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# Submission to the House of Representatives Standing Committee on Science and Innovation Review of the Department of Education, Science and Training's Annual Report 2002-2003: Encouraging Student Participation in the Enabling Sciences

## The University of Melbourne Faculty of Science and Careers and Employment

The Faculty of Science at the University of Melbourne continues to commit significant resources to the encouragement of student participation in the sciences at university, in particular in the enabling sciences of physics, chemistry and mathematics. This submission summarises some of the analyses, actions and recommendations of the Faculty arising from its recruitment activities through the Faculty's Science Communication and Marketing unit.

The Faculty has an ongoing partnership with the Careers and Employment unit of the University of Melbourne, and this submission also summarises joint programs and insights from the unit.

### 1 Factors affecting the quality and quantity of applicants for entry to University of Melbourne Bachelor of Science

#### 1.1 Declining Numbers of Suitably Prepared Year 12 Students

The Bachelor of Science at Melbourne is now virtually unique in Australia in being a broadly based science degree which requires a strong school background in science by maintaining pre-requisite subjects for admission. In contrast, other institutions have reduced their requirements to "assumed knowledge" (eg UNSW and the University of Sydney) or removed many science prerequisites (eg Monash University requires only English). All tertiary educators would prefer to ensure that first year students have an appropriately broad background in laboratory sciences and mathematics, but the dilution of the requirements has resulted from necessity – a reduction in the number of students undertaking the range of sciences and mathematics at secondary level as shown through the analysis of Victorian enrolments against the requirements of the University of Melbourne.

The Bachelor of Science course at Melbourne requires<sup>1</sup> applicants to have undertaken a combination of subjects at Year 12 Unit 3 and 4 level of the Victorian Certificate of Education (VCE) - Mathematical Methods plus two of Biology, Chemistry, Physics or Specialist Maths.<sup>2</sup> Data obtained from the Victorian Curriculum and Assessment Authority have allowed the trends in numbers of students undertaking combinations of subjects to be analysed, and in particular, the overall pool of students with a strong background in mathematics and sciences.

The number of VCE students undertaking the prerequisites for the Bachelor of Science dropped from 11,528 in 1994 to 9,054 in 2003 (Table 1), representing a decrease of 21.5% in the pool of eligible students. However, over this period, enrolments peaked at 11,927 in 1997, representing a decrease of 24.1% from 1997-2003.

Table 1 also shows the trend of entry level (Clearly-In-Rank ENTER) over the same time period.

Table 2 takes the same cohort and shows trends of students taking particular subjects within the overall cohort defined in Table 1. Within this cohort of students, the trends for subsets undertaking particular subjects for the period 1994-2003 are as follows:

Chemistry	26.8% decrease
Physics	17.5% decrease

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<sup>1</sup> Since 2003, the University has allowed students with a high ENTER to be eligible with Mathematical Methods and one laboratory science (Biology, Chemistry or Physics). This ENTER level was set at 96.00 in 2002, and reduced to 92.00 in 2004.

<sup>2</sup> Further Mathematics is also allowed, however, numbers of students studying the combinations are low and unnecessarily complicate this analysis.

Biology 37.3% decrease  
 Specialist Maths 1.3% decrease

Original data and graphs are given in Appendix 1.

*Table 1: Number of students undertaking specific subjects within the group of students undertaking a combination of Methods plus two of Biology, Chemistry, Physics, Specialist Maths*

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
No of students taking Maths Methods plus two of Biology, Chemistry, Physics or Specialist Maths	11528	11433	11689	11927	10967	10478	9584	9333	9061	9054
BSc Clearly-In-Rank ENTER <sup>3</sup> (Year -1)			83.75	86.45	86.45	82.60	75.20	78.15	80.00	81.00

*Table 2: Number of students undertaking specific subjects within the group of students undertaking a combination of Methods plus two of Biology, Chemistry, Physics, Specialist Maths*

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Chemistry	7106	6878	6812	6867	6269	6009	5566	5345	5236	5203
Physics	5394	5201	5307	5562	5079	5010	4606	4550	4438	4451
Biology	3186	3215	3121	3006	2894	2611	2372	2153	2036	1999
Specialist Maths	4432	4438	4867	5041	4742	4546	4224	4305	4277	4373

These analyses show that subject enrolments within the overall suite of subjects taken, were relatively constant from 1994-1997 but suffered significant decline from 1997-2002. Numbers appear to have settled since 2002, although numbers from 2004 have not yet been analysed to confirm this.

It is worth noting that between 2000 and 2003 the number of eligible VCE students rose from 44,950 to 48,180<sup>4</sup>

## 1.2 Poor Visibility of Career Pathways in Science

The factors causing the downward trend in the Clearly-In-Rank ENTER (or entry level) for the Bachelor of Science shown in Table 1 are difficult to isolate. In particular, since the cohort of students is different every year, it is impossible to identify students who would have chosen the Bachelor of Science had they been in Year 12 in previous years. However, it was noted anecdotally that during the period 1999-2001, there was a trend for students to feel the pressure (from peers, parents and their schools) to pursue a vocational course rather than their interest in science. Feedback from students indicated that they could not understand the career pathways or benefits from studying science. Indeed, many with intermediate scores (ENTER 85-95) considered a Bachelor of Commerce or other business degree to offer a stronger guarantee of a career pathway.

