx

47. Under CfE, all pupils should have a broad, general education from S1 – S3 and will experience a wide range of subjects across eight curriculum areas; one of which is sciences.[25] Learning from S4 – S6 is now termed the senior phase, where pupils can enhance their knowledge, understanding and skills through qualifications and build on the broad general education phase. The development of the senior phase in schools is intended to provide increased flexibility and a more individualised approach to learning for pupils. It will be supported by new and updated qualifications.

48. While the aims of the senior phase to introduce more flexibility and choice for pupils are to be welcomed, SSAC is aware of concerns that, under the new arrangements, some pupils may have to make subject choices too early in their academic career and are concerned that this has the potential to reduce the opportunity for pupils to study 2 or 3 sciences at Higher or Advanced Higher. SSAC welcomes the CfE Management Board statement on the Senior Phase[26] and understands that the design of the curriculum and, therefore, the number and range of qualifications on offer, as well as when they can be taken, will be a decision for individual schools. However, SSAC believe that it is important that all schools promote a model that allows all the sciences to be studied in sufficient breadth and depth until S3 and that will offer the opportunity to study three STEM subjects in the senior phase.

Recommendation 9: SSAC consider that there should be close monitoring of the curriculum models introduced across Scotland to ensure that a sufficient breadth of opportunity to study the full range of STEM subjects is available to all pupils across Scotland.

49. A recent welcome development, the Scottish Science Baccalaureate[27] has been available to schools since August 2009, with first certificates awarded to pupils in August 2010. The Science Baccalaureate requires two, different eligible science courses, at least one of which must be at Advanced Higher level, together with an inter-disciplinary project. The aim is to offer pupils increased breadth and depth of study in sciences.

[25] http://www.ltscotland.org.uk/understandingthecurriculum/whatiscurriculumforexcellence/index.asp
[26] http://www.ltscotland.org.uk/publications/c/publication_tcm4662740.asp?strReferringChannel=understandingthecurriculum&strReferringPageID=tcm:4-613276-64
[27] http://www.sqa.org.uk/sqa/35858.html

50. However, the inter-disciplinary project is a new element which can place significant extra demands on both the school and the pupil in preparing for the project. Support to engage effectively with the project element is required in order to see success. Forth Valley College is already active in this area and supports a number of schools in offering interdisciplinary projects for the Baccalaureate.

51. It is too early to tell whether the Science Baccalaureate is having an impact on the number of pupils choosing to study science overall although there has been a small rise in the numbers and pass rates of those taking it over the two years it has been available. However, SSAC believe that its standing in the eyes of university admissions officers needs urgent clarification if it is to grow in popularity amongst pupils and parents/carers.

Overall Conclusion

52. In considering all of the evidence, SSAC conclude that there is excellent work being undertaken to support the teaching of science in Scotland, often drawing on the valuable expertise of external partners. However, a consistent issue highlighted is that a lack of central mapping and co-ordination of existing activity means that for individual schools and teachers the landscape appears crowded and confused. This results in opportunities not being maximised nor used to their full potential. Industry has also noted the lack of a clear mechanism or process by which they can engage appropriately with Scottish schools.

53. Clearly with the wealth of material and ongoing activity across this area, any proposed solution should seek to assist with and build on existing activity rather than adding to an already crowded landscape.

54. After much discussion, and with the support of organisations such as the Deans of Science and Engineering in Scotland Group, Scottish Government, SSERC, STEM-ED Scotland, CBI Scotland and SEMTA, SSAC consider that one solution to the problems identified above would be to create one or more **Industry/Academic Schools Liaison Co-ordinator for Science posts**. The individuals would work to draw together existing activity, map it effectively and translate it into good practice examples that could be disseminated to schools across Scotland.

55. In addition, it provides the opportunity to draw together and directly implement many of the recommendations highlighted throughout this report. SSAC has identified that a particular focus (through Recommendations 1, 2, 4 and 6) would be required for the liaison activity between schools and external partners (industry, academia and others) and the provision and availability of science-related CPD in Scotland. This could be achieved directly through the creation of the co-ordinator post. There may be an option for creating two posts which could be split according to scientific discipline (e.g. one covering the life sciences and one covering the physical and engineering sciences and mathematics).

Recommendation 10: SSAC strongly recommend the creation of one or more Industry/Academic Schools Liaison Co-ordinator for Sciences posts.

56. SSAC consider that the initial outline of key role and tasks associated with the Industry/ Academic Schools Liaison Co-ordinator for Science post should be along the lines below:

Role

- To act as a central co-ordinator for science-related schools activities, including CPD for science teachers and schools science engagement activity, which provide support for science teachers and schools as they implement new science courses under the Curriculum for Excellence (CfE).

