Education and the Economy – Background Information

Northern Ireland — Section 1

- Campaign for Science and Engineering in the UK (2006) *Science Education in Northern Ireland's schools* (A report of a series of meetings with teachers, education officials, educationalists, academics and other groups.)

http://savebritishscience.org.uk/documents/2006/CaSE0613b.pdf

- Education and Training Inspectorate (2002) *A survey of the Science and Technology Area of Study in a Sample of Northern Ireland Primary Schools 2000-2001* (Introduction and Executive summary)

http://www.etini.gov.uk/survey_of_science_and_technology_area_of_study_in_a_sample_of_ni_primary_schools1.pdf

England — Section 2

- Department for Children, Schools and Families (24 January 2008) *£140 million boost to science and maths teaching in schools* (Press release)

http://www.dfes.gov.uk/pns/DisplayPN.cgi?pn_id=2008_0017

- Select Committee on Science and Technology (October 2006) *Tenth Report: Science Teaching in Schools* (Abstract and Summary of Key Recommendations)

http://www.publications.parliament.uk/pa/ld200506/ldselect/ldsctech/257/257.pdf

Republic of Ireland — Section 3

- Department of Enterprise, Trade and Employment *Strategy for Science, Technology and Innovation 2006 – 2013* (Chapter 5: Science Education and Society)

http://www.entemp.ie/publications/science/2006/sciencestrategy.pdf

- Royal Irish Academy (2005) *School Science Infrastructure: Can Ireland deliver?* (Report from workshop held in May 2005)

http://www.ria.ie/committees/pdfs/physcialsciences/science_report.pdf

Scotland **Section 4**

- Scottish Executive (2001) *A Science Strategy for Scotland* (Executive summary and Chapter 3 on science education)

http://www.scotland.gov.uk/Resource/Doc/158401/0042918.pdf

Wales **Section 5**

- Welsh Assembly Government (2006) *A Science Policy for Wales – The Welsh Assembly Government's Strategic Vision for Sciences, Engineering and Technology* (section on science education)

http://new.wales.gov.uk/docrepos/40382/4038231141/403821124158/science-policy-eng?lang=en

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Campaign for Science and Engineering in the UK

CaSE 06/13b

Science education in Northern Ireland's Schools

Report of a series of *Opinion Forum* meetings with teachers, education, officials educationalists, academics and other groups

Contents

Preface

CaSE exists to improve the scientific health of the UK by promoting effective policies in areas relevant to science and engineering. The education system is a crucial part of this, and is currently one of the areas presenting some of the greatest barriers for UK science. CaSE's standpoint on school level science was set out in detail in Chapter 6 of *Science and Engineering Policies for the Next Parliament: Agenda 2005-2010,* which is available at http://www.sciencecampaign.org.uk/documents/2005/CaSE0503.htm We believe that every young person has the right to a high quality and engaging experience of science at school and to the career opportunities presented by science qualifications.

This document presents a an assessment of the current situation in Northern Ireland, and covers issues that CaSE believes could most effectively be addressed by Government policies. A companion document in CaSE's series of *Opinion Forums* sets out a summary of CaSE's findings and policy recommendations. It can be downloaded from http://www.sciencecampaign.org.uk/documents/2006/CaSE0613a.pdf

Our starting point was a series of meetings that took place in Belfast in December 2005. We have brought the results of these meetings together with further data and evidence, and would like to thank all those who have helped to inform this report. Appendix 1 gives more detail about the meetings.

Introduction

Northern Ireland's education system is a unique within the UK. The province has its own curriculum regulations and school funding mechanisms, as well as its own arrangements for Further and Higher Education. The 11-plus exam (referred to as the 'transfer test') is still used to measure pupils' attainment. However, the challenges facing science education here are similar to those in the rest of the UK and indeed across most of the industrialised world. Low student uptake of science, engineering and mathematics subjects remains the key concern.

The education system and distribution of responsibilities in the region are currently in flux. Since the Northern Ireland Assembly was suspended in 2002, ministerial responsibility for education has been removed to the Northern Ireland Office. The Assembly is has reconvened on a temporary basis, and this attempt to restart devolution may lead to further changes to the administrative structure the education system.

The Curriculum Authority for Northern Ireland has undertaken a major review and reform of the school curriculum through all key stages, with the official changeover due to occur in September 2007. The teaching profession is also under review. The Departments for Education and for Employment & Learning have been undertaking this review jointly since 2003, focusing on professional development, and the role of the General Teaching Council for Northern Ireland. Meanwhile independent bodies have been moving toward developing a regional strategy for science education, with a publication from the Northern Ireland Science Education Forum (Northern IrelandSEF) expected soon.

There is now a climate of motivation to improve science education as part of the broader aim of tackling social inclusion issues in a post-conflict society and to provide the skills base needed to strengthen Northern Ireland's economy.

The usefulness of science qualifications is already well documented on a national level. Post-compulsory science qualifications have been linked to favourable career prospects and earnings potential. A survey carried out specifically within the Northern Ireland region found that graduates in science and engineering subjects were less likely to be over-qualified in their jobs than graduates of other disciplines[1]. Another survey showed that return in earnings on science and engineering degrees have been rising since the 1980s, with men earning on average 21% more relative to arts graduates[2].

Larger companies are currently providing support for anything from PhD placements to primary school experimental kits, indicating the importance of science skills in the region. Further information will soon be available on the skills needs of Northern Ireland's scientific companies, as the Learning & Skills Development Agency for the region are currently carrying out a survey on this issue.

Due to its small size and partial autonomy, Northern Ireland presents opportunities for cohesion and coordination throughout the science and educational communities which may be more difficult to achieve in other parts of the UK.

[1] Overeducation and the graduate labour market, Economic Research Institute of Northern Ireland, 2004.
[2] Education and Earnings in Northern Ireland, Harmon and Walker for DELNI, March 2000

Uptake of science & engineering subjects and Standards

The UK Government has begun to respond to the need to improve standards and uptake in science subjects in post-compulsory education. For example, in 2002, the Roberts Review looked at various school level issues, the science strategy *Investing in Innovation* set out plans for improving schools science, and the Budget for 2006 sets out targets for increasing the numbers of A-level students and teachers in physics and chemistry over the next eight years. However, both in terms of the research and evidence for understanding the problem and in terms of subsequent actions schemes, much of this work has excluded Northern Ireland. The region's own Departments and educational bodies do not consistently prioritise science subjects to the same extent as their English counterparts.

Northern Ireland published its regional innovation strategy *Think Create Innovate* in 2003, a year after the UK wide *Investing in Innovation*. It sets out an intention to move toward a 'knowledge based economy'. Unlike the UK strategy, it does not mention science, maths and engineering education specifically, only noting that overall achievement at school is high. It aims to "promote innovation at every level of the Northern Ireland education system", and sets out that "education and vocational training deliverers should target resources on developing the knowledge and skills necessary to enhance the selected areas of high promise for R&D and innovation". However, the emphasis throughout the strategy is on further and vocational education, with the only specific proposal for schools being a reference to CCEA's curriculum review. It is not yet clear how this will manifest itself.

For example, The Department for Education (DENI) Business Plan for 2005-6 includes attainment targets for English and mathematics, but science is not mentioned anywhere in the document. A recent review of the Curriculum Advisory Service suggested "Regional Strategies, similar to Literacy and Numeracy, to provide coherent and consistent levels of support across key areas of service such as Special Educational Needs, Irish Medium, English as an Additional Language and Behaviour Support"[3], but again, science is not mentioned.

In *Science Policies for the Next Parliament*, CaSE proposed the inclusion of science in national educational strategies[4]. This proposal applies equally to Northern Ireland as well as other parts of the UK. Teachers involved in our *Opinion Forum* meetings told us that schools have reduced funding for science support since efforts are have been focused on literacy and numeracy hours. Teachers in primary schools were particularly frustrated that extra teaching support is now provided for these hours, but is not available for practical sessions where it would be of more use. CaSE believes that science should be represented in regional targets and school development plans.

The Department for Employment and Learning (DELNI) Skills Strategy published in February this year includes a key target to develop a *Skills for Innovation Action Plan* by September 2006. In order to be effective in developing the skills needed for an innovative and successful economy in the long term, CaSE believes that this action plan must include the school science that lies within DENI's remit.

The region remains in a slightly better situation than the UK as a whole in terms of post- 16 uptake in science subejcts, and has a strong participation and achievement in education overall.

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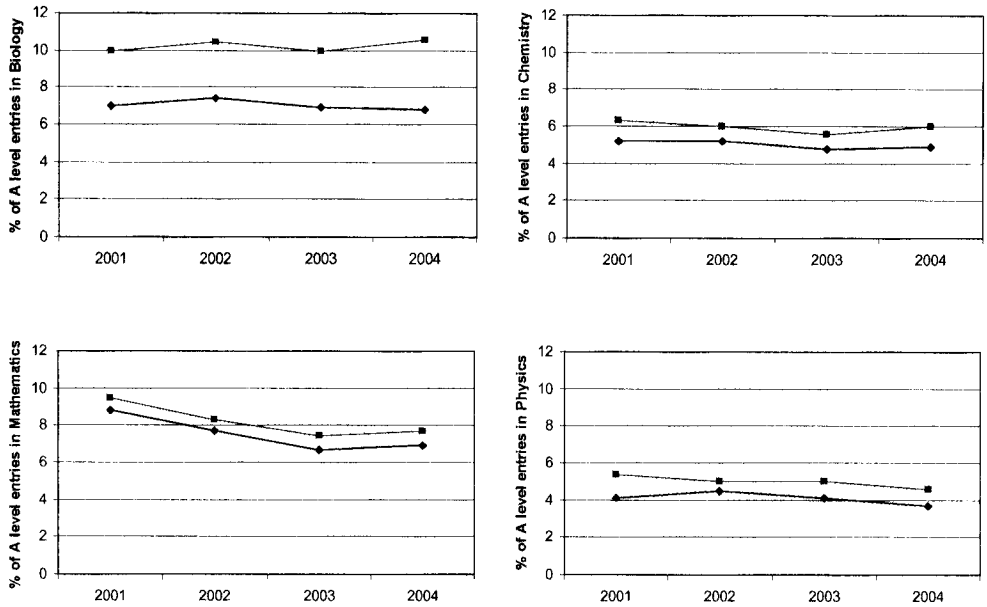
[3] CASS Best Value Fundamental Service Review, Centreal Management Support Unit for ELBs, December 2005

[4] chapter 6, page 49

This position gives the responsible bodies and Departments an opportunity to act before greater challenges arise.

Participation of 16-17 year olds in full time education and training is high at around 78% as compared to only 67% in England[5], and these rates have shown a steady increase in recent years. GCSE and A-level results are traditionally higher in Northern Ireland than the national average. For example, in 2002, 58.7% achieved 5 or more A*-C grades in their GCSEs, compared to only 52.5% across the UK as a whole[6].

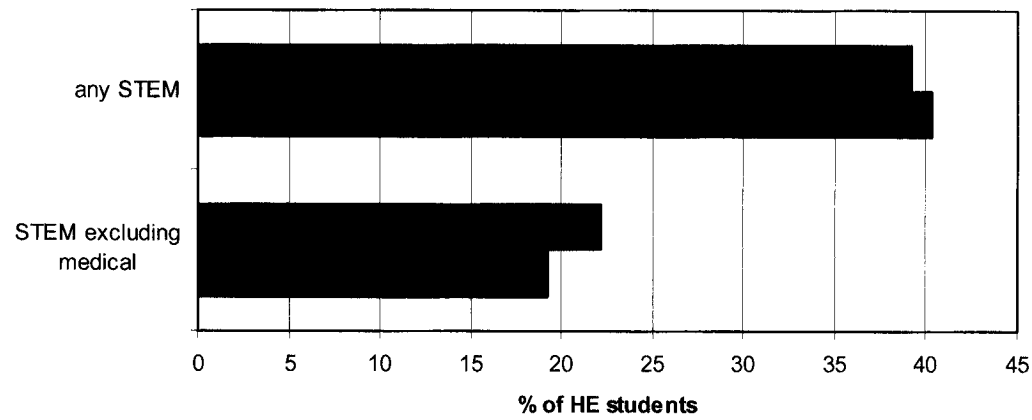
However, in the uptake of science and engineering Northern Ireland follows similar trends to the UK. At A-level, Northern Ireland consistently enters a slightly higher proportion of its students for science subjects than in the UK as a whole, but patterns of low and declining entries in the physical sciences are the same. The graphs below show percentages of total A-level entries in each subject for 2001-2004[7]. Northern Ireland entries are shown in red and UK entries in black.



For students leaving school and entering Higher Education, the picture changes. At this stage Northern Ireland's students are less likely than those in the rest of the country to take up sciences. The table and graphs below show this. Again, Northern Ireland students are shown in red and UK students in black. While the overall proportion studying the selected subject areas is slightly higher among Northern Irish students, this is mainly due to the enormous popularity of healthcare subjects. In any other area apart from computer science, students are less likely to study sciences than their UK counterparts.

[5] DENI statistics for 2004/5
[6] http://www.statistics.gov.uk/STATBASE/ssdataset.asp?vlnk=7733
[7] JCQ data

	% of all HE students (at any UK institution) gaining a qualification in this subject area	
	Northern Ireland domiciled[8]	**UK domiciled[9]**
medicine and dentistry	2.3	2.5
subjects allied to medicine	19.0	14.0
veterinary science	0.1	0.2
biological sciences	5.4	6.9
physical sciences	2.9	3.5
mathematical sciences	0.9	1.3
computer science	5.8	5.5
engineering and technology	4.2	5.0
STEM (science, technology, engineering & medicine) excluding medical and veterinary	19.2	22.2
any STEM	40.3	39.2



Admissions tutors from Northern Ireland's universities in physical sciences and engineering told us that they have seen a continuing decline in applicants since the 1990s. The situation is taken as a signal of broader problems with the education that students receive at school. In order to maintain student intake relative to other subjects, departments have adapted either by lowering entry requirements or by offering new courses combining traditional scientific content with other areas of study. This can either lead to lower output standards, or to courses becoming highly pressured with less time for personal development and creative or innovative thinking. The current situation is of great concern and is unsustainable if trends continue.

