A lack of chemistry

The figures are disputed but there is a worrying downward trend in science enrolments in senior years. **Darragh O Keeffe** speaks to experts about causes and solutions, and to the Chief Scientist as he prepares advice for government.

Just as the country was quietly winding down for the Christmas break, the long-running discussion about declining enrolments in science in the senior years took an interesting turn.

The Australian Academy of Science released a report which claimed that year 12 science enrolments had fallen from 94 per cent in 1992 to just under half last year. Before long, attention quickly turned to the numbers quoted in the report.

It subsequently became apparent that the data had been miscalculated, because of a break in the series of student numbers. The total number of students studying science in 1992 had been overstated, experts suggest by about 20 per cent.

While unfortunate, the episode did, however, bring fresh public attention to the issue. Long-time experts and researchers in the field say that whatever set of student numbers is examined, the trend in science enrolments is the same – downwards.

Rather than focusing on the total number of students studying science, as the academy attempted to do, it is best to look at trends within individual subjects, says Dr John Ainley, principal research fellow at the Australian Council of Educational Research (ACER).

Ainley, who authored a report on participation in science, maths and technology for DEEWR in 2008, says that the enrolment trends in biology, chemistry, physics, psychology and geology have all been in decline since before the late 1980s. This has "flattened out" somewhat since 2002, he adds.

"The decline has been greater in some areas than others; it has been greater in biology and in physics and less so in chemistry. But generally the pattern is the same," he told *Education Review*.

A fellow expert in the field, Dr Terry Lyons of the University of New England, echoes this. He points to Ainley's figures from 2008, as well as his own reading of DEEWR data since then. "The most recent figures confirm that all three sciences are on the way down," he says. Lyons also refers to one of his PhD students, John Kennedy, who is currently conducting an analysis of the trends in physics.

Kennedy's analysis shows that physics is in dire straits, with enrolments falling from about 21 per cent of year 12 candidates in 1992 to about 14 per cent in 2010. Lyons says the 2011 data he has looked at continues the trend, with NSW and Victoria recording their lowest ever physics enrolments as a percentage of year 12 cohorts – 13.1 per cent in NSW and 13.8 per cent in Victoria.

Lyons points out that nationally this represents a loss of more than 10,000 physics students during a period when overall year 12 enrolments increased by about 20,000. [Read more on John Kennedy's Australian Physics Enrolment project at http://physics.simple-url.com.]

Lyons estimates that the proportion of science students overall has dropped from about 70 per cent in the early 1990s to just 50 per cent today. "So the [academy] report is probably correct in claiming we have only half of our senior students taking science. Are we happy with a citizenry in Australia of which half didn't do science beyond year 10?" he asks.

Lyons has been researching enrolments in science since his PhD in 1998. He admits he is disappointed that the trends haven't been reversed during that time.

"It's a surprise to me because the language of crisis that we've been hearing over the last few weeks, due to [the academy] report, isn't new and it's sort of a periodic thing; it's always been in the back of people's minds. Between 2005 and 2007 the statistics seemed to be stabilising and people thought that with all of our combined efforts, initiatives and interventions, we had finally managed to reverse or stabilise these falls. But the statistics that I've looked at show it's still on the way down."

Lyons and fellow UNE academic Frances Quinn released a report on this issue, *Choosing Science*, based on a survey of 589 science teachers and 3759 students. Interestingly, while enrolments in science have trended downwards during the past 30 years, it seems student attitudes towards science have not – at least not sufficiently enough to warrant such change in behaviour.

"Frances Quinn and I fully expected to see a decline [in attitudes] and we thought our key finding would be that the decline in attitudes would parallel the decline in enrolments – but we didn't find that, not in any meaningful way," says Lyons.

Another interesting finding was that the fall in science mirrors that of some other subjects. In other words, science is not alone in experiencing downward trends.

"Like many people I was mesmerised by the falls in science and hadn't looked at what was happening in other subjects ... To find that subjects such as economics, geography, modern history and advanced maths had even steeper declines, in some cases, than physics, chemistry and biology was a revelation," says Lyons.

Which gives rise to a broader point – one observers increasingly point to as a cause of the decline in science studies; a busier curriculum in the senior years with greater choice of subjects which, in some cases, students feel relate more to their lives.

"Anecdotally a lot of teachers say students are choosing easier subjects, or choosing from a broader range of subjects. When we asked that question of teachers in the *Choosing Science* study it was cited by them as one of the most influential factors," says Lyons.