- To act as a central liaison to facilitate good practice engagement between schools, universities and industry to widen pupil experience and teaching in support of the new CfE.

Suggested Key Tasks

- To map, evaluate and co-ordinate current schools engagement activities with industry/academia and develop good practice models that can facilitate the transfer of good learning models across Scotland.

- To map, evaluate and co-ordinate existing Continuing Professional Development (CPD) activity in life sciences and physical/engineering sciences and mathematics and ensuring engagement with and/or input from universities/industry where appropriate.

- To develop, evaluate and disseminate through appropriate fora a range of exemplar learning materials using a variety of sources including academia and industry, that can be used by science teachers as a resource as they implement the CfE.

- To consider how inter-disciplinary linkages in support of the pupil learning experience might be created which would bring additional learning benefits over and above single topic learning.

57. **SSAC believes that it has identified a clear gap in the current landscape and the solution that it proposes has the advantage of seeking to simplify the landscape for individual schools and teachers. SSAC has had strong support for the creation of a co-ordinator role from a variety of stakeholders and some have indicated that they will provide funding support in principle to facilitate the creation of the post(s). Further discussion about the details of the role and the most suitable location for the posts are ongoing.**

ANNEX A

SSAC Science Education Sub-Group Membership

Professor James Hough FRS FRSE FAPS FinstP C.Phys FRAS (Chair)
Kelvin Professor of Natural Philosophy and Associate Director of the Institute for Gravitational Research University of Glasgow, CEO SUPA

Professor Nigel Brown FRSE, CBiol, FSB, CChem, FRSC
Senior Vice Principal, University of Edinburgh

Professor Alan Bundy, FRSE, FREng, FAAAI, FAISB, FECCAI
Professor of Automated Reasoning, School of Informatics, University of Edinburgh

Mrs Angela Mathis
Chief Executive, ThinkTank Maths

Professor Marian Scott OBE, FRSE, FISI, CStats
Professor Environmental Statistics, University of Glasgow

Professor Lord Winston Hon FREng, F Med Sci, DSc
Professor of Science and Society, Imperial College London

Sources of Evidence

This list includes the main activities undertaken but is not exhaustive. A number of other meetings, discussions and attendance at events have informed the work of the sub-group.

- Science Education Workshop – 14 December 2010
- Meeting with CBI Scotland – 12 January 2011
- Meeting with Curriculum Division, Scottish Government – 31 March 2011
- Meeting with Scottish Qualifications Authority (SQA) – 6 May 2011
- Meeting with Scottish Schools Education Research Centre (SSERC) – 3 May 2011
- Industry Workshop – 15 June 2011
- Meeting with Technology for Learning Strategy team, Scottish Government – 16 June 2011

- Meeting with Education Scotland, Chief Executive – 27 June 2011
- Meeting with Education Scotland Science Development Officer – 23 August 2011
- Meeting with Education Scotland, National Co-ordinator in Curriculum & Assessment – 31 August 2011
- Meeting with CBI Scotland – 21 September 2011
- Meeting with SEMTA Scotland – 21 October 2011
- University of St Andrews Teaching Learning and Assessment Open Forum: Curriculum for Excellence – 2 November 2011
- Meeting with Scottish Government, Education Scotland and Headteachers – 3 November 2011

SSAC would like to thank all of those who have contributed to their work over the last year but particular thanks go to:

Lauren Boath, Development Officer Sciences, Education Scotland

Dr Allan Colquhoun, University Liaison and Emerging Technologies Manager, SELEX Galileo

Dr Quintin Cutts, Senior Lecturer, School of Computing Science, University of Glasgow

Prof Martin Hendry, Professor of Gravitational Astrophysics and Cosmology, University of Glasgow

Bill Maxwell, Chief Executive, Education Scotland

Lauren McNicol, Policy Executive, CBI Scotland

Nicola Nielsen, Development Officer Sciences, Education Scotland

Linda Rae, National Co-ordinator in Curriculum and Assessment, Education Scotland

Stuart Sharkie, Engineering Manager, Optronics and Land, Thales UK

Fred Young, Chief Executive, SSERC

Members of the Deans of Science and Engineering in Scotland Group

ANNEX B – List of Recommendations

Recommendation 1: SSAC consider that it is essential to capture and map the breadth of existing schools' engagement with industry, professional institutions, learned societies and academia with a view to developing good practice guidance (including guidance on the evaluation of the impact of the activities) and examples – as well as co-ordinating and publicising opportunities.

Recommendation 2: SSAC consider that it would be valuable to capture and map the breadth of science-related CPD available to teachers on an ongoing basis.

