



HOUSE OF LORDS

Science and Technology Committee

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7th Report of Session 2006–07

# Science Teaching in Schools: Follow-up

Report with Evidence

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For membership and declared interests of the Committee which conducted the original inquiry, see the Committee’s 10th Report of Session 2005-06 *Science Teaching in Schools* (HL Paper 257)

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# Science Teaching in Schools: Follow-up

## THE COMMITTEE'S COMMENTARY ON THE GOVERNMENT RESPONSE

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### *Background*

1. In November 2006 we published our Report *Science Teaching in Schools*<sup>1</sup>. The Government responded in January 2007, and the text of that response is now printed as *Written Evidence*. Our Report was debated on 3 May, and the full text of the debate can be found in the *Official Report* (HL Deb., 3 May 2007, cols. 1208–1242).
2. We welcome the generally positive tone of the response. In particular, we welcome the Government's willingness to expand availability of the International Baccalaureate Diploma (IB) with a view to ensuring that there is at least one institution offering the IB in every local authority area. However, we urge the Government to work closely with local authorities and schools and to consider carefully possible practical problems. In particular, we will follow with interest the steps the Government will take to ensure that parents and stakeholders are properly advised of the choices available within their local authority.
3. There remain other areas of concern where the Government response was unsatisfactory. In February we therefore wrote to some of our original witnesses and asked them to comment on the response. We are grateful to those who replied, and their replies are also printed as *Written Evidence*. It will be seen that they share some of the concerns set out below.

### *Student Attitudes and Choice*

4. Although the Government acknowledge that some students perceive science and mathematics as being difficult A level subjects, they fail to engage with the underlying issue. Instead the response repeats the formula that "All A levels have strict standards which have been set by the awarding bodies and are monitored by the Qualifications and Curriculum Authority. This standard is set as 'advanced' regardless of the nature of the subject" (p 2). No evidence was put forward to support this assertion, which, in the face of the contrary evidence put forward in our Report, is no longer tenable. We therefore echo the suggestion by SCORE, a partnership representing not only the Association for Science Education but a broad cross-section of the wider science community, that matched subject pair analyses be carried out before awarding grades to ensure subjects are of equal difficulty (p 18).
5. Perceptions of the relative difficulty of A levels are compounded by the lack of good careers advice which might encourage students to study science and mathematics post-16. Although we welcome the work of the Government through the STEM Strategy Group and the STEM Advisory Forum, we are

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<sup>1</sup> House of Lords Science and Technology Committee, 10th Report, Session 2005–06 (HL Paper 257).

disappointed to see the Government reject our recommendation to establish a small central team of advisers to support existing career advisers, teachers and parents in making pupils aware of the full range of opportunities and rewards open to those with science qualifications.

6. There is good evidence that at present school career advisers are ill equipped to provide high quality advice about the significant benefits of studying the sciences and mathematics. They have little knowledge of what career paths can follow a degree in science and the kind of salaries that such jobs attract. Better training is urgently required; a template indicating the careers open to science graduates would also be a good starting point as a resource for school careers advisers.

### *Teaching Methods*

7. There appears to be broad acceptance that there is no option but to introduce the revised A Level syllabus on schedule on 2008. However, we echo the call by CLEAPSS, a consortium of local authorities supporting practical science and technology, for the Qualifications and Curriculum Authority (QCA) to urge awarding bodies, publishers and others to seek expert scrutiny of all resource materials for the new A levels, particularly those for practical science, before they are published. There are clearly concerns over the lack of time available to ensure both the scientific accuracy of textbooks and the provision of appropriate health and safety information.
8. Moreover, we urge the Government to think again with regards to the introduction of the Key Stage 3 (KS3) changes, also scheduled for 2008. Too many curriculum changes are being implemented at once and not enough time is being allowed to deliver the expected outcomes. As SCORE comments, we strongly believe that there would be considerable advantages in allowing schools the option of piloting the KS3 changes from 2008 but not insisting that all schools implement the KS3 changes until September 2009 with the first end of key stage assessments available in 2011 (p 20).
9. We have already welcomed the increased availability of the IB. But we also note that the Government are pressing ahead with the introduction of the new “specialised Diplomas” as an alternative to the traditional syllabus. The Engineering Diploma is amongst those to be introduced in the first cohort of Diplomas in September 2008. The Royal Academy of Engineering has been closely involved in helping develop this Diploma, which provides a unique opportunity to introduce more practical training alongside the academic. But the whole Diploma programme is highly complex and we share many of the reservations about its implementation expressed by the House of Commons Education and Skills Committee in its Report *14–19 Diplomas*<sup>2</sup>, published on 17 May. In particular we share their concern (para 55) that “It is absolutely essential that the first Diploma cohort is limited in size and that thereafter expansion takes place at a slow and controlled rate, with sufficient time for development and assessment”. We also endorse the comment of the Royal Academy of Engineering, that “A levels are still seen as the Level 3 qualification required for progression towards an engineering, technical or scientific career” (p 15).

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<sup>2</sup> House of Commons Education and Skills Committee, 5th Report, Session 2006–07 (HC Paper 249).

10. We welcome the Government's announcement of additional funding for the Student Associate Scheme with a view to increasing the number of mathematics and science placements. However, we are disappointed at the Government's rejection of our recommendation that outreach work in schools should be properly valued as part of the Research Assessment Exercise. This proposal would not involve a major new injection of funds and would be easy to implement. We urge the Government to think again, and, if necessary, bring forward an alternative mechanism by which outreach work could be recognised.
11. We highlighted in our report the importance of science technicians. It is essential that the career structure for science technicians as a specialist group is improved and separated from teaching assistants. The response makes no commitment on this issue. Indeed CLEAPSS cautions that the Government's pledge that "every secondary school, which wishes to do so, should be able to recruit at least one science-specialist Higher Level Teaching Assistant by 2008" may further deplete science technician numbers (p 14). We echo their concern.

#### *Teacher Recruitment and Retention*

12. Our Report highlighted the level of teacher vacancies in science and mathematics, and proposed that the Government encourage schools to offer better starting salaries. The response made much of the soon-to-be-published Sixteenth Report by the School Teachers' Review Body. This report, which appeared in February, echoed our own comments, recommending "a programme of action to secure a significant increase in the use of existing flexibilities in the School Teachers Pay and Conditions Document to address local teacher shortages in priority subjects<sup>3</sup>." We welcome this recommendation. It is not enough that there is a formal opportunity for flexibility if that opportunity is immediately undermined by discouragement from local authorities and unanswered concerns over compliance with employment law. We therefore repeat our call for Government action in this area.
13. We are also disappointed at the Government's decision not to pursue the scheme to write off teachers' loans at the end of the pilot. SCORE claims that the scheme has had some success. It also argues that "as financial demands on undergraduates increase due to increasing tuition charges, the scheme could become even more attractive." We endorse their call for the Government to think again.

#### *Continuing Professional Development*

14. We are encouraged by the Government's willingness to support and encourage schools to undertake subject-related continuing professional development. However, clarification is needed on how the Government's expectation that "all teachers should have a professional responsibility and a contractual entitlement to be engaged in effective, sustained and relevant professional development throughout their careers" is to be realised. We support SCORE's suggestion that greater emphasis should be placed on the need for subject-specific improvements to be included in personal development plans (p 22).

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<sup>3</sup> *School Teachers' Review Body Sixteenth Report—2007*, February 2007 (Cm 7007), p 14.

*Conclusion*

15. **Science teaching in schools is vital to support innovation and growth in our economy, never more so than now, when the booming economies of China and India are supported by huge increases in the numbers of well-qualified science graduates. On 11 July the Prime Minister announced “A new educational opportunity Bill [which] will mean that for the first time not just some but all young people will be able to stay in education or training until the age of 18” (HC Deb., 11 July 2007, col. 1449).**
16. **We support this objective. But if this extension of education for all from 16 to 18 is to bring long-term benefits to our competitiveness, rather than just imposing an extra burden on tax-payers, the Government must act now to ensure that a growing proportion of these young people study science and mathematics. We shall therefore follow closely the Government’s work in this area in the coming years.**



## RECENT REPORTS FROM THE HOUSE OF LORDS SCIENCE AND TECHNOLOGY COMMITTEE

Information about the Science and Technology Committee is available on [www.parliament.uk/hlscience/](http://www.parliament.uk/hlscience/), which also provides access to the texts of Reports.

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### Session 2003–04

- 1st Report Chips for Everything: follow-up
- 2nd Report Science and the RDAs: follow-up
- 3rd Report Science and Treaties
- 4th Report Renewable Energy: Practicalities
- 5th Report Radioactive Waste Management (*follow-up to 3rd Report 1998–99 and 1st Report 2001–02*)

### Session 2004–05

- 1st Report Science and Treaties: follow-up
- 2nd Report Radioactive Waste Management: Government Response

### Session 2005–06

- 1st Report Ageing: Scientific Aspects
- 2nd Report Energy Efficiency
- 3rd Report Renewable Energy: Practicalities and Energy Efficiency: Government Responses
- 4th Report Pandemic Influenza
- 5th Report Annual Report for 2005
- 6th Report Ageing: Scientific Aspects—Follow-up
- 7th Report Energy: Meeting with Malcolm Wicks MP
- 8th Report Water Management
- 9th Report Science and Heritage
- 10th Report Science Teaching in Schools

### Session 2006–07

- 1st Report Ageing: Scientific Aspects—Second Follow-up Report
- 2nd Report Water Management—Follow-up
- 3rd Report Annual Report for 2006
- 4th Report Radioactive Waste Management: an Update
- 5th Report Personal Internet Security
- 6th Report Allergy
- 7th Report Science Teaching in Schools: Follow-up
- 8th Report Science and Heritage: an Update

# Written Evidence

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## Government Response to the House of Lords Science and Technology Committee's Report into Science Teaching in Schools

### INTRODUCTION

The Government welcomes the Committee's report and its contribution towards the important goals we share of engaging young people in science, raising attainment and encouraging more to continue with their science studies.

