



# Macquarie University Science, Engineering and Technology Study

This report was commissioned by Professor John Loxton, Vice Chancellor (Academic) and was prepared with input and support from the Heads of Divisions in the College of Science and Technology and selected other academics of Macquarie University. Access to school students was granted by the Department of Education and Training.

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# **Executive Summary**

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The Macquarie University Science, Engineering and Technology Study (MQ SET Study) was commissioned in February 2005 by the Deputy Vice Chancellor, Academic. This action was sought to address the observed decline in enrolments in the science, engineering and technology areas over time and particularly in recent years. This large scale investigation used online surveys, focus groups and qualitative questionnaires to canvass over 1300 high school students across NSW, more than 300 current Macquarie University students over 70 professional scientists, and 120 Macquarie University Open Day visitors. The data obtained included qualitative and quantitative information from these key groups as they relate to SET in general and more specifically SET study at secondary and tertiary level and SET careers.

This report provides insight into the attitudes held by these groups with respect to SET and explains the factors that influence the choices of prospective students. This data may be used as a tool to shape SET promotion in order to foster interest and increase participation rates in SET tertiary study and encourage subsequent uptake of SET careers.

The main findings of the study are outlined below:

## **General Findings**

- The majority of survey participants believe SET areas are exciting and relevant to themselves and the wider community
- More effort is required for promotion and support of SET, to which universities are thought to play a key role in addition to high school science teachers

## **High School Students**

- High school science teachers hold a strong influence over the attitudes of their students, with general enthusiasm cited as the most important factor in maintaining student interest. Teachers are viewed as a valuable resource with respect to providing information on SET developments, study and career opportunities
- Most respondents were highly career focused; viewing tertiary education as the means towards a specific job, rather than a tool for expanding their education or experiences
- Most respondents have clear views about what is important to them with respect to career choices. In many instances these views do not match their perception of SET-based careers, although respondents have a very limited understanding of actual SET based study and career opportunities and characteristics. This is demonstrated by the fact that the top three desired job characteristics of high school students actually match with the top three characteristics experienced by SET professionals

## **Current Macquarie University Students**

- High school experiences are the main influence on attitudes towards SET careers and study for all respondents. Students enrolled in BA or business/finance degrees and those with high UAIs exhibited more of an aversion towards SET, citing negative high school experiences, whilst BSc students were attracted by encouraging and positive high school experiences
- University students hold more accurate views with respect to their opinions of SET job characteristics compared with high school students, however many of their main desired job characteristics did not match their expectations of a SET career or the actual experiences of SET professionals
- A large majority of students, and particularly those in BSc programs, were attracted to their area of study mainly through general interest
- No BSc student considered good career prospects as an influencing factor in degree choice. In contrast, one third of finance students rated job opportunities as a key decider

## **Science Professionals**

- A large majority of SET professionals are concerned about the state of awareness and support for SET from the greater community; universities and high schools are considered important players in these areas
- SET professionals held a wide variety of jobs, with experience in secondary or tertiary teaching most prevalent
- Less than one third of respondents indicated they had experiences of earning good money with a similar percentage expressing difficulty in maintaining steady employment in a SET area

## **Employers**

- Employers do not believe a basic tertiary science education equips graduates with essential generic skills, namely: effective written and oral communication, networking and negotiation skills, time management and self motivation
- Forty percent of employers are dissatisfied with the quality and/or quantity of job applicants

## **Actions**

The majority of study respondents indicate dissatisfaction at the quality and quantity of SET promotional activities. There are many opportunities for collaborative projects to address these concerns:

- Develop SET promotional strategies during one-day workshop in collaboration with other universities, government and relevant industry bodies

# Context

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## Trends in Science Enrolments

### High Schools

The number of high school students completing through to HSC level has increased significantly since 1980 (Board of Studies), with the flow-on effect of increased student numbers across all examinable subject areas. There has, however, been a steady decline in the proportionate numbers of students enrolling in science and science-related subjects at the examinable level in the senior years of high school, as documented over the last decade (see table 1: Board of Studies; Dekkers & De Laeter, 2001; Dekkers & De Laeter, 1996; Fullerton & Ainley, 2000; Fullerton *et al*, 2003; Mattick, 2002).