Recommendation 3: SSAC consider that CPDFind should be developed further to include the full range of science-related CPD opportunities available (including those available via industry) and more actively promoted to teachers as the 'one-stop shop' to find CPD. There is currently a function to 'endorse' certain courses and consideration could be given to expanding this function in order to provide an approximate 'quality marking' for others who may be considering undertaking the CPD.

Recommendation 4: SSAC consider that there should be a greater role for industry and academia in developing and contributing to science-specific CPD for science teachers.

Recommendation 5: SSAC recommend that consideration be given to providing centrally coordinated science-specific CPD across Scotland, at a time when it would be convenient for most teachers to attend.

Recommendation 6: SSAC consider there may be a need to have a central resource to develop, evaluate and disseminate through appropriate fora a range of exemplar materials developed in conjunction with schools. These can draw on a variety of sources including academia and industry and can then be accessed by science teachers as a resource as they implement the CfE.

Recommendation 7: STEM Central is a welcome development providing additional resource for teachers. However, it is currently very engineering focused. SSAC recommend that it would helpful for Education Scotland to consider expanding the focus of STEM Central to cover the wider STEM agenda and for STEM Central to become the entry portal to Education Scotland science material as the name suggests.

Recommendation 8: SSAC consider that there should be a greater role for industry in educating teachers, particularly career advisers and guidance teachers, and parents/carers about the wealth and diversity of STEM-related careers.

Recommendation 9: SSAC consider that there should be close monitoring of the curriculum models introduced across Scotland to ensure that a sufficient breadth of opportunity to study the full range of STEM subjects is available to all pupils across Scotland.

Recommendation 10: SSAC strongly recommend the creation of one or more Industry/Academic Schools Liaison Co-ordinator for Sciences posts.

ANNEX C

Entrants to Higher Education in Scottish HEIs and colleges by level, subject and gender: 2009-10, 2008-09 and 2007-08 *(contained in separate tables).*

2009-10

		All levels			Postgraduate			First degree			Sub-degree		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
Medical Studies	**Total**	**147,465**	**44.2**	**55.8**	**31,490**	**47.1**	**52.9**	**50,295**	**44.0**	**56.0**	**65,680**	**43.0**	**57.0**
	Subjects allied to Medicine	**15,640**	17.7	82.3	**3,210**	30.7	69.3	**6,010**	15.4	84.6	**6,420**	13.3	86.7
	Medicine and Dentistry	**2,025**	43.1	56.9	**760**	43.5	56.5	**1,230**	42.5	57.5	**35**	54.1	45.9
	Total	**17,665**	**20.6**	**79.4**	**3,970**	**33.2**	**66.8**	**7,240**	**20.0**	**80.0**	**6,455**	**13.6**	**86.4**
Science and Engineering	**Agriculture & related subjects**	**1,105**	57.3	42.7	**295**	47.1	52.9	**190**	45.0	55.0	**620**	66.0	34.0
	Architecture, building and planning	**4,415**	74.7	25.3	**1,155**	62.9	37.1	**1,425**	67.8	32.2	**1,835**	87.6	12.4
	Biological Sciences	**7,940**	36.5	63.5	**1,400**	34.3	65.7	**5,445**	35.6	64.4	**1,100**	44.0	56.0
	Engineering and Technology	**12,260**	86.0	14.0	**2,660**	79.6	20.4	**4,505**	86.5	13.5	**5,100**	88.8	11.2
	Computer Science	**8,010**	80.2	19.8	**1,360**	76.2	23.8	**2,670**	83.9	16.1	**3,980**	79.1	20.9
	Mathematical Sciences	**1,490**	57.2	42.8	**270**	66.1	33.9	**1,000**	54.0	46.0	**220**	60.4	39.6
	Physical Sciences	**4,095**	57.6	42.4	**1,100**	59.1	40.9	**2,605**	57.6	42.4	**390**	53.1	46.9
	Veterinary Science	**570**	19.4	80.6	**50**	36.1	63.9	**295**	24.2	75.8	**225**	9.3	90.7
	Total	**39,885**	**68.0**	**32.0**	**8,285**	**64.5**	**35.5**	**18,125**	**62.0**	**38.0**	**13,475**	**78.2**	**21.8**
Business and Social Studies	**Business & Administrative studies**	**27,540**	45.4	54.6	**6,935**	54.5	45.5	**7,420**	46.6	53.4	**13,185**	40.0	60.0
	Law	**4,305**	42.2	57.8	**1,950**	47.9	52.1	**1,830**	39.5	60.5	**525**	30.2	69.8
	Mass Communication & documentation	**2,040**	46.3	53.7	**480**	41.4	58.6	**800**	42.7	57.3	**760**	53.1	46.9
	Social Studies	**12,630**	28.0	72.0	**2,045**	40.7	59.3	**4,200**	35.9	64.1	**6,385**	18.8	81.2
	Total	**46,515**	**40.4**	**59.6**	**11,410**	**50.3**	**49.7**	**14,255**	**42.3**	**57.7**	**20,855**	**33.8**	**66.2**

