Getting a taste for the many flavours of science

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In a recent issue of *Education in Science*, Martin Monk wrote about the place that a historical approach to science might have in the new GCSEs (Monk, 2004). I agree with him that the history of science has a lot to tell us about the nature of scientific discovery and the concepts which we expect pupils to tackle. His appeal for a *'liberated pluralism'* set me thinking about the many different approaches to science which we could use in teaching 14–16 year-olds.

The National Curriculum spells out the **content** which must be taught – the hierarchy of increasingly complex and interlocking ideas about physics, chemistry and biology. It also deals with **how science works** – through experimentation and all the other processes. However, I am not thinking of these.

I am thinking about the different '**flavours**' which science comes in; history is just one of these. What follows is a list of the other flavours which I have identified. They may well overlap one another, and you may be able to think up more. My idea is that different parts of the curriculum should be taught with different flavours, and that this can help to broaden the appeal of science. This would ensure that different students encounter an approach that they enjoy from time to time. Here is the list.

Technological

Science can be taught through its applications – see the various Salters' projects, which have proved highly motivating for many students. We 'do science' because we want to understand the natural world, but we also do science because we want to develop devices and processes which are useful. The Wright brothers did not study the forces produced by the flow of air over aerofoils because they felt it was intrinsically interesting – they wanted to fly! If you start on the topic of genetics with a GCSE class, they want to know the latest about cloning. A technological approach seems to make sense to many students.

Vocational

Take a look at the work of practising scientists, technicians and engineers. The next generation are in our school labs now. Bringing teachers and practising scientists closer together is one of the emphases of the new Science Learning Centres. Look out for existing publications and schemes, such as the Acclaim project and Researchers in Residence, both from Sheffield Hallam University. *Catalyst*, the GCSE Science Review, regularly includes articles by and about practising scientists (www.philipallan.co.uk)
For a discussion of applied and vocational approaches, see Ken Gadd's article in the June 2004 issue of *School Science Review.*

Historical

We can understand some ideas better by looking at how they were developed. We can also see how science is controversial – and there is a lot of fun to be had from learning about some of the wackier ideas of the past. All teachers are actors – why not take on a role? For example, the diaries of Henri Becquerel spell out exactly the sequence of his experiments and the development of his ideas which led him to discover radioactivity. It is not difficult to act this out as an introduction to the topic – see *Henri Becquerel and the Discovery of Radioactivity* (please contact ASE Booksales for availability).

Personal

Bodies, minds, relationships – teenagers spend more time thinking about themselves and their peers than anything else. They like to see scientific ideas in terms of the impact they may have on themselves – perhaps we all do. Piercings and tattoos – what do they do to your skin? Alcohol and other drugs – how do they affect your nervous system? These can be starting points, rather than something tacked on to the end of a discussion of cells and tissues.

Futuristic

We take the present for granted, but the future is where we will all live. What will it be like? Here is a chance to use ideas from science fiction and the realms of fantasy. Students might feel it was worthwhile studying gravity and the solar system if it helped you to assess the practicality of setting up new colonies of human beings on other planets. The recent film *The Day after Tomorrow* is an excellent place to start discussing the

impact of our current use of energy on the climate of tomorrow. (See www.climateprediction.net for linked teaching resources.)

Multidisciplinary

Science is not easily divided into physics, chemistry and biology (but it helps the timetable if that is how we approach it). Many of today's biggest developments are happening where these traditional disciplines overlap. Take a look at the Royal Society's Summer Exhibition (online at www.sc1.ac.uk/discover/exhibition2004.cfm) and see how difficult it is to categorise the forefront of science under the traditional headings. Let's break out!

Mathematical

The mathematical content of science seems to have almost disappeared, and yet so much of maths was invented to solve scientific and technological problems. Many pupils find GCSE maths abstract and irrelevant. For those students who like it, let us find topics which lend themselves to numbers, equations and formulae, without being apologetic about it. There are many parts of physics which can be summarised in equations; for example, to recall Newton's Second Law of Motion, most physicists probably say to themselves, '$F = ma$', rather than trying to recall some archaic formulation in words. Maths is the language of much of science; it is concise and precise, and it cuts through to the heart of the subject.

Investigative

Science proceeds through enquiry, so it would be good to tackle some topics entirely through an investigative approach. One problem with this is that an investigative approach can take more time. It is quicker to present students with a digested version of science, although this misses out the 'how do we know?' aspect. When the new GCSEs come along in 2006, there should be more scope for investigative approaches, with the possibility of a slimmed-down content and more credit for internally-assessed work.

Social

This goes to an extent with 'personal'. Pupils care about what goes on in the world, and increasingly science gets the blame for problems. They can enjoy looking at the social impact of science, weighing up the problems, considering the implications – in QCA-speak, that is benefits, drawbacks and risks. The 21st Century Science pilot materials show the way on this (www.21stcenturyscience.org).

Conventional

Pupils do not always want to be tangling with the development of ideas. Sometimes, they just want to know what established science says. For example, they might learn standard laboratory techniques – after all, that is what scientists spend a lot of their time doing. Ask any MSc student.

ICTish

Some topics lend themselves to being taught through the use of ICT, for animations, simulations, computer-based tasks and so on – very motivating for the Playstation generation. Most schools have a copy of *Multimedia Science School* (PLATO Learning). These tools (and many other similar products) come with materials to guide pupils through a particular topic. The developers have learned a lot from computer games, and there are ample opportunities for pupils to be set free to explore a topic at their own pace and in their own way.

Arty

How about some science through drama, or with a story or video as an end-product? As a pupil, I think I was partly attracted to science because it was not arty. The content seemed well-defined, and I always knew what was right. But there are many students who are not like that, and there are many aspects of science where the answers are not clear-cut. Take a look at the materials produced during Science Year for Science and Citizenship (www.sycd.co.uk/can_we_should_we/everywhere/citizenship.htm) to find some approaches through drama.

Psychological

Learning science is about changing your own ideas. What better than to spend some time discovering how science can tell us about this amazing process? Show your students a few simple optical illusions as a way of introducing a discussion on the nature of scientific observation. Might we be misled by what we think we see? Does what we already think influence what we observe?

Magical

Science is not really common-sensical. It only appears that way after it has been in your head for a while. Science is often challenging and counter-intuitive, and that can arouse students' interest, as well as showing them an important aspect of the subject.

That's my list of flavours so far. If you can think of more, please pencil them in at the end – and use them in your teaching!

I'm not suggesting that we want single-flavour GCSEs. What I would like to see is syllabuses and schemes of assessment that recognise that science has all of these flavours, and more. Our students' experience today is too often one of a route march through a sequence of topics. No sooner have they dealt with one concept than another one comes along. There is no time to reflect on or apply new learning, and each new topic is dealt with in much the same way.

That may be a bit of a caricature, but it is clear that the last decade has seen a narrowing of teaching styles. We have lost a lot of what was good – the ASE's SATIS projects, for example. The 21st Century Science pilot materials have made a noble attempt to reinstate much of this.

It is not clear to me that students are in a position to choose for themselves which approach is appropriate to themselves, be it applied, historical or whatever. The choice would probably end up with teachers – and if they teach with an approach that they themselves find exciting, that's no bad thing. But I would prefer to see GCSE courses where different topics were taught with different flavours, and where the content was chosen, not because it is the same old reliable stuff, or because it is easy to assess, but because it allows us to show off all the flavours of science.

References

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