This phenomenon may, in part, be attributed to an increase in the overall choice of subjects available to high school students. Perhaps in response to an ever-increasing diversity within the senior student body, the choice of HSC-level subjects has grown considerably, to over 150 courses; more than tripling since 1979 (see table 1). Even within the areas of science, engineering and technology, the subject choices have increased, although the overall percentage of science and related subjects has dropped from 22 percent in 1979 to 17 percent in 2005.

### Tertiary

Enrolments at tertiary institutions have also been increasing over the past 20 years (see table 2), with NSW consistently holding the highest proportion of tertiary students. The proportionate number of tertiary students enrolled in the SET areas, particularly in the enabling sciences of physics, chemistry and mathematics, however, have been in decline over the past decade (see table 3: Birrell *et. al.*, 2005; Board of Studies; Dobson, 2003; Dekkers & De Laeter, 2001; Mattick Report, 2003). Apart from the generic loss associated with a general population less educated in general sciences, it is widely feared that a lack of SET graduates will have significant and adverse flow-on effects across a range of Australian scientific industries (Batterham, 2000; FASTS, 2005; Engineering Australia, 2004; Lawrance & Palmer, 2003; RACI, 2005; State of Victoria, 2004).

	1979			1988				2000				2004				% change 1979-2004			
	No.	% of total	% of SET <sup>a</sup>	No.	% of total	% change on 1979	% of SET	% ch. SET on 1979	No.	% of total	% change on 1988	% of SET	% ch. SET on 1988	No.	% of total		% change on 2000	% of SET	% ch. SET on 2000
Agriculture	1495	4.28%	4.69%	1,798	2.75%	<b>20.27%</b>	3.16%	<b>-32.55%</b>	1,706	2.73%	<b>-5.12%</b>	2.91%	<b>-7.87%</b>	1,294	1.95%	<b>-24.15%</b>	2.01%	<b>-31.10%</b>	-13.44%
Biology	15128	43.32%	47.43%	14,907	22.82%	<b>-1.46%</b>	26.21%	<b>-44.73%</b>	14,878	23.84%	<b>-0.19%</b>	25.40%	<b>-3.09%</b>	13,105	19.77%	<b>-11.92%</b>	20.32%	<b>-19.99%</b>	-13.37%
Chemistry	9157	26.22%	28.71%	10,269	15.72%	<b>12.14%</b>	18.06%	<b>-37.10%</b>	10,201	16.34%	<b>-0.66%</b>	17.42%	<b>-3.55%</b>	10,282	15.51%	<b>0.79%</b>	15.95%	<b>-8.44%</b>	12.29%
Geology (Earth & Environmental Science)	1099	3.15%	3.45%	265	0.41%	<b>-75.89%</b>	0.47%	<b>-86.48%</b>	203	0.33%	<b>-23.40%</b>	0.35%	<b>-25.62%</b>	1,131	1.71%	<b>457.14%</b>	1.75%	<b>406.10%</b>	2.91%
IT Total <sup>b</sup>				13,740	21.04%		24.16%		15,456	24.76%	<b>12.49%</b>	26.39%	<b>9.22%</b>	14,333	21.63%	<b>-7.27%</b>	22.23%	<b>-15.76%</b>	4.32%
Mathematics Total	31897	91.34%	100.00%	56,871	87.08%	<b>78.30%</b>	100.00%		58,573	93.84%	<b>2.99%</b>	100.00%		64,480	97.29%	<b>10.08%</b>	100.00%		102.15%
Physics	8372	23.97%	26.25%	9,310	14.25%	<b>11.20%</b>	16.37%	<b>-37.63%</b>	9,121	14.61%	<b>-2.03%</b>	15.57%	<b>-4.88%</b>	10,114	15.26%	<b>10.89%</b>	15.69%	<b>0.73%</b>	20.81%
General Science Total	5971	17.10%	18.72%	6,329	9.69%	<b>6.00%</b>	11.13%	<b>-40.55%</b>	5,586	8.95%	<b>-11.74%</b>	9.54%	<b>-14.30%</b>	4,354	6.57%	<b>-22.06%</b>	6.75%	<b>-29.20%</b>	-27.08%
<b>Total HSC candidates</b>	<b>34,921</b>			<b>65,311</b>		<b>87.02%</b>			<b>62,415</b>		<b>-4.43%</b>			<b>66,279</b>		<b>6.19%</b>			<b>89.80%</b>
<b>Total subjects offered<sup>c</sup></b>	<b>46 (10)</b>	<b>21.74%</b>		<b>153 (22)</b>	<b>14.38%</b>				<b>150 (24)</b>	<b>16.00%</b>				<b>157 (27)</b>	<b>17.20%</b>				

a Total students enrolled in SET classes (taken as total mathematics students)

b All computing, information technology and software design & development enrolments

c Total HSC subjects against total SET subjects in parentheses-percentages given as contribution of SET subjects to total offerings

