Arresting the decline in senior school chemistry (Note †)

Enrolments in Australian Year 11 and year 12 chemistry are declining. In 1992, 23% of Australian year 12 students studied chemistry, decreasing to 18% in 2010. For science as a whole, the decrease is even more dramatic, from 94% to 51%. The decrease is slowing, but is continuing.

Year 12 Science participation (%)

	1992	2010
Biology	35.2	24.7
Chemistry	22.6	18.0
Physics	20.9	14.6
All Sciences	94.11	51.42

These are just some of the data in *The Status and Quality of Year 11 and 12 Science in Australian Schools*,[2] released by the Academy of Science, just days before Christmas 2011. Some of the report's findings are summarised in this month's column. The full publication is available from <http://www.science.org.au/publications/documents/Year11and12Report_Final.pdf>.

Learning outcomes in junior school science are generally good. The triennial *Programme for International Student Achievement* (PISA) assesses the reading, mathematical and scientific literacy skills of 15-year-old (mainly Year 10) students. Australia's performance in scientific literacy has remained unchanged from 2000 to 2009, but our ranking has decreased slightly. The number of countries that performed significantly better than Australia has increased from two in 2000 (Korea and Japan), to six in 2009 (China, Finland, Hong Kong, Singapore, Japan and Korea). The *Trends in International Mathematics and Science Study* (TIMSS) assesses the mathematical and science performance of Year 4 and Year 8 students. Compared to an international average score of 500, Australia's year 8 score has decreased from 527 in 2003 to 515 in 2007.

> "The disturbing trend is that while some other countries are improving their science achievement scores, as in the case of PISA, Australia's scores remain static and in the case of TIMSS the results for Year 8 have actually fallen."[2]

The majority of secondary science teachers have university studies in the biological sciences, but years 11 and 12 chemistry teachers are generally well qualified and well experienced. A 2008 Australian Council of Educational Research (ACER) survey[3] indicates that 95% of senior chemistry teachers have at least one year of chemistry tertiary education and 73% with three years or more of chemistry tertiary education. At least 70% have received training in the teaching of chemistry and have been teaching for more than five years. There is concern about the shortage of qualified science teachers in junior secondary science, but this overall shortage of chemistry teachers is not yet apparent in senior classrooms, perhaps as a result of the declining numbers of chemistry students.

It is the decline in student numbers that is most alarming, with students choosing senior science mainly to get into their desired university course or occupation, with few studying science because they enjoy it.

> "Non-science students report that senior secondary science is hard, boring and involves lots of formulas and equations. They are not interested in science related careers and, therefore,

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do not see the value of including science in their subject selection. Many students report that school teachers counsel against choosing science unless they are 'really good at it' or require it as a prerequisite subject."[2]

The report finds that there is too much content in all senior science courses. Teachers feel a heavy responsibility to assist students to optimise university entrance rankings, which inhibits them from exploring some topics in greater depth to cater for student interest or to engage students. Consequently, senior science is is characterised by teacher-centred activities such as listening to the teacher and taking notes from the whiteboard or PowerPoint slides. 73% of science students indicated that they spend every lesson copying notes from the teacher. There are far fewer student-centred hands-on investigations in senior science than in junior science, yet students perceive that their experiences in years 11 and 12 are more representative of the actual practice of science.

How should we respond to the report? Firstly, we should realise that it is not all gloom and doom. For example, the new Australian Curriculum offers an opportunity to renew the senior chemistry curriculum in particular and the F-10 science curriculum in general. Secondly, we can all profess our discipline and profession. Here are some ideas, which only require a small time commitment, as little as a couple of hours per year.

- Visit a local school. This might be for the annual careers information session, or an incursion to a junior classroom. Remember that the decision to study senior science is usually made in earlier years.
- Have a talk to the school careers advisor; many advisors lack a science background. Information from chemistry-educated professionals in less traditional careers such as merchant banking, journalism and local government, is just as valuable as from those in the more traditional careers.
- Offer an after-school-hours professional development session for science teachers, to share information about the latest developments in your area.
- Give a presentation to the local service organisation, such as Rotary or Lions. Informing parents and community leaders of the significance of chemistry is just as important as informing students. Your visit will encourage these organisations to continue their support of programs such as the National Youth Science Forum and the Siemens Science Experience.

Education is not solely the responsibility of curriculum authorities and teachers. Each RACI member can communicate, inform and generally educate the wider community about the excitement and value of chemical science. Just a couple of hours of your time is not a panacea, but it can still make long-lasting impacts and affect career choices: even the largest beach consists of tiny individual grains of sand.

1 K. F. Lim, "Arresting the decline in senior school chemistry", *Chem. Aust.,* 2012, **2012 (March)**, 40.

2 D. Goodrum, A. Druhan and J. Abbs, *The Status and Quality of Year 11 and 12 Science in Australian Schools*, Australian Academy of Science, Canberra, 2011 <http://www.science.org.au/publications/documents/Year11and12Report_Final.pdf%3E.

3 P. McKenzie, J. Kos, M. Walker and J. Hong, *Staff in Australia's Schools 2007*, Department of Education, Employment and Workplace Relations, Canberra, 2008 <http://www.dest.gov.au/sectors/school_education/publications_resources/profiles/sias2007.htm%3E.

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