What's in high school science and who's teaching it?
Joe Wolfe, Sydney Morning Herald, 22/4/05 p13 (minor changes were made by the editor)

Last year Queensland's Chief Scientist, Professor Peter Andrews, was quoted as saying that Australia would require by 2010 an extra 75,000 PhD level graduates in science for Australia to maintain and grow its international competitiveness. That's how many more scientists we'd need for Australia to get its fair share of booming knowledge-based industries.

However, the teaching of soft versions of science in our high schools, often by teachers who themselves have little training in the discipline they teach, does not bode well for the clever country.

High school science syllabi try to satisfy two different needs. In contemporary society, a large fraction of students needs to know *about science*: its history, its achievements and its limitations. A small subset, an elite group who will go on to careers in science, technology, engineering are other science-based professions, needs to know *how to do science*. These are different goals and must be taught in different ways.

Recent major revisions to high school science syllabi, especially in New South Wales, have concentrated much more on their human side, on science history and social context. For example, the first stated objective of the HSC Physics syllabus is that students will develop knowledge and understanding of the history of physics.

Many students find success in these new subjects because they find it easy to remember facts and write short essays about social and historical aspects. What they don't find easy is quantitative analysis of situations in the world.

For some teachers, the new subjects may be easier to teach. This is an important pressure on syllabi in physics and chemistry because of the shortage of well-trained science teachers, especially in physics and chemistry. Many more scientists graduate in biology than in other experimental sciences. A high school science teacher with no or little university training in physics or chemistry may find him/herself teaching in those areas.

Pressures including these have produced the new syllabi. There is, of course, a down side. The heads of the physics schools at 18 of Australia's most prestigious universities issued a press release decrying Australian high school syllabi. According to John Storey (then head of Physics at UNSW), the New South Wales HSC Physics is an "interesting subject—but it's not physics". Brian James, head of physics at Sydney University, blamed the same syllabus for giving students "less depth of understanding".

Nevertheless, the new syllabi have defenders. Ross McPhedran, also of Sydney University, has said that understanding physics is about more than high-level mathematics. "There's a narrow view that if you can't write the equation then you haven't understood; but if you can read about it on the internet and explain it to your girlfriend and father then you have understood."

Two quotes sum it up. The father of a HSC Physics student wrote, after seeing the exam: "Now I understand why my son – whose natural strengths are in the arts and humanities and not in science – did so well in HSC Physics (indeed it was his top mark): because he is very good at rote learning and social science!" The next is from a first year student, who had come with his father to talk to his lecturer about his problems with physics: "But I used to be so good at physics at high school. I never dreamed that it would have all this maths in it. I hate maths."

The new syllabi will not help schools to obtain well-qualified teachers in physics and chemistry. Market forces are part of the problem: relatively few science students graduate with a major in these disciplines, and only a tiny fraction of those become teachers. Apparently the combination of salary, working conditions and job satisfaction doesn't compete with other opportunities.

Heads of school science departments prefer that teachers have a degree with a major in the relevant discipline. One solution would be to offer undergraduate scholarships, like the teacher training scholarships of the seventies, that would oblige recipients to work as teachers on graduating, or else pay back the scholarship.

The new, softer syllabi do not serve Australia well. Students who are good at remembering may like them, but what of those students who are really talented at analytical thought? The ones who would easily learn how to take a problem in the world, to translate it into physical parameters, to solve the mathematics, then to take the answer back to the physical world? Engineering, various technologies, physical sciences and increasingly biomedical sciences need such students, and Australia needs good engineers and scientists. These students need subjects that will let them discover and use their talents.

One solution would be to combine elements of the existing HSC science syllabi in a single science studies subject, aimed at a large majority of students, and to introduce new subjects teaching biology, chemistry and physics to the future technologists, engineers, scientists - and science teachers.

Joe Wolfe is a professor of physics at the University of New South Wales, author of the FAQ in High School Physics and moderator of the High School Physics Bulletin Board. www.phys.unsw.edu.au/hsc/