In subjects allied to medicine courses are very popular, and the main barrier to increasing uptake is the MaSN cap on student numbers, which was abolished in England in 2002/3.

[8] DELINorthern Ireland 2004-5
[9] HESA 2004-5

Allocating the cap separately between subject boundaries would be one way of optimising return on government investment in HE.

The Further Education sector faces a different range of problems recruiting students into science subjects, as it has struggled to offer qualifications and courses which are seen as appropriate. For example, the science GNVQ was perceived as harder than and not equivalent to the standard of other GNVQs. Due to funding pressures many colleges decided to offer this in place of existing courses, even though there was a lower demand for it. This situation is now developing and there are hopes that foundation degree and HND programmes in science will tackle these particular issues. In Engineering, vocational and FE routes are better established. Deans of Engineering reported to us that undergraduates entering via these routes have a clearer idea of what the subject entails than those who have entered through academic routes such as maths and physics A levels. At Ulster University, the drop out rate is lower among these students.

The teachers we spoke to told us they generally observe a drop in enthusiasm for science toward the end of Key Stage 2. This contrasts to impressions of teachers in England, where pupils more commonly turn away from the subject at the end of Key Stage 3. This has been accounted for by the pressures of the Transfer Test which Northern Ireland students were taking at the end of Key Stage 2, in English, Maths and Science. The decision has now been taken to abandon these tests, and the last round will be held in November 2008. Teachers at both primary and post-primary levels told CaSE that they are optimistic that the end of these tests will at least delay the decline in pupils' enthusiasm for science. It is also interesting to note here that DENI decided to drop school league tables in 2001[10].

Of course, exam pressures are not the only barrier to students' enthusiasm for science. The curriculum and the way it is delivered present a much more complex picture. We will consider these factors in more detail in the next sections. Further research is needed regionally, nationally and internationally to understand student uptake in science subjects. Some of the schools represented in CaSE's focus groups in Northern Ireland had seen increases in physical science uptake in recent years, against the national trend, but were not able to account for this on the basis of their own experience. An investigation of uptake trends on a school-by-school comparative basis could be informative.

Science teachers in Northern Ireland's post-primary schools told CaSE that they feel blamed for the decline in student interest, but at the same time powerless to make a real difference to the situation. Faced with various combinations of unsupportive school management, lack of resourcing, inappropriate careers advice, an unsatisfactory curriculum or the need to meet other pressures, many are not in a position to take the main responsibility for their students' choices.

For example in careers education, some science teachers told us they feel unable to advise in case they are accused of 'canvassing'. This leaves advice solely in the hands of careers teachers, who may not have all the relevant expertise in particular subject areas. Many teachers told us that there is a tendency for students only to choose science subjects if they are requirements for a particular career. Teachers are disappointed that this seems to be the only way they can promote their subject to students.

Stronger Government support is needed to tackle these issues. The next sections look at ways of approaching this.

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[10] http://www.bbc.co.uk/dna/actionnetwork/A1181819#3

Science teaching Workforce

A good science teacher can be the most important part of a student's science education.

In a recent survey, A quarter of the interviewees remarked that advice from their subject teachers had influenced their decision to study AS/A2-levels post-16. These young people reported that subject teachers had given them the impression that it was best to stay on at school and had encouraged them to do so. One commented:

> *'I think it's encouragement from teachers, because they would talk about the A-level courses and they give you loads of information about what you are going to do, so they kind of persuade you into staying on.'*[11]

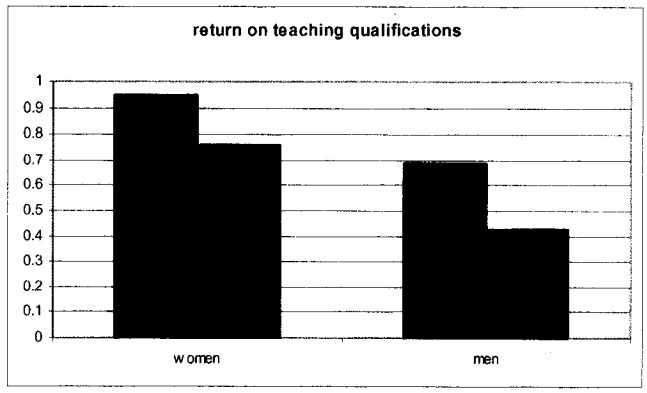
Nationally, science teachers are among the hardest subject groups to recruit. However, many of the surveys and reports looking at this challenge have either excluded data from Northern Ireland, or grouped it together with the whole of the UK. While data on applications to undergraduate courses are published nationally (by UCAS), postgraduate (PGCE) data are published separately. The Graduate Teacher Training Registry (GTTR) aims to represent the whole of the UK, but obtains its statistics only from England's Teacher Training Agency (now the Teaching Development Agency) the National Assembly for Wales and the Scottish Higher Education Funding Council. The equivalent figures for Northern Ireland are not included, but are published separately by DELNI.

Northern Ireland represents around 3% of the UK's population[12], but has 3.5% of its school pupils and 3.7% of its teachers[13].

	pupil: teacher ratios (2002/3)
Wales	18.0
England	17.9
UK total	17.6
Northern Ireland	16.3
Scotland	14.9

The ratios shown above are indicative both of the number of posts available in the school system, and of the popularity of teaching as a career. There are indications that teaching is a more attractive career to Northern Ireland students than in it in the rest of the UK. Research on individuals' financial return on qualifications (illustrated in the graph below) shows how teaching represents a higher proportional earnings potential in Northern Ireland (shown in red) than it does in the rest of the UK (shown in black)[14].

[11] CCEA 'moving forward, thinking back'
[12] http://www.statistics.gov.uk/CCI/nugget.asp?ID=6
[13] http://www.statistics.gov.uk/STATBASE/Expodata/Spreadsheets/D7727.xls
[14] Education and Earnings in Northern Ireland, Harmon and Walker for DELNI, March 2000



Looking at applications to undergraduate teacher training degrees, these represent a lower proportion of both applicants and acceptances among Northern Ireland students than among UK students. They consistently represent around 1% of applications from Northern Ireland students, compared to 2% of applications from UK students. However, most of the region's science teachers are science graduates holding a PGCE. This may in part be encouraged by the fact that most of Northern Ireland's schools do not require teachers to teach outside of their specialism of biology, chemistry or physics.

The vast majority of Northern Ireland's teachers are home-grown. Qualified Teacher Status (QTS) does not apply in Scotland or Northern Ireland, but in most cases it is possible for candidates to transfer their qualifications and register with the GTCNI if DENI grants them eligibility[15]. Initial Teacher Education for Northern Ireland is offered by three institutions and their member colleges: Queen's, Ulster and the Open Universities. The relevant courses include elements specialising in the Northern Irish curriculum and educational system. In 2004-5, 72% of all Northern Ireland domiciled students took their first degree within the region and over 90% of students studying for a PGCE in Northern Ireland were native to the region[16].

In the current climate this does not present a problem for teacher recruitment, but it does make the supply of science teachers more vulnerable to changes in the region. Post-primary teachers to whom we spoke were concerned that if science departments in Northern Ireland's universities were to close, the supply of teachers for those disciplines would dry up. There is an increasing awareness in the teaching community that there are shortages 'on the horizon'.

While the situation for the teaching workforce is better in Northern Ireland than it is in the rest of the UK, the situation for school lab technicians situation is if anything worse, and the supply is almost non-existent. In one of the schools we contacted, the post had been filled by a dinner lady. At present science teachers are heavily relied upon to train candidates for these posts. Teachers felt strongly that standards and qualifications should be made mandatory, and that every school should be entitled to an adequate number of posts.

One of DENI's Strategic Aims is 'to have highly skilled and motivated teachers and support staff', and it has set out its intention to develop workforce plans by March 2006[17]. The approach to achieving this aim has so far largely been via professional development of teachers. It is not yet apparent what steps will be taken as part of the review to address the careers of laboratory technicians. Professional Development is the responsibility of the General Teaching Council,

[15] I have requested data on how many actually do this each year, it is not publicly available. The idea is that they aren't a significant number.
[16] DELNI statistics
[17] DENI Business Plan 2005-6, Strategic Aim 4.3

GTCNI, and we will look at this in more detail in the next section. While the GTCNI reports to DENI, ITE comes under DELNI's rather than DENI's remit. CaSE believes that the Departments will need to collaborate to consider the supply of the workforce in the longer term, and to approach the issue with consideration to the different situations in specific subject areas. As is the case for post-16 science uptake, when it comes to science teaching uptake, Northern Ireland is in a position to learn from other areas of the UK and act now before problems arise.

Continuing Professional Development in Science

One way of ensuring that teaching remains an attractive option for science graduates is through the right professional development and progression opportunities (CPD). Following the recent work of GTCNI and DENI, CPD will play a more important role for Northern Ireland's teaching workforce and raise the profile of the profession.

> *I know that in Northern Ireland we are very fortunate with the calibre and qualifications of young people who want to go into teaching and of course that is a real plus for the system in Northern Ireland. But high quality beginning teachers must stay high quality, and that means high quality training and support throughout their careers*
> Angela Smith, Minister for Employment and Learning and Education[18]

The General Teaching Council for Northern Ireland[19] has said that the nature of CPD "has been somewhat restricted, characterised by reactivity and driven by systemic priorities."

These are very positive steps, but are not in line with the needs that teachers we spoke to told us about. The emphasis is on professional and pedagogical knowledge, with less subject content. CaSE has consistently argued for improved subject knowledge CPD in science[20]. The primary and post-primary teachers we spoke to in Northern Ireland raised science support and training as one of their main unmet needs. Not only does this greatly strengthen the case that there is a need for such provision, but it also suggests that it is likely to be welcomed by the workforce, and therefore more effective. Teachers also clear on their preferred ways of receiving CPD.

Primary teachers told us that they would strongly welcome peripatetic specialists to their lessons. A scheme currently in place at Queens University achieves this by placing science graduates into primary schools as part of their PGCE training[21]. Trainees have an opportunity to learn how to teach, but teachers also have an opportunity to learn more science. Obviously the number of schools this scheme reaches is highly limited. There is a need to make similar projects available to all schools on a regular basis.

Teachers at both levels are excited about the prospect of improving their science knowledge with training from scientists in industry and academia. Many feel uninspired by the CPD they are already familiar with, and would in any case welcome contact with practicing scientists. At the Teacher Education Conference last November, Angela Smith, Minister for Employment and Learning and Education, said "it is vital that all teacher educators should have recent and relevant experience of teaching in the classroom so that they are best placed to support beginning teachers by knowing of what they will actually face". In context here, referring to professional ITE providers, this is highly appropriate. However, it should be noted that teacher education does and should not only come from professional educators, other professionals also have a highly valuable contribution to make. In the same way that teacher educators must stay in touch with teaching, science educators must also stay in touch with science. An example of a highly successful regional scheme achieving this is the Teacher Scientist Network based at the John Innes Centre in Norfolk. Similar projects should be supported in Northern Ireland.

Teachers at both levels generally agreed that one day training courses may be helpful but are insufficient to make a real impact. This is the basis on which three day residential courses are

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[18] at the Teacher Education Conference, November 2005
[19] in its review of CPD.
[20] *Science Policies for the Next Parliament*, page 49
[21] http://www.qub.ac.uk/edu/

now offered at the National Science Learning Centre. However teachers in Northern Ireland are concerned that cost will mean this training is inaccessible for most teachers.

Post primary teachers raised one further point about their preferred forms of CPD, which is peer-based. One of the main concerns of science teachers was that they can become isolated from science teachers outside of their own school. The enthusiasm of teachers at both levels to share ideas and learn from each other was quite apparent. Northern Ireland needs more fora and networking opportunities, and to ensure that they are accessible to all.

Support is currently available from a range of bodies and institutions:

Education & Library Boards and their Curriculum Advice and Support Services:

Northern Ireland is split into 5 Education and Library Boards (ELBs), which were established in 1972. Their statutory role includes the provision of a Curriculum Advisory and Support Service (CASS). Since the curriculum changes of 1989, each has provided a science advisor as part of this service. CASS was reviewed at the end of last year by the Central Management Support Unit for ELBs[22], and DENI has set out its intention to take forward their recommendations[23].

Teachers at CaSE's focus group told us that their ELB advisors had originally been very active in providing advice for science when the service was first introduced, but that support had gradually waned over the following decades. It was understood that Advisors' activities are currently driven largely by changing government priorities such as literacy or social inclusion targets, rather than ongoing subject support. The review of CASS described the role as having 'evolved' from supporting programmes of study to playing 'a wider school improvement role', and recommends that the service be renamed '"The School Improvement Service" to describe its activities more fully'. However, there was a unanimous impression among teachers we spoke to from all ELB areas that the changing role had left a gap in science- specific provision.

Teachers also told CaSE that for a number of reasons ELB science courses were only reaching a small proportion of teachers. In many cases only subject coordinators or heads of department have been involved. Teachers believe that science support should boost the subject confidence of all teachers, but in most cases ELBs had not been able to provide this. The financial management difficulties of the Belfast and South Eastern Boards[24] have meant that these areas have become less proactive in publicising and promoting their courses to teachers. It was also noted that meetings for the whole region were always held in Belfast, placing an uneven burden on schools from different areas.

Teachers told us that travel expenses and funding for cover teachers were also a significant problem. The Review of CASS report noted the "concern of teachers regarding the effects of their absence from class and the extent of preparatory work to enable them to attend courses" and proposes "to assess the support among teachers and to review the potential for providing courses for teachers outside of term-time, which would reduce the impact of their absence on the classroom". CaSE awaits developments on this issue, but we note that funding for cover teachers may also be a necessary part of the solution, and that this particular barrier applies to CPD from all sources.

As well as difficulties in accessing science provision from CASS, teachers told CaSE that there were limits to the quality and expertise available. Support mentioned included managing laboratory equipment budgets, health and safety advice and physics boosters for those teaching outside of their specialism. When it came to science teaching in general, however, teachers felt that ELBs offered a repetitive, worksheet based programme. They were not the interesting

[22] Best Value Fundamental Service Review, December 2005
[23] DENI Business Plan 2005-6
[24] See the Jack Report, DENI website

opportunities that teachers were looking for. Post primary teachers made it clear that since most Science Advisors do not hold a science degree, they do not present a suitable source of expertise for subject training.