The Government agrees with the Committee that effective science teaching in schools is essential, and this is why we have made improving the teaching and learning of science and mathematics a high priority. Our ambition is to create an education and training environment that delivers the best in science and mathematics teaching and learning at every stage. *The Science and Innovation Investment Framework 2004–14: Next Steps*, published in March 2006, outlines a strong programme for stimulating and improving the teaching and learning environment, to ensure that pupils have a positive learning experience. Equally important, it sets out our plans for ensuring that teachers are thoroughly equipped for, and can take a flexible approach to, delivering the curriculum to inspire students.

The Committee will be pleased to learn that we are making good progress towards implementing the *Next Steps* plans. We have remitted the School Teachers' Review Body to advise on improving the use of current pay incentives and flexibilities to improve the recruitment, retention and quality of science and mathematics teachers; and to advise on whether science teachers who are not physics and chemistry specialists should receive an incentive to encourage them to complete accredited continuing professional development to enhance their physics and chemistry knowledge and skills.

We have also made progress towards expanding the Independent State Schools Partnership Scheme to promote collaboration in science teaching and learning between maintained and independent schools, universities and industry. Schools have been identified to participate in the scheme and activity will commence in the New Year. Other developments include:

- (i) work to expand the Science and Engineering Ambassadors scheme to support teachers and engage and enthuse pupils to continue studying science;
- (ii) SETNET has invited schools to apply for a place on the after school science and engineering clubs pilot; and
- (iii) the Training and Development Agency for Schools will shortly be launching a tender exercise to pilot the physics and chemistry accredited diploma for science teachers.

The Government's response to the Committee's recommendations is set out below.

### 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.*

The Government fully shares the concern of the Committee that too few students are taking science and mathematics post-16. *The Science and Innovation Investment Framework 2004–2014, Next Steps* document, published in March 2006, sets out our commitment to achieve year on year increases in the number of young

people taking A-levels in physics, chemistry and mathematics so that by 2014 entries in England to A-level physics are 35,000 (from 24,094 in 2005); chemistry A-level entries are 37,000 (from 33,164 in 2005); and mathematics A-level entries are 56,000 (from 46,037 in 2005).

Student perceptions and attitudes to subjects undoubtedly affect their choices post-16. The Government acknowledges that some students do perceive science and mathematics as being difficult A-level subjects, although it does not agree that some A-levels are easier than others. All A-levels have strict standards which have been set by the awarding bodies and are monitored by the Qualifications and Curriculum Authority. This standard is set as “advanced” regardless of the nature of the subject.

It is important to know what motivates students’ subject choices post-16 and we are undertaking further work to improve our understanding. Our work to date shows that students do not necessarily feel most negative about the subjects they find difficult or most positive about the subjects they have an aptitude for. Differences in student motivation, learning or teaching, assessment methods and the numbers of specialist teachers (a particular problem for physics and chemistry A-level) will also be factors in A-level choice and performance.

Depth of subject knowledge is one of the strengths for which A-level is widely renowned. A-levels in the sciences and mathematics are generally preferred by universities for entry to science related degrees over broader based curriculum qualifications such as the International Baccalaureate. Nonetheless, we agree that students should not specialise too early. Our Curriculum 2000 reforms have ensured that students no longer just study a narrow programme of three A-levels. The majority of students following A-level programmes now take four or five AS subjects in Year 12 (excluding general studies), and take three or four of those subjects through to full A-level (excluding general studies). Many also take key skills qualifications and Duke of Edinburgh Award Schemes with A-level. From 2008 students will also be able to complete an Extended Project alongside their A-level or other advanced level studies.

The Government agrees that the International Baccalaureate Diploma is a good quality qualification, providing a broad base of study. It is already offered in 46 maintained schools. On 30 November, the Prime Minister announced that he wanted to expand availability of the International Baccalaureate Diploma within the maintained sector as part of the Government’s proposals to increase choice and diversity. The Government will provide £2.5 million funding to ensure that there is at least one institution offering the International Baccalaureate Diploma in every local authority where there is currently no provision. This will mean that up to 100 additional institutions will offer the International Baccalaureate Diploma by 2010.

In addition, in the 14–19 Education and Skills White Paper published in February 2005, the Government set out proposals to introduce new 14–19 Specialised Diplomas. Diplomas will be available in fourteen lines of learning at levels 1, 2 and 3 covering all the sectors of the economy with the first five available for teaching in September 2008.

The Diplomas will provide, for the first time in this country, a highly valued mixed theoretical and practical route for young people which genuinely meets the needs of employers and provides a sound basis for progression into higher education.

The Diplomas are designed to sit alongside and complement the National Curriculum core and foundation subjects and also offer a broad learning experience in their own right. To get a Specialised Diploma, young people will have to secure that set of skills essential for success in future life; functional skills in English, mathematics and ICT, and personal, learning and thinking skills including team work and self-development. They will also acquire the skills and knowledge essential for a range of related sectors, through a practical, work-related curriculum, and will be able to select from a wide range of options which allow them to specialise in particular occupational areas or widen their breadth of study. Existing A-levels and GCSEs will be permitted as part of the optional learning, and it is expected that those young people who are particularly interested in studying certain areas at university will be encouraged to take science subjects.

Science clearly features in some of the current range of Diplomas, Engineering and Health and Social Care, for example, so there were no plans for a separate specialised Diploma in Science. However, following representations from employers the Government asked the Qualifications and Curriculum Authority to consider the need for one and is now considering the evidence.

*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 has 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.*

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.*

The Government fully supports the intention behind these recommendations. It is vital that there is accurate, up-to-date careers information for pupils, and parents, and that skilled and knowledgeable professionals are available to provide high quality advice to complement the information.

The Green Paper *Youth Matters* proposed the development of quality standards for young people's information, advice and guidance to drive up the quality and impartiality of provision. Draft standards were available for public consultation. Elements of the standards include:

- Practitioners give impartial advice and guidance to meet individual young people's needs based on accurate information;
- There are effective systems to ensure that the information provided to young people is comprehensive, up-to-date, appropriate and complies with equal opportunities and other relevant legislation;
- Young people are made aware of skill shortages and the labour market opportunities (eg in science and mathematics) that are available as a consequence. They are advised on the subjects that they need to study to take advantage of future opportunities.

The final standards will be published in April 2007.

Since the Roberts Review there have been a number of changes, not least the establishing of SEMTA (Science, Engineering, Manufacturing, Technologies Alliance), the sector skills council for science, engineering and manufacturing technologies, and the proposals to integrate Connexions delivery into children's trusts.

This will bring resources and services for young people together under a coherent structure. Through involvement with children's trusts, schools and colleges will have the opportunity to influence the information, advice and guidance that is commissioned to support their students' choices.

In addition, the Government has recently set up a high level STEM Strategy Group and plans a wider STEM advisory forum. It is important that the Government takes a co-ordinated approach to further development work on STEM careers information and advice. However, the Government is not convinced that setting up a central team of advisers is necessarily the best way to take it forward.

To make sure we put in place appropriate action, we will work closely with the high level STEM strategy group and advisory forum, looking at existing and planned provision alongside recommendations 6.3 and 6.4. In particular the Government wants to look at how it might build on SEMTA's role in relation to promoting science-related careers, and how we can better incorporate that into the delivery of careers information, advice and guidance.

The Government has already taken a number of specific steps to improve information on science careers—in particular:

- The jobs4u careers database, accessible on the Connexions Direct website holds information on over 800 jobs including within 40 job titles in the science, mathematics and statistics job family. This database is updated regularly to ensure the information is still relevant and up-to-date; the database includes case studies and links to useful external websites eg SEMTA, NHS Careers, the Health Protection Agency and is promoted by direct links from banner messages on the front page of the Connexions Direct site. The science job family article is due to be revised in December, for uploading in the New Year, and will include positive information on the wide range of jobs to which science can lead;
- For the third year running, the Government has supported SEMTA in the production of their "Directions" booklet for young people. The support has entailed ensuring up-to-date information on sources of support available to young people;
- There is a banner on the home page of the Connexions Direct website which directs people to the Science, Mathematics and Statistics job family;

- The Government has produced the publication *Working in Science* in collaboration with the Women into Science and Engineering Campaign. Science related jobs are also included within the range of over 40 publications including *Working in Engineering* and *Working Outdoors*. These are available in careers libraries, Connexions centres and on-line.

In response to the Committee's specific recommendation that the Government should provide financial assistance to the Science Council, the Department is currently in discussions with the Science Council to explore ways in which it might be able to provide support for the "Careers from Science" website.

In promoting excellence in science education it is important that we continue to pursue the twin goals of raising scientific literacy in the population at large, and ensuring that teaching and learning of science in schools is sufficiently interesting and challenging to inspire the more able pupils to pursue science at A-level and in higher education. It is also important that they go on to pursue careers in science to become the teachers and researchers of the future. In doing this it is vital that the education community continues to be really honest with itself about what is working and what isn't.

## 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.*

The Government acknowledges the Committee's concern that the sample of schools to be visited as part of subject inspection on science teaching is not statistically significant. However, to increase the number of visits as proposed would be contrary to the Government's strategy for a more proportionate and risk based approach to inspection, incorporating greater use of self evaluation and subsequently reducing costs and burdens of public service inspections.

New school inspection arrangements were introduced in September 2005 as part of the Government's plans for a modernised risk-based accountability framework for schools. These arrangements seek to minimise inspection related burdens on schools whilst improving the impact of inspection on school improvement. The new Section 5 inspections take account of schools' self-evaluation evidence and a range of performance data. They focus on key issues and outcomes, and concentrate on the school's core systems. As science is a core subject, schools will be expected to evaluate the effectiveness of this aspect of the curriculum and to reflect this in their self evaluation. The inspection reports will highlight particular strengths as well as including recommendations for improvement which schools are expected to address, with support and challenge from their School Improvement Partners.

The programme of Section 5 inspections is augmented by a programme of subject-specific surveys. In the case of science, this involves visits to thirty primary schools and thirty secondary schools each year. Inspections are conducted by HMI or additional inspectors trained and experienced in the subject. The evidence obtained is used in the context of other information, including evidence from Section 5 inspections and test and examination results, to identify strengths in the subject and any barriers to improvement. An assessment of science is included in HM Chief Inspector's Annual Report and a more detailed assessment is made every three years on the basis of a highly focused inspection of science in ninety schools per sector.