## Table One: Student head counts for HSC science enrolments over time

([www.boardofstudies.nsw.edu.au/](http://www.boardofstudies.nsw.edu.au/))

- Increase in total number of HSC candidates
- Total number of subjects offered has tripled since 1979
- Decrease in the proportion of science subjects offered
- Large decrease in enrolments throughout 1980s and continuing throughout 1990s, particularly in Earth sciences
- Mathematics enjoys consistent enrolments, increasing on par with total student enrolments
- Physics and Chemistry exhibit mild increase in total numbers, not in proportion to total student population growth
- General and Life sciences show large-scale decline in enrolments over time

Commencing Students											All Students																						
	1979				1988				2000				2004					1979				1988				2000				2004			
	No.	No.	% of total	% change on 1979	No.	% of total	% change on 1988	No.	% of total	% change on 2000	No.	% of total	% change on 1979	No.	% of total	% change on 1988		No.	% of total	% change on 2000	No.	% of total	% change on 1979	No.	% of total	% change on 1988	No.	% of total	% change on 2000				
New South Wales	35,366	51,369	30.4%	45.2%	94,382	33.1%	83.7%	110,724	30.6%	17.3%	100,268	132,979	31.6%	32.6%	223,459	32.1%	68.0%	296,546	31.4%	32.7%	97,941	122,005	29.0%	24.6%	185,978	26.7%	52.4%	241,755	25.6%	30.0%			
Victoria	37,735	49,128	29.1%	30.2%	73,862	25.9%	50.3%	91,531	25.3%	23.9%	44,064	62,792	14.9%	42.5%	125,185	18.0%	99.4%	182,569	19.3%	45.8%	31,361	41,712	9.9%	33.0%	65,321	9.4%	56.6%	93,593	9.9%	43.3%			
Queensland	15,649	25,049	14.8%	60.1%	54,224	19.0%	116.5%	73,723	20.4%	36.0%	29,054	35,355	8.4%	21.7%	49,027	7.0%	38.7%	65,502	6.9%	33.6%	6,262	8,739	2.1%	39.6%	12,778	1.8%	46.2%	18,068	1.9%	41.4%			
Western Australia	12,147	17,768	10.5%	46.3%	25,649	9.0%	44.4%	34,649	9.6%	35.1%	714	2,053	0.5%	187.5%	4,496	0.6%	119.0%	6,001	0.6%	33.5%	12,434	15,215	3.6%	22.4%	19,528	2.8%	28.3%	28,244	3.0%	44.6%			
South Australia	11,062	14,249	8.4%	28.8%	18,620	6.5%	30.7%	23,852	6.6%	28.1%	9,713	9,713	0.0%		9,713	1.4%		12,699	1.3%	30.7%													
Tasmania	2,406	3,656	2.2%	52.0%	4,873	1.7%	33.3%	8,233	2.3%	69.0%																							
Northern Territory		1,150	0.7%		2,382	0.8%	107.1%	2,882	0.8%	21.0%																							
Australian Capital Territory	4,165	6,547	3.9%	57.2%	7,574	2.7%	15.7%	10,929	3.0%	44.3%																							
Multi-State			0.0%		3,952	1.4%		5,569	1.5%	40.9%																							
<b>TOTAL Australia</b>	<b>118,530</b>	<b>168,916</b>	<b>100.0%</b>	<b>42.5%</b>	<b>285,518</b>	<b>3769.7%</b>	<b>69.0%</b>	<b>362,092</b>	<b>100.0%</b>	<b>26.8%</b>	<b>322,098</b>	<b>420,850</b>	<b>100.0%</b>	<b>30.7%</b>	<b>695,485</b>	<b>100.0%</b>	<b>65.3%</b>	<b>944,977</b>	<b>100.0%</b>	<b>35.9%</b>													