SLCs:
Science Learning Centres were introduced in 2004 to provide CPD to science educators. There is one in each of the 9 English Regions, with a national centre based in York. At present there are no centres in Scotland, Wales or Northern Ireland, although professionals in these regions can access training at the National centre. The teachers we spoke to were not particularly concerned that this scheme is not extended more fully to Northern Ireland, but if the project is successful DENI should consider setting up its own.

Inspectors:
The Education and Training Inspectorate (ETI) is run by DENI. It plays a similar role to OFSTED and ALI in England, and is responsible for inspecting ITT, the CCEA and ELB curriculum services[25]. The ETI's statutory role is "to monitor, inspect and report on standards of learning and teaching". Beyond this, the teachers we spoke to saw scope for a stronger supportive and advisory role, both for subject teaching and for school management. They commented that inspectors used to be able to provide subject specific advice, but this is no longer available. It was very much dependent on expertise of individuals, and the culture and climate of the Inspectorate. Some science teachers felt that their inspectors placed too much emphasis on exam results as opposed to the overall quality of the learning experience and actual learning outcomes. This opinion was not consistent across all areas, giving the impression that the approach of inspectorate teams is variable.

CLEAPSS:
CLEAPPS is the Consortium of Local Education Authorities for the Provision of Science Services, providing advice on practical science. It is an independent organisation based at Brunel University and run through subscriptions from LEAs, ELBs and others throughout the UK.

The Primary School Science Coordinators who we spoke to had found this service to provide the most useful advice on purchasing laboratory equipment. They said they would normally turn to CLEAPSS rather than their ELB for this kind of advice. However, teachers across Northern Ireland are not making as much use of this service as they could.

ASE:
The Association for Science Education operates in regional groups, one of which covers Northern Ireland. It provides advice, guidance and professional development opportunities to its members, who are individual teachers rather than ELBs. The regional secretary told us that the greatest barrier to training events and courses is time. Courses and events recently arranged on Saturday mornings have been poorly attended, while it is difficult to arrange time off for courses during school hours. Some teachers we spoke to mentioned that they can be put off joining the organisation or attending its events because of its reputation. It can be seen as boring, cliquey, for a certain 'type'. Despite this other teachers had found the courses very useful, and membership numbers have increased in Northern Ireland in recent years.

NIESU:
The Northern Ireland Educational Support Unit was set up at Queens University in 1991 to focus on teachers' professional development. It has a strong science emphasis with subject panels in biology, chemistry, physics and maths, which 'provide short courses, consultancies and support activities associated with curriculum development, innovation, evaluation and assessment'. The

[25] ETI, A Charter for Inspection

panels include teachers, ETI, ELB and university representatives. Each of the panels has its own emphasis and approach to CPD.

The SETPOINT for Northern Ireland is called SETINUS, and also represents the BA in the region. Main focus is in providing science events for students. Teachers we spoke to were very positive about these activities. According to SETNET, for the most recently published results, only 40% of schools are 'active in STEM', which is a lower proportion the UK total at 47%[26]. At that time only 18,000 students were involved in SENTINUS's activities, but in 2005 the number rose to over 58,000. This increase is a great achievement for the region[27].

[26] SETPOINT Effectiveness Survey 2003-4
[27] Ann Morrison, Belfast Institute

Curriculum and assessment

Northern Ireland has a single exam board unlike England, which has several independent awarding bodies. In Ulster, this function is combined with that of curriculum authority in a single body, the CCEA. The two functions are now dealt with by two separate branches, which in 2005, moved into separate office buildings.

The secondary teachers to whom we spoke were generally satisfied with the Examinations Team, which they perceive as responsive to feedback and offering good courses. While all the UK exam boards meet the requirements of Northern Ireland's GCSE and A-level provision, in practice, CCEA is chosen by many schools. The Curriculum and Assessment Division of CCEA plays a more challenging role in improving science education. As mentioned in the Introduction, a curriculum reform is currently underway across all key stages. CCEA has submitted reform proposals for approval to DENI for all key stages. Implementation of the revised Key Stage 3 began in September 2005, with statutory changes at all levels due in 2007-8[28]. Many sectors of the science education community view this division as too powerful in the current political vacuum and are concerned that the organisation has been left with responsibilities beyond its resources.

While many teachers we spoke to highlighted constant change as their main concern, there are hopes that the new curriculum will prove to be an opportunity for improvements to science education. The GTCNI review of CPD highlighted concern among teachers about implementing the new curriculum, and steps are being taken to address this. However, implementation is not the only concern that teachers have about the new curriculum.

The teachers we spoke to were very dissatisfied with CCEA's consultation process. They were concerned about manipulation of results, misunderstanding of responses, ignoring teachers' input, asking leading questions, misrepresenting proposals, not consulting at the right time, and writing such long-winded documents that teachers simply could not realistically take the opportunity to respond. This has resulted in a strong feeling of mistrust among the teaching community, and a risk of unwillingness to implement changes. In many cases teachers, are bemused at CCEA's decisions. Some thought that the curriculum reform process had pandered to intra-subject rivalries.

There is a general opinion that current teachers should be more closely involved in curriculum development. They have clear ideas about curriculum content, and are well placed and motivated to develop these. Some commented to us that CCEA staff 'must have forgotten what it's like in the classroom'. While this concern has already been acknowledged by the education Minister, it is vital that it be addressed in an appropriate way.

Widespread use of a single exam board makes the transition from school to university slightly easier in Northern Ireland than in the rest of the UK. For example, there is generally consistency in the mathematics that has been covered at A2 level. However, there may be a lack of awareness among those designing and delivering undergraduate courses as to the changes that are occurring at school level. Likewise there is a lack of awareness among secondary school teachers as to what changes are occurring at primary level. While it is to a large extent the responsibility of educators to remain up-to-date with changes, CCEA could do more to publicise its work. Consultation documents are typically only sent to those teaching at the particular Key Stage in question. However, teachers at earlier or subsequent stages may also have valuable contributions to make, and should be made aware of the details of the reform process. A stronger effort is needed in the fields of communications and publicity.

[28] See CCEA's Pathways website

In *Science and Engineering Policies for the Next Parliament,* CaSE recommended for England that "the Qualifications and Curriculum Authority needs to liaise more effectively with higher education institutions in order to address the issue of the interface between school and university science courses". If anything, this applies to an even greater extent in Northern Ireland.

CCEA does not appear to make sufficient use of university expertise when it comes to determining syllabus content. Only a few members of Northern Ireland's universities have contact with the authority. One barrier to communications is that there is little incentive for individual university staff in terms of career structure, ratings in the Research Assessment Exercise or financial reward. A further barrier to involvement has been the attitude of the CCEA itself. Academics told CaSE that their attempts to join CCEA curriculum boards had repeatedly been rejected over a period of over ten years. They also pointed out that some relevant areas can be excluded unintentionally. For example since engineering is not a school subject, these faculties can easily be neglected, even though maths and science qualifications are essential for engineering.

In our *Science Policies*, CaSE set out that "science must remain part of the curriculum throughout compulsory education. Giving up science at any earlier age would mean that students would be limiting their options of subject choice far too early on, and would mean that not all students reached a basic level of science knowledge to which they are entitled. Following the recent decision to remove modern languages from the core subjects for the 14-16 age group, the Government was surprised to find that at least a quarter of students have now opted to study no foreign language at Key Stage 4. The same should not happen to science lessons". This was written bearing in mind the age at which students *give* up science, rather than the age at which they *take* it up.

CaSE emphasises the need for a curriculum that maintains pupils' and teachers' enthusiasm. Allowing primary teachers the flexibility to cover only the topics which they feel are appropriate and are comfortable teaching will help to achieve this. It is also important to appreciate that at primary school level, much of the work is project-based and includes aspects of several disciplines. For this reason the primary teachers to whom we spoke thought that a more integrated approach to subject boundaries in the curriculum would be appropriate.

The main concern about delaying the start of compulsory science was about how this would affect standards further down the line. University staff were undoubtedly the most concerned group, and felt that pupils' progress was being sacrificed for the sake of 'selling' science to them. However, according to the views of some of the post-primary teachers we spoke to, the changes could actually quicken a pupil's progress during Key Stage 3.

The current national curriculum has not served to provide sufficient consistency between primary schools, with the result that post-primary teachers sometimes have to re-cover most topics in order to ensure that pupils are all up to speed. This interface was identified as a problem, and teachers were unanimous about the importance of a joined-up approach to designing each stage in the curriculum. 'Horizontal continuity' between mathematics and science was also raised as an important issue. CCEA must ensure consistency between different curriculum areas. The current repetition of content at Key Stages 2 to 4, and between different curriculum areas, mean that pupils get bored in lessons.

There was a strong consensus among the primary school teachers whom we consulted that the new, more flexible curriculum will be a good thing. There would be more opportunities for hands on science, and teachers will be able to spend more time on topics in which they are confidence, competent and interested.

There is also an issue that in some cases, primary teachers' lack of scientific knowledge and understanding has misled pupils on some scientific issues. This could be avoided under the new Key Stage 1 and 2 regulations. Throughout the UK, most primary school teachers have no post-compulsory science education, and are less confident in teaching science than other subjects[29]. The primary school teachers we spoke to openly acknowledged the lack of science background among themselves and their peers, recalling the reaction of the workforce to the introduction of compulsory science as 'fear and panic'. One educationalist commented to us that 'the old physics curriculum was written so as to be unintelligible to most primary teachers, this resulted in teaching to test'.

Unpicking misunderstanding of scientific concepts and then 'starting from scratch' takes up additional time during the first few years of post-primary. The post-primary teachers we asked about this were confident that they would be able to bring students up to at least current standards at Key Stages 3 and 4. They also thought that pupils would enjoy physics more if it was taught thoroughly and accurately later in their educational careers.

Chief examiners have been told that science must still be taught, even if it is not to be assessed. Teachers pointed out that students and parents find it easier to recognise the value of courses that lead to a qualification. Although little is likely to change in the next few years, teachers are concerned that room has been made for science to be dropped in the longer term, perhaps as a response to future teacher shortages. Post primary teachers were outraged at the principle that post-14 science should be non-compulsory. They felt this provided an opportunity to 'dump' lower ability sets and give up on their science education.

At primary and post primary levels teachers were unanimous in wanting more time and flexibility to include practical classes in the curriculum.

If the new compulsory requirements mean students end up taking two rather than three sciences, teachers would not be concerned - this would merely be reverting to the situation that pertained several years ago. Chemistry and physics uptake would 'inevitably' suffer. Teachers think pupils have more to gain by developing their skills in a particular area, rather than be pressured to somehow cover 'the whole of' science. The history curriculum was cited as an example: students develop their skills looking in-depth at a few different historical periods or events, but are not expected to memorise a few facts from each period from across the whole of history. In science, the problem is exemplified in that students are required to know what momentum is, but not to know anything about it.

[29] for example Ofsted has surveyed this in England

Appendix 1

Participants in CaSE's Opinion Forum meetings in Northern Ireland in December 2005

Bob Bankhead, Science Teacher
Jim Beggs, Graduate School of Education, Queen's University
Martin Brown, NISEF
Kevin Burness, Primary Teacher, Science and ICT Coordinator
Paul Canavan, Science Teacher
Maureen Eccles, Primary Teacher, Science Coordinator
J Emmerson, Science Teacher
Jeremy Farrell, Primary Teacher [Principal]
Cathy Ferrin, Primary Teacher
Mr W. Gordon, Science Teacher
Caroline Greer, Science Teacher and representative of the Association of Science Education
Chris Hardacre, School of Chemistry and Chemical Engineering, Queen's University
David Hatton, Engineering Training Council
Alan Hibbert, Department of Applied Mathematics and Theoretical Physics, Queen's University
Clare Hill, Primary Teacher
Lesley Hunter, Primary Teacher
Mr R Irvine, Primary Teacher
Harry Johnston, School of Civil Engineering, Queen's University
Steven Kelly, Primary Teacher [Assistant Principal]
Marian McAllister, Primary Teacher
Mrs Linda McKee, Primary Teacher
Hugh McKenna, Dean of Life Sciences and colleagues, University of Ulster
M. McLaughlin, Primary Teacher
Richard Millar, University of Ulster
Edwin Mitchell, Science Teacher
Lorna Monroe, Science Teacher, and representative of the Association of Science Education
Rosemary Moore, Science Teacher
Robin Morrow, Science Teacher
Collette Murphy, Graduate School of Education, Queen's University
Lisa Murphy, Primary Teacher
Brian O'Donnell, Science Teacher
Catherine O'Jeill, Science Teacher
Peter O'Prey, Primary Teacher
Colin Press, NISEF
Irvine Richardson, the Principal Science Inspector for Northern Ireland
Maggie Robinson, Learning and Skills Development Agency
Therese Searle, Primary Teacher, Science Coordinator
Dr. John K. Watterson, School of Mechanical and Aerospace Engineering, Queen's University
Brian Wheeler, Science Teacher
Maureen Young, Science Teacher

Appendix 2

Abbreviations and website addresses:

CASS	Curriculum Advisory and Support Service	
CCEA	Council for the Curriculum, Examinations and Assessment	http://www.ccea.org.uk
DELNI	Department of Employment and Learning	http://www.delni.gov.uk
DENI	Department of Education	http://www.deni.gov.uk
DETI	Department of Enterprise, Trade and Investment	http://www.detni.gov.uk
ETI	Education and Training Inspectorate	# see DENI site
ELBs	Education and Library Boards:	
	Belfast	http://www.belb.org.uk
	North Eastern	http://www.neelb.org.uk
	South Eastern	http://www.seelb.org.uk
	Southern	http://www.selb.org
	Western	http://www.welbni.org
GTCNI	General Teaching Council	http://www.gtcni.org.uk
HESA	Higher Education Statistics Agency	http://www.hesa.ac.uk
JCQ	Joint Council for Qualifications	http://www.jcgq.org.uk
LSDA	Learning and Skills Development Agency	http://www.lsda.org.uk/ni/
	Northern Ireland Assembly	http://www.niassembly.gov.uk
NICS	Northern Ireland Executive	http://www.nics.gov.uk
NIESU	Northern Ireland Educational Support Unit	http://www.qub.ac.uk/edu/niesu/
NISRA	Statistics and Research Agency	http://www.nisra.gov.uk
NITEC	Teacher Education Committee	# existed 1994-2002 #
NISEF	Northern Ireland Science Education Forum (also Northern Ireland Student Endowment Fund)	
PMB	Partnership Management Board	http://www.pmbni.org.uk
SENTINUS	SETPOINT Northern Ireland	http://www.sentinus.co.uk
UCAS	(universities and colleges admission service)	http://www.ucas.co.uk
UCET	Universities Council for the Education of Teachers	http://www.ucet.ac.uk

Think-Create-Innovate DETI's Innovation Strategy.
http://www.detini.gov.uk/cgi-bin/moreutil?utilid=19
included Further and Higher Education, but not school-level issues.

eti

The Education and Training Inspectorate -
Promoting Improvement

INVESTOR IN PEOPLE

Providing Inspection Services for
Department of Education
Department for Employment and Learning
Department of Culture, Arts and Leisure

Education and Training Inspectorate

A Survey of

the Science and Technology Area of Study in a Sample of Northern Ireland Primary Schools 2000-2001:

Inspection and Improvement 2001-2002

1. INTRODUCTION

The survey report, published in 2001, was prepared to help primary schools, the Curriculum Advisory and Support Service (CASS), and the Department of Education (DE) to identify and address priorities for action in the science and technology area of study. As part of the Inspectorate's commitment to promoting improvement, members of the survey team returned to a sample of the survey schools during the third term of the 2001/2002 academic year, in order to review the progress made following the publication of the survey report.