*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.*

The Government acknowledges the Committee's concern.

The Twenty First Century suite of science GCSEs was piloted in 75 centres, including community, foundation, voluntary aided and independent schools and an adult education college. An evaluation of the pilot, undertaken for the Qualifications and Curriculum Authority and published in 2005, found that:

- The pilot content has been generally well received by students who have a good working understanding of the differences between the three courses. There is substantial parity of esteem between the General and the Applied routes;

- Students show an encouraging appreciation of some of the distinctive features of the pilot courses. They are positive about the way in which science is set in relevant contexts and appreciate the opportunity to discuss issues;
- A large majority of students are positive about their experience of the new courses although there are some common concerns. They strongly support the view that it is helpful to base the science taught in schools on contexts that are relevant and contemporary to young people;
- Science departments had to work hard to introduce the pilot courses, but, despite some doubts, remained enthusiastic about the long-term benefits. Teachers appreciated that the courses required adjustments to their classroom styles and techniques and many were making these changes, only a few were struggling or reluctant to do so.

The Government had originally planned to introduce changes to the science GCSEs in 2004 but delayed their introduction by two years to allow schools more time to prepare.

With such a positive evaluation of the first year and no contraindications in the second year, there were no compelling reasons for further delay in the introduction of the new programme of study into all schools.

The new programme of study and suite of science GCSEs was introduced into schools for first teaching in September 2006. They maintain the breadth, depth and challenge of the previous ones. They provide a sound basis for progression to A-level science and beyond. They give teachers greater flexibility to provide for the wide range of students' interests and aptitudes. The Committee will be pleased to learn that early feedback from schools has been largely positive.

The Government accepts the Committee's recommendation to monitor how the new GCSEs are bedding down. The Government has asked the Qualifications and Curriculum Authority to design and implement monitoring arrangements for the new Key Stage 4 programme of study which will include representation from a group of independent scientists.

The Qualifications and Curriculum Authority has issued guidance to schools on the changes and has run, together with other delivery partners, dissemination conferences. The Qualifications and Curriculum Authority also provides guidance and support via its website [www.qca.org.uk](http://www.qca.org.uk).

The Government is currently working with the science community (Association for Science Education, Specialist Schools and Academies Trust, Secondary National Strategy, and Science Learning Centres) to provide additional support for teachers.

The Government welcomes the Committee's recommendation to allow adequate time between piloting new courses and rolling them out. In particular, the Government accepts that schools should be given adequate preparation time to plan for any changes and organise resources prior to implementation.

*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.*

The Government recognises the need to align the Key Stage 3 and A-level science curriculum closely with the recent changes at Key Stage 4. As part of the current Key Stage 3 Review, the Qualifications and Curriculum Authority is developing a new Key Stage 3 science programme of study which will build on pupils' achievements at Key Stage 2 and offer good progression to Key Stage 4. The Government has established a clear timetable for implementing the changes at Key Stage 3. Schools will receive the new programme of study and guidance on the changes in September 2007 to give them a year to plan for implementation (before the new curriculum becomes statutory from September 2008). The Government is putting in place a package of training and support for school leaders and subject teachers to support them in delivering the new curriculum.

It is too late in the development process to pilot the Key Stage 3 programme of study and the A-level changes. Suitable A-levels need to be available for students who have taken the new science GCSEs when they are ready to begin level 3 study in 2008. The new A-level subject criteria were developed by the Qualifications and Curriculum Authority after extensive consultation with specialist subject groups and subject teachers. They have close links with the new science GCSEs.

The revised A-level assessments are scheduled to be trialled in summer 2007, and 2008, and case study work on some aspects is being undertaken at Key Stage 3. Pilots of the advanced level extended project began in October and will continue until 2008, when they will become available to all schools and colleges. There is much evidence of existing good practice to support all aspects of the changes proposed, eg the project A-levels such as Salters-Horners physics, and schools such as Fairfield High School, featured in the TES Magazine,

who already fully use the high degree of flexibility available in the present National Curriculum with considerable success.<sup>1</sup>

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.*

The Government supports the Committee's view about the substantial benefit that science academics and students bring by their volunteering activities in schools. The Science and Engineering Ambassadors Programme now has over 13,000 volunteers and the aim is to reach 18,000 by March 2008. The Student Associate Scheme has been running alongside the Science and Engineering Ambassadors scheme for the past four years. The Student Associate Scheme has placed more than 25,000 students into classrooms, the vast majority of which have been in secondary priority subject areas such as science and mathematics. The scheme has been an important recruitment tool for Initial Teacher Training with somewhere in the region of 40 percent of participants going on to Initial Teacher Training. Its other main aim is to use the undergraduates as role models to help increase pupil participation in higher education. It also helps support the curriculum by bringing bright undergraduates with fresh and often cutting-edge ideas into the classroom. Its contribution to improving access to high quality mathematics and science was recognised in March 2006 by an announcement by the Chancellor of additional funding for the scheme in 2006–07 and 2007–08, above core funding, to increase the number of mathematics and science placements.

The purpose of the Research Assessment Exercise is to recognise and reward excellence in higher education research rather than to promote links between universities and schools, valuable though these are. A consultation exercise on a metrics-based system to replace the Research Assessment Exercise after 2008 closed on 13 October 2006. The outcome was announced on 6 December alongside the Pre-Budget Report.

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.*

The Government welcomes this recommendation. The Science, Technology, Engineering and Mathematics (STEM) Programme Report, published jointly by DTI and DfES addresses this issue.

Action 11 states: "By June 2007 we will have established the potential to develop a national STEM communities portal from the existing Science Learning Centres' web portal and the possibility of providing peer reviews of resources, events, industry contacts, continuing professional development (CPD) and links and feeds from related sites as well as regional portlets. The Science Learning Centres' web portal is already providing a platform for the National Centre for Excellence in the Teaching of Mathematics."

The STEM web-portal, focusing on enhancement/enrichment activities, is in the development stage and will be launched shortly (it also uses the Science Learning Centres' web portal as its platform). The four pilot Regional STEM Centres are populating the portal with activities. It is likely that all regions should be able to establish a STEM Centre by 2008.

Each of these web portals has been specifically designed to give teachers access to regional, as well as national information.

By June 2007, the Government should have a clearer idea on the feasibility of joining these three web portals together under one umbrella portal to optimise access for teachers.

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.*

The Government supports the aim of encouraging teachers to take a flexible approach to delivering the curriculum and to inspire students. There is no evidence that good test results can only be obtained at the expense of the broader curriculum and engaging teaching. Ofsted has found that the best schools achieve good test results in the context of a broad and rich curriculum. That is what the Government wants for every child.

The National Curriculum tests are designed to assess how well pupils have learned and understood the National Curriculum. To achieve attainment targets in science and mathematics, pupils have to show that they have mastered a range of skills and can apply them in unfamiliar situations. The tests were revised in 2003,

<sup>1</sup> *TES Magazine*, 17 November 2006, pp 20–22, "Happiness is a serious subject . . ." Note that this school, in an area of rural deprivation, was rated "outstanding" at its last inspection and has achieved 80% A\*- C in recent years in GCSE.

following a major review of assessment. For science and mathematics tests, the aim was to prompt pupils to apply a broad range of skills, knowledge, creativity and ideas rather than simply recall facts. As a result, test content should be less predictable. It is not possible for those tests to cover the full breadth of a programme of study each year. However, the National Assessment Agency monitors the items in those tests to ensure that the full programmes of study are covered over time.

Key Stage 3 science tests now include more questions that assess scientific enquiry, with a focus on assessing pupils' understanding of the development of scientific ideas and the use of scientific evidence. Key Stage 3 mathematics tests better reflect the breadth of the curriculum and complement current approaches to teaching and learning in the classroom. For example, there are more questions that assess using and applying mathematics.

New Key Stage 3 programmes of study for science and mathematics will be introduced in 2008. The 2011 tests will be the first assessments made on the basis of those new programmes of study. The National Assessment Agency, test development agencies and the Qualifications and Curriculum Authority will consider the effect on tests. We would expect to manage any change to reflect the new curriculum as part of the normal process for reviewing tests and are not expecting a major upheaval.

The National Curriculum tests in science and mathematics have evolved since their introduction in 1993, taking account of feedback from teachers and other educational experts. Teachers have a crucial role to play in test development. Each year, the National Assessment Agency carries out an evaluation of the tests, which takes account of the views of a representative sample of teachers and informs test development. Teachers also influence test development through their involvement in feedback groups, where they have the opportunity to comment on curriculum coverage and the extent to which draft test items are likely to engage pupils and whether or not the items take an innovative approach to the subject. Members of these groups frequently comment on the quality and the originality of the test items.

#### THE ROLE OF THE PRACTICAL

6.11 *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.*

The Government agrees with the importance the Committee has placed on practical science. The changes proposed by the Committee in relationship to the national tests were instituted in 2003. The Qualifications and Curriculum Authority's monitoring subsequently showed some increase in teaching scientific enquiry skills.<sup>2</sup>

From 2008, most A-levels will have only four assessment units. However, A-levels in the sciences will continue to have six units specifically to allow the requirement to assess practical skills. The subject criteria for A-levels in the sciences have been revised to emphasise the importance of practical work and out-of-classroom/out-of-laboratory work, and to include "How science works", ensuring progression from the new GCSEs.

6.11 *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.*

The Government will consider this recommendation in the light of its CSR settlement.

The Secondary National Strategy provides guidance and lesson materials to encourage effective and engaging practical work in the classroom and to ensure that teachers link this to learning objectives and development of subject knowledge. They also encourage practical work to be used with other learning tools such as ICT. As one of our "Next Steps" commitments, the Government has also asked the Secondary National Strategy to promote effective practice in interactive teaching including imaginative use of practical work.

Continued support for effective practical work is also available to schools via strategy consultants and other providers such as the Science Learning Centres and subject associations. In addition the Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS) provide training and guidance on matters to do with health and safety in science education to help teachers and technicians undertake more challenging practical work within safety standards.