		All levels			Postgraduate			First degree			Sub-degree		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
Education and the Arts	**Creative Arts & Design**	**10,220**	34.9	65.1	**900**	39.1	60.9	**2,915**	33.2	66.8	**6,400**	35.0	65.0
	Education	**9,185**	27.9	72.1	**5,070**	26.2	73.8	**2,045**	17.0	83.0	**2,070**	42.7	57.3
	Historical & Philosophical Studies	**5,280**	42.4	57.6	**910**	47.7	52.3	**2,120**	45.8	54.2	**2,245**	37.1	62.9
	Languages	**7,065**	35.5	64.5	**825**	32.4	67.6	**2,490**	29.6	70.4	**3,750**	40.1	59.9
	Total	**31,745**	**34.2**	**65.8**	**7,710**	**30.9**	**69.1**	**9,570**	**31.6**	**68.4**	**14,465**	**37.7**	**62.3**
	Combined	**11,655**	41.3	58.7	**115**	47.0	53.0	**1,110**	36.5	63.5	**10,430**	41.7	58.3
	supplementary subjects contained in the above categories												
	Economics and Politics	**2,525**	55.9	44.1	**875**	57.5	42.5	**1,565**	55.6	44.4	**85**	36.2	63.8
	English	**2,190**	38.2	61.8	**360**	27.7	72.3	**1,125**	32.1	67.9	**705**	54.3	45.7
	Geography	**1,140**	45.9	54.1	**280**	49.1	50.9	**710**	44.9	55.1	**150**	44.6	55.4
	Psychology	**3,005**	24.2	75.8	**500**	22.0	78.0	**2,265**	24.5	75.5	**240**	26.6	73.4

Sources: Higher Education Statistics Agency (HESA) and Scottish Funding Council (SFC).

The 'combined' subject grouping is used in recognition of programmes of study which cut across different subject areas.

Please also see relevant sections of 'Notes to Tables'.

2008-09

		All levels			Postgraduate			First degree			Other HE		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
	Total	**144,130**	**43.8**	**56.2**	**29,380**	**46.5**	**53.5**	**46,775**	**43.8**	**56.2**	**67,935**	**42.8**	**57.2**
Medical Studies	**Subjects allied to Medicine**	**16,085**	16.3	83.7	**3,065**	30.0	70.0	**5,345**	14.1	85.9	**7,675**	12.3	87.7
	Medicine and Dentistry	**2,030**	43.0	57.0	**760**	45.9	54.1	**1,215**	40.7	59.3	**50**	53.8	46.2
	Total	**18,115**	**19.3**	**80.7**	**3,825**	**33.1**	**66.9**	**6,560**	**19.0**	**81.0**	**7,730**	**12.6**	**87.4**
Science and Engineering	**Agriculture & related subjects**	**1,025**	55.2	44.8	**260**	51.6	48.4	**190**	48.2	51.8	**570**	59.1	40.9
	Architecture, building and planning	**4,570**	74.0	26.0	**1,005**	59.0	41.0	**1,565**	67.5	32.5	**2,005**	86.6	13.4
	Biological Sciences	**6,985**	36.4	63.6	**1,280**	35.9	64.1	**4,795**	35.3	64.7	**915**	43.0	57.0
	Engineering and Technology	**12,105**	87.1	12.9	**2,430**	81.7	18.3	**4,115**	86.6	13.4	**5,555**	89.8	10.2
	Computer Science	**7,400**	79.4	20.6	**1,210**	76.1	23.9	**2,385**	84.5	15.5	**3,805**	77.3	22.7
	Mathematical Sciences	**1,375**	56.2	43.8	**275**	56.6	43.4	**910**	54.0	46.0	**190**	66.2	33.8
	Physical Sciences	**3,680**	56.7	43.3	**1,060**	58.0	42.0	**2,330**	56.8	43.2	**290**	51.4	48.6
	Veterinary Science	**530**	21.3	78.7	**55**	41.7	58.3	**260**	25.5	74.5	**215**	11.1	88.9
	Total	**37,670**	**68.7**	**31.3**	**7,580**	**64.5**	**35.5**	**16,550**	**62.2**	**37.8**	**13,540**	**79.0**	**21.0**
Business and Social Studies	**Business & Administrative studies**	**25,675**	44.9	55.1	**5,920**	55.4	44.6	**7,105**	44.9	55.1	**12,645**	40.0	60.0
	Law	**4,155**	41.6	58.4	**1,890**	47.2	52.8	**1,845**	38.9	61.1	**415**	28.3	71.7
	Mass Communication & documentation	**1,960**	44.1	55.9	**385**	32.2	67.8	**760**	42.0	58.0	**810**	51.7	48.3
	Social Studies	**12,755**	28.1	71.9	**1,775**	41.7	58.3	**4,105**	35.9	64.1	**6,875**	20.0	80.0
	Total	**44,540**	**39.8**	**60.2**	**9,970**	**50.5**	**49.5**	**13,820**	**41.3**	**58.7**	**20,750**	**33.6**	**66.4**