The general perception of lack of vocational outcomes from a science degree has led to increasing interest in combined degrees. These are believed to offer the flexibility to continue an interest in science whilst increasing perceived employability through the second degree undertaken. However, the proportion of students continuing from a combined degree program of 5 years into the Honours year and Higher Degrees is much lower than single Bachelor of Science students. Despite approximately equal numbers of single and combined science-degree students being

<sup>3</sup> The Equivalent National Tertiary Entrance Ranking (ENTER) was introduced in 2000. Conversion tables for the Tertiary Entrance Rankings (TER) used in 1997 and 1998 are available and have been used to allow comparison for these years.

<sup>4</sup> Data from the VCAA website for students "eligible to complete VCE". Figures prior to 2000 were not available at the time of writing this submission.

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accepted into the University of Melbourne, the relative proportion in Honours is 4:1 and is dominated by students who have taken the single science degree.

Both of these issues - vocational focus and interest in combined degrees - were reinforced by the fall in the Clearly-In-Rank ENTER which is viewed as an indicator of “market-value” and quality of a degree program.

The general perception of lack of career pathways and outcomes in science was (and continues to be) a significant cause of reduced demand for science degrees as well as a potential threat to future supply of research scientists. The Faculty of Science responded to this particular issue as discussed in section 2, by promoting both the benefits of the single degree pathway and the overall breadth of career opportunities available after a science degree.

### **1.2.1 Issues with the Graduate Destination Survey as a Measure of Graduate Outcomes for Science**

The main source of information on outcomes from particular disciplines or degree programs is the Graduate Destination Survey (GDS). This annual survey is sent to all graduates 3 months after graduation, and reports on their employment status, including further postgraduate studies. In general, science and arts graduates appear to fare poorly compared to their peers in business or vocational degrees, with higher rates of unemployment.

Concerned with the outcomes of the GDS and apparent public perception of the lack of career pathways in science, the Australian Council of the Deans of Science (ACDS) commissioned research by the Centre for the Study of Higher Education (CSHE) at the University of Melbourne into destinations of graduates up to 10 years post-graduation. The report, *What did you do with your science degree?*, and associated occasional paper, *Why do a science degree?*, can be found at the ACDS website, [www.acds.edu.au](http://www.acds.edu.au).

The longitudinal study of the CSHE found that contrary to the results of the Graduate Destination Survey, science graduates:

- have a much lower unemployment rate than the national average
- are paid salaries that are, on average, in the top 20% of the workforce for their age groups
- progress in their careers towards management and professional roles
- obtain considerable levels of personal satisfaction from their jobs
- would do a science degree again.

Although no formal research has been undertaken to analyse the discrepancy between the results of the two surveys the following comments can be made on the basis of anecdotal evidence.

- Science students (as with arts students) tend to undertake their studies based on interest rather than mainly vocational reasons.
- Students tend not to focus on graduate outcomes until late in their degrees or after graduation. Also they are often less aware of the how their education, personal strengths and interests, as well as personal characteristics and life experience combine to influence both their choice of pathway and employer interest.<sup>5</sup>
- The timing of the Graduate Destination Survey, 3 months post graduation, is too short a timeline to reflect the outcomes of generalist degrees accurately over time.<sup>6</sup>

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<sup>5</sup> To counteract this, the University of Melbourne Faculties of Science and Arts in conjunction with the Careers and Employment unit introduced the *Kickstart Your Career* program in 2000.

<sup>6</sup> Universities also have the responsibility to ensure that students focus on their career pathways early in their degree to counteract the issues raised above.

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## 1.2.2 Lack of Visibility of Science Employers On-Campus

The Careers and Employment unit at the University of Melbourne runs a series of employer fairs in Semester 1 each year, to provide opportunities for employers and final-year students to make contact. However for current students in science degrees, the visibility of science employers on-campus is minimal in comparison to business, law, engineering and (until recently) information technology. Traditional science employers, rather than science-related or non-science employers have low representation.

In general, interest in on-campus events from individual employers in the scientific industries has been limited due to the small number of vacancies offered by each firm each year. Appearance on campus may result in the need to process large volumes of applications which discourages such employers from participating in employer fairs. It is also costly to participate in a Fair when there are few vacancies on offer. This response leads to a much lower overall profile for the scientific industries compared to other employment sectors.

The lack of visibility impacts on current student perception of their potential employability which is at odds with the reality found in the ACDS survey. It also leads to the unjustified perception and negative spiral in prospective students, their parents and schools regarding the apparent lack of career opportunities for science graduates.