The purposes of the follow-up to the survey were to:

i. establish the extent to which the original survey visits had helped to set an agenda for improvement in each of the schools and had, therefore, acted as a catalyst to improvement;

ii. gauge the extent of improvements brought about in the intervening period by the work of the schools supported by CASS; and

iii. determine, in particular, the improvements in learning and teaching, and in the standards across and within the science and technology area of study.

A number of qualitative terms are used throughout the report to present the findings. These terms should be interpreted as follows:

Almost/nearly all	more than 90%
Most	75%-90%
A majority	50%-74%
A significant minority	30%-49%
A minority	10%-29%
Very few/a small number	less that 10%

2. SUMMARY OF MAIN FINDINGS

2.1 The original survey visits by the Inspectorate had set a clear agenda for improvement within individual schools, and the published report had recognised much good practice within the schools involved.

2.2 Significant improvements in learning and teaching and in the quality of the children's work were noted in the year following the survey, by the staff in the schools and by the Inspectorate.

2.3 The CASS officers had made a significant contribution to bringing about improvement in science and technology in the schools, and to raising the profile of the science and technology area of study within them.

2.4 Effective working relationships were established between the CASS officers and the Inspectorate over the period of the survey, during the follow-up activity, and during the dissemination of the main findings.

2.5 The principals and teachers in the vast majority of the survey schools responded positively to the findings of the survey and, in the main, they engaged enthusiastically in the follow-up work and had worked hard to bring about improvement.

2.6 The work undertaken during the survey and the subsequent follow-up activity contributed to an overall improvement in the quality of the children's experiences in science and technology.

2.7 The work of the Inspectorate in planning and carrying out the survey, and in working co-operatively with CASS, achieved notable success as an inspection and improvement exercise.

2.8 The dissemination of the findings to a wider audience was a significant factor in influencing improvement in an area of study which had not been given particular priority in recent years, due to the current emphasis within school improvement on literacy, numeracy, and information and communication technology (ICT).

2.9 The schools and CASS face constraints in effecting improvement in science and technology. The constraints include the conflicting demands for time to review the various aspects of the curriculum, the sometimes limited availability of specialist CASS support, and the lack of teacher expertise in the assessment of skill development in science and technology. These constraints need to be overcome if continued development in the science and technology area of study is to be maintained.

3. BACKGROUND TO THE KEY FINDINGS OF THE FOLLOW-UP TO THE PRIMARY SCIENCE AND TECHNOLOGY SURVEY 2001-2002

3.1 In preparation for the follow-up work, all of the schools visited during the survey were asked to complete a questionnaire about those aspects of the survey which had enabled them to bring about improvement. Approximately two-thirds of the schools completed the questionnaire. One-third of the schools in the original survey were then identified in a random sample and re-visited by members of the survey team, in order to evaluate the progress made following the survey; follow-up reports were issued to all of these schools.

3.2 KEY FINDINGS BASED ON SELF-EVALUATION BY THE SURVEY SCHOOLS

3.2.1 All of the survey schools were asked by the Inspectorate to complete a written evaluation of the progress which they felt they had made as a result of the survey and, as indicated in paragraph 3.1, approximately two-thirds of the survey schools responded to the written questionnaire. All of the responses received indicated that the survey visits had been helpful in setting an agenda for improvement in the work in science and technology, and all confirmed that the discussions with the inspectors had been of professional value to the staff. In the vast majority of the responses there was a clear indication that, in the view of the principals, the work in the area of study had improved as a result of the survey visits. A number of principals recorded their appreciation that the good work within the area of study had been recognised and acknowledged by the inspectors, and indicated that teachers were encouraged by the comments made about their work. In most instances, the survey findings reported to individual schools confirmed the high standards of teaching and learning in science and technology.

3.2.2 In their responses to the written questionnaires, the schools indicated improvement in key areas of their work; many of these were similar to those noted by the Inspectorate during the follow-up visits to the schools. The most significant improvements identified by the schools included:

- improved planning for the development of skills particularly in relation to Attainment Target 1 (AT1);
- increased opportunities for the children to engage in investigative work;
- the introduction of recording strategies which enabled the children to record independently and to develop their own initiative;
- a greater awareness of the need for a balance between theoretical and practical work in key stage (KS) 2;
- the revision of whole-school planning to take account of the issues raised;
- more effective development of the children's competence in ICT within science and technology;
- more attention given to technology and design within the science and technology programme;
- more opportunities given to the children for independent writing and for oral work;
- the provision of additional books and resources to extend the children's learning in science and technology;
- the development of new approaches to monitor the children's progress and standards in the area of study;
- improved links between science and technology and other areas of the curriculum; and
- the professional development and improved confidence of the teachers;

3.3 KEY FINDINGS OF THE INSPECTORATE DURING THE FOLLOW-UP TO THE SURVEY

3.3.1 During the follow-up visits, it was found that the vast majority of the schools had taken account of the issues raised during the survey, and had made significant progress in dealing with the areas identified for improvement. A very few schools had been unable to address the issues raised during the survey as they had been dealing with other curricular priorities, or there had been changes in senior staff. In all of these schools, however, science and technology had been placed within the school development plan to be addressed at a future date.

3.3.2 During the follow-up visits, the inspectors were encouraged by the willingness of principals and teachers to discuss the positive effect of the survey, and by the work which had been undertaken to address the associated issues within the schools. The professional dialogue between the Inspectorate, the staff in schools and members of CASS was a key, influential feature of the work undertaken during the survey. The improvements noted by the Inspectorate correspond closely with those noted by the schools through the process of self-evaluation. The most significant improvements identified by the Inspectorate in almost all of the schools included:

- improved independent writing and recording skills in science and technology lessons;
- the children displaying more independence and willingness to take initiative;
- more effective progression and coherence in the development of the children's investigative and experimental skills;
- better use of ICT to support and enhance learning and teaching in science and technology;
- improved links between the work in science and technology and other areas of the curriculum; and
- the more effective identification by teachers of the intended learning outcomes in science and technology lessons.

3.3.3 **The following improvements were noted by the Inspectorate in most of the schools:**

- more effective monitoring of the science and technology programmes and of the standards of the children's work;
- a more appropriate balance between theoretical and practical work in the children's learning experiences in years 6 and 7;
- more regular opportunities for the children to undertake work in technology and design, thereby enhance their skills of designing and making;

4. CASE STUDIES (SCHOOLS)

4.1 The following case studies from schools are quoted to indicate the value of the Inspectorate survey in helping to bring about improvement.

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£140m BOOST TO SCIENCE AND MATHS TEACHING IN SCHOOLS

24 January 2008

Ministers want lessons to be more exciting for budding scientists

Schools Minister Jim Knight today outlined a £140 million strategy to educate the next generation of scientists and mathematicians and help recruit and train more science and maths teachers.

The Government wants the very best teachers to increase the number of young people opting for Science, Technology, Engineering and Mathematics (STEM) subjects and following a related career which will help the UK compete in the global economy.

And it also wants to ensure that lessons are lively for budding scientists, with more "flash bang" excitement to bring these fascinating subjects to life while maintaining academic rigour.

The £140 million package over the next three years is more than double the amount spent between 2005 and 2008, underlining the government's commitment to increasing the number of science and maths teachers, improving results at GCSE and increasing the number of young people studying these subjects post-16.

Schools Minister, Jim Knight said:

"Britain has a great tradition for producing world class scientists and engineers and I want to not only maintain but enhance that. When I visit schools I see that science and maths lessons can be exciting and inspiring. I want more science in action in the classroom, more flash bang to enthuse budding scientists.

"We want more young people studying science and maths A levels, that is why we are investing more than ever in these important subjects. As well as learning the periodic table students must be able to experience the excitement of practical experiments."

The £140m package for Science Technology Engineering and Mathematics includes:

• £31 million for recruitment and retention including £11.4 million so that teachers can retrain to become maths, physics and chemistry specialists - every teacher who retrains will receive a financial incentive of £5,000;

• £50 million for continuing professional development including:

£18 million to fund the regional science learning centres plus continued funding for the National Centre for Excellence in the Teaching of Mathematics;

£4.5 million for schools to encourage them to release teachers for professional development at our science learning centres;

• £34 million to help boost the number of young people studying science STEM subjects post-16 including up to £9 million so that more pupils can take the three GCSEs in physics, chemistry and biology;

• £9 million to improve pupils' learning experience through enhancement and enrichment activities including doubling the number of science and engineering clubs in schools from 250 to 500.

John Holman, Director, National Science Learning Centre, said:

"It is tremendous news that the government is investing in the continuing work of the Science Learning Centres, so they can reach even more teachers to update their science knowledge and teaching skills. This investment in science teaching is an investment in young people and in the country's economic future."

Professor Celia Hoyles, Director National Centre for Excellence in the Teaching of Mathematics said:

"I am absolutely delighted at the news that the government will continue to support The National Centre for Excellence in the Teaching of Mathematics (NCETM). Mathematics is at the heart of so much of education across all phases. It is a life skill and it provides a unique and powerful perspective on the world. We must engage more learners in mathematics and nurture their mathematical potential. We in the Centre are playing our part in furthering this crucial agenda by working with partners to enhance opportunities for mathematics-specific continuing professional development for all teachers. "

Editor's Notes
This press notice relates to 'England'

Work already being done to improve teacher training includes:

• A special partnership (called Transition to Teaching) between employers and the Training and Development Agency for Schools to attract more scientists and mathematicians into teaching. The programme will be formally launched in the spring and will begin training new teachers from the autumn;

• Continuing to pay the teacher training bursary for maths and science (£9,000) and the golden hello (£5,000); giving additional £1,000 payments to ITT providers for each physics or chemistry trainee teacher they recruit; offering additional courses to enhance physics, chemistry and maths subject skills for those entering teaching who do not have a recent degree in the subject; expanding the student associate scheme to give science and maths undergraduates a taste of teaching with a view to encouraging them to pursue teaching as their career.

The PISA study on the attitudes of 15 year olds to science found:

• 75 per cent agreed that they study science because they know it is useful for them;

• 71 per cent agreed that making an effort in science subjects is worth it because this will help them in the work they want to do later on;

• 71 per cent agreed that studying science subjects is worthwhile for them because what they learn will improve their career prospects;

• 54 per cent agreed that what they learn in their science subjects is important for them because they need this for what they want to study later on.

The report also found that although English teenagers say that studying science is useful for their futures, fewer say that they want to work in science-related careers or to study science. Although students agree that science is useful and beneficial, most do not wish to be involved with it in their future lives.

• 34 per cent agreed that they would like to work in a career involving science;

• 33 per cent agreed that they would like to study science after secondary school.

Contact Details
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Press Notice 2008/0017

HOUSE OF LORDS

Science and Technology Committee

10th Report of Session 2005–06

Science Teaching in Schools

Report with Evidence

Ordered to be printed 19 October 2006 and published 5 November 2006

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HL Paper 257

ABSTRACT

Effective science teaching in schools is essential, both for ensuring a satisfactory degree of scientific literacy in society at large, and for equipping the next generation of scientists and engineers to progress into higher education and beyond. In this report, we seek to show how the examination system and the provision of advice to students can be improved; how science and mathematics teaching can be enhanced and enriched; how the current problems with teacher recruitment and retention can be tackled; and how the take-up and provision of continuing professional development (CPD) can be addressed.

There is good evidence that students are opting for "easier" A-levels over the sciences and mathematics. This problem is compounded by the fact that students are being forced to study an excessively narrow range of subjects at too early an age. The Government should replace A-levels over the long-term with a broader-based syllabus for post-16 students. To this end, we recommend that the Government both revisit Sir Mike Tomlinson's proposals for a broader diploma system for 14–19 students and give further consideration to the International Baccalaureate. These systems would ensure that students receive a more rounded education and do not over-specialise before they have seen the merits of pursuing science and mathematics. We also call for the Government to improve the quality of careers advice in schools as a matter of urgency.

We are deeply concerned about the impact that so-called "teaching to the test" is having upon the quality of science and mathematics teaching. We therefore call on the Government to alter the current testing regime so that the tests assess a much broader range of skills, thus allowing teachers greater flexibility to inspire students in the classroom. In particular, we believe that the Government must act to secure the future of practical science in schools. We call for a central website on practical science to help address health and safety fears, and urge the Government to improve their unsatisfactory "exemplar" designs for science laboratories by consulting much more widely with experts in the field. Finally, we recommend a proper career structure and improved pay for school science technicians, who continue to be undervalued in spite of the crucial role they play.