		All levels			Postgraduate			First degree			Other HE		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
Education and the Arts	**Creative Arts & Design**	**9,340**	35.0	65.0	**740**	36.9	63.1	**2,565**	35.3	64.7	**6,035**	34.7	65.3
	Education	**9,405**	28.0	72.0	**5,590**	25.9	74.1	**1,875**	17.8	82.2	**1,940**	43.9	56.1
	Historical & Philosophical Studies	**5,325**	41.3	58.7	**805**	49.3	50.7	**2,165**	45.1	54.9	**2,355**	35.0	65.0
	Languages	**7,195**	35.4	64.6	**755**	37.0	63.0	**2,385**	28.9	71.1	**4,055**	38.9	61.1
	Total	**31,270**	**34.1**	**65.9**	**7,895**	**30.4**	**69.6**	**8,985**	**32.3**	**67.7**	**14,390**	**37.2**	**62.8**
	Combined	**12,535**	43.6	56.4	**105**	57.9	42.1	**860**	36.6	63.4	**11,525**	44.0	56.0
	supplementary subjects contained in the above categories												
	Economics and Politics	**2,270**	55.9	44.1	**725**	57.1	42.9	**1,470**	56.3	43.7	**80**	30.6	69.4
	English	**2,370**	42.8	57.2	**335**	38.8	61.2	**1,105**	32.3	67.7	**930**	57.1	42.9
	Geography	**965**	50.4	49.6	**245**	57.5	42.5	**655**	47.4	52.6	**65**	56.4	43.6
	Psychology	**2,515**	23.4	76.6	**440**	24.0	76.0	**1,985**	23.1	76.9	**90**	27.8	72.2

Sources: Higher Education Statistics Agency (HESA) & Scottish Funding Council (SFC).
The 'combined' subject grouping is used in recognition of programmes of study which cut across different subject areas.
Please see 'Notes to Tables' on page 62.

2007-08

		All levels			Postgraduate			First degree			Other HE		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
	Total	**137,495**	**43.4**	**56.6**	**27,920**	**46.7**	**53.3**	**42,965**	**43.7**	**56.3**	**66,510**	**41.8**	**58.2**
Medical Studies	**Subjects allied to Medicine**	**14,810**	17.5	82.5	**2,850**	33.0	67.0	**4,640**	14.0	86.0	**7,325**	13.7	86.3
	Medicine and Dentistry	**1,830**	40.9	59.1	**595**	39.6	60.4	**1,185**	41.4	58.6	**50**	46.0	54.0
	Total	**16,640**	**20.1**	**79.9**	**3,445**	**34.1**	**65.9**	**5,820**	**19.6**	**80.4**	**7,375**	**14.0**	**86.0**
Science and Engineering	**Agriculture & related subjects**	**1,000**	51.4	48.6	**260**	47.3	52.7	**130**	38.7	61.3	**610**	55.7	44.3
	Architecture, building and planning	**4,510**	74.6	25.4	**875**	60.8	39.2	**1,370**	68.1	31.9	**2,265**	83.9	16.1
	Biological Sciences	**6,610**	36.0	64.0	**1,130**	38.0	62.0	**4,660**	35.8	64.2	**770**	35.7	64.3
	Engineering and Technology	**10,870**	86.9	13.1	**2,110**	81.6	18.4	**3,670**	85.4	14.6	**5,050**	90.1	9.9
	Computer Science	**7,045**	78.2	21.8	**1,130**	78.5	21.5	**1,990**	85.2	14.8	**3,930**	74.6	25.4
	Mathematical Sciences	**1,285**	59.5	40.5	**255**	63.9	36.1	**780**	56.4	43.6	**250**	64.8	35.2
	Physical Sciences	**3,855**	57.7	42.3	**1,185**	63.7	36.3	**2,325**	55.8	44.2	**345**	50.0	50.0
	Veterinary Science	**515**	19.7	80.3	**45**	39.1	60.9	**260**	24.0	76.0	**210**	10.0	90.0
	Total	**35,690**	**68.1**	**31.9**	**6,990**	**66.2**	**33.8**	**15,180**	**61.1**	**38.9**	**13,430**	**77.1**	**22.9**
Business and Social Studies	**Business & Administrative studies**	**24,525**	43.9	56.1	**5,430**	54.8	45.2	**6,430**	46.3	53.7	**12,670**	38.0	62.0
	Law	**3,930**	41.7	58.3	**1,655**	46.4	53.6	**1,740**	40.6	59.4	**535**	30.7	69.3
	Mass Communication & documentation	**2,125**	45.2	54.8	**460**	34.8	65.2	**770**	42.4	57.6	**895**	53.0	47.0
	Social Studies	**12,765**	26.9	73.1	**1,715**	41.0	59.0	**3,825**	35.0	65.0	**7,230**	19.2	80.8
	Total	**43,345**	**38.7**	**61.3**	**9,260**	**49.7**	**50.3**	**12,755**	**41.9**	**58.1**	**21,330**	**32.1**	**67.9**
Education and the Arts	**Creative Arts & Design**	**9,200**	35.2	64.8	**710**	41.0	59.0	**2,730**	36.4	63.6	**5,765**	34.0	66.0
	Education	**9,765**	28.6	71.4	**5,865**	27.3	72.7	**1,595**	18.6	81.4	**2,305**	38.8	61.2
	Historical & Philosophical Studies	**4,740**	41.2	58.8	**795**	50.6	49.4	**1,845**	42.1	57.9	**2,105**	36.8	63.2
	Languages	**6,470**	34.1	65.9	**760**	39.3	60.7	**2,245**	28.2	71.8	**3,460**	36.8	63.2
	Total	**30,175**	**33.8**	**66.2**	**8,130**	**31.9**	**68.1**	**8,410**	**32.1**	**67.9**	**13,630**	**36.0**	**64.0**

