

Science Education for the 21st Century

Your correspondent Dave Smith (*EiS* April 2002, p32) has expressed some concerns about the plans we have for a new GCSE to be piloted in September 2003 (*EiS* September 2001). I hope that the following points may help to address these concerns.

The GCSE Science pilot project has an evolutionary nature. Originally based on proposals for curriculum renewal from ASE, Nuffield and others, the GCSE is being developed in conjunction with a wide range of interest groups. Volunteer centres will be invited to participate in the pilot phase.

The proposed changes do have some implications. However, a carefully constructed and evaluated pilot will help ensure that these are positive and gain widespread support. That support will depend primarily on teachers recognising the potential for new qualifications to satisfy the educational needs of their students, better than existing ones. What those needs are has been expressed in general terms, in the Green Paper *14 - 19 extending opportunities, raising standards*. They include the needs for:

- students' personal development, especially preparation for adult life in society and the world of work;
- clear progression routes for students aged 14 to 19 and beyond; and
- greater choice for students, which requires better careers advice and more flexibility in the curriculum offered by schools and colleges.

The new science pilot aims to contribute to these requirements by providing:

- a motivating single GCSE course designed for all students to develop their scientific capability as future citizens, whether or not they specialise in science;
- high quality additional GCSE science for those who wish to continue within either more academic or more applied routes to further and higher education; and
- a more distinctive set of options to choose from with these routes than

those currently available which consists of one, two or three GCSE doses of similar science courses.

The changes that we are planning to introduce have been developed by those with pedagogical, scientific and assessment expertise. We hope that a successful and carefully controlled pilot can demonstrate the relevance and attractiveness of the new GCSE. This is not an approach that seeks to impose unwanted change.

Martin Hollins

Principal Subject Officer, Science Qualifications and Curriculum Authority

I am writing in response to the letters in *EiS* April 2002 because they seem to be expressing the concerns that I have had about science at key stage 4 and I would like to contribute to the debate.

I stated teaching science in 1970 and have recently retired. I have worked in a number of different schools and was, for a few years, a head of science in an 11 - 16 comprehensive school. My degree was in physics.

I will focus on the 14 - 16 year group because I feel that, although some students do not like science at key stage 3, in my experience the dissatisfaction becomes much more pronounced at key stage 4. My response is inevitably mainly a personal account.

In my early years of teaching, before 'science for all', my CSE/GCE groups for physics were those students who had chosen to do the subject. They were usually groups of less than 25 and mainly boys. Most of the students were well motivated and usually had clear ideas about why they were doing the subject. The boys often had some form of engineering career in mind, the girls needed physics for medicine. I know this is an over-simplification!

I welcomed 'science for all', but I had not thought through the implications for my teaching. My first group, a top set, 30 in number and 50% girls, were a lovely group of well motivated students. In this group were the 'physicists' who, as always, understood the topic under discussion very quickly and were asking searching questions about the implications. In

meeting their needs I was neglecting those students who needed much more help in understanding the topic. A group of students (girls!) complained that I was always answering the questions of the keen boys and they did not understand what the discussion was about. So I changed, I spent more time explaining to those who had difficulties and less time with the potential A-level students. They did 'extension work' by going to the library, but I always felt that I no longer had time for the exchange of ideas that they really wanted. Did 'science for all' increase the number girls doing A level which was, I think, one of the intentions?

For me the National Curriculum made things more difficult. 'Why are we doing this stuff?' became a question that I was finding more and more difficult to answer. In 1996 Robin Millar wrote *Towards a Science Curriculum for a Public Understanding* (SSR, vol.77, no.280, pp7-18) and this article clearly expressed all the doubts I had had about the science that I was teaching. I decided to teach part time and do an M.Phil. at Exeter University to try to find out students' views on why they were doing science. I used both a questionnaire and interviews with students aged 14 - 16. My work was completed in 1998 and among the conclusions I found that:

- Students felt that one of the most important reasons for doing science was because it could be needed for a possible future career.
- Biology was seen as the most important of the sciences for increasing scientific knowledge and for making sense of the world.
- Most students seemed unaware of the importance of the wider aspects of science education, e.g. understanding the role that science has played in our understanding of the world, the ability to communicate with professional scientists and knowing when the claims of scientists should be questioned.

I feel that improving scientific literacy should be a vital part of 'science for all'. Unfortunately, the GCSE syllabuses stress learning scientific facts for exams and the coursework has become a limited number of set experiments which can fulfil the criteria in the mark scheme.

Am I being too negative? The need to maintain/improve exam results is a driving force in most schools and if

the syllabus does not provide imaginative ways of engaging students with science, then dull science will result. For example, why does all the coursework have to be practical work? Couldn't students do some research on a current issue or on something that interests them? My bottom set in science last year, never the most enthusiastic of students when it came to many of the topics on the syllabus, became a totally different group when we discussed the foot and mouth crisis which was hitting our local farms at the time. I did not have the courage to abandon the syllabus and coursework on rates of reaction, and instead research the causes of foot and mouth and its effect on rural life. How would I have marked this coursework according to the rigid guidelines given in my syllabus?