**Table Two:** Tertiary student head counts by state over time

(www.dest.gov.au)

- Large increase in student numbers, particularly from 2000
- Almost one third of tertiary students are enrolled in NSW institutions

	Commencing Students									All Students								
	1998	2000			2003		2004		% change from 1998-2004	1998	2000			2003		2004		% change from 1998-2004
	No.	No.	% of total	% change on 1998	No.	No.	% of total	% change on 2003		No.	No.	% of total	% change on 1998	No.	No.	% of total	% change on 2003	
Natural and Physical Sciences	22,468	46,459	16.3%	106.8%	24,307	25,460	7.0%	4.7%	13.3%	56,021	115,396	16.6%	106.0%	70,556	73,987	6.0%	4.9%	32.1%
Information Technology					27,559	26,058	7.2%	-5.4%	-5.4%					77,004	72,734	5.9%	-5.5%	-5.5%
Engineering and Related Technologies	10,658	16,565	5.8%	55.4%	21,816	21,178	5.8%	-2.9%	98.7%	31,153	50,780	7.3%	63.0%	64,670	65,527	5.3%	1.3%	110.3%
Agriculture, Environmental and Related Studies	3,183	4,119	1.4%	29.4%	6,796	6,856	1.9%	0.9%	115.4%	7,603	11,136	1.6%	46.5%	18,493	18,434	1.5%	-0.3%	142.5%
<b>Total science</b>	<b>36,717</b>	<b>67,647</b>	<b>23.7%</b>	<b>84.2%</b>	<b>80,478</b>	<b>79,552</b>	<b>22.0%</b>	<b>-1.2%</b>	<b>116.7%</b>	<b>96,271</b>	<b>179,176</b>	<b>25.8%</b>	<b>86.1%</b>	<b>230,723</b>	<b>230,682</b>	<b>18.7%</b>	<b>0.0%</b>	<b>139.6%</b>
Architecture and Building	3,086	5,674	2.0%	83.9%	6,460	6,571	1.8%	1.7%	112.9%	9,323	15,463	2.2%	65.9%	18,676	19,112	1.6%	2.3%	105.0%
Health	16,286	31,576	11.1%	93.9%	36,616	37,691	10.4%	2.9%	131.4%	42,894	79,731	11.5%	85.9%	100,348	102,978	8.4%	2.6%	140.1%
Education	31,613	31,520	11.0%	-0.3%	36,045	36,599	10.1%	1.5%	15.8%	72,616	73,680	10.6%	1.5%	90,312	91,995	7.5%	1.9%	26.7%
Management and Commerce	32,288	76,394	26.8%	136.6%	98,689	100,377	27.7%	1.7%	210.9%	80,700	180,503	26.0%	123.7%	255,756	267,006	21.7%	4.4%	230.9%
Other <sup>b</sup>	5,101	8,122	2.8%	59.2%	46,328	45,725	12.6%	-5.0%	796.4%	6,220	8,807	1.3%	41.6%	84,954	85,688	0	0.9%	1277.6%
<b>Total (a)</b>	<b>168,916</b>	<b>285,518</b>	<b>100.0%</b>	<b>69.0%</b>	<b>361,555</b>	<b>362,092</b>	<b>100.0%</b>	<b>0.1%</b>	<b>114.4%</b>	<b>420,850</b>	<b>695,485</b>	<b>100.0%</b>	<b>65.3%</b>	<b>1,214,230</b>	<b>1,231,379</b>	<b>100.0%</b>	<b>1.4%</b>	<b>192.6%</b>

a Total students across Australia

b Including creative arts, hospitality, and non-award courses

### Table Three: Tertiary student head counts by broad area of study over time

(www.dest.gov.au)

- Although total science numbers show positive growth, they are not in keeping with the overall growth of the student body over time
- Natural and Physical sciences exhibit very limited growth
- Enrolments in Information Technology dropped between 2003 and 2004; long term trends cannot be seen due to the absence of split data for 1980s and 1990s
- Non-science courses, including Management and Commerce courses show stronger growth than the sciences

# SET in a changing environment

## SET graduates, careers and government initiatives

Concern for a possible shortage of trained professionals across a range of SET industries has been building for some time now, both nationally and internationally (Professions Australia, 2005; State of Victoria, 2004; Visa skilled shortage list; *Why Do A Science Degree?* 2001). Professional bodies such as Engineers Australia are taking the initiative by actively promoting themselves to high school audiences and the greater community in an effort to reverse the downwards trend. Large scale studies, such as that commissioned by the Victorian government on attitudes to ICT careers and study (2004), have arisen from observed flagging enrolments in these areas, not in keeping with the increases in job opportunities across this continually growing sector.