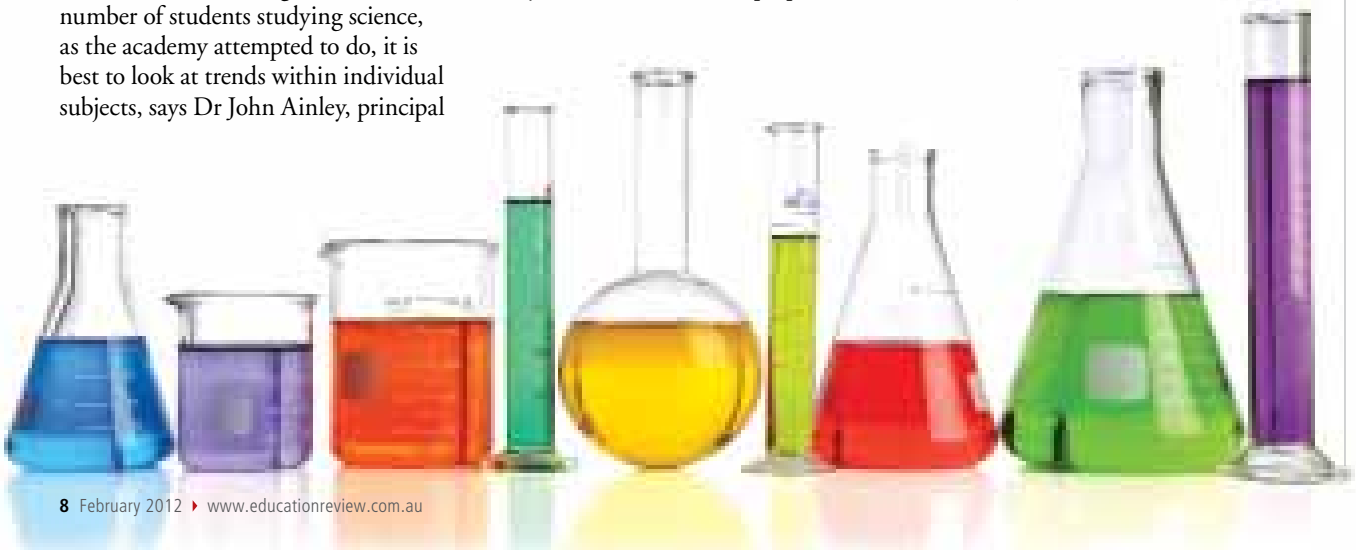
Ainley echoes this. "One of the things that has happened, from the early 2000s, has been the growth of year 12 subjects," he says. "The growth of courses in year 12 that are not necessarily intended as a precursor of tertiary students."

Unsurprisingly then, Ainley says that any strategy to reverse the downward trend in science enrolments must include attempts to make the content more interesting and engaging. "It's about developing kids' interest, seeing what's done in science as being of value to them, of relating to the world that they interact in everyday."

Australia's Chief Scientist, Professor Ian Chubb, agrees.

He is currently preparing advice for the Prime Minister on how to boost student enrolments in science and maths in the senior years. He says that student interest and engagement has featured strongly in the feedback he's getting.

"How it's delivered, we're being told that that's quite important. If you look at student surveys, and there was a large piece of work done on biology teaching at university in the US and



it said the same thing, it's not taught in an interesting way, not taught with relevance to us. The feedback we get is that you have to engage them, keep them engaged, and the best way to do that is to show the relevance of it to their lives," says Chubb.

He was asked to prepare his advice last year when the government decided to remove the HECS discount for students studying science and maths at unviersity. He is due to report back at the end of the month.

Speaking to Chubb it becomes apparent that while schools will undoubtedly play a key role in his plan, the issue is more than just student enrolments, it's a societal one; a matter of national importance.

"Somewhere around 50 per cent of students in year 12 currently take science; then the real question is how much more than that should it be, and what are the benefits from that even if they don't go on further to do science? Well, one of the issues I'm particularly interested in is increasing the level of understanding of science in the community at large."

Chubb agrees with the proposition put to him that this was most recently evidenced during the public debate about climate change.

"Exactly. People being uncomfortable, or being made to feel uncomfortable, or being made to doubt information, when in fact if they had done enough to get an understanding of science, its processes, methods, probabilities, it would increase the level of understanding. It would be really desirable to have citizens in a position where they could make relatively informed judgments," he says.