There is a serious shortage of specialist physics and chemistry teachers, which is a barrier to better teaching of these subjects. We strongly believe that this issue can only be tackled effectively if schools are given more freedom to offer significantly higher salaries to candidates with specialist qualifications in these subjects: market forces cannot be ignored. We also call for the Government to offer longer-term incentives to science and mathematics teachers, by reducing the size of the golden hellos and offering to write off student debts in return for four or five years' service. Finally, we call for a better-paid and faster route for those people with substantial expertise of science or mathematics in industry to gain qualified teacher status.

On professional development, we recommend that the Government make it compulsory for teachers to undergo a certain amount of subject-specific CPD each year. We also call for additional ring-fenced money to be allocated to schools in order to cover the cost of supply teachers standing in for staff on CPD courses.

CHAPTER 6: SUMMARY OF RECOMMENDATIONS

6.1. We outlined the key points of our report in the Abstract. In this chapter we set out our conclusions and recommendations in full. The numbers in the brackets refer to the relevant paragraphs in the text.

Student Attitudes and Choices

6.2. There is good evidence that students are opting for "easier" A-levels over the sciences and mathematics, a problem which is compounded by the specialisation forced upon students by the A-level system. We call on the Government to replace A-levels, over the long-term, with a broader-based syllabus for post-16 students. To this end, we suggest that they revisit Sir Mike Tomlinson's proposals for a diploma system and also consider the International Baccalaureate Diploma Programme. These systems would allow students to maintain greater breadth in their studies, giving them more time to choose the areas which they wish to pursue. They would also result in a more rounded education and would prevent the damage caused by the perception that science and mathematics A-levels are particularly difficult. (2.28)

6.3. In general, the Science, Technology, Engineering and Mathematics (STEM) careers advice offered in schools appears not to be of sufficient quality, and the Connexions Service is not well adapted to the needs of high achieving students. The Government have largely neglected careers advice in *Next Steps*, and this omission should be remedied at the earliest opportunity. We recommend that the Government act upon the findings of the Roberts Review by establishing a small central team of advisers to support existing advisers, teachers and parents in making pupils aware of the full range of opportunities and rewards opened up by studying science, mathematics and engineering subjects. (2.41)

6.4. The proposed "Careers from Science" website would be a valuable tool in persuading more students to study STEM subjects at A-level and beyond. In light of earlier commitments, the lack of Government assistance to the Science Council is unacceptable. We urge the Government to provide financial and logistical support to the project as a matter of urgency. (2.42)

Teaching Methods

6.5. We do not believe that Ofsted's new regime for the inspection of individual subjects, based on a small and statistically insignificant sample of schools, will provide sufficiently reliable data on science teaching. We recommend that Ofsted revisit the new subject-specific inspection regime with a view to devising a system which draws evidence from a substantially larger number of schools. We further recommend that subject-specific inspections be carried out by specialists in the subject concerned. (3.7)

6.6. We welcome the new science GCSE courses, although it is essential that teachers should maintain the necessary rigour in their teaching and ensure that the "hard" science is retained. However, it is unfortunate that the Government opted to roll out the new courses before the results of the Twenty First Century Science pilot could be fully evaluated, and before the other, unpiloted courses had been sufficiently scrutinised. We recommend that, in future, the Government should allow more time between piloting

new courses and rolling them out across the country. In addition, the Government must keep a very close eye on how the unpiloted courses are bedding down, providing appropriate support where necessary. (3.16)

6.7. We welcome the Qualifications and Curriculum Authority's (QCA) plans to align the Key Stage 3 programme of study and the science A-levels with the new GCSEs. However, the introduction of the new A-levels in particular must not be rushed. We recommend that the Government review the proposed timetable for introducing the new A-levels, so as to ensure that there is sufficient time for the new GCSEs to bed down and for teachers to adjust before national roll-out. Furthermore, we call on the Government to ensure that some piloting takes place before the new courses are introduced. (3.19)

6.8. Whilst we welcome the existing schemes that bring scientists and engineers into the classroom, particularly the Science and Engineering Ambassadors Programme, we are concerned that academics and university students receive little recognition for helping to inspire the next generation of scientists in schools. We recommend that the Government work with the funding councils to ensure that outreach work in schools is properly valued as part of the RAE, and to encourage higher education institutions to provide details of any such work in their submissions. (3.30)

6.9. We welcome the formation of the Regional STEM Support Centres as a means to provide a single, simple source of information on STEM enrichment opportunities. However, the web portal must be comprehensive and accessible. We therefore recommend that there be separate sections for each region, so that the content is tailored to the audience, and teachers and students are thus able to obtain information with the minimum time and effort. (3.35)

6.10. We are seriously concerned about the impact that the national testing regime is having upon the teaching of science and mathematics. We call on the Government to ascertain as a matter of urgency how the tests can be altered so as to assess a much broader range of skills, thus allowing the teacher greater flexibility in inspiring students in the classroom. (3.42)

6.11. Practical science is at risk in our schools. We urge the Government to take the following action.

- We call on the Government to review the place of practical science within the national tests as a matter of urgency so as to secure the future of genuinely open-ended, investigative science both inside and outside the classroom. Similarly, the new A-levels should place greater emphasis on practical work, including that outside the classroom or laboratory.
- We recommend that the Government assess the feasibility of a unified and comprehensive central website dedicated to practical work in all the sciences. Such a website, which could be closely linked to the Science Learning Centres' web portal, should offer health and safety advice and exemplar practicals that can stimulate students.
- Significant funding is required to remedy the unsatisfactory state of many school science laboratories. We therefore deplore the Government's failure to deliver the £200 million promised for school science laboratories during the 2005 General Election campaign. We welcome the Building Schools for the Future programme, but are

concerned that an insufficient amount of the funding will be spent on improving science laboratories. It is not the role of central Government to determine in detail how schools spend their budgets, but we recommend that the Government, together with local education authorities and Ofsted, initiate a campaign to persuade schools of the huge importance of high quality laboratories.

- The low quality of so many new or refurbished science laboratories is both regrettable and avoidable. We are mystified that the Government, in developing exemplar designs as part of the "School Labs of the Future" programme, have failed to consult acknowledged authorities such as the Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS) and the Association for Science Education (ASE). We recommend that the Government rectify this omission immediately. (3.64)

6.12. A motivated and well-trained supply of technicians is an essential component of effective science teaching. We therefore wholeheartedly endorse the ASE's proposed career structure for technicians, the new NVQ and the virtual assessment centre. We recommend these proposals to the Government, and in addition invite them to consider whether the career structure could be linked to advisory salary scales, in an attempt to increase the almost universally low level of pay for technicians. (3.72)

Teacher Recruitment and Retention

6.13. We welcome the provision of pre-Initial Teacher Training (ITT) enhancement courses in physics, mathematics and chemistry. We recommend that the Government implement a loan system to help participants—especially those with family commitments—to meet their living costs between the end of the course and the commencement of ITT. We also call on the Government to consider further incentives to encourage higher education institutions to participate on enhancement courses. (4.20)

6.14. A clear system of accreditation—accompanied by appropriate rewards—is essential if practising teachers without a physics or chemistry specialism are to be persuaded to give up their time to take courses which will qualify them to teach these subjects more effectively. We recommend that the Government introduce such a scheme as soon as possible. (4.24)

6.15. If the targets for increasing the number of specialist teachers of physics, chemistry and mathematics are to be met, the Government must confront the issue of salaries. Whilst schools already have some flexibility with regard to salaries, the current situation is not satisfactory. We therefore recommend that the Government grant schools a specific right to offer significantly higher starting salaries to candidates specialising in physics, chemistry and other shortage subjects. The Government should simultaneously work to ensure that head teachers are aware of this power and that, where necessary, they make this information available when placing job advertisements. (4.35)

6.16. Whilst the training bursaries and golden hellos offered to postgraduate trainee teachers appear to have had a positive effect, we are concerned that they may have a fairly short-term impact on the recipient. We call on the Government to examine the merits of reducing the size of the golden hello and offering instead to write off a certain amount of the student debt of new

science or mathematics teachers, in return for four or five years of full-time teaching. (4.41)

6.17. We recommend that the Government introduce a modified version of the Graduate Teacher Programme which will allow those with extensive relevant experience of science or mathematics in industry to gain Qualified Teacher Status more rapidly. We further recommend that relevant knowledge and experience should be reflected in a higher salary for career changers commencing their teacher training. (4.50)

6.18. We call on the Government to ensure that schools have sufficient powers and funds to offer generous retention bonuses to teachers of shortage subjects, and that those schools with retention problems are fully aware of these powers. (4.59)

Continuing Professional Development

6.19. Whilst we welcome the Government's attempts to link continuing professional development (CPD) to career progression, we remain unconvinced that those teachers who could most benefit from subject-specific CPD will take advantage of such opportunities. We therefore recommend that the Government introduce a requirement for all teachers—whatever their subject—to undertake a certain number of hours of subject-specific CPD each year. We further recommend that the Government provide schools with ring-fenced funding for supply teachers to cover staff on external CPD courses, whilst simultaneously giving urgent consideration to how the availability of supply teachers or higher level teaching assistants can be maximised. (5.16)

6.20. We have already recommended that Ofsted revisit the new subject-specific inspection regime with a view to devising a system which draws evidence from a substantially larger number of schools. Following on from this, we recommend that the Government, along with Ofsted, explore more formal mechanisms to promote contact between schools performing poorly in science or mathematics and better performing schools in the area. This would enable teachers, teaching assistants and technicians to share best practice and to find out how they might improve their performance. (5.19)

6.21. We welcome the new Science Learning Centres, but have serious concerns that they will not be able to attract a sufficient number of attendees once the bursaries have come to an end. We urge the Government to work with the Wellcome Trust to determine how bursaries can continue to be provided in the longer-term, to ensure that the centres are able to flourish. (5.26)

3

Strategy for Science, Technology and Innovation

2006 ~ 2013

Science Education and Society

5.1 Introduction

A sustainable knowledge economy needs strong foundations – and these are to be found in first and second level education. The primary and secondary students of today are the potential star researchers of tomorrow. Although perhaps self evident, it has to be said that first and second level education provides the foundations for a knowledge-based society. In that context, if we aspire to being world leaders in science and technology, our education system needs to develop to make this happen and needs to support creativity in all its dimensions; technological, scientific and social.

5.2 Primary School

The reintroduction of science into the primary curriculum in all classes is a recent and significant development. From an early age, children are introduced to basic scientific concepts and methodology such as the observation of experiments and deductive reasoning. This has been accompanied by in-service training of primary teachers to equip them to teach the new science curriculum. The linkage between the primary and post-primary curricula should be strengthened to enable a gradual deepening and widening of science and scientific issues from one level to the other.

Given the introduction of science in the primary curriculum, more emphasis will be placed on science teaching methodologies in the Colleges of Education and through in-service training, particularly targeting the needs of those Education graduates who do not have a science background. In addition, a core area of study in the Colleges of Education will involve science and an awareness of scientific issues.

The implementation of the primary science curriculum will soon be reviewed. This review will include an examination of the effectiveness of teaching methodologies in stimulating interest in and awareness of science at a very young age. It will also examine how best pre-service training of teachers can address the ongoing needs of the primary science curriculum.

5.3 Second Level

At second level almost 90% of students study Junior Certificate science. A revised syllabus was introduced in 2003 and represents a significant change in the way science is taught

at junior cycle including in the area of teaching methodology and assessment, reflecting international trends towards a more investigative approach to science education. This approach provides for a move towards more practical and project work, with thirty practical experiments and investigations which can be carried out at different times over the period of the programme and presented for assessment as one of the components of the final examination. The reforms are seen as an important part of the moves towards making science more attractive, and encouraging students to continue the subject at senior cycle. The next round of OECD PISA (Programme for International Student Assessment) will allow progress to be internationally benchmarked as science is a major domain in the assessment.

At Leaving Certificate Level approximately 60% of students study at least one of the three science subjects. Currently, 14.7% of the cohort study physics and 13.6% study chemistry. The uptake of Physics and Chemistry has been a concern for some time. The numbers taking these subjects has declined substantially since the 1980s, and although the downward trend has been arrested, there is a critical need to achieve increases in the take up of these subjects over the coming years. This problem is not just an Irish problem, other countries are experiencing the same types of difficulties.

A critical concern is to increase the numbers who continue to study these subjects at senior cycle. The objectives will be to increase the percentage taking Chemistry and Physics subjects at Leaving Certificate generally to 20% of the overall cohort by the conclusion of this Strategy. As part of this approach, concerted efforts will be made to encourage a better gender balance in the take up of Physics, where females are under–represented at both ordinary and higher level and to increase the proportions of students generally who study these subjects at Ordinary level. Increased participation will be achieved as follows:-

- Reform of the science curricula in Leaving Certificate, particularly physics and chemistry subjects, to ensure a continuum from Junior cycle with the emphasis on project-based hands-on investigative approaches and the completion of practical coursework, and assessment of these as part of the overall examinations, allied with embedding of key skills and ICT; a more applied focus, and an emphasis on the inter disciplinary nature of science in society.

- Investment in teacher professional development in collaboration between Second Level in-service providers, higher education institutions and the Discover Science and Engineering programme, as appropriate.

- Promotion of information brochures, guidance materials and resources and awareness initiatives in collaboration with the Discover Science programme, and effective linking of this with school guidance services, targeting in particular transition year students.

Crucially, there is a widespread belief that physics, maths and chemistry are subjects in which it is difficult to score high grades, and the choices made by students are inter alia, influenced by the need to get points for courses such as medicine and other health sciences courses, rather than the pursuit of the 'pure sciences'. In line with proposals generally for reform of senior cycle, the science subjects will be reviewed with a view to re-balancing of content, greater emphasis on problem solving, and modernisation, to the extent feasible in order to allow a better embedding of key skills and an applied focus. It is important that the examination of new models leads to the development of new approaches and examplars.

In addition, there will be a need to ensure the availability of appropriate and suitably qualified personnel to undertake the associated assessments.