<sup>2</sup> <http://www.publications.parliament.uk/pa/ld200506/ldselect/ldstech/257/257.pdf>

6.11 *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 Government fully recognises the importance of well-built, designed and resourced school buildings to support the transformation of education, and that science teaching has a high priority. This year, £5.9 billion of capital funding is available for investment in schools, and this will rise to over £8 billion a year by 2010–11. This compares with an annual rate of under £700 million in 1996–97.

Most of this money is available for investment in school science facilities where this is the local priority. The Government welcomes the Committee's point that it is not the role of central Government to dictate how capital funding is spent locally. Widely allocated, relatively small amounts of ring-fenced funding, whilst no doubt always welcomed, may not target need, and may not achieve the step change in provision which we seek from more strategic investment.

The major strategic programme, Building Schools for the Future, aims to renew all secondary schools in England in fifteen waves of investment starting from last year. This programme will fund new and refurbished laboratories. By 2010, about a third of all secondary schools will have been prioritised through this and the Academies programme. In addition, substantial additional funding is available to authorities and schools for local investment. This can include improving science provision in school buildings which cannot wait for their relatively late prioritisation in the Building Schools for the Future programme. This year, a further £2.5 billion of formulaic unhypothecated capital is allocated to schools and authorities. A typical secondary school will receive over £100,000 of its own capital money which it can use to improve its buildings, which of course includes its science provision: this funding can be rolled over and joined to other sources of funding for bigger projects.

Therefore, the Government believes that there is now sufficient funding being provided overall to bring all school laboratory provision to 21st century standards, and agrees with the Committee that there is a need to persuade schools and authorities to prioritise this.

Therefore, the Government has launched "Project Faraday" (formerly "School Labs of the Future") to provide exemplar school science laboratory designs which reflect the best in forward thinking on science teaching and inspirational laboratory design; and to build a range of demonstration laboratories around the country which will stimulate local interest.

This project is still in its early stages. The Government has recently procured through open competition three teams of educationalists and designers who will each be matched with at least two schools, which are developing or considering building projects, which include science provision. The teams will work with these schools to challenge, explore and develop their laboratory designs. This will include consideration of how science teaching may also use features of the whole of school buildings and its grounds. This work is in its earliest stages and there has not yet been any design output. The Government aims to publish inspirational exemplar designs during 2007, and to build a range of demonstration laboratories throughout the country reflecting these designs by 2008–09, including in the schools working with the teams. Some capital has been set aside to support development and implementation of these demonstration projects to supplement their other capital resources.

6.11 *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.*

The Government shares with the Committee its regret that a significant proportion of new school laboratories are not found to be satisfactory by their users. However, it notes that a high proportion of the dissatisfaction is with the quality of the finish of fixtures and fittings, and with the quality of build, rather than with the overall design of the new laboratories. Through Project Faraday, the Government aims to work with manufacturers and contractors to improve these matters.

The Association for Science Education has been a member of the Steering Group for Project Faraday since its inception. The Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS), while not a member of the Steering Group, is being included in a wider group who will be asked to comment on the exemplar laboratory designs as they are developed.

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 virtual assessment centre. We recommend these proposals to the Government, and in addition invite them to consider whether career structures could be linked to advisory salary scales, in an attempt to increase the almost universally low level of pay for technicians.*

The Government recognises the important role that science technicians can play. That is why the Training and Development Agency for Schools, is working with the Association for Science Education to provide flexible training and assessment, and career pathways for science (and design and technology) technicians.

The Government is awaiting the outcome of the working group, established with the unions representing school support staff (including technicians) and their employers, on fair pay and rewards for all school support staff. This is expected shortly. The Government will want to consider the position of technicians in the light of the issues highlighted by the Committee in their report and the proposals made by the group.

#### ACHIEVING THE GOVERNMENT’S TARGETS

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.*

The Government welcomes the Committee’s endorsement of the pre-Initial Teacher Training enhancement courses to enhance physics, chemistry and mathematics skills for those entering teaching who do not have a recent degree in the subject.

The Government has increased the bursary for the enhancement courses to £225 per week for 2007. This is a significant increase on the £150 per week in 2006 and has led to significantly increased recruitment to the enhancement courses for 2007. Best estimates are that over 450 people will begin these courses in January; this is an increase of 50 per cent on 2006.

The Training and Development Agency for Schools is currently reviewing how subject knowledge training in mathematics, chemistry and physics can be most efficiently and effectively delivered. The Training and Development Agency for Schools is considering the amount of financial support that should be provided to trainees over the whole period of their postgraduate training, including subject knowledge training provided through pre-Initial Teacher Training enhancement courses and through extended postgraduate courses. This review will consider the appropriate amount of bursary to make available over the period of postgraduate training; and whether the existing flexibility for when training bursary payments are paid to individual trainees could be widened. It will also have regard to the summer holiday period and is due to report early in the new year (2007).

To continue the drive to recruit science graduates into teaching via employment based routes, the Training and Development Agency for Schools provides a £1,000 premium to providers offering these courses in 2007. Part of this premium will be recovered if a participant does not progress to Initial Teacher Training.

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.*

The Government, together with the Training and Development Agency for Schools, are working towards this recommendation. As outlined in *The Science and Innovation Investment Framework 2004–2014: Next Steps*, the Training and Development Agency for Schools is developing and piloting a continuing professional development programme, leading to an accredited diploma to give existing science teachers without a physics or chemistry specialism the deep subject knowledge and pedagogy they need to teach these subjects effectively.

The course specification requires that providers offer accreditation at Postgraduate (M) level. It has not yet been agreed how many M level points the course will accrue, but where the credits from the course contribute to a Postgraduate award then it could attract funding from the Training and Development Agency for Schools, through the Postgraduate Professional Development programme. Both the Institute of Physics and the Royal Society of Chemistry have representatives on the working group, which is developing the course specification and have agreed to offer providers in the pilot the opportunity to gain professional accreditation. They would visit the provider and, if satisfied, would offer professional accreditation for teachers who successfully completed the course with that provider. It is hoped that the Association for Science Education’s

Chartered Science Teacher scheme will also recognise the course as contributing to the requirements for Chartered Science Teacher status.

The current remit to the School Teachers' Review Body asks it whether science teachers who are not physics and chemistry specialists should receive an incentive to encourage them to complete a physics and chemistry continuing professional development enhancement, leading to an accredited qualification, to enable them to teach those subjects effectively. The School Teachers' Review Body's report to the Secretary of State and the Prime Minister is due to be received by 22 December, in accordance with the remit set in May. The Secretary of State will then consider how to take this forward and will announce his response when the report is published for consultation in the New Year.

*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.*

The Government has already taken some steps towards meeting this recommendation. Schools have a number of existing flexibilities in relation to teachers' starting pay. These flexibilities include determining a five point range on the Advanced Skills Teachers' pay spine (and increasing the pay range). The criteria that apply here could include subject criteria and there is complete flexibility for schools to choose whatever range they consider appropriate. Schools and local authorities may also provide recruitment and retention payments, support or benefits, in addition to the normal salary entitlement to attract and retain any grade of teacher. Schools and local authorities can pay these in accordance with whatever criteria they set in their pay policies to meet their own local need, including making payments in respect of particular subjects where there are recruitment and retention difficulties. There are no limits on value or on the nature of payments, though there are time restrictions.

The Government believes that the existing pay flexibilities already offer schools sufficient scope for recruiting and retaining teachers of shortage subjects. However, the evidence suggests that schools remain reluctant to use these flexibilities when recruiting staff. Therefore the School Teachers' Review Body has been remitted to advise on the use of current pay incentives and flexibilities to improve the recruitment, retention and quality of science and mathematics teachers. The School Teachers' Review Body's report to the Secretary of State and the Prime Minister is due to be received by 22 December, in accordance with the remit set in May. The Secretary of State will then consider how to take this forward and will announce his response when the report is published for consultation in the New Year.

*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.*

The Government has already examined a scheme to write off teachers' loans in some detail. Between 2002 and 2005 the Government piloted a scheme which wrote off the student loans of new teachers of shortage subjects, including mathematics and science. The scheme aimed to encourage more people into teaching, but it was essentially intended as a retention measure, because beneficiaries needed to spend 10 years in teaching to have their whole outstanding loan written off. Evaluation of the scheme indicated strongly that the presence of a loan repayment scheme per se made very little difference to trainees' decisions to pursue teaching as a career. It was also difficult to assess whether the scheme positively influenced recruitment because it was just one of several financial incentives that were on offer to many new entrants. The scheme also proved complex and difficult to administer and it was decided not to pursue the scheme after the end of the pilot because it had not proved effective and did not offer value for money.

Other routes to improving the number of people training to be science teachers have been explored. From 2006–07 the Training and Development Agency for Schools has, with the support of the Government, recalibrated the Golden Hello and bursary schemes, with a notable shift of funding towards mathematics and science trainees. We have increased the value of the teacher training bursary for science graduates. The bursary rose to £9,000 in September 2006. The current budget (financial year 2006–07) for Golden Hellos is £25 million and the Golden Hello for new science teachers rose to £5,000 for trainees entering PGCE and equivalent courses in September 2005.

The Golden Hello incentive is currently targeted on a range of priority subjects (design and technology; English—including drama, dance and performing arts; information and communications technology; mathematics; modern languages and science). Using this funding for science trainees only could result in an increase in the Golden Hello for these trainees, which may be seen as a contribution to eliminating any debt incurred at undergraduate level for these trainees. However, it carries the risk of reducing the attractiveness of other initial teacher training priority subjects (including mathematics).

*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.*

The Government has already removed the time limit from the Graduate Teacher Programme, so participants can gain Qualified Teacher Status as soon as they are able to. The course is already targeted at career changers and has expanded from around 30 participants six years ago to 500 people training to be science teachers in 2004–05. The flexible postgraduate routes can lead to Qualified Teacher Status in a very short space of time, taking full account of candidates' prior experience and learning.