		All levels			Postgraduate			First degree			Other HE		
		Total	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)	**Total**	Male (%)	Female (%)
	Combined	**11,645**	43.3	56.7	**95**	49.5	50.5	**790**	39.2	60.8	**10,745**	43.6	56.4
	supplementary subjects contained in the above categories												
	Economics and Politics	**2,000**	55.4	44.6	**675**	58.1	41.9	**1,225**	55.7	44.3	**100**	22.9	77.1
	English	**1,675**	37.8	62.2	**360**	45.6	54.4	**985**	30.4	69.6	**330**	51.5	48.5
	Geography	**940**	47.6	52.4	**220**	54.2	45.8	**665**	45.0	55.0	**60**	56.8	43.2
	Psychology	**2,365**	22.7	77.3	**380**	24.7	75.3	**1,825**	22.2	77.8	**65**	29.8	70.2

ANNEX D

Tables showing Higher and Advanced Higher entries and course awards for 2011
(contained in separate tables).

Higher entries and course awards for 2011

SUBJECT	Entries 2010	Entries 2011	A	B	C	Passes in Ungraded Courses	Passes	D	No Awards	Pass Rate 2010	Pass Rate 2011
English	29,470	30,068	5,503	7,655	8,328	-	21,486	3,287	5,295	68.1%	71.5%
Mathematics	20,654	20,550	5,175	5,136	4,528	-	14,839	1,729	3,982	72.1%	72.2%
Chemistry	10,177	10,288	2,953	2,427	2,513	-	7,893	1,041	1,354	76.1%	76.7%
Biology	9,291	9,767	2,209	2,308	2,484	-	7,001	1,083	1,683	69.1%	71.7%
Physics	9,014	9,445	2,794	2,592	1,950	-	7,336	745	1,364	77.9%	77.7%
History	9,189	9,379	2,501	2,865	2,209	-	7,575	626	1,178	79.6%	80.8%
Geography	7,385	7,778	2,533	1,851	1,690	-	6,074	590	1,114	72.7%	78.1%
Modern Studies	7,366	7,673	1,730	1,990	2,167	-	5,887	603	1,183	76.9%	76.7%
Art and Design	7,239	7,192	1,898	2,145	2,133	-	6,176	568	448	83.7%	85.9%
Business Management	6,514	6,932	981	1,529	1,898	-	4,408	822	1,702	66.5%	63.6%
Physical Education	5,814	5,874	1,233	1,961	1,932	-	5,126	435	313	90.6%	87.3%
Music	4,597	4,585	2,026	1,396	786	-	4,208	172	205	92.1%	91.8%
French	4,595	4,352	1,885	987	789	-	3,661	272	419	86.6%	84.1%
Human Biology	4,076	4,266	821	965	1,131	-	2,917	434	915	67.2%	68.4%
Graphic Communication	4,069	4,171	1,015	1,037	1,047	-	3,099	409	663	77.0%	74.3%
Computing	4,356	4,124	883	1,039	959	-	2,881	436	807	70.4%	69.9%
Religious, Moral and Philosophical Studies	3,152	3,756	984	988	810	-	2,782	322	652	77.8%	74.1%
Psychology	3,293	3,517	933	707	659	-	2,299	240	978	68.1%	65.4%
Administration	2,914	2,608	518	602	660	-	1,780	261	567	75.4%	68.3%
Drama	2,446	2,456	518	963	673	-	2,154	141	161	86.7%	87.7%
Product Design	2,462	2,441	382	669	708	-	1,759	298	384	71.0%	72.1%
Spanish	1,361	1,498	751	322	204	-	1,277	78	143	85.9%	85.2%
Information Systems	1,432	1,407	242	372	437	-	1,051	167	189	73.5%	74.7%
Accounting	1,219	1,204	466	226	194	-	886	76	242	64.5%	73.6%
Photography	-	1,153	281	389	374	-	1,044	38	71	-	90.5%
German	1,178	1,054	398	244	231	-	873	74	107	82.1%	82.8%
Sociology	895	982	141	204	243	-	588	73	321	71.8%	59.9%
Philosophy	914	912	177	185	230	-	592	91	229	67.2%	64.9%
Media Studies	801	869	136	218	241	-	595	102	172	66.9%	68.5%
Home Economics: Health and Food Technology	863	799	209	287	170	-	666	55	78	74.9%	83.4%