In the context of the plans for assessment of science practical coursework as part of the overall examination, the issue of technical assistance for schools will be revisited. A range of models will be explored in collaboration with other actors to see how best the work of schools in this area can be supported and enhanced.

Developments at senior cycle science will be informed by a further survey of pupil/teacher attitudes to be undertaken in 2006 in the light of the first cohort of students completing the revised junior cycle syllabus. This will focus on their experiences of the revised syllabus and assessment arrangements and the factors which influence their decision making in relation to the take up of the physical sciences at senior cycle. This will inform the ongoing process of curricular reform at Senior Cycle being undertaken by the NCCA.

There are also concerns regarding the numbers of students who choose science options at third level. Ireland in 2002 was above the EU average in terms of the numbers of students enrolled in maths, science and technology courses as a percentage of students in tertiary education. Despite this positive appearance, two problems underlie the statistic. First, the number of science graduates is now decreasing and secondly the demand for science graduates is increasing. A critical part of the overall strategy will be to encourage more students who perform well in science in senior cycle to choose science options in third level and to pursue careers in this area.

In the engineering and technology areas at second level, the revised syllabi in Architectural Technology, Engineering Technology, and Design and Communication Graphics with Technology have been developed. These, together with a new syllabus in Technology, are important in providing for an increased emphasis on investigative approaches, problem solving and entrepreneurial skills, CAD/CAM and control technology. These revised syllabi also provide a strong emphasis on practical project work for which 50%-60% of the marks are available. Implementation of the curriculum reforms in this area, allied with improved performance in maths, is necessary to provide the appropriate foundation on which the success of the higher education initiatives in science, technology and engineering depend.

To achieve the target of increased participation in the sciences, it is recommended that HEIs should consider the option of a science subject for matriculation.

The number of science graduates training as second level teachers will also be examined with a view to increasing the numbers of teachers available in science and maths, and establishing "quotas" for specific subject areas as necessary to ensure that the subject needs of the curriculum are adequately met. In addition, the coverage of science and maths in Higher Diploma in Education programmes and the concurrent BSc (Education) degrees will also be reviewed.

This work will be further strengthened through enhanced in-service training, promoting the development of Teacher Professional Networks and increased collaborative links between industry and schools and colleges.

An initiative is planned where direct financial support will be provided to Teachers' Professional Networks involving all teachers of a particular subject, including those who may be members of an existing subject association. This support will be used to encourage the development of teachers' networks. These will focus on improving teaching and learning, including teachers' own Continual Professional Development, along with capacity building of 'expert' teachers in regions based on the twenty one Education Centres. It is intended to prioritise science subjects and maths for this financial support, stressing the need for collaborative working with the curriculum support services and HEIs, as well as industry and Local Authorities.

5.4 Science Awareness

The Government's integrated awareness programme, Discover Science & Engineering (DSE), established in 2003 and managed by Forfás, has brought together and built on existing awareness activities and expanded these in a way that provides a focused and effective communications strategy. This is aimed at increasing the numbers of students taking SET as a career and raising the general level of awareness of the physical sciences amongst the public. The programme is intended to act as a catalyst in attracting a much higher level of private investment in awareness activities.

The Discover Science and Engineering programme will have a particular role to play in complementing the developments in the school system through:-

- Continuing awareness measures with primary schools, accompanied by enhanced supports for second level schools;

- Increasing the number of participating primary teachers/schools in the DSE teacher training initiative;

- extending the reach of this initiative to the second level sector in line with curricular reforms in collaboration with the second level school support service and higher education institutions as appropriate;

- providing enhanced internet based support materials and resources for teachers at both levels of the system;

- provision of information and guidance on careers in science, which will feed into school guidance programmes;

- supporting pilot initiatives with schools in disadvantaged areas promoting innovative approaches to awareness initiatives and teaching methodologies in science. Experience in this area will also inform the development of further modules and short course options in science in the Transition Year Programme.

A greater awareness among students of career opportunities in science, engineering and technology is needed. The development of information brochures, guidance and resource materials and effective linking with school guidance services in this area will be promoted, allied with a continued strengthening of school industry links.

There is a clear need therefore to find ways to stimulate interest in science before students enter senior cycle, so that they will be motivated to continue to study the subject and to choose it as a third level option. The Transition Year Programme has great potential in this regard, given its flexibility and emphasis on community, workplace and experiential learning.

A range of initiatives will be implemented which will optimise the interaction between the Transition Programme and relevant industries and third level research sites, through school visits, work placements and other measures. The scope for students to pursue short courses in science, as envisaged in the NCCA's proposals for senior cycle reform, should also be explored.

Where students are following a transition year programme, the choice of subjects they wish to take for the leaving certificate should be delayed until the end of Transition Year.

The continuing outreach and awareness activities and programmes of SFI, the Royal Irish Academy (RIA) and the Irish Council for Bioethics will make a major contribution to the achievement of this goal.

Key Actions

- **DES to review the implementation of the primary science curriculum to ensure the new curriculum and teaching methodologies are stimulating interest in and awareness of science at a very young age;**

- **Science and awareness of scientific issues to be a core area of study for student teachers in Colleges of Education;**

- **Reform the maths and science curricula starting with physics and chemistry subjects in Leaving Certificate to ensure a continuum from junior cycle with the emphasis on hands-on investigative approaches and the completion and assessment of practical coursework;**

- **Invest in teacher professional development in collaboration between second level in-service providers, higher education institutions and the Discover Science and Engineering programme, as appropriate;**

- **At the Transition Year, the promotion of information brochures, guidance materials and resources and awareness initiatives in collaboration with the Discover Science and Engineering programme, and effective linking of this with school guidance services;**

- **Survey pupil attitudes to the revised junior cycle syllabus in 2006;**

- **Support the development of teachers' networks which will focus on improving teaching and learning, including the Continuing Professional Development of teachers;**

- **Further develop the full range of awareness raising activities under Discover Science and Engineering;**

- **Higher Education Institutes to consider the option of a science subject for matriculation.**

ROYAL IRISH ACADEMY

School Science Infrastructure:

Can Ireland Deliver?

School Science Infrastructure: Can Ireland Deliver?

Executive Summary

The RIA Workshop entitled '**School Science Infrastructure: Can Ireland Deliver?**' held in May 2005 arose from serious concern which has been voiced in the Irish scientific community for some years regarding the declining uptake of the Physical Sciences by students at second and third level. This can be directly contrasted with the government policy of investment in the knowledge economy and the strategic targeting of investment in research and development, especially in the ICT, Pharmachemical and Biotechnology industries.

The glaring deficit in the system is the low uptake, for a variety of reasons, of Chemistry and Physics at senior cycle in second-level education. This has a direct impact on the number of students opting for Physical Sciences at third level and therefore on the future supply of engineers and scientists for the projected knowledge economy.

The workshop found that a revised education policy should aim to achieve a scientifically literate society in a holistic way. There should be a clear development of science education from primary and throughout second level, with logical progression from the Junior Certificate curriculum to the Leaving Certificate curriculum. It was strongly held that the Leaving Certificate syllabi in Chemistry and Physics should be revised, with the implementation of practical examinations at the earliest possible opportunity and with a greater emphasis on more STS (Science-Technology-Society) content. The impacts of changes in curricula take a long time to manifest and the process of development of curricula and syllabi needs to be reassessed to ensure that the impacts are both positive and substantial.

In addition to the long-term development of science education at second level the workshop strongly recommends that the government make an immediate response in the following areas:

- The professional development of science teachers must be emphasised as part of an increased investment in human capital at second level to complement the proposed changes in the curriculum. A better process of recognition and reward is necessary for teachers taking part in science education initiatives such as SFI's STARs Programme.
- A series of positive action initiatives to protect science education at second level, for example, Minister Mary Hanafin's recent suggestion of a positive bias towards science in the Higher Diploma in Education, needs to be put in place. Increased funding for science education infrastructure is needed and existing funding for science education at second level must be ring-fenced so that the decline in student numbers does not lead to further reductions in investment by individual schools.

Background

This report presents a summary of a workshop held in Academy House on 25 May 2005, entitled 'School Science Infrastructure: Can Ireland Deliver?'.

The workshop was initiated by the Physical Sciences Committee of the Royal Irish Academy in response to concerns from Irish academics and scientists about the uptake of science at secondary and third level. The major concern is that the supply of high-calibre students needed to support the national development plan is lacking.

The uptake of physics and chemistry at second level, especially in the senior cycle, has been decreasing while the demand for graduates and postgraduates in the physical sciences and engineering has increased.

The aims of the workshop were

- to enable the key stakeholders to discuss the reasons for the decline in uptake of the physical sciences and mathematics in secondary education, particularly in the senior cycle;
- to look at ways of addressing this trend, such as articulating the need for science to be a practical, hands-on subject, with provision for the necessary infrastructure and technical support in schools;
- to examine the barriers that inhibit access to science education, on the basis that hands-on science should be available to every student in every school in the country;
- to propose an effective and inclusive way forward that engages all the main stakeholders.

The recent report to the Inter-Departmental Committee on Science, Technology and Innovation, '**Building Ireland's knowledge economy: the Irish action plan for promoting research in R&D to 2010**', sets out targets towards increasing Ireland's investment in research and development in line with the Lisbon 2010 agenda, as well as targets for increasing the number of postgraduates and researchers. In order to provide these third-level postgraduates and researchers and achieve the targets set out in the report, the entire system of science education in Ireland must be examined and infrastructural deficits addressed. But the situation may need an even more radical approach, requiring a fundamental change in Ireland's culture towards a society in which science is fully embedded rather than peripheral.

The workshop programme (Appendix A) attracted a wide range of delegates (Appendix B), including academics, teachers, government representatives, media and other interested parties. They came to hear the nine speakers cover a range of topics that can be broadly categorised as (a) policy and (b) practice. The workshop concluded with a discussion bringing together a number of suggestions for follow-up.

All documentation associated with this meeting, including the presentations, background information and a list of delegates, is available at www.ria.ie.

2 Context

Several factors, both positive and negative, influence science education in Ireland today. The workshop considered a number of these.

- Ireland's industrial strategy is based on moving up the value chain of the knowledge economy, with science and technology making an increasingly ubiquitous impact on society. This strategy has led to an increased awareness amongst government members and policy-makers of the importance of research and development to the Irish economy.
- The recent appointment of the Chief Science Advisor to the Government, Dr Barry McSweeney, and the establishment of a Cabinet committee on science are key steps in developing the infrastructure needed to reach the Lisbon Agenda target of an investment in research and development amounting to 3% of GDP by 2010.
- The most important element in a research-intensive nation is people. The government's strategy will require a dramatic increase in the numbers of science and engineering graduates and a doubling in the number of PhDs by 2010.
- There is a drop in the number of students taking Leaving Certificate physics, chemistry and higher level mathematics, compared to the number taking Junior Certificate science, at a time when increases in both the quantity and the quality of science and mathematics students are all-important. There is also strong evidence of modest performance among Irish 15-year-olds on science literacy tests compared to their peers in other OECD countries.
- The CAO points system creates a demand for courses that require a minimum investment of time and effort to achieve high scores. This free market in points acts to reduce participation in the senior-cycle physical sciences and mathematics subjects, as these require more effort on the part of students and produce, on average, less reward.
- Low participation rates among girls, especially in physics and chemistry, reduces by almost 50% the talent pool from which we draw our engineers and scientists. The inadequate access of disadvantaged groups to education at second and third level, which is most notable in science and engineering, further depletes our talent pool. Our education system offers poor access to mature people and emigrants.
- Reports such as that of the Taskforce on the Physical Sciences have identified deficits in the delivery and teaching of science in Irish education, especially with regard to hands-on practical content and teacher training, but government has so far failed to act adequately on these reports.

3 Economic and Social Impact

The decline in uptake of science and mathematics at secondary (and tertiary) level has a potentially severe economic and social impact. Is this poor participation really a crisis that we should aggressively attack, or can it be ignored as an irreversible international trend?

Industry representative organisations see a clear crisis in the quantity and quality of scientifically competent graduates coming through the education system. The demand for scientists and engineers is increasing dramatically, while

output is falling and is taken from an ever decreasing and unrepresentative pool of students. Access and the lack of multiple entry points to the education system are major issues. Unlike the USA, Ireland does not facilitate students dropping out and re-entering.

Some workshop attendees also expressed concern that our culture and democracy demand a better understanding of science to function well. Many major issues today—waste, energy, food, health and safety—require a scientifically educated population to ensure that appropriate policies are developed.

The drop-off in students taking science from junior to senior cycle at second level is dramatic. Combined with poor access it reduces the pool from which science workers are drawn. A well-educated work force is a strong catalyst for the success of the Irish economy. Ireland could lose that advantage if we are complacent and fail to improve our education system to stay ahead of other countries and meet the needs of our industry.

Infrastructure at second level is below par and students can see this as clear evidence that science is not important. This view is reinforced by many teachers, principals and career guidance teachers. The reliance of the examination system on rote learning and its failure to adapt to the need for hands-on practical work further erode students' interest. A key to reversing the decline in uptake of science subjects is for schools to demonstrate a commitment to science by investing in it, rather than to shut down science laboratories in response to poor uptake by pupils.

Infrastructure

The question of infrastructure is at the heart of this debate. To what extent is the drop-off in senior-cycle science a consequence of infrastructural deficits in science education, both human and physical, especially in the junior cycle?

The general consensus is that human capital is the area where the greatest impacts can be made. In-service training and professional development for teachers of science at second level are key areas for development. The American experience indicates that up to 100 hours of in-service training per year are needed to maintain an optimal standard of science teaching. In addition, it is vital to provide technical support to science teachers in the preparation of laboratories.

Equipment and laboratory facilities are held to be adequate, but only given the existing examination system and the expectations of teachers and students. In the context of what is expected of science in Ireland over the next decade, however, it is clear that laboratory equipment is very poor.

Changes in the curriculum are necessary, and the deficiencies in this area most notably affect participation in science in the senior cycle. In particular, the fact that most schools offer a core of four Leaving Certificate subjects—mathematics and three languages—means that the science subjects are competing with 31 other subjects for three choices. Science subjects require a greater effort from both the student and the school but receive equal weight with non-science subjects in points at examinations. Schools and students are driven by the examination system, and the decline in science is in part the result of the current

curriculum. However, changing the curriculum is a slow and difficult process, and changes in this area will not solve the decline at a fast enough pace.