## 2 The University of Melbourne Response

### 2.1 Recruitment of Students into the Bachelor of Science

As shown in Table 1, substantial movement of the entry level (Clearly-In-Rank ENTER) for the Bachelor of Science at Melbourne occurred in 1999. The Faculty of Science responded rapidly to this change in the environment by creating a new unit to promote the value of science to prospective students. This Science Communication and Marketing unit is charged with increasing the profile of science, particularly the enabling sciences, and over 4 years has reversed the downward trend of the Clearly-In-Rank ENTER.

The unit has focused on developing methods for communicating the range of outcomes for science graduates. The “Pathways” flier in Appendix 2 has been very successful in schools, as well as presentations to students and teachers. The latter broadens the concept of a science degree as preparation for the “scientist in a white coat”, research outcome, introducing science related (science communication, patent attorney, commercialisation officer) and non-science (finance industry) outcomes. Within the Faculty of Science’s limited resources to pursue this agenda, it has been extremely successful, increasing interest in the single Bachelor of Science degree, with flow-on into interest in the enabling sciences and mathematics at undergraduate levels.

### 2.2 The Kickstart Your Career program

To respond to issues with the Graduate Destination Survey and recognised lack of vocational focus of science students, the Faculty of Science and Careers and Employment introduced the *Kickstart Your Career* program in 2000. Now in its fifth year, this program has enrolled 275 undergraduate students per year. The 7-week seminar series provides insight into the career value of a science degree, the breadth of science outcomes, assists in career self-analysis and develops generic career skills such as resume writing and interview techniques. Graduates of the Faculty of Science have been used to illustrate the variety of pathways and the process of obtaining a career that suits the individual.

*Kickstart*’s success has resulted from focusing on a particular discipline cohort and developing material that suits the style, background and interests of this group of science students. Other versions of *Kickstart* have been developed subsequently by the University of Melbourne for Arts, Engineering, Psychology and Land and Food Resources students.

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### 2.3 Retention of students in the enabling sciences

Concurrent with efforts to increase the quality of students recruited into the Bachelor of Science, the Faculty of Science has aimed to increase retention in the enabling sciences and mathematics. There is an ongoing process of integrating career focus throughout the student experience, taking it beyond the *Kickstart* program and into the processes of course advice and planning. These efforts at both Faculty and Departmental level have already resulted in some increases in retention into later years, but it is still too early to analyse overall trends.

### 3 Recommendations

Based on the observations and analyses given above, the University of Melbourne Faculty of Science and Careers and Employment unit views the following activities as critical to assist in the recruitment and retention of students in all the sciences, but in particular the enabling sciences.

1. Increasing recruitment into undergraduate programs through a coordinated approach aimed at changing perceptions of the value of studying science. Previous campaigns in the areas of teaching and nursing have had significant impact on perceptions of the value of these vocations. Universities have recognised that repositioning of the science degree in a similar way would be of great benefit to recruitment and retention, but it is beyond the scope of individual institutions to pursue this agenda.
2. Ongoing analysis of career outcomes in a manner more appropriate to science is needed in order to overturn public perceptions resulting from the Graduate Destination Survey. One option would be to undertake additional research to follow a sample of graduating students over time to map their destinations more accurately and to build science career profiles which can then be fed back to current students. A further option would be to support science/industry mentoring programs for current students with a particular focus on the enabling sciences.
3. The provision of leadership by government to employers in the scientific industries is desperately needed in order to raise the profile of careers in science. Individual employers have few vacancies each year, but collectively there are significant opportunities to rival those in high-profile areas such as management consulting and accounting. The development of a central body to represent the scientific industries and their employment needs would enable the profile of science careers to be raised significantly (on-campus and in the general community) as well as allowing trends and employment outcomes (eg salary levels) to be analysed and communicated.

## Appendix 1: Number of Students taking combinations of subjects at VCE Unit 3 and 4 level

UNIT 3/4 COMBINATION	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Methods + Biology + Chemistry	2939	2978	2829	2646	2477	2211	2043	1822	1751	1725
Methods + Biology + Physics	523	570	541	657	639	602	530	483	418	419
Methods + Biology + Specialist	373	473	591	596	647	525	433	452	420	342
Methods + Chemistry + Physics	3960	3831	3776	3967	3428	3430	3062	2958	2836	2754
Methods + Chemistry + Specialist	3120	3175	3443	3581	3239	3098	2821	2834	2739	2779
Methods + Physics + Specialist	3593	3588	3818	3888	3520	3422	3124	3117	3046	3131
Methods + Biology + Chemistry + Physics	326	384	324	384	319	311	275	235	221	217
Methods + Biology + Chemistry + Specialist	298	394	481	458	475	366	319	325	287	243
Methods + Biology + Physics + Specialist	67	76	73	81	108	80	69	64	59	41
Methods + Chemistry + Physics + Specialist	2331	2376	2469	2515	2114	2083	1795	1729	1596	1609
Methods + Biology + Physics + Chemistry + Specialist	42	48	38	30	33	30	29	20	14	14

Source: Victorian Curriculum and Assessment Authority