
*Professor Colin Pillinger, Lord Sainsbury and the Rt Hon Charles Clarke MP with Beagle2 and admiring onlookers.*

# Science in Schools

*The Rt Hon Alan Johnson MP, Minister of State for Lifelong Learning, Further and Higher Education*

The UK produces some of the best science and scientists in the world. If we want to continue to be successful in the future, the science we teach in schools needs to be relevant and engaging and it needs to prepare students effectively for further study post 16.

Science teaching and learning in schools has two main aims. We need to make sure that young people have sufficient knowledge and skills to pursue further study in science. We also need to make sure that all young people leave school with an understanding of the relevance and importance of science and technology to the world around them. We live in a world where progress in science and technology frequently prompts us to ask ethical questions about how controversial scientific and technological developments should be applied. It is essential that we successfully equip today's young people studying science in schools who may well be making decisions about how we address these difficult issues in the future.

So how do we get more young people engaged in science? Despite explosive media coverage of controversial scientific developments, the Science and Technology Select Committee suggested that school students often perceive science as dull. Like all subjects, science can be hard and intellectually challenging but it is not dull. The challenge we face in schools is to ensure that teachers feel sufficiently confident and inspired to teach science in a way that conveys its relevance and importance to young people.

## Curriculum and teaching

Our vision is to create a curriculum and a style of teaching that reflect the reality of science and its many applications in an informed and objective way. In doing so, not only will we improve the scientific literacy of all students, but we will also

motivate more of them to pursue science beyond 16, and those who go on to study science at university will have a surer foundation.

We know from OfSTED that Initial Teacher Training (ITT) for science teachers is good. However, there is a need to make sure we continue the momentum of this good start throughout every science teacher's career. In October, I announced who would be running the science learning centres, which will provide training and continuing professional development to teachers and technicians. Through access to training at the centres, we aim to make it as easy as possible for all science teachers to keep up with new developments in their field and able to apply these in the classroom. There are also specific aspects of science teacher training that the centres will focus on such as subject specialism for teaching students post 16 and exciting practical work.

## Key Stage 3

The science strand of the Key Stage 3 Strategy has provided a crucial building block for improving teaching and learning in science in schools. We have invested £300 million in the overall strategy already, with a further £200 million in 2003-04 for high quality materials and classroom support to enhance teachers' professional development. The strand for science sets high expectations and challenging targets which provide pupils with a springboard to success at GCSE and beyond. The focus of the science strategy for Key Stage 3 is on teaching styles: encouraging inspiring and creative teaching practices that will enthuse students at a stage where in the past we have seen the interest levels of young people in science drop.

## Key Stage 4

The new Programme of Study for science at Key Stage 4 is the next step. It will be based around practical skills and knowledge and understanding of how science works and how it is applied. The programme of study can lead to three different courses: developing scientific literacy for the 21st Century, enabling students to engage with the world of science as a consumer or citizen; developing a broad understanding of science, enabling progression for more advanced study; or developing practical scientific capability, engaging students in occupations such as health care, manufacturing, agriculture and communications. The changes will come into effect in 2006, and the outcomes of the pilot GCSE, Science in the 21st Century will feed into these changes.

## Partnerships

However, this is not an agenda that schools and teachers should feel they have to take forward alone. Employers, universities and research councils also have a key role to play in demonstrating to young people some of the interesting and inspiring opportunities that studying science can lead to. This could be by encouraging scientists to go into schools through schemes like the Science and Engineering Ambassadors Programme or by giving students opportunities to see and experience science in action in the workplace. Innovative projects that encourage young people to learn through contemporary science, such as the Beagle II education materials and the Genetic Futures event, are the result of successful partnerships between Government, employers, universities, science institutes and research councils. They can have a real impact on young people's enthusiasm for science and I hope that there are many more opportunities to work together to create similar opportunities for young people and their teachers in 2004.

# Science Education

*By Maggie Leggett on behalf of the Biosciences Federation*

School science teachers have been dealing with change over the last 15 years, and will continue to do so. The Government wants larger numbers of young people to go to university, but many academics are unaware of what is happening in schools, and are struggling to adjust to a new type of undergraduate. School teachers, the Government and university tutors all share the same ultimate goal of producing educated people capable of undertaking work. Is there any communication between these three corners of the educational triangle, or are they just working in isolation?

## Should students decide for themselves?

Industry, Government and Universities have expressed concern about the decrease in students opting for science. For many this choice is taken quite early – reducing to single science at GCSE can be the end of scientific aspirations. Are the consequences understood? The view of the Qualifications and Curriculum Authority was that a sensible choice would be made by a 14 year old if provided with all the information. However, discussion with academics, teachers and parents suggests that many 14 year olds would take the path of least resistance, and were most affected by peer pressure. Andrew Kendall, who is currently enjoying a biological science course at King's College London, says he would have taken the subjects he perceived as easiest (not science) if he had been given the option at 14.

Imminent changes by the QCA will concentrate the compulsory science curriculum on "scientific literacy" – enabling young people to understand scientific advances and hazards reported in the media. This is justified by the decision that the majority of pupils do not pursue a scientific career, and therefore do not need to study science in depth. However, students following this route would be ill-prepared for a career in science and are therefore taking the decision to "opt out" of science early.

Wilf Hudson, from the Standards Unit, proposed the attractive option that pupils should have flexibility to pick neglected subjects up later on, although

Pauline Lowrie (Head of Science, Sir John Deane's 6th Form College) points out that school curricula are constrained by timetables. Rebecca Edwards from the QCA describes her preference for non-compulsory science, and a requirement for teachers to "sell" their subject. However, with the current shortage of science teachers and the problems they have outside their subject area, this would be a tall order. Research commissioned by the Wellcome Trust found that most teachers have insufficient opportunity for CPD and staying in touch with current developments. The new centres of excellence for science teachers will need to address these problems as a matter of urgency.