There are also issues of subject content: the general perception amongst 15-year-olds is that science is difficult, boring and time-consuming; they are thus only too happy to drop the subject at the first available opportunity, i.e. after the Junior Certificate or Transition Year.

One suggestion is that we lead by example, make science important and students will notice. Invest in infrastructure, teacher training and laboratories and change the culture. Motivate teachers and make science more interesting and less of a drudge. Teach students problem solving, mathematical logic, visual pattern learning. Let the students play with things, take them apart, put them together. In this way a better general education will enable students to adapt more easily to the scientific approach.

5 Access

The question of access is central to this discussion. Is access to quality science education restricted by economic circumstances, geographic location, ethnic origin or age?

In the case of disadvantage, it is not that students lack the ability to succeed but that the culture is not supportive. For instance, some parents do not see the point in education, but instead see it as difficult, irrelevant and beyond their children's ability—or, in the case of adult education, their own ability. This view is often reinforced by teachers, the media and the elite. As a result, many potentially fine students are denied a proper education and the follow-on career opportunities that flow from science education.

Irish society needs to raise the expectations of students and parents. For instance, women and mature students often presume that they are bad at mathematics and that science is too complex for them to learn. This does not have to be the reality, but students are often denied the chance to test their capability.

Access to the higher education system is designed to facilitate the admission of Leaving Certificate students, so, for instance, there are serious issues around re-entry. Specific difficulties arise with mature students and the children of emigrants. It is in the national interest that students be able to drop out of and re-enter the education system without encountering unnecessary barriers. This is needed to increase the pool from which engineers and scientists are drawn and thus to maximise Ireland's performance and reputation in these fields.

Pro-disadvantaged access programmes, which are generally considered to be very successful in breaking the cultural cycle, are countering a free-market approach that allows this disadvantage to continue in our country. The universities and the institutes of technology have appointed Access Officers who work with the disadvantaged, mainly through targeted schools and groups within their hinterland.

Putting resources in place to target science in access programmes and creating entry opportunities that favour science can help increase uptake in science. Many Americans credit the post-war science and engineering degree programmes for returning GI's, which brought 5 million mature students into university science programmes, as being a key factor in America's economic success in the post-war years.

6 The way forward

What strategies can be identified and adopted to facilitate progress in solving the 'drop-off' problem? The following suggestions emerged from the workshop.

Create a national vision for mathematics and science education. This vision must involve a wide partnership of all the key players, but teachers are the key: we need to respect teachers and offer them the highest standards of professional development.

The government needs to make a significant investment in second-level science infrastructure, particularly in human resources. The Department of Education and Science needs to agree a model or mix of models, and to commit the associated funding, for provision of technical support in secondary schools.

Introduce financial incentives to allow school principals to continue offering science across all the main subject areas but not at the expense of their broader commitments. Ring-fence existing support for science education and introduce positive action initiatives such as targeting science graduates for entry to the Higher Diploma in Education.

Ensure that the senior-cycle curriculum supports science-oriented students. Core subject choices need to be flexible in order not to hinder the uptake of science. Turn the teaching of science around, especially in the pre-senior cycles, so that the emphasis is on context and applications, leading to an understanding of the basic skills, rather than the current emphasis on knowledge through facts and formulae. Changes in curricula must be designed to make a positive and substantial impact in making science more relevant and interesting.

Make science intrinsic to the culture of the nation, rather than an activity that is regarded, with some justification, as elitist and marginal to 'normal' people. Engage the media in highlighting the all-pervasiveness of science and technology within society, through examples like the mobile phone, Internet communication, transportation and energy.

Review the CAO points system. The need for special access routes for the disadvantaged reflects not only a fundamental problem in society generally but also inherent flaws in the CAO points system, which contribute particularly to difficulties with student retention at third level. There is a case for amending the points system such that the points available in each subject reflect the efforts expended by the students. If it is unavoidable that a subject such as higher-level mathematics needs, on average, more study time to master then it should attract a higher number of points. There is also a case for ensuring that the examination process rewards those with practical (as opposed to analytical) skills.

Ensure that the senior-cycle curriculum supports science-oriented students. Core subject choices need to be flexible -in order not to hinder the uptake of science.

Hold more events that (a) provide incentives for students to participate and (b) encourage the media to publicise science.

Outcomes/Actions

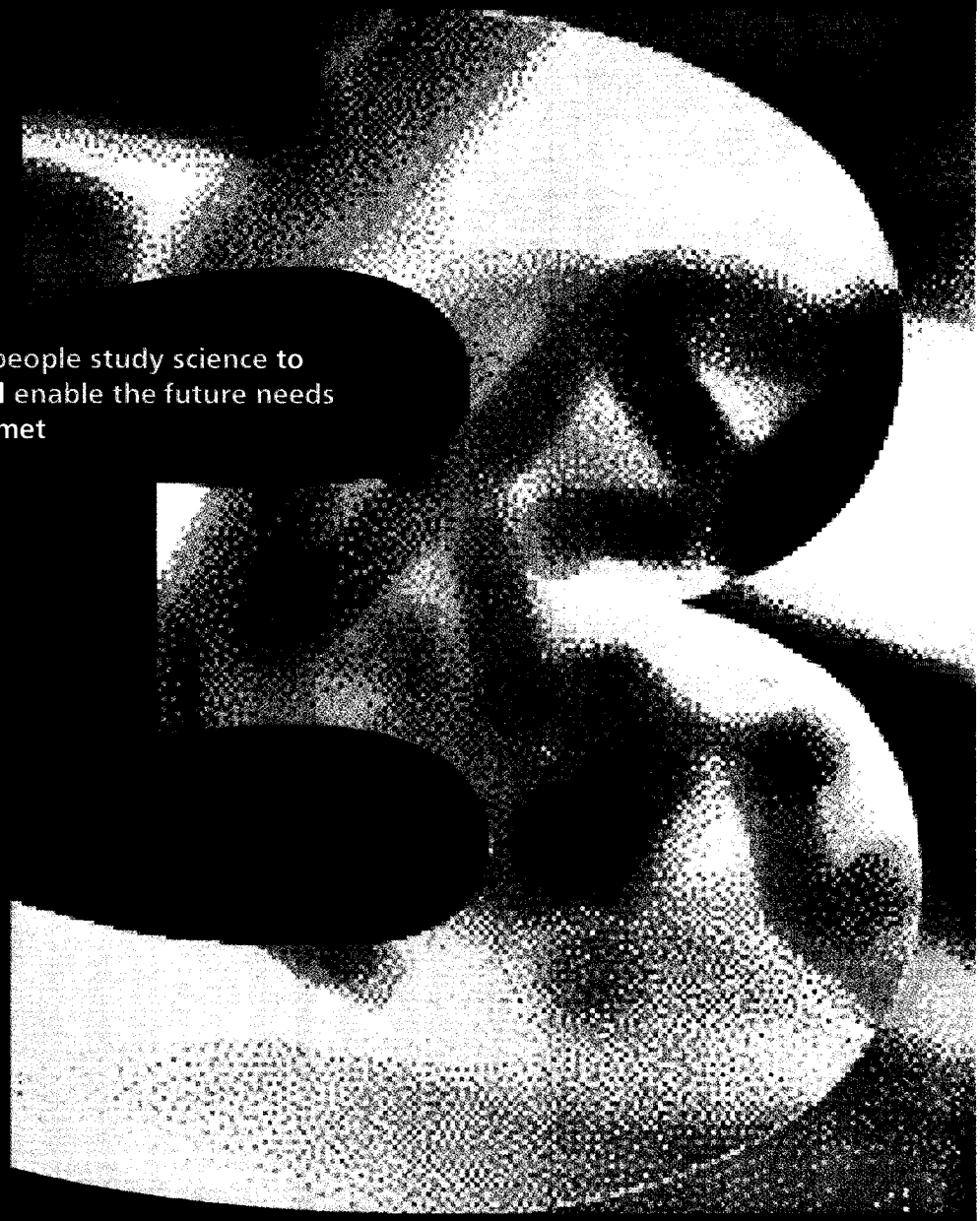
In order to begin to create a strategic vision and develop the necessary partnerships, a National Science Education Strategy Group will be established under the auspices of the Royal Irish Academy. The committee will bring together a diverse range of interested people, who are representative of the attendees at the workshop, to help articulate a vision and a strategy to improve our performance in science and engineering education in the years to come.

This committee will also bring the consensus on the way forward that emerged from the workshop to the appropriate decision-making bodies, such as the Interdepartmental Committee on Science, Innovation and Technology, the Dáil All-party Committee on Education and Science and key policy-makers within government and education.

4

A SCIENCE STRATEGY FOR SCOTLAND

Ensure that enough people study science to a standard which will enable the future needs of the country to be met



THIS WILL REQUIRE A SCHOOL CURRICULUM WHICH MEETS THE NEEDS AND CHALLENGES OF THE 21ST CENTURY, AND WHICH IS DELIVERED BY TEACHERS WHO HAVE THE NECESSARY MOTIVATION, KNOWLEDGE, SKILLS, RESOURCES AND SUPPORT.

High quality school science education for all must be followed by provision of a wide range of further and higher education and training opportunities. We also need good careers advice and effective communication of the opportunities that a science education can offer.

Science education in schools is an area where the Executive can take a wide range of actions to promote science, and where recent studies indicate that there is still much to be done. Strong support for science education in schools is more likely to lead to the development of a culture that is comfortable with scientific thinking and which encourages young people to pursue science and related subjects. What happens in our schools lies at the heart of making Scotland a scientifically confident society.

Young children are fascinated by dinosaurs, volcanoes, space ships, insects and bubbling test tubes. Our aim must be to encourage and build on that natural curiosity and excitement about science, to ensure that throughout their school education, children and young people have access to a stimulating and dynamic curriculum that progressively develops their scientific knowledge, understanding and skills leading to positive and informed attitudes to science.

School science education has two important objectives: to lay the foundations for the development of Scotland's future scientists; and to give everyone the skills and confidence to act as informed and questioning citizens in relation to scientific issues.

National advice on the curriculum recommends that science is taught to all pupils at all stages up to S4. Most primary schools are in the process of introducing science education as part of their environmental studies curriculum, although provision varies considerably across schools. Science courses are provided to all pupils in S1/S2, and virtually all pupils undertake at least one science course in S3/S4. The sciences remain the most popular subjects in S5/S6 after English and mathematics, but uptake has fallen in recent years. The range of provision has been updated and extended as part of the development of the Scottish National Qualifications.

As well as demonstrating knowledge and understanding of scientific facts and concepts, young people need to be able to interpret and evaluate evidence, take account of ethical, social and economic issues, make informed decisions, communicate effectively about science, and cope with future scientific developments. Pupils' classroom experience often concentrates on the acquisition of knowledge and practical skills, at the expense of engaging with scientific issues and learning how to make informed choices based on a knowledge and understanding of science. We need to help teachers deliver a vibrant curriculum via a range of high quality learning and teaching experiences that promote effective lifelong learning of science, especially the capacity to respond effectively to new scientific developments and issues. The curriculum should feed children's curiosity about science and build on their enthusiasm.

Although Scottish children show high interest in science at the early stages, standards of attainment are below expected national levels in P7 and S2, and relatively low by international standards. In primary schools and in S1/S2, most schools have limited information about the progress and attainment of individual pupils relative to national attainment targets in science. The attainment of pupils in S3-S6 in national examinations is generally good, relative to the standards set in the syllabuses.

Many of those who achieve the highest standards in the sciences go on to study medicine and related disciplines. This is a worthwhile outcome but we also need high levels of achievement by all learners of science, to form a secure base for public understanding of science and effective citizenship, and to ensure the supply of very able scientists.

Most primary school teachers have limited formal training in science. Many secondary science teachers have undergone limited updating in their specialism since graduating, and some are uncertain about their capacity to teach science topics outside that specialism. We need to refresh and update their knowledge of modern science. The teaching of science in schools should also reflect best scientific practice in the wider scientific community, and should be supported by effective interaction with that community.

We need teachers of science who have the necessary confidence, competence, resources and support. We also need to address the need to recruit sufficient new teachers to replace those who will retire soon.

Science should be taught in a safe, modern environment that promotes effective learning. In many schools, there has been relatively little investment in science equipment and accommodation in recent years.

To ensure that enough people study science to a standard which will enable the future needs of the country to be met, the Executive:

has asked *Learning Teaching Scotland* to prepare **exemplar material** for teachers of science in primary and early secondary school;

will develop more rigorous **assessment of science** as part of the development of a coherent assessment system across the 3-14 stages to support learning and teaching and the monitoring of performance;

is giving Local Authorities resources to employ **additional teachers**, as part of the recent pay and conditions settlement. Together with some additional targeted resources, these will enable education authorities to support the teaching of science in primary schools, and to enable experienced science teachers to undertake sabbaticals;

will ask the Higher Education Institutions responsible for the delivery of teacher education and training to train **additional secondary science teachers**;.

will consider, as part of more general reviews of **Initial Teacher Education** and **Continuing Professional Development**, what changes are needed to enable delivery of a high quality science education and will support initiatives to provide teachers of science with **high quality professional updating**;

will ask the Scottish Qualifications Authority to ensure that **national examinations test candidates' capacity across the full range of knowledge, understanding and skills as specified in the Examination Arrangements**;

will ask. Learning Teaching Scotland to advise on how best to ensure that **all** school pupils have the opportunity to acquire the **capacity to cope as citizens and decision makers** with scientific issues;

will work with the science community, the network of Scottish Science Centres, and business and industry to harness their willingness to provide **practical support to science education**, and to promote young people's **understanding of and enthusiasm for science as a career**;

will work with local authorities to consider how to secure the provision of **modern accommodation and resources** for science education; and

will as part of **Science Year**, organise an **international conference of science educators**, to consider innovative approaches to the teaching of science, at school and post school levels including community education and wider public understanding across society.