Schools already have scope to place a person (for example, someone on the GTP) where they choose on the unqualified teacher pay spine, having regard to any qualifications or experience considered to be of value for the performance of duties. An additional allowance of any value may be paid where the salary is deemed inadequate, having regard to any qualifications or experience relevant to the particular teaching undertaken. This could take the salary up to and beyond that of a qualified teacher.

*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.*

The current School Teachers' Review Body remit asks it to consider whether there are steps that should be taken to improve the use of current pay incentives and flexibilities to improve the recruitment, retention and quality of mathematics and science teachers. The School Teachers' Review Body's report to the Secretary of State and the Prime Minister is due to be received by 22nd December, in accordance with the remit set in May. The Secretary of State will then consider how to take this forward and will announce his response when the report is published for consultation in the New Year.

#### UPTAKE OF CPD

*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.*

The Government is committed to clarifying, updating and strengthening the subject disciplines, promoting subject specialism and to continuing the professional development of subject teachers and leaders.

The revised framework of professional standards for teachers makes a commitment to improving teaching practice through appropriate professional development. The revised performance management arrangements which take effect from September 2007 will ensure that all teachers review their performance and agree plans for their future training and development which reflect their needs.

Evidence was submitted to the School Teachers' Review Body jointly by the Secretary of State and social partners (members of the Rewards and Incentives Group, RIG) in May 2005. Together they recognised that all teachers should have a professional responsibility and a contractual entitlement to be engaged in effective, sustained and relevant professional development throughout their careers. They further believed that these expectations should be reflected in revised professional duties for teachers, complemented by a revised framework of professional standards for teachers. The Secretary of State for Education and Skills expects to receive the School Teachers' Review Body's report by 22 December.

The Training and Development Agency for Schools is working with a National Reference Group of stakeholders to provide a framework to help teachers develop their subject skills and knowledge. The framework draws on a broad evidence base, including discussions with continuing professional development advisors and national stakeholders, policy documents, academic studies and National Reference Group members' analysis of relevant research.

In the Schools White Paper, “Higher Standards, Better Schools for All”, the Government pledged to support teachers to develop their subject expertise by encouraging them to join their relevant subject association and to keep their subject knowledge up to date via continuing professional development. Some schools are already using a proportion of their five non-contact days on subject-related development to do this, but the Government wants to support and encourage this further.

The Government will continue to work closely with the Training and Development Agency for Schools, and subject associations, on a range of projects to raise the profile of subject continuing professional development, and to improve the range and quality of provision for subject teachers. The Government will support the Associations’ efforts to build capacity and membership over the next few years, and to promote collaborative working across subjects, particularly for the benefit of primary teachers, many of whom face the considerable challenge of addressing all the subjects of the curriculum.

The Government also provides substantial continuing professional development support to teachers through the National Strategies. The Strategies offer a vast range of guidance, teaching materials and training to enhance subject pedagogy and teaching approaches. This support is accessible for all teachers, and schools are provided with adequate funding for the provision of supply teachers to cover training absences.

The Government recognises that in some subject areas, such as science and mathematics, there is scope to train and deploy support staff in increasingly specialist roles to better support the curriculum and teachers. That is why the Government has pledged that every secondary school, which wishes to do so, should be able to recruit at least one science-specialist Higher Level Teaching Assistant (HLTA) by 2008.

The supply teacher market is well developed and very competitive. Agencies will normally work towards satisfying schools’ needs wherever they can, but there need to be more science and mathematics teachers available generally to satisfy the needs of schools and agencies. This is why the Government is pursuing its current policies to bring more people in to teach mathematics and science.

*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.*

Ofsted already collaborates with other organisations to share information to the benefit of pupils in school. For example, Ofsted has provided the National Science Learning Centre with data showing the poorer performing schools, such that they can target continuing professional development provision at those schools to help raise standards. The science specialist adviser has also worked with several of the regional Science Learning Centres to promote high quality science education. Ofsted has worked with the Specialist Schools and Academies Trust to identify good practice in science education and thus to promote good standards throughout those schools. The Specialist Schools and Academies Trust itself promotes the sharing of good practice amongst schools in a range of ways, including schools with science specialist college status being encouraged to work to support science in other schools in their area.

The Government has commissioned the National Strategies to work with schools at a local level, including by identifying and disseminating good practice case studies so that other schools can benefit. The Strategies also hold termly meetings for school subject leaders to discuss best practice and effective collaboration.

The reports on subjects, which Ofsted publishes on a three-yearly reporting cycle, will help to share good practice.

*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.*

The Government and the Wellcome Trust are investing heavily in the network of Science Learning Centres and want to see them develop and thrive.

The Government welcomes the Select Committee’s support for this initiative and is currently developing its strategy for the next Comprehensive Spending Review (CSR). The outcome of the CSR is expected in summer 2007. At present, therefore, the Government is not in a position to make any funding commitments beyond the end of March 2008.

In considering its strategy for the CSR the Government, together with the Wellcome Trust and the centres themselves will be looking at the overall model for the Science Learning Centre network. The Government and the Wellcome Trust will continue to discuss with the centres how best to overcome the financial barriers to

teachers' take up of professional development, including the place of bursaries and other incentives to address schools' concerns about affordability. We will also look at the options for targeting any bursaries to achieve maximum impact. Alongside this, we will together continue to address the cultural barriers to take up. In response to demand from schools, the centres have already started to do this by developing a richer mix of models for continuing professional development, including in-school and bespoke continuing professional development as well as their published core programme of courses.

**Memorandum by the Consortium of Local Education Authorities for the Provision of Science Services (CLEAPSS)**

*Section 6.7 Concerning the Timetable for the Introduction of the new A Levels*

CLEAPSS has, in recent months, accrued considerable evidence that the introduction of the new science GCSEs has not been as smooth as might have been hoped. It is evident that too little time for awarding bodies, authors of textbooks and others to check, in sufficient detail, the scientific accuracy or the health and safety requirements of practical activities to be used by teachers for assessing and/or teaching GCSE science. We have collated the most significant of our observations into a position statement which is available to all CLEAPSS members on our web site. The statement is developing all the time and, at the time of writing, includes comments on 36 different, substantial practical activities. For 11 of these we have produced individual supplementary documents to provide advice on how to carry out a practical activity both successfully and safely.

We conclude that similar issues may well arise with the new A levels. Recognising that the timetable for introduction is now difficult to change, we suggest that the QCA strongly urges the awarding bodies and, as far as possible, publishers and others providing curriculum support to seek expert scrutiny of all materials, particularly those for practical science, before they are published. This would help to ensure both scientific accuracy and the provision of appropriate health and safety information.

*Section 6.11 Concerning the role of the practical in science teaching and the facilities within school science laboratories*

Recent discussion within the scientific community has identified a lack of a clear and shared understanding of what constitutes practical science. Steps are being taken to resolve this and to agree a definition of practical work in science. However, at the moment, activities as diverse as drama, web-searches, book research, computer simulations, video films of practicals, "live" teacher demonstrations and the more traditional class science practical activities are all being used as examples of "science practical work". While we would agree that all these activities, and other similar ones, have a role in securing learning, there is universal agreement, including comments in the Government's response to the House of Lords report, that "live" teacher demonstrations and hands-on laboratory practical work are essential for pupils to learn science appropriately.

The other types of activities described above require furniture, room layout and equipment which are different from those currently expected in a science laboratory. We have heard of new science laboratory designs which include extensive internet facilities and large screens but limited bench space, gas and electricity for practical work. We are concerned that suggestions for internet searches or video demonstrations might be regarded as legitimate replacements for activities in which students see and do "live" practical work, with a consequent reduction in laboratory facilities in schools.

Since our original submissions, CLEAPSS has heard of the installation of more unsatisfactory laboratories, often those in new PFI-built schools. At the heart of many of the complaints is cost reduction. Between the original design and final commissioning, suites of laboratories have emerged with less in-lab storage, less equipment and often significantly-reduced technician preparation and storage facilities. It is clear to us that some decision-makers are not sufficiently conversant with the needs of practical science, or are easily persuaded that a reduction in the performance of practical work is not ultimately harmful to standards. We strongly believe this to be a false argument and, given the Government's drive to persuade more students to take sciences at A level, entirely counter-productive.

*Section 6.12 and Section 6.19 Concerning school science technicians*

Related to the cost-saving point above, we continue to hear from our members of reductions in the number of science technicians and/or their working hours. In some cases, schools are increasing the number of teaching assistants while reducing the number of science technicians in order to balance the books. Other schools are already encouraging science technicians to take on additional teaching assistant work in science lessons but

without any compensatory reduction in technician duties or the appointment of additional technical personnel. In effect, some schools are trying to appoint one person to do two jobs. Since we have already suggested that the majority of schools have insufficient science technicians, a further reduction in the time available, by making them part-time teaching assistants, will inevitably mean less practical science will be possible in some schools.

We noted that, in its response to section 6.19, the Government has pledged that every secondary school, which wishes to do so, should be able to recruit at least one science-specialist Higher Level Teaching Assistant (HLTA) by 2008. We believe that this may well further deplete science technician numbers unless the case is strongly made that schools should employ adequate numbers of science technicians.

We also believe that rates of pay for science technicians do not stand fair comparison with those of other non-teaching staff in schools and in fact are falling further behind.

#### *Section 6.13 Concerning training more teachers of chemistry and physics*

The Institute of Physics and the Royal Society of Chemistry (together with the Nuffield Curriculum Centre) have, separately, developed web sites to help existing and new science teachers learn about classic and new physics and chemistry practical activities. The web sites are respectively called Practical Physics ([www.practicalphysics.org](http://www.practicalphysics.org)) and Practical Chemistry ([www.practicalchemistry.org](http://www.practicalchemistry.org)). CLEAPSS has supported, and advised on, their development

16 April 2007

### **Memorandum by The Joint Committee for Psychology in Higher Education**

1. The Joint Committee is the umbrella group for the three main bodies that represent British Psychology—the British Psychological Society (with over 44,000 members, including academics, students and practitioners), the Experimental Psychology Society (representing over 600 established research scientists), and the Association of Heads of Psychology Departments (representing over staff and students in over 100 Departments in Higher Education Institutions).