Government initiatives to address the issues have come from both a state and federal level. The Department of Education and Training has been following HSC science enrolment trends, with adjustments to the curricula in 2001, in part, an attempt to boost enrolments in these areas. On a national level, the federal government, through the Department of Science, Education and Training has commissioned a number of investigations into SET trends in study and careers (Australian Science and Innovation System-A Statistical Snapshot, 2003; Backing Australia's Ability, 2001; Backing Australia's Ability- Building Our Future Through Science & Innovation Package, 2004; Mapping Australian Science & Innovation, 2003).

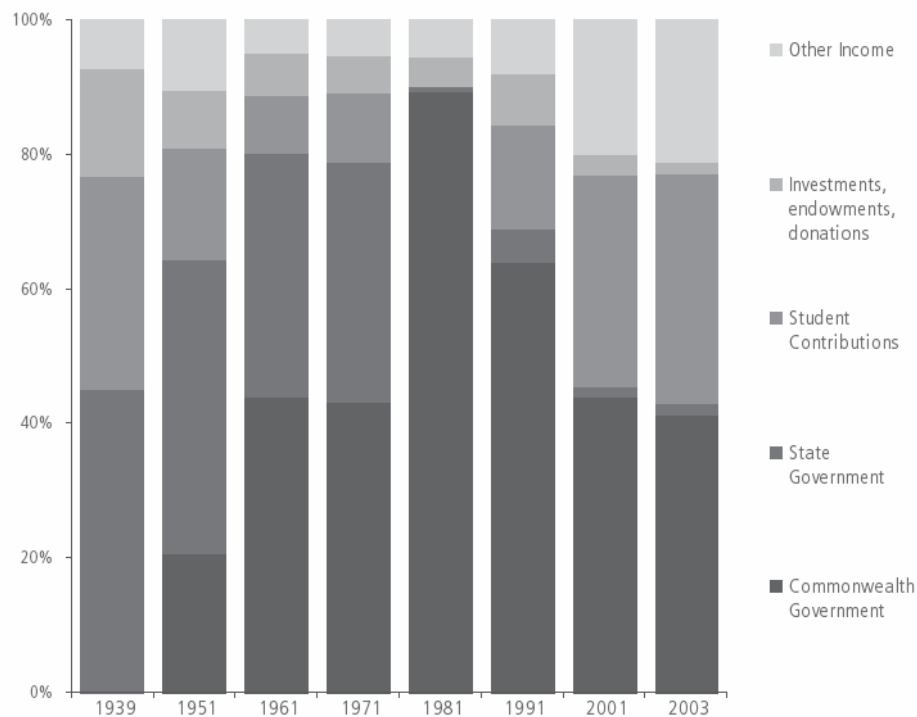
In addition, a number of initiatives have been put forward, including the Collaboration & Structural Reform Fund: \$42 million over 2005-2008 towards projects that encourage collaboration and promotion of SET study and careers. Priority areas include partnerships between universities and their communities (particularly regional communities), as well as universities and business, industry, employers and professional associations.

## SET Tertiary Environment

Much attention has been directed towards the university system in recent years, particularly in relation to the funding structure for research, with the new Research Quality Framework proposals. Figure 1 shows the changing pattern of university funding over time, going from a primarily government funded system to one relying more and more on independent means. Tertiary education providers are now focusing even more on developing their key research and teaching strengths and it is hoped that the SET areas will benefit from these initiatives.