SUBJECT	Entries 2010	Entries 2011	A	B	C	Passes in Ungraded Courses	Passes	D	No Awards	Pass Rate 2010	Pass Rate 2011
Early Education and Childcare	731	711	79	128	193	-	400	80	231	75.1%	56.3%
English for Speakers of Other Languages	591	684	237	139	121	-	497	31	156	76.1%	72.7%
Technological Studies	728	683	197	136	107	-	440	62	181	64.3%	64.4%
Care	649	581	93	148	117	-	358	47	176	42.4%	61.6%
Economics	632	576	219	138	99	-	456	39	81	78.2%	79.2%
Classical Studies	418	431	132	81	85	-	298	20	113	80.1%	69.1%
Mental Health Care	423	388	11	35	122	-	168	62	158	35.9%	43.3%
Health and Social Care*	465	378	-	-	-	274	274	-	*	56.3%	72.5%
Politics	202	302	88	70	67	-	225	19	58	88.6%	74.5%
Home Economics: Lifestyle and Consumer Technology	325	300	105	115	65	-	285	9	6	86.8%	95.0%
Care Practice	310	294	31	55	104	-	190	33	71	76.8%	64.6%
Dance Practice	288	294	82	91	58	-	231	12	51	95.5%	78.6%
Italian	241	227	152	31	22	-	205	5	17	91.7%	90.3%
Home Economics: Fashion and Textile Technology	166	223	65	66	45	-	176	17	30	81.9%	78.9%
Latin	228	222	117	43	40	-	200	8	14	80.7%	90.1%
Managing Environmental Resources	210	220	30	63	52	-	145	21	54	78.1%	65.9%
Personal Development*	111	210	-	-	-	193	193	-	*	89.2%	91.9%
Play in Early Education and Childcare	184	205	24	62	69	-	155	7	43	70.7%	75.6%
Gaelic (Learners)	131	127	42	33	40	-	115	6	6	75.6%	90.6%
Gàidhlig	90	116	49	35	19	-	103	5	8	88.9%	88.8%
Urdu	89	92	79	4	3	-	86	3	3	96.6%	93.5%
Travel and Tourism	78	78	5	7	13	-	25	8	45	42.3%	32.1%
Hospitality - Professional Cookery	72	77	25	29	16	-	70	1	6	80.6%	90.9%
Retail Travel	58	67	15	14	22	-	51	4	12	94.8%	76.1%
Geology	63	63	17	9	15	-	41	6	16	82.5%	65.1%
Beauty*	47	47	-	-	-	31	31	-	*	36.2%	66.0%
Biotechnology	27	27	12	2	6	-	20	5	2	70.4%	74.1%
Mandarin (Simplified)	28	26	25	1	0	-	26	0	0	100.0%	100.0%
Mechatronics	26	26	20	1	5	-	26	0	0	88.5%	100.0%
Russian	25	25	22	1	0	-	23	1	1	92.0%	92.0%
Architectural Technology	39	17	4	3	4	-	11	4	2	71.8%	64.7%