2. Whilst the Committee welcomes the thoroughness of the report and the strength of some of its key recommendations, we were extremely disappointed to note that whilst reference is made to psychology being a science (section 2.9), that this is the only mention of the discipline within the report. As a result of this narrow definition of science, we believe that the report fails to recognise a number of important points:

- That psychology is the fastest growing science subject, it not only has a very strong scientific basis in the biological and computational sciences, but share many similarities with other long established quantitative social sciences. Its diversity is one of its core strengths and as such, it has much to contribute to the future development and strengthening of the UK research and science base;
- The Qualifications and Curriculum Authority and the Joint Council for Qualifications have recently re-classified psychology as a science. From 2008, psychology will be included in the schools science curriculum.

3. This being the case, the teaching of psychology in schools should have been considered alongside other science subjects as part of this review. We feel that this is vital given the proportions of students studying psychology at this level, and the importance of the discipline in attracting people into science, especially those who may otherwise have undertaken law or humanities, thus bucking the trend of decline in other science disciplines (physics, chemistry etc). The reluctance to accept psychology as a *bone fide* scientific discipline has meant that the resources required to support the scientific methods that underpin the discipline are often not supplied or are inadequate. This is the case both within schools and HEIs (British Psychological Society accredited psychology degrees are centred on practical training in the scientific method and statistics; and require an independent third year empirical research project).

4. We also wish to highlight the following concerns:

- In light of the comments outlined above, references within the report that “there is good evidence that students are opting for “easier” A-Levels over the sciences and mathematics” (Abstract); are misleading to the extent that the figures within the report do not include the numbers of students undertaking psychology (and that these should have been included within the numbers for science subjects);

- In section 2.11, reference is made to the need to portray science subjects in the best positive light, to overcome the perception by students that the topics are boring and irrelevant to modern life. Moreover, in section 2.12, it is stated that evidence was received that poor science teaching affects female students. The increased popularity of psychology does not reflect that this is the case. Rather than there being a decline in the number of students studying science, we believe that the evidence shows that there has simply been a shift in the kinds of science that are being studied. Importantly, in relation to the concern outlined in section 2.12, psychology also attracts a significant number of women into science, again re-addressing the balance in relation to some of the problems faced by some of the other sciences;
- In section 2.39, reference is made to the Science Council “Careers from Science” project. The British Psychological Society is not only a member organisation of the Science Council but it is also directly involved in this project. Again, the failure of the report to acknowledge psychology as a science in its references to STEM subjects, results in a failure of the report to present an accurate picture of the present state of science in schools;
- Section 4.5 discusses the importance of appropriately trained science teachers and the number of teachers teaching outside of their own subject area. It is difficult to gain reliable data pertaining to the number of teachers in psychology—and specifically the numbers of teachers that are non-psychologists, or more seriously, non-scientists. This presents various problems for the students and the teachers, particularly in relation to the analysis of statistics, ethical issues and the research project elements of A Level psychology;
- The important point to note is that whilst it appears that there is not a problem encouraging psychology graduates to undertake teacher training; we have anecdotal evidence that our graduates either experience difficulty getting onto teaching training or in achieving QTS. Few institutions run PGCEs with a psychology specialism, and those that do, request that students provide evidence and undertake training in another subject alongside psychology;
- Measures therefore need to be taken to ease the route to QTS for psychology graduates. This is particularly important now that psychology is included in the schools science curriculum.

#### **Letter from The Royal Academy of Engineering**

Further to the Committee’s inquiry into “Science Teaching in Schools”, I wish to offer comment on two points raised in the Government’s response to the committee’s report.

#### *6.2 On students opting for “easier” A-levels over the sciences and mathematics and alternatives to the A-level system*

The Government’s response raises the subject of the new 14-19 Specialised Diplomas. The Engineering Diploma is certainly relevant to the issue of young people continuing with mathematics and science learning beyond the age of 16. For this reason The Royal Academy of Engineering has been closely involved in the development of the Engineering Diploma at a national level but also with the preparations for its launch in 2008 in Southwark and Lambeth (areas where the Academy is actively involved in school science and mathematics learning through its London Engineering Project).

The Committee might be reassured that the Level 2 Engineering Diploma is already taking shape as a qualification where pupils can learn mathematics and science within the Diploma which adds to that learned in the GCSE studies they will complete alongside the Diploma. This should better prepare learners for technical employment as well as progression to technical and scientific Level 3 studies.

However, the Committee might continue to question how the Level 3 Engineering Diploma will encourage more young people than at present to study mathematics and science beyond the age of 16. Currently the Level 3 Engineering Diploma specification seems relatively ill defined and has proven subject to sudden changes in direction. There is a body of concern that it will not adequately prepare students for engineering studies at university due to a lack of identifiable mathematics and science content. The Academy is working with the wider engineering community to see this situation rectified.

The Committee might choose to recommend that the DfES School Science Board and its sister School Mathematics Board are given roles in overseeing the science and mathematics content of the new Diplomas. The current focus of these two Boards is solely on GCSEs and A Levels and this is hampering the progress of 14–19 reforms by creating an impression that school science and mathematics only takes place within GCSE and A Level studies. Recent communications from these two Boards reinforces a message to schools that A levels are still seen as the Level 3 qualification required for progression towards an engineering, technical or scientific career. I say this as a member of School Science Board myself.

6.8 *On the recognition offered to academics and university students working to inspire the next generation of scientists in schools*

The Committee's suggestion that university links with schools be reflected in submissions to the Research Assessment Exercise was an excellent one and easy to implement. It is surprising to note Government's reluctance to act on this.

Much of Government's science budget is spent with the Research Councils. Research Council funded work is typical of the kind of research that produces peer-review publications that will always provide the backbone of any Research Assessment Exercise. Already, Research Councils encourage their funded research programmes to incorporate elements aimed at promoting the public understanding of science. University-school links are typical ways of promoting public understanding of the value of research. Therefore the connection between research, the RAE and university-school links is clear. The Committee might further question Government on this issue.

There is a second related point. The RAE will always require evidence of a researcher's esteem. For long-established researchers, Fellowships and memberships of technical committees count as evidence of esteem. Such evidence, requiring many years of experience, cannot be claimed by younger researchers, but evidence of demand for their work in schools can.

*Professor Matthew Harrison*  
Director, Education Programmes

10 April 2007

**Memorandum by the Royal Society of Chemistry (RSC)**

The RSC is the largest organisation in Europe for advancing the chemical sciences. Supported by a worldwide network of members and an international publishing business, our activities span education, conferences, science policy and the promotion of chemistry to the public.

The RSC welcomes much of the Government's response, particularly in the areas of improving the supply of qualified chemistry teachers. The RSC is convinced that a teacher with appropriate subject knowledge in their specialism is a major factor in enthusing pupils to further study.

There are two areas where further comments must be made:

1. The Government's response to Para 6.2, in particular the second paragraph:

"Student perceptions and attitudes to subjects undoubtedly affect their choices post-16. The Government acknowledges that some students do perceive science and mathematics as being difficult A-level subjects, although it does not agree that some A-levels are easier than others. All A-levels have strict standards which have been set by the awarding bodies and are monitored by the Qualifications and Curriculum Authority. This standard is set as 'advanced' regardless of the nature of the subject."

This response ignores a vast amount of evidence, some of it emanating from Government commissioned reports, such as that by Lord Dearing on 16–19 education in 1996. In this report, and in the work of the University of Durham Curriculum, Evaluation and Management (CEM) Centre,<sup>3</sup> widely used by many schools and colleges under the acronym ALIS (Advanced Level Information System), a study of matched subject pair analyses shows that performance in some A-level subjects is lower than others when other factors, such as prior performance, are taken into account.

The introduction of new A-levels in 2008 gives an opportunity for these inequalities to be ironed out. This does not necessarily mean altering the "gold standard" of subjects such as mathematics, physics and chemistry, nor altering the content or assessment models of other subjects. The RSC recommends that awarding of marks using the unified mark score (UMS) system for modules during the assessment of the new A-levels be subject to review by QCA and that Awarding Bodies be required to change their UMS scores if matched pair analyses show these to be inequitable across subjects.

2. The Government's responses to paras 6.6 and 6.7 with respect to piloting and the introduction of new qualifications. The response baldly states "It is too late in the development process to pilot the Key Stage 3 programme of study and the A-level changes".

This is purely as a consequence of the Government not seeing curriculum change as a coherent and long term process. In science in particular the radical changes at Key Stage 4 have meant that greater changes are necessitated both at key Stage 3 and A-level to produce coherence. At Key Stage 3, unlike at Key Stage 4 and

<sup>3</sup> www.cemcentre.org

A-level there are no subject criteria nor awarding body specifications to clarify what teachers teach and what students learn and are assessed on. This exacerbates the concerns of teachers as how best to reflect the new, much more general programme of study. A major concern is that teachers will respond by teaching to the test, to the detriment of pupils' enjoyment and enthusiasm.

The RSC recommends that DFES and QCA urgently addresses these issues and makes its recommendations widely known to the teaching profession.

*March 2007*

### **Memorandum by the Science Community Partnership Supporting STEM Education (SCORE)**

This response has been prepared for the House of Lords Science and Technology Committee by the SCORE partnership and therefore represents the combined views of the following organisations: Association for Science Education, Biosciences Federation, Institute of Biology, Institute of Physics, Royal Society, Royal Society of Chemistry, Science Council. The aim has been to highlight aspects of the Government's response to the Committee's report on Science Teaching in Schools which are to be commended, or those which need further investigation, particularly in the light of change and new evidence since the Committee published their report in November 2006.

The SCORE partnership aims to bring collective action and a strategic approach to strengthening science education, and believes that the key to maximising the impact of its efforts, especially their influence on government, lies in a greater degree of collaboration and in having a sense of common purpose. Through this collective action, the partnership aims to increase its influence over the direction of science education in the years to come, in particular over teacher supply and retention, curriculum development, assessment, delivery of support to teachers and students, and strategies for reaching all young people regardless of age, background, level of ability, gender, ethnic origin and geographical location.