If I were still teaching, my plea would be for a more flexible syllabus at key stage 4, which allowed teachers to provide students with a more individualised learning scheme which met their needs more closely. From discussion with students in my research project, I gained an impression that they were overwhelmed by the number of topics and the amount to be learned. They seemed to feel that insufficient time was devoted to parts that they liked and they were having to learn things that they found uninteresting. The physical sciences fared badly.

In 1988 D. P. Newton wrote: *'Given a choice, many may not have chosen to do science at all, so the teacher may be faced with a lack of interest and negative attitudes. Science will be taught to all, regardless of ability and inclination. It is an unavoidable part of every child's life, so it is important that it is both a worthwhile activity and that it is seen to be worthwhile. That means the relevance of what is taught needs to be clear.'* (Making Science Education Relevant. London: Kogan Page pp29-30) Newton's warning of 1988 does not seem to have been heeded.

I was relieved to read in Daniel Sandford Smith's letter that he had also questioned his ability to make physics stimulating for his students. It is very easy to blame oneself when sometimes there are factors involved which are beyond one's control. My suggestions for changes are:

- Teachers need a small core curriculum that is taught to all students. This should free up 'science time', so that students can be given work which is appropriate and interests them.
- Coursework needs to be reviewed, preferably by discussion with teachers. Why do many teachers choose: rate of photosynthesis, rates of reaction and resistance of wires? Does all coursework have to involve practical work?

Mari Galvin
Bideford, Devon

NOTES & NEWS

Golden Anniversary in the Golden State

ASE Chair, Ian Galloway, reports on the 50th Anniversary meeting of the NSTA

Eight hours behind and one third the way round the globe, San Diego sits on the Pacific Coast and the Mexican Border. Ten past Chairs of ASE, along with myself and several members of Headquarters staff, converged from different parts of the UK for the biggest gathering of past Chairs and Presidents in the two associations' histories.

Approximately 15,000 delegates attended the annual convention of the National Science Teachers' Association, at the largest convention centre on the west coast of the USA. Anne Goldsworthy delivered the Honours Exchange Lecture on Getting to Grips with Graphs to a terrific reception from the audience of more than a hundred, and every book taken over by Headquarters staff was sold. Nobel Laureates abounded, while the district in and around San Diego was rich with scientific interest.

I attended a session on the Maths Science Strategy being launched by the Federal Government and discovered a strong resistance from teachers to national testing, a requirement if districts are to secure funding for their strategy. No surprise there, but it was interesting to find the same tensions in the States, as here, between maths and science. I also made the mistake of visiting Tijuana, only to find that getting back across the border was much more difficult!

I have brought back fantastic memories from Arizona and some valuable insights into the way Americans conduct their business. If there are colleagues out there who have had experience of, or have strong views on, the American educational system I would be glad to hear from them, e-mail: ian@gallowayhome.freeseve.co.uk

Earth Science Teachers' Association conference

The 2002 ESTA Conference will be held at the headquarters of the British Geological Survey at Keyworth, Nottingham, from Friday, 13th to Sunday, 15th September.

The meeting will be at the home of British geology, with its state of the art equipment, well stocked library, and the amazing Core Store. Delegates will take advantage of the location, to be brought up-to-date with current developments, and to use the facilities and staff to the full. In addition to viewing the 'normal' exhibitions, participants will be able to shop at the superb BGS sales point.

Residential accommodation will be at Sherwood Hall, part of the University of Nottingham, which is about 15 minutes drive away.

The programme

- Friday, 13th September
INSET for local teachers and ESTA members. INSET for teachers of pupils at key stages 1 to 4 is aimed at improving the teaching of the earth science component of the National Science Curriculum. There will be four sessions covering key stages 1/2, key stages 3/4, post-16 and higher education.
- Saturday, 14th September
There will be a choice of talks and workshops, as well as the AGM and Open Forum for ESTA members.
- Sunday morning, 15th September
This morning will involve fieldwork, with a choice of visits including Bardon Hill Quarry, Curbar Edge and The National Stone Centre.

Attendance is open to all with an interest in earth science education, on a day visit, or a residential basis. Details and booking forms are obtainable from Dr David Bailey, British Geological Survey, Keyworth, Nottinghamshire NG12 5GG.

ASE Area Meetings

- **South West Area Meeting** 28th June, University of the West of England, Bristol.
- **Northern Area Meeting** 28th - 29th June, Minsthorpe Community College, near Pontefract.
- **Southern Area Meeting** 5th July, University of Surrey.
- **Midlands Area Meeting and National Technicians' Conference** 5th July, University of Leicester.
- **Anglia Area Meeting** 28th September, University of Reading.