The other feedback making its way to Chubb centres around support for teachers in the classroom and their preparation for science teaching.

"Now, what recommendations we turn that feedback into I couldn't tell you, but I can say that nearly everybody talks about how we support our teachers and how we should be doing that particularly well. And increase that comfort level in being able to teach science and to attract more people to it," he says.

Teacher support leads to teacher confidence, which would address the issue of student interest and engagement, he argues.

"There's an issue that relates to how interesting you can make it, and I suppose the more comfortable you are with the subject matter the more likely you are to be comfortable making it a bit more interesting and exploring the boundaries rather than sitting in the core."

Chubb says that international research, which includes a review of Australian literature, shows science experiences a drop along the continuum from primary to secondary. "In primary you get visits from scientists and are shown things and it's whizz bang. Then you go into first year of secondary school and suddenly the brakes are on, it becomes more didactic and less interesting."

The idea of the continuum is also raised in Lyons' most recent research. His findings from the year 10 student surveys went some way to countering the commonly held view that the primary years are the most important grounding for students' future attitudes to science.

"Targeted intervention is very important from a policy point of view," says Lyons. "From our results, overwhelmingly students say they most enjoyed science in the last two years [Years 9 and 10] and they were more influenced in their decisions about taking science [in senior years] by their experiences in the last two years. That really surprised us," he says.

One of Lyons' recommendations is that the new national science curriculum should strive to address the issues with student interest and engagement. "I would like to see science as a human endeavour – anything that talks about the applicability of the content and the relevance of that to students personally and to society – as something that needs to be emphasised. I would hate to see that relegated to a secondary objective," he says.

Chubb also sees natural synergies between his own impending advice to government and the broader schools education agenda – including not just the national curriculum but also the focus on professional development and standards.

"There's a coming together of issues that create an opportunity that probably hasn't existed in quite the same way for a long time now. Quite how we try to stitch them together won't be up to me. But some of the things we ultimately recommend will doubtless require further work to turn the threads into a fabric," he says. n

Follow *Education Review*'s weekly online news for updates on Chubb's advice to government and any subsequent action. *Choosing Science* by Terry Lyons and Frances Quinn is available to read online at: www.une.edu.au/simerr/pages/projects/131choosingscience.php

Science of attraction

Terry Lyons' report, and several others, discussed the importance of school–industry–university collaborations in the effort to boost student interest and engagement in science.

There are countless such initiatives happening at various levels across the country, one of which is the Monash Science Centre.

Established by Professor Patricia Vickers-Rich in 1993, the centre is modelled on the Lawrence Hall of Science at the University of California, Berkeley, which provides a forum for students to meet and interact with scientists, researchers and academics.

While the academics behind the program describe it as a small department, which lives on a small budget and the kindness of volunteers, it manages to provide an impressive range of on-site programs and outreach initiatives.

The newest is its Lab Rats program, a monthly club which allows students to gain hands-on experience working with Monash University scientists.

Sandra Thong, education officer at the centre, says the Lab Rats club was born out of the centre's other major schools initiative, its school holiday program.

"We have a very successful school holiday program which we run four times a year. A lot of parents were saying they needed something else, something ongoing where their child could be challenged. We were lucky to get funding from CETEC as well as Monash to get the Lab Rats program running," Thong told *Education Review*.

As well as encouraging the children's interaction with scientists, the club also enables them to mix with like-minded peers. "Part of it is giving these children who are already engaged [in science] a chance to socialise with children who have similar interests ... maintaining their interest and seeing validity in it from their peers' point of view," says Thong.

The program consists of two groups (years 5–6 and 7–8) of 25 children. They meet monthly for an hour and a half, each session focusing on a theme set by the Monash academic. The students keep a journal throughout the year and present work and projects to the group regularly.

The school holiday program, on the other hand, is the centre's way of "engaging those not yet converted", says Thong.

In terms of outreach, the academics also visit primary schools where they provide workshops; creating positive experiences for both students and teachers. This is backed up with ongoing teacher support. "We provide a packet of resources including worksheets they can use, links across other areas of curriculum, background information for the teacher," says Thong.

For schools out of reach, the centre provides a "science box" which contains equipment related to a range of experiments, a manual with step-by-step instructions for the teacher, and discussion outcome guidelines. n

For more on the Monash Science Centre see http://sciencecentre.monash.edu/

Engaging students at the Monash Science Centre