#### **KEY POINTS**

1. The introduction of new A-levels in 2008 gives an opportunity for inequalities across subjects to be ironed out and we hope that the review of 14–19 education, promised in the 2005 14–19 Education and Skills White Paper and due to take place in 2008, considers whether the current and proposed qualification framework meets the needs of the UK economy and individual learners.
2. We look forward to seeing a much more co-ordinated and strategic plan for promoting science careers from the Government.
3. We would like to see the Department for Education and Skills (DfES) and the Qualifications and Curriculum Authority (QCA) agree and publicise a best practice model of curriculum development, based on experience with Twenty First Century Science, which could be used as a quality standard for future change.
4. A public consultation on the changes to KS3 is currently underway; the QCA and DfES will need a strong justification for ignoring responses that suggest the development process is too short for successful implementation.
5. We strongly believe that there would be considerable advantages in allowing schools the option of piloting the Key Stage 3 (KS3) changes from 2008 but not insisting that all schools change KS3 until assessment material is available in 2011.
6. If the Research Assessment Exercise (RAE) is not a suitable mechanism by which outreach activities can be recognised, then the Government needs to consider what would be an appropriate mechanism.
7. We feel that the introduction of "How Science Works" to A levels in the sciences needs to be closely monitored by QCA for impact on practical work.
8. The Government appears to have no reliable mechanism to collect data on how Building Schools for the Future (BSF) money is being spent on school science laboratories, and, just as important, the quality and impact of the work undertaken.
9. We would continue to press the case for an improved career structure for science technicians as a specialist group distinct from Higher Level Teaching Assistants (HLTAs).
10. Continuing Professional Development (CPD) remains essential for science teachers though we doubt that any step change will occur without ring-fenced funding to facilitate teacher release from other duties.
11. We feel that the autonomous nature of the SLCs has acted to reduce their activity as a national network.

*Committee recommendation 6.2*

SCORE welcomes the Government's commitments to achieving year on year increases in the number of young people taking A levels in physics, chemistry and mathematics as set out in the *Science and Innovation Investment Framework (2004–2014) Next Steps* document, and recognises that considerable efforts are being made to realise these ambitions.

However, the Government appears to dismiss a significant amount of evidence, some of it commissioned by the DfES, suggesting that student perception of the greater difficulty of the sciences and mathematics is grounded in reality. In the 1996 Dearing Report,<sup>4</sup> and in the current work of the University of Durham CEM Centre (widely used by many schools and colleges under the acronym ALIS), a study of matched subject pairs<sup>5</sup> shows that performance in some A-level subjects is lower than others when other factors, such as prior performance, are taken into account. Indeed, on announcing the creation of the STEM Advisory Forum in March 2007 the Minister for Lifelong Learning, Further and Higher Education, Bill Rammell, said "Science, Technology, Engineering and Maths are the higher value, more difficult, strategic subjects the Government wants to see maintained and which are crucial to the country's future competitiveness".<sup>6</sup>

We believe the introduction of new A-levels in 2008 gives an opportunity for these inequalities to be ironed out. This does not necessarily mean altering the "gold standard" of subjects such as mathematics, physics, chemistry and biology, nor altering the content or assessment models of other subjects. It requires the regulator—the Qualifications and Curriculum Authority (QCA)—to ensure that matched subject pair analyses are carried out before awarding grades to ensure subjects are of equal difficulty.

In addition we hope that the review of 14–19 education, promised in the 2005 14–19 Education and Skills White Paper and due to take place in 2008, considers whether the current and proposed qualification framework meets the needs of the UK economy and individual learners. In science there is a particular concern about the status of the applied route and how best to ensure appropriate progression routes to HE and employment.

*Committee recommendation 6.3*

SCORE welcomes the DfES' development of quality standards for young people's Information, Advice and Guidance (IAG) but would like to see how performance will be monitored and evaluated against these standards and a clear statement as to where the responsibility for this lies.

It is still the case that the majority of careers information, advice and guidance practitioners do not have a STEM background and lack experience of the STEM sector. They therefore would particularly benefit from training and support to deliver IAG in this area so they know what is available through science. The Government is not yet addressing this issue. The first priority of science teachers is the teaching of science, and providing careers IAG is not perceived as part of their role. However, greater collaboration between science teachers and careers practitioners would enhance opportunities to discuss and promote careers opportunities from science.

We are pleased to see that the Government intends to improve the link between SEMTA's promotion of science careers and the delivery of careers information, advice and guidance. However, SEMTA's footprint does not incorporate all of STEM and we would like to see SEMTA co-ordinating this work with the other Sector Skills Councils that hold a science remit such as Automotive Skills, Lantra and Skills for Health.

While we welcome the addition of a banner on the homepage of the Connexions Direct website directing people to the science, mathematics and statistics job family as an initial step, we look forward to seeing a much more co-ordinated and strategic plan for promoting science careers from the Government.

In the Government's response to this recommendation they state that "It is also important that [students] go on to pursue careers in science to become the teachers and researchers of the future. In doing this it is vital that the education community continues to be really honest with itself about what is working and what isn't". We are unclear what is meant by this and would appreciate clarification.

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<sup>4</sup> Report of the National Committee of Inquiry into Higher Education (1996), chaired by Sir Ron Dearing.

<sup>5</sup> Report on A-level Subject Difficulties from the CEM centre website at <http://www.alisproject.org/Documents/Alis/Research/A-Level%20Subject%20Difficulties.pdf>

<sup>6</sup> Press Notice 2007/0043: Forum to boost science, technology, engineering and maths education (13 March 2007), Department for Education and Skills.

*Committee recommendation 6.4*

SCORE is pleased that the Government has now committed £500,000 towards the funding of the Careers from Science project. We would like to emphasise to the Committee that Careers from Science is not simply a website; it is a wider project that has support across the science community and aims to complement the work of Government and other organisations such as SEMTA. The Science Council is working with the National STEM Director to ensure that the project is central to the STEM community's careers activities and continues to aid greater co-ordination. It is important that the National STEM Director will also be able to assist in linking Careers from Science to the Government's own activities.

*Committee recommendation 6.5*

The issue of inspection data remains a problem but we would wish to highlight the importance of quality of evidence. We feel that some attention needs to be given to increasing the number of science specialists in inspection teams and to supporting schools to ensure the quality of their self evaluation in relation to subject-specific (in this case science) aspects of their review.

*Committee recommendation 6.6*

SCORE is pleased the Government accepts that schools should be given adequate preparation time to plan for any changes when new courses are being piloted and rolled out, and to organise resources prior to implementation. It is important that curriculum development—from initial research and consultation through to implementation and evaluating impact—addresses the needs of a range of stakeholders and produces a coherent and meaningful programme of learning in science. We would like to see the DfES and QCA agree and publicise a best practice model of curriculum development, based on experience with Twenty First Century Science, which could be used as a quality standard for future change.

With specific reference to the Twenty First Century Science GCSE, the Committee will be aware that an independent evaluation of the pilot was published in 2007 and made a number of positive observations as well as noting recommendations that had already been acted on. However it should be stressed that the evaluation concentrated on the Core Science GCSE. As the evaluators note “Perhaps our greatest regret is that resource limitations obliged us to focus so narrowly on one element of the Twenty First Century Science pilot—the Core Science course. As a result we have little objective evidence of the outcomes of Core Science plus Additional Science (General) or of Core Science plus Additional Science (Applied)”.<sup>7</sup>

*Committee recommendation 6.7*

SCORE agrees that since Awarding Bodies are currently writing specifications for revised A levels in 2008 it is probably undesirable to delay their introduction. However, it is much less clear that it is too late to delay the introduction of the KS3 changes. A public consultation on the changes to KS3 is currently underway; the QCA and DfES will need a strong justification for ignoring responses that suggest the development process is too short for successful implementation.

In support of our concerns we note that in 2007–08, in addition to preparing for the changes to Key Stage 3, science teachers will be attempting to implement some or all of the following changes:

- teaching the second year of new GCSEs from September 2007;
- preparing to deliver new courses teaching the separate sciences from September 2008 under the entitlement given in the Next Steps document;
- preparing for the new A level courses and Extended Projects from September 2008;
- preparing to deliver some science elements in the new specialised 14–19 diplomas, starting in September 2008.

We do not believe that teachers will have sufficient time to deliver the outcomes that these reforms are intended to achieve: planning for cross-curricular links and providing different pathways through the curriculum requires time and co-ordination. Phased implementation does not really help here as the whole KS3 curriculum will have to be mapped out before it can be taught.

<sup>7</sup> *Evaluation of the Twenty First Century Science pilot: a project response* (2007) Jenifer Burden, Peter Campbell, Andrew Hunt and Robin Millar, University of York and Nuffield Curriculum Centre, available from [www.21stcenturyscience.org](http://www.21stcenturyscience.org)

We also believe that publishers and others will not be able to provide high quality resources in the suggested timescale. The only option seems to be to repackage existing resources—again this is hardly like to lead the intended outcomes of the review. We are also concerned about the number of errors that are creeping into resources—the rush to have material available before teaching starts in September 2008 can only exacerbate this situation.

We note that the QCA recently asked science teachers what they would need to support implementation of the new Key Stage 3 Programme of Study (PoS) and found that “The most useful types of science exemplification for nearly all of the schools in our survey would be comprehensive teacher assessment guidelines and a range of assessment tasks. Also rated as very useful or essential by more than 90 per cent are hard copy, exemplar/guidance materials and web-based exemplar/guidance materials. Almost as many schools feel that continued professional development/INSET would be very useful or essential for supporting teaching and assessment. Exemplar material on CD-ROM is seen as more useful in science than in other subjects”.<sup>8</sup> We therefore hope the promised “package of training and support for school leaders and subject teachers” is in place before the new curriculum becomes statutory in September 2008.

We note that statutory assessment material for the new KS3 programme of study will not be ready until 2011, so it is not clear how schools that currently teach KS3 in two years will manage the assessment of their students who start their KS3 programme in 2008. We also note that DfES has just announced a pilot to trial changes to assessment, allowing children to take national key stage tests as soon as they are ready, rather than only at the end of a long key stage.<sup>9</sup>

Taking all these issues into account we strongly believe that there would be considerable advantages in allowing schools the option of piloting the KS3 changes from 2008 but not insisting that all schools implement the KS3 changes until September 2009 with the first end of key stage assessments available in 2011.