SUBJECT	Entries 2010	Entries 2011	A	B	C	Passes in Ungraded Courses	Passes	D	No Awards	Pass Rate 2010	Pass Rate 2011
Classical Greek	5	9	7	2	0	-	9	0	0	100.0%	100.0%
Cantonese	3	6	5	1	0	-	6	0	0	***	100.0%
Mandarin (Traditional)	5	6	6	0	0	-	6	0	0	100.0%	100.0%
Building Construction	7	0	-	-	-	-	-	-	-	14.3%	-
Totals	**175,492**	**178,838**	**44,271**	**45,802**	**43,887**	**498**	**134,458**	**15,783**	**28,597**	**74.6%**	**75.2%**

* SfW and Personal Development Courses are a flexible provision, not necessarily completed by candidates in a single academic year. The expectation is that most candidates will complete the course at a later date. Consequently the results are not directly comparable with other courses.

*** Grade Distributions and pass rates are not reported for subjects with fewer than 5 entries in order that individual candidates cannot be identified.

Advanced Higher entries and course awards for 2011

SUBJECT	Entries 2010	Entries 2011	A	B	C	Passes	D	No Awards	Pass Rate 2010	Pass Rate 2011
Mathematics	2,935	3,098	693	640	713	2,046	314	738	64.4%	66.0%
Chemistry	2,225	2,472	795	617	522	1,934	196	342	76.6%	78.2%
Biology	2,177	2,288	499	595	617	1,711	215	362	72.8%	74.8%
English	1,839	1,861	425	585	496	1,506	129	226	82.3%	80.9%
Physics	1,736	1,757	622	399	371	1,392	127	238	77.8%	79.2%
Music	1,205	1,299	786	355	111	1,252	18	29	94.2%	96.4%
History	1,193	1,204	318	371	352	1,041	92	71	90.1%	86.5%
Art and Design: Expressive	901	926	256	257	279	792	75	59	83.7%	85.5%
Graphic Communication	797	903	344	301	178	823	31	49	90.3%	91.1%
Geography	873	818	183	290	224	697	63	58	72.2%	85.2%
Modern Studies	688	801	247	237	203	687	59	55	88.5%	85.8%
French	702	691	225	173	158	556	61	74	72.9%	80.5%
Art and Design: Design	701	657	182	199	192	573	46	38	86.2%	87.2%
Computing	414	461	105	134	106	345	49	67	75.6%	74.8%
Drama	376	327	50	89	97	236	39	52	65.4%	72.2%
Applied Mathematics	263	279	107	61	44	212	18	49	71.1%	76.0%
Religious, Moral and Philosophical Studies	243	266	91	81	54	226	13	27	74.1%	85.0%
Spanish	247	232	67	74	50	191	19	22	80.6%	82.3%
Business Management	224	197	7	34	56	97	37	63	52.7%	49.2%
German	161	160	65	40	27	132	12	16	82.0%	82.5%
Physical Education	106	112	19	19	18	56	13	43	70.8%	50.0%
Product Design	72	111	14	14	27	55	11	45	70.8%	49.5%
Technological Studies	90	81	35	9	16	60	5	16	54.4%	74.1%
Economics	76	74	33	20	16	69	4	1	81.6%	93.2%

SUBJECT	Entries 2010	Entries 2011	A	B	C	Passes	D	No Awards	Pass Rate 2010	Pass Rate 2011
Classical Studies	60	66	42	12	8	62	0	4	96.7%	93.9%
Information Systems	51	53	13	17	12	42	3	8	62.7%	79.2%
Latin	45	43	23	13	4	40	3	0	86.7%	93.0%
Accounting	50	39	11	6	7	24	1	14	42.0%	61.5%
Italian	34	34	14	10	5	29	2	3	82.4%	85.3%
Home Economics: Health and Food Technology	34	33	4	7	17	28	2	3	76.5%	84.8%
Gaelic (Learners)	15	18	10	4	3	17	0	1	93.3%	94.4%
Gàidhlig	25	18	9	6	3	18	0	0	72.0%	100.0%
Administration	12	17	3	2	6	11	1	5	100.0%	64.7%
Mandarin (Simplified)	2	14	14	0	0	14	0	0	***	100.0%
Media Studies	6	2	***	***	***	***	***	***	66.7%	***
Classical Greek	1	1	***	***	***	***	***	***	***	***
Mandarin (Traditional)	0	1	***	***	***	***	***	***	-	***
Cantonese	1	0	-	-	-	-	-	-	***	-
Totals	20,580	21,414	6,313	5,671	4,992	16,976	1,659	2,779	77.5%	79.3%

*** Grade Distributions and pass rates are not reported for subjects with fewer than 5 entries in order that individual candidates cannot be identified.