The decline in SET enrolments discussed above, are not unique to Macquarie University. Studies by Dekkers and De Laeter (1996; 2001), Lyons (2004), LSAY reports (2000; 2003), federal and state government departments, other universities as well as the Australian Council of Deans of Sciences have been reporting on this phenomenon for the past two decades, warning of the implications for such a situation (Mansfield & Hutchinson, 1992; *Is the Study of Science in Decline?*, 2003; Review of the National Innovation Awareness Strategy, Eureka Strategic Research, 2003; Science teaching and research, which way forward for Australian

universities?, 2004). This study is an important step in understanding what is behind this observed shift away from SET study in general, and the corresponding attitudes towards future careers within SET. The comprehensive data set will serve as a valuable resource for the greater science community, as all related government departments and universities hold a responsibility to be involved in general science education and awareness activities.



**Figure One: Changes in university funding structures over time**

(DEST, 2004; Issues Paper, *Rationalising Responsibilities for Higher Education in Australia*)

- Revenue dominated by government funds, peaking in the 1980s
- Steady decline in government support since 1990s
- Increase in student contributions and other income to offset drop in government contributions

# Methods

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## Online Surveys

### High School

#### Design

Survey questions were designed to capture quantitative information on participant's broader opinions towards SET and related issues, before narrowing the focus to concentrate on SET careers and tertiary study options, gaining insight into what the students consider important when choosing a university and a career path. Surveys were accessible for a period of three months between July and September, 2005.

#### Promotion

Letters were sent to principals and head science teachers in every high school in NSW, inviting participation in the online surveys. Included with the letters were a number of advertising cards to distribute to the students, raising awareness of the survey and advertising the opportunity to win prizes. Participating students had the opportunity to win one of three Apple iPods (donated by Students at Macquarie). Advert cards were also distributed at careers markets throughout May and June, and during the HSC Enrichment lectures on campus throughout July, accompanied by a five minute introductory presentation.

#### Analysis

Information was captured to enable display of data based on region and type of high school attended, year group, and subject choice. Significant trends were calculated on the raw frequency data using chi-square analysis with  $p < 0.01$  at 2 degrees of freedom.

### Current Macquarie University Students

#### Design

Survey questions were designed to capture a mixture of quantitative and qualitative information on participant's broader opinions towards SET and related issues, before narrowing the focus to concentrate on SET careers and tertiary study options, gaining insight into what the students consider important when choosing a university and a career path. Questions reflected a mixture of that used in the high school survey and the science professional's survey. Surveys were accessible for a period of three months between July and September, 2005.

## Promotion

Notice was placed on the Macquarie University homepage for the duration of the survey. In addition specific unit coordinators were informed across a range of Macquarie University subject areas (see Appendix B) and advertisement slides were shown during lectures, accompanied by a five minute introductory presentation.

## Analysis

Information was captured to enable display of data based on region of high school attended, UAI, and degree program. Significant trends were calculated on the raw frequency data using chi-square analysis with  $p < 0.01$  at 2 degrees of freedom.

## **Science Professionals**

### Design

Survey questions were designed to capture quantitative and qualitative information on participant's broader opinions towards SET and related issues, before narrowing the focus to concentrate on their experiences of SET careers and tertiary study, gaining insight into what the participants consider important in relation to SET study and general support of SET issues.

A final section for employers of university graduates was included to assess what employers look for in terms of generic and specific skills and to obtain feedback on their experiences with university graduates if applicable. Surveys were accessible for a period of three months between July and September, 2005.

### Promotion

The study was heavily reported on by local and national press, including a front page article in the *Higher Education supplement of The Australian*. Targeted letters were also sent to a range of representatives of SET companies, chosen either through graduate destination data or their importance in the wider SET community. In addition, science teachers who received notice of the high school student survey were invited to participate in the science professional's survey.

### Analysis

Information was captured to enable display of data based on the SET field represented, university attended and whether the participant had teaching/lecturing experience.

## **Open Day Survey**

### Design

Survey questions were designed to gain entirely qualitative information from Open Day visitors on general attitudes towards SET and SET tertiary study and careers and the promotion and support of such, plus any comments on their direct experiences in these areas. Information on who else within their family or acquaintances had attended university was also captured.

# Focus Groups

## High School Students

Small groups of students in Years 10-12 from 16 NSW high schools were selected to participate in focus group discussions. Participants were selected from a range of backgrounds to ensure each group contained students who had chosen to study science subjects in their senior years and those who had not. Students who displayed a capacity to study science at a tertiary level were preferentially selected.