There is a continuing need for substantial numbers of people trained in science, across a wide range of disciplines. There is an increasing need for scientists with both a secure base of core scientific skills and specialist knowledge and skills. The capacity to work closely with other specialists in multidisciplinary teams is also increasingly important.

In the context of the increasing need for society and people to make difficult decisions about controversial challenging issues such as cloning and global warming, science education needs to be about more than acquisition of scientific knowledge and skills. Scientists need the capacity to understand, and reach balanced informed views, on a range of complex issues, communicate about science, and contribute effectively to debates and decision making.

Effective science education is more complex than simply studying one or two specialist subjects to a high level. We need more courses of undergraduate and postgraduate study across a wide range of scientific disciplines that develop not only specialist scientific knowledge and skills, but also the capacity to contribute to decision making about scientific issues, plus generic skills such as communication and entrepreneurship. Lifelong learning in science is increasingly important if people are to keep abreast of new thinking and developments.

It is important for those working in management, finance and government to have a broad understanding of science, since they make business, investment and policy decisions about scientific issues. This will be partly achieved by the recruitment of those with formal qualifications in science into such posts, but also by ensuring that decision makers have sufficient scientific awarenesss.

As those working at technician level are increasingly qualified to degree level, it is important to ensure that their education provides them with a secure base of practical skills, and work experience, as well as the necessary theoretical knowledge.

An important source of qualified scientists and technicians is people who have returned to formal education. Some of them will need basic science education, perhaps as part of a wider access programme. Attention must be paid to providing courses of study at all levels (including those designed to encourage people back to formal education) that will enable adults to gain access to further and higher education science courses.

The Executive will:

ask *Future Skills Scotland* to work with others to undertake an **analysis of the supply and demand for people with science qualifications**, with a view to offering advice to education and training providers;

ask the Scottish Funding Councils and the further and higher education institutions how undergraduate and post graduate science courses might best develop the **generic skills** of communication, decision making and working in teams; and how all science students might have the opportunity to acquire business and entrepreneurship skills, and to undertake work experience;

encourage the establishment of a range of undergraduate and short courses in **science communication**; and

ask Careers Scotland to ensure there is good quality, unbiased **information and advice about education and career opportunities in science**.

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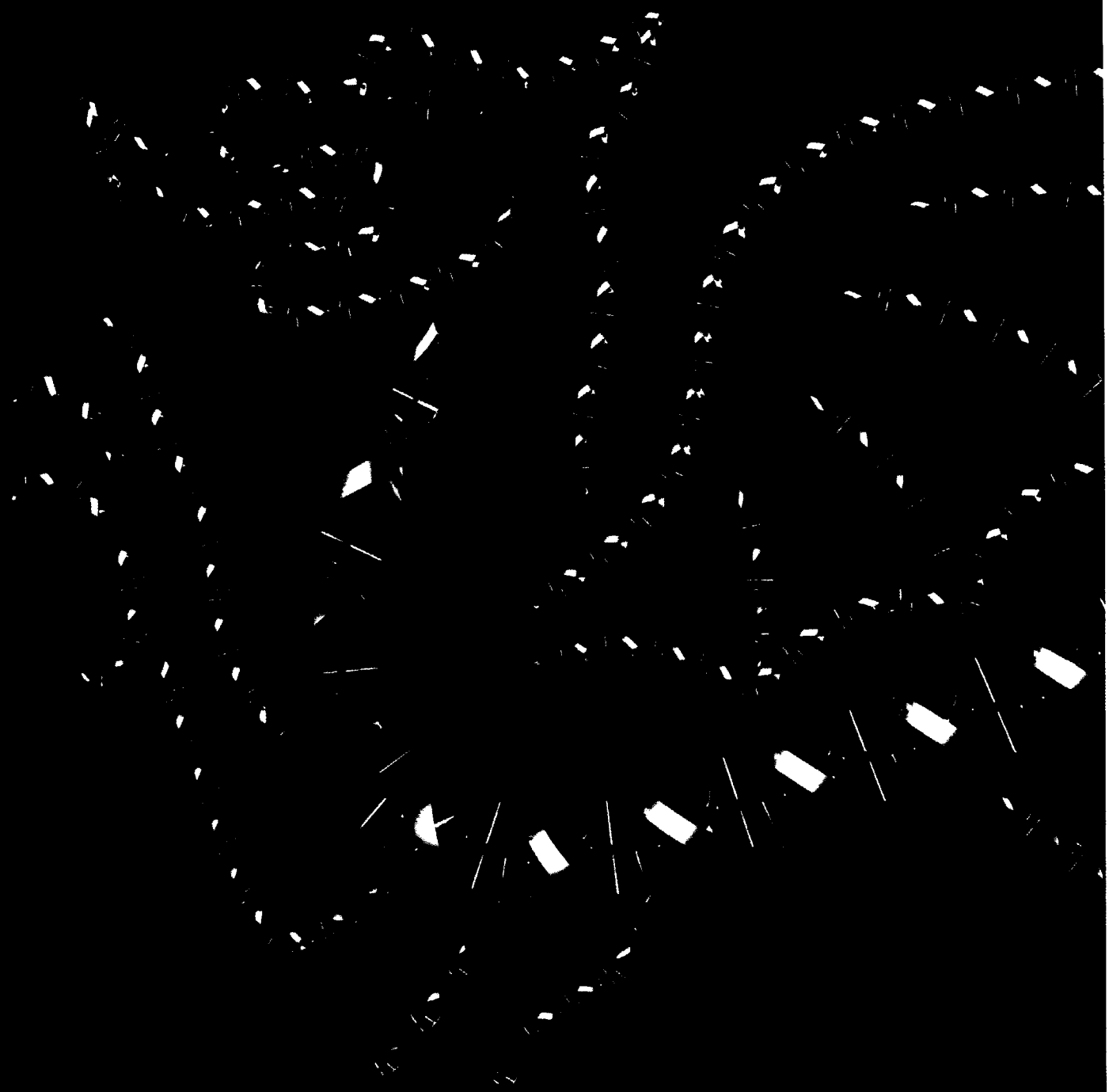

A Science Policy for Wales 2006

The Welsh Assembly Government's Strategic Vision for Sciences, Engineering and Technology

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Science Education

Science and the school curriculum

Since 1988 every pupil who attends a maintained school will have studied science throughout their years of compulsory schooling. This core status recognises the important part that science plays in the school curriculum, whilst allowing sufficient flexibility to meet individual learners' needs and motivate them to enjoy and succeed in science.

Science teaching at Key Stages 1 – 4 (that is ages 5-7, 7 to 11, 11 to 14 and 14 to 16) is focussed on four learning areas:

- scientific enquiry
- life processes and living things
- materials and their properties and
- physical processes

At Key Stage 4 (ages 14-16), pupils study science courses at Entry Level or GCSE. These provide a balance of chemistry, physics and biology, leading to a single or double award in science, depending on the breadth of study. Pupils having a particular interest in the sciences may be entered for three separate GCSEs in chemistry, physics and biology. GCSEs in double award science or the three separate sciences provide sufficient preparation for further study of chemistry, physics and biology at A Level. A recent addition to this suite of qualifications is the 'vocational' GCSE in applied science which provides sufficient preparation for pupils to move on to study a range of science related and technical courses post-16. Schools may also offer other science-related courses, such as the vocational GCSE in health and social care. This range of opportunities allows schools to select the most relevant qualifications for their pupils.

Pupils' attainment in science has shown substantial improvement over the last ten years at Key Stages 1, 2 and 3. Whilst GCSE results in science have tended to "plateau" over the seven years to 2005, results at A level have shown a substantial improvement during the same period.

Planned changes to the science curriculum will build further on this progress. The Assembly Government's Department for Education Life-long Learning and Skills (DELLS) is already reviewing the curriculum, from age 3-16, including science, and there will be national consultation in spring 2007. It will have greater emphasis on the skills young people need for life and work, and include greater emphasis on contemporary issues, and environment.

These changes are intended to run from the very earliest years to the end of compulsory schooling. The Foundation Phase will subsume Early Years and Key Stage 1. Science will form part of a wider area of learning entitled "Knowledge and Understanding of the World". The main focus of this phase is that children learn through experiential activities, structured play, exploration and develop their skills across the curriculum – intended to stimulate children's interest and curiosity. In this area of learning, children are developing the crucial knowledge, skills and understanding that help them to make sense of the world. This forms the foundation for later work in science, design and technology,

history, geography, and information and communication technology (ICT).

The revised National Curriculum will be available for consultation early in 2007, prior to planned implementation from September 2008. The aims for the revised curriculum are to ensure that the curriculum:

- focuses on and meets learner needs
- is inclusive and provides equality of opportunity
- equips learners with transferable skills
- is relevant, challenging, interesting and enjoyable for all learners
- transforms learning to produce resourceful, resilient and reflective lifelong learners
- is achievable and adequately resourced

For science at Key Stages 2 and 3 (ages 7 to 11 and 11 to 13), this will mean a reduction in the content of the programmes of study to allow teachers to focus on the pupils' prior learning and individual needs and to give more time to develop pupils' skills in the areas of thinking, communication, number and ICT. The programmes of study and level descriptions are to be revised to emphasise the opportunities for making links between the different areas of science. Similarly at Key Stage 4, the content will be reduced to allow greater flexibility in qualification design leading to a wider range of approaches and difference in content between the various options. Our aim is to enable pupils of all abilities to take the qualification that best suits their needs and abilities, allowing those with the interest and ability to progress further.

Our Better School Fund will include a new activity area aimed at supporting this revised national curriculum, including the important changes to the science curriculum.

The Assembly Government is also investigating the potential for promoting innovative approaches to maths and science teaching in collaboration with Techniquest and the (UK) National Science Learning Centre in York.

STEM careers

Careers Wales, launched in April 2001 is the first all-age information, advice and guidance service in the UK. Its services are available to all in Wales via high street careers shops; outreach work in the community; a presence in schools and further education colleges; by telephone and online at. www.careerswales.com.

Careers advisers' role is very much centred on the individual. Firstly they must provide independent and impartial information, advice and guidance to young people and adults, in accordance with the individual's interests. They do not promote or advocate careers in particular sectors or industries, but do provide up-to-date information on trends in the labour market and bring attention to areas of skill shortage. They always work closely with Sector Skills Councils – who do have responsibility for marketing careers in particular sectors of the economy,

including science, engineering and technology, to ensure up to date and useful information is available to clients.

Careers Wales companies also support schools in delivering the work-related education element of the basic curriculum linking employers with education through activities such as:

- work experience
- providing opportunities for teachers to have placements in business and industry
- employer mentoring for young people
- enterprise and business awareness programmes and
- employer involvement in the delivery and development of the curriculum

This last aspect includes a wide range of activities, programmes events and competitions that involve employers from Science, Engineering and Technology with schools and colleges. These raise the profile of the sector with young people from primary school level onwards. Examples include Engineering Team Challenge events; the Micro-mouse competition (electrical engineering) – involving a teacher placement and then a project with pupils; Young Engineers Knex Challenge; robotics competitions; the Jaguar Formula 1 Challenge (Key Stage 3 and 4 pupils and sixteen+ pupils design and build a model of a carbon dioxide powered racing car using a CAD package); the Creativity in Engineering, Science and Technology (CREST) Awards Scheme (awarded to pupils who have participated in particular school projects). In the old Mid Glamorgan area (Bridgend, Rhondda Cynon Taff and Merthyr) over 2,000 primary children attended science clubs and gained First/Young Investigator Awards – 25% of the UK total.

In 2005-06, Careers Wales worked closely with Fforwm to develop a National Engineering Week, to include all FE colleges and their 14-19 Network partners. They have also worked closely with the Welsh Electronics Employers Forum on both marketing materials and contents on their website, plus the distribution of information across Careers Wales companies.

The Careers Wales Association is also a strategic partner with Chwarae Teg on their "Ready, SET, Go" project. Careers Wales involvement is two fold i.e. activities run as part of the teacher training programme and adult guidance. Careers Advisers provide support and guidance activities for 10-week taster programmes for women who are interested in opportunities in science engineering and technology.

In 2004/05, two-thirds of Welsh domiciled undergraduate enrolments in science, engineering and technology were male. The ratio has been fairly steady over the past few years. Males outnumber females in all subject groups apart from biological sciences. The proportion of females is least in engineering and technology (around 10 per cent) and computer science (around 20 per cent). There has been very little noticeable change in this profile in recent years.

Around 80 per cent of academic staff employed in science, engineering and technology cost centres are male. Females are most likely to be researchers, although it is still the case that 70 per cent of researchers are male. The proportion of SET staff that are female falls in higher grades. There are very few female professors, 5 out of nearly 190. Since it is well-documented that there are proportionately too few women entering careers in many aspects of SET, the Welsh Assembly Government has provided funding and support for some time to Women Into Science and Engineering (WISE) in Wales. We will continue that support.

Teaching science and science teachers in Wales

Statistics suggest that mathematics, chemistry, physics and design & technology are areas where, compared with secondary subjects overall, there tend to be difficulties in recruiting to posts in maintained schools. They tend to attract fewer applications than average and to have higher vacancy figures.

Action has been taken to improve the attractiveness of these subjects in initial teacher training (ITT). The Welsh Assembly Government offers incentives for eligible people to undergo a postgraduate (PGCE) ITT course (training grants) and for eligible persons to take up particular teaching posts (teaching grants). We have designed the incentives to attract the best quality, highly-committed students to train and teach in Wales. They have been increased for courses starting in September 2006:

- eligible trainees on secondary PGCE courses in these subjects can receive a £7,200 training grant
- those eligible can also receive a teaching grant of £5,000 when they complete Induction and are teaching their subject (£2,500 for design & technology)

We will take forward changes in ITT provision in the light of a recent review. Past over-production coupled with falling pupil numbers means we will need fewer ITT places in the future.

Within reduced numbers, however, the Assembly Government intends to increase the proportion of places in priority subjects, including mathematics, chemistry, physics and design & technology.

We will be taking steps to improve teacher workforce planning. We will be examining teacher supply modeling, used for calculating ITT intake targets, to see the scope which might exist for better inputs to and the outputs from the process using data which is more specific to and reflective of issues of concern in Wales.