## Do students have the necessary information to make decisions regarding their careers?

Careers advice is a priority for QCA, shortly to be introduced into the national curriculum from Year 7. Currently, careers provision is poor. With the introduction of "Connexions", careers advisors now concentrate on children who are disaffected or who have problems, leaving others with no advice. The benefits of psychometric testing, which are extolled by Angela Lowi (Connexions), costs over £50 and is therefore a minority interest. Pauline Lowrie suggests that children often have little idea what scientists do other than their TV *persona* – hence the current fad for forensics. Although Learned Societies produce careers information, they often lack the resources to develop and distribute it fully as confirmed by a MORI poll, where 44% of students had never received information regarding Higher Education.

## Changing styles of teaching and learning

Over the last 20 years children have been introduced to a far greater range of teaching methods. Pupil-led research by Planet Science suggests that children prefer traditional forms of teaching such as taking notes from the teacher and class discussion and differentiate between methods they enjoy (videos rated high) and those that actually result in learning (videos rated very low). Internet-based research and learning was rated lowest by the 2000 pupils who took part in this survey.

There is still a shock when a student arrives at university however they were taught. Most courses are still taught in large lecture theatres although some universities (eg medicine at Manchester) are moving towards small group problem-based approaches. Student numbers are growing with an increasingly diverse academic background. Some universities provide training in study skills and support and guidance for students. Newcastle University showed that students found academic challenges less problematic than dealing with lifestyle changes, indicating where universities could concentrate their efforts.

## The chemical question

Students enter university with a much greater range of qualifications, and are accepted on biological and biomedical courses without A levels in chemistry and maths. Many believe that a motivated and committed student will overcome deficiencies in the academic background. For example, Laura McRobb, a student at Westminster University studying Biomedical Sciences has entirely Arts based A levels but is enjoying the course and succeeding at Westminster. However, lack of chemistry is still the greatest predictor of failure at the end of the first year in Biological Sciences at Manchester University. The Newcastle study has shown that only 1 in 5 arriving without A level chemistry felt that their chemical knowledge was sufficient. Once again, universities are adapting to the change, providing catch-up courses and other support, but on a reactive rather than proactive basis.

## Assessment

Children are allowed to retake their exams at school. This culture is to be extended so that they can retake as often as they wish, and only "cash in" their grades when they are satisfied. Will this really be a realistic proposition, considering the time and cost implications? Wilf Hudson, from the Standards Unit, extols the virtues of the new system, and comments that he had to retake exams himself. When introduced it will also add to the "culture shock" of a university education, as normally at this level the first mark gained is carried through, and retakes only used to gain entrance to the next year rather than to better marks. Keith Elliott, admissions tutor at Manchester University, feels that students are poorly prepared for this change in culture. Participants also felt that the "bite size" nature of school exam questions led children to think in this way, rather than integrate and apply their knowledge.

## Widening participation or bums on seats?

Louise Archer (London Metropolitan University)[1] has gathered evidence that traditionally under-represented groups are still not going to university, despite recent initiatives. Results of discussion groups with over 200 young people from this background showed that they were not being approached in the right way, since financial and cultural risks of attending university were so much higher, and they lacked role models from their communities. There is very little possibility that any of these school children would even consider HE unless information is portrayed in a way they could trust, even though they recognise the advantages this bestowed. Government and other stakeholders need to rethink their strategies if the aim is to widen participation in addition to increasing numbers.

## The practical issue

Pauline Lowrie asserts (echoed by teachers around the room) that coursework requirements mean that the pupils realised they were being made to "jump through hoops" and resented what they regarded as boring practicals. Further evidence from the Planet Science survey showed that most students want to do more practicals, but these should be more interesting and challenging. Research commissioned by the Wellcome Trust shows that students' experience of school based science practicals is actually very varied, but that teachers feel close assessment of practicals imposes unnecessary rigidity. Save British Science have produced evidence from the Deans of Science in UK universities showing that that fewer than 50% of their students arrive with the necessary practical skills and are graduating with poorer practical skills.

## Links between schools and universities

There must be a benefit to all parties of increasing links between schools and

universities. Local schemes and networks grow rapidly. Peter Robinson who runs Biology4all.com, a website for school and university teachers which incorporates an on-line discussion list and speaker database, speaks enthusiastically about the benefits of this communication forum. The site, which is private and free, enables university academics and school teachers to swap information, learn from each other and set up school talks quickly and easily. Other schemes, such as Researchers in Residence, are spoken of warmly.

## The way forward

The newly formed Biosciences Federation has recently held a meeting to address the above points, and they have declared their intention to make this an annual event. Specific suggestions from their first meeting include:

Building on current networks and links, developing simple methods of two-way contact between schools and universities. This is one of the aims of the Education Committee of The Biosciences Federation.

School biology practicals and coursework need to be overhauled, to present more interesting and stimulating material. Replacement of practicals with IT based alternatives should be discouraged at all levels.

In order to widen participation in HE, marketing campaigns need to target under-represented groups with a greater understanding of their particular problems.

Information should be shared between universities on methods of supporting undergraduates on arrival.

The Government, schools, HE Institutions and learned societies need to work more closely together to provide careers advice.

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*References:*
*Individual references are available on the Biosciences Federation website, www.bsf.ac.uk.*
*1. Archer, L, Hutchings, M & Ross, A (2003) Higher Education and Social Class: Issues of exclusion and inclusion (London, RoutledgeFalmer)*