It is disappointing that the Government still does not seem to have accepted the fact that proper piloting and evaluation is essential for effective curriculum change, nor that it is in the end more cost efficient and beneficial for teachers and students if sufficient time is allowed. In particular, the radical changes at Key Stage 4 have meant that greater changes are necessary in science than in other subjects, both at Key Stage 3 and A-level, to produce coherence, and these changes do not seem to have been properly co-ordinated within the overall timetable for 11-19 change. We recommend that the Government ensures that the QCA urgently addresses the above issues and makes its recommendations widely known to the profession.

#### *Committee recommendation 6.8*

The Government’s response avoids the issue. If the Research Assessment Exercise is not a suitable mechanism by which these activities can be recognised, then the Government needs to consider what would be an appropriate mechanism. University academics have over many years become resigned to the fact that outreach work may receive little recognition from their institutions. However, with the current pressures within the university system, some academics are now positively discouraged from engaging with these activities. This is despite the current climate in which the Higher Education Funding Council has provided funding to both the Royal Society of Chemistry and the Institute of Physics to attempt to increase participation in chemistry and physics in Higher Education.

A recent report from the Royal Society<sup>10</sup> (with support from Research Councils UK and the Wellcome Trust) concluded that further research is needed on how the pressure on academics to publish and attract research funding impacts on their involvement in public engagement activities. We are encouraged by the recent “Beacons of Public Engagement” initiative from HEFCE, RCUK and the Wellcome Trust which is making £8 million available over 5 years to encourage outreach work by universities. However, this initial scheme will be of direct benefit to only a small number of universities and sustained investment will be required to bring about major changes on this issue.

#### *Committee recommendation 6.10*

The Committee will be aware that the House of Commons Education and Skills Committee has recently launched an inquiry into Testing and Assessment and we hope that this will encourage debate on a number of serious issues relevant to all subjects. The breadth of this inquiry’s remit indicates that the testing and assessment regime continues to have major implications for education, and that to improve this regime we need to take into account the whole educational climate. Recent proposals for “testing by level on demand”

<sup>8</sup> *Monitoring curriculum and assessment project 2005-2006: Science* (March 2007) Qualifications and Curriculum Authority.

<sup>9</sup> *Making Good Progress* (8 January 2007), Department for Education and Skills consultation document.

<sup>10</sup> *Survey of factors affecting science communication by scientists and engineers* (2006) The Royal Society.

may mean that some pupils could be tested more frequently than they are now, and on the assumption that school performance tables will continue there could be further pressures to “push” pupils through the tests. At Key Stage 3, unlike at Key Stage 4 and A-level, there are no subject criteria nor Awarding Body specifications to clarify what teachers teach and what students learn and are assessed on. This exacerbates the concerns of teachers as how best to reflect the new, much more general programme of study proposed for 2008. A major concern is that teachers will respond by teaching to the test, to the detriment of pupils’ enjoyment and enthusiasm.

*Committee recommendation 6.11*

The importance of practical work in school science is widely accepted but it is important we ensure that such practical work genuinely supports learning and teaching, and that flexibility is given to the teacher to do this in relation to their pupils’ needs and the courses they are studying. In particular, SCORE feels that the introduction of “How Science Works” to A levels in the sciences needs to be closely monitored by QCA for impact on practical work, as anecdotal reports suggest inconsistencies of interpretation between Awarding Bodies.

With regard to additional resources, practical work in chemistry and physics is already being supported through two websites<sup>11</sup> funded by the Nuffield Curriculum Centre, Royal Society of Chemistry and Institute of Physics. For most teachers, the main need is to be able to try out practicals and develop their own confidence and skills, together with technician support. We hope this continues to be a priority for the Secondary National Strategy and Science Learning Centres in partnership with CLEAPSS, professional bodies and subject associations.

The Government states it wants to achieve “a step change in provision” through their strategic investment in school buildings, and promises that the Building Schools for the Future (BSF) programme will fund new and refurbished laboratories, alongside additional funding available for local investment in schools which cannot wait for their relatively late prioritisation in the BSF programme. However, the Government appears to have no reliable mechanism to collect data on how BSF money is indeed being spent on school science laboratories, and, just as important, the quality and impact of the work undertaken.

SCORE is pleased to see the Government agree with the Committee that there is a need to persuade schools and authorities to prioritise school laboratory provision but we are not convinced that Project Faraday will be successful on its own, and would encourage the Government to work with us to come up with additional activities in this area. On a small point of accuracy, ASE has indeed been a member of the Project Faraday Steering Group from the first meeting but this did not take place until August 2006, and ASE did not receive its invitation to join the group until after it had given its written evidence to the Committee. Since then ASE has worked to play its part in the development of the project.

*Committee recommendation 6.12*

The role of technicians is crucial, as the Committee and the Government acknowledge, but we would continue to press the case for an improved career structure for science technicians as a specialist group distinct from Higher Level Teaching Assistants and as such requiring specialist training. The ASE project in partnership with DATA and funded in its pilot phase by the Gatsby Charitable Foundation has been very successful but to build on this there needs to be very clear information regarding funding for technicians to undertake the necessary assessments leading to qualifications. This still needs addressing with some urgency.

*Committee recommendation 6.13*

We note the Government states that the Training and Development Agency for Schools will be reporting “early in the new year (2007)” on the issue of financial support for students on pre-Initial Teacher Training enhancement courses: we hope they are now ready to share their recommendations with the Committee and other interested parties.

*Committee recommendation 6.14*

On 6 February 2007 the Secretary of State for Education announced proposals for financial incentives for completion of accredited qualifications in priority subjects,<sup>12</sup> following advice from the School Teachers’ Review Body (STRB). The STRB specifically recommended that:<sup>13</sup>

<sup>11</sup> [www.practicalchemistry.org](http://www.practicalchemistry.org) and [www.practicalphysics.org](http://www.practicalphysics.org)

<sup>12</sup> Press Notice 2007/0019 Alan Johnson announces proposals for changes to pay and conditions for teachers (6 February 2007) Department for Education and Skills.

<sup>13</sup> *School Teachers Review Body Sixteenth Report Cm 70/07 (2007)* HMSO.

- teachers receive a financial incentive for completion of accredited qualifications in priority subjects designated by the DfES or, for teachers in Wales, the Welsh Assembly Government;
- the DfES and the Welsh Assembly Government consider using the golden hello payment as the mechanism for this purpose; and
- the effectiveness of this approach be evaluated as part of the pilot for the mathematics, physics and chemistry diplomas.

Questions remain however as to the incentives for schools to release their staff to undertake this diploma, particularly if they are mindful that gaining the additional specialism raises a teacher's market value and therefore may increase the likelihood that they will move schools.

*Committee recommendations 6.15 and 6.18*

Again we note that the STRB recently concluded that based on their evidence and analysis “We do not therefore see a case at this stage for national-level action on pay to address continuing issues of recruitment and retention in mathematics, physics and chemistry. A permanent change to the teachers’ pay system to provide a salary uplift of any magnitude to all 44,000 secondary teachers of these subjects would be expensive and indiscriminate in its effects, and would take time to stimulate an additional supply of graduates.”<sup>14</sup> However, the STRB have recommended that:

- the DfES undertake a programme of action to secure a significant increase in the use of existing flexibilities in the School Teachers’ Pay and Conditions Document and Guidance on School Teachers’ Pay and Conditions to address local teacher shortages in priority subjects; and
- the DfES focus this programme on three areas, namely more effective support for local managers, a sharper framework of accountability, and school budgets.

*Committee recommendation 6.16*

The Government refers to a scheme to write-off the student loans of new teachers of shortage subjects running from 2002 to 2005, and the evaluation of that scheme. We assume they are referring to an evaluation undertaken by the University of Durham in 2004<sup>15</sup> which does actually claim some success for the “Repayment of Teachers’ Loans Scheme”, concluding that “we estimate that the scheme impacted in some way on 76 of the 246 teachers surveyed” (Executive Summary, point 36). The researchers also highlight that because many of the teachers interviewed had not known about the scheme before entering their initial teacher training, the scheme’s impact might actually be greater with a more effective marketing strategy. In 2006 the Government introduced variable tuition fees allowing universities and colleges in England to charge new full time home undergraduates up to £3,000 a year. We believe this change in the financial demands on teacher trainees, which is likely to increase in the future, merits a re-examination of the Repayment of Teachers’ Loans Scheme, with particular emphasis on the sciences and mathematics, the impact on recruitment to subject enhancement courses and two-year PGCEs, and the impact on recruitment and retention of subject specialists in London schools.

*Committee recommendation 6.19*

Continuing Professional Development (CPD) remains essential for science teachers and we welcome the willingness of Government to support and encourage schools to undertake subject-related CPD, though we doubt that any step change will occur without ring-fenced funding to facilitate teacher release from other duties. We agree with members of the Rewards and Incentives Group who are quoted in the Government’s response as recognising that “all teachers should have a professional responsibility and a contractual entitlement to be engaged in effective, sustained and relevant professional development throughout their careers”. We would welcome clarification on the realisation of this expectation; although the performance management arrangements will help, greater emphasis needs to be placed on the need for subject-specific developments/improvements to be included in personal development plans.

<sup>14</sup> *Ibid.*

<sup>15</sup> Barmby, P. and Coe, R. (2004) *Evaluation of the Repayment of Teachers’ Loans scheme*, DfES Research Report RR576.

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*Committee recommendation 6.21*

The entire science education community joins the Government and the Wellcome Trust in wishing to see the Science Learning Centres (SLCs) develop and thrive, and we hope the upcoming Comprehensive Spending Review will make adequate commitments to ensuring their future. However, we feel that the autonomous nature of the SLCs has reduced their activity as a national network, increased the likelihood that science teachers in different regions have markedly different CPD opportunities on offer locally, and placed barriers to national organisations, like the SCORE members, working in partnership with them. We would suggest that when their contracts are renegotiated they are given strong incentives, perhaps even requirements, to work in partnership with each other during their next phase of development.