Hour long sessions were conducted with the aim of obtaining detailed information about high school students' attitudes and opinions towards study and careers in the SET areas. Students were encouraged to share their experiences of SET and were asked to consider what tools they currently use to form their opinions and make their choices about future study and careers and what they might like available to them in order to assist them further in this regard.

Sessions were facilitated to encourage free-form discussion based around the following broad questions:

- What do the following terms mean for you? Science, Engineering, Technology
- Describe your experiences with regards to SET, how have these experiences shaped your attitudes and opinions towards SET?
- What are your expectations of tertiary study?
- What are your career expectations?
- Who/what do you consider holds most influence over your attitudes and opinions towards SET-based issues?

## High School Science Teachers

Informal discussions were held with science faculties from six high schools mostly in the Sydney metropolitan area. Discussions centred on issues and concerns of high school science teachers and what support they might require from universities and other sources.

# Results

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## Online Surveys

### High School Students

- A total of 1316 high school students contributed to the online survey data base, with fully completed surveys totalling 798. One hundred and sixty four high schools are represented, offering a broad perspective from the range of schools across NSW, including a small proportion of respondents from interstate. Following is a summary of significant results and trends. For further discussion please refer to Supplementary report 1 *High School Student SET attitudes, experiences and influences*

**Table Four:** Schools attended by High School student survey respondents

	Zone	No. of Schools	No. of Students
<b>Sydney Metropolitan</b>	Central	12	160
	East	1	2
	South	7	64
	South West	10	120
	West	24	134
	North West	19	118
	North	14	94
<b>NSW Non-metropolitan</b>	Central Coast	16	56
	New England	4	36
	North Coast	18	234
	Riverina	6	32
	South Coast	12	84
	Western NSW	12	74
<b>Interstate</b>	ACT	2	6
	QLD	1	1
	VIC	3	20
	WA	3	6
<b>O t h e r</b>	Unknown		75
	<b>Total</b>	164	1,316

## High School Student General SET attitudes

Students were asked to respond to a range of statements covering general attitudes towards SET by rating each statement Strongly Agree, Agree, Don't Know/Not Relevant, Disagree, Strongly Disagree. For ease of display in the tables, responses to Agree or Disagree have been pooled. Students were then supplied with a list of possible influences towards their held beliefs and were able to make multiple responses as to which of these applied to them.

**Table Five:** High School student attitudes towards SET in general, SET study and SET careers and the influences for these attitudes

Attitudes:

- A large proportion of all students expressed long-term interest in SET, considering them exciting and constantly changing areas
- Students not enrolled in senior science were three times more likely to consider science boring and twice as likely to consider it difficult compared to senior science students
- Less than 10 percent of students agree with the statement that only “geeks” or “nerds” study science, with 16 percent of non-science students adhering to this statement
- A large majority of all students believe SET areas are relevant, with a minor trend for non-metropolitan students to disagree
- The majority of all students disagree with the statement “science is more suited to boys than girls”, with HSC Biology students the least likely to agree
- Students enrolled in HSC science subjects are more likely to indicate interest for a SET career, however 51 percent of non-science students also indicate an interest
- More than half of all students do not know enough about SET career options, particularly HSC Biology students
- Roughly one third of all student respondents considered it difficult to get a job in SET, particularly HSC Biology students
- Students were just as likely to indicate a willingness to include SET subjects or IT-specific subjects in their tertiary study programs as they were to exclude them, with more than 50 percent of non-science students indicating interest in some tertiary science, particularly IT areas

Influences:

- Positive high school science teachers and hands-on experiments are strong influences for all students
- Involvement in organised SET activities also rated as a positive influence for students, with non-metropolitan students significantly more likely to be involved in these activities compared to metropolitan students
- Parents are also considered a positive influence for almost half total respondents, more so with students enrolled in HSC science
- Non-science students are more likely to contribute attitudes to boring school experiences or intimidation by scientific jargon

**Discussion points:**

- The way in which science is being taught at high school is clearly influencing the attitudes of students. This is a multifaceted situation, discussed in detail in the Supplementary Report 1
- Students already appear to be interested in SET and they are asking for interesting and relevant SET experiences
- It is encouraging that non-science students are still indicating a willingness to participate in SET activities and study
- Students are indicating a strong requirement to have relevant SET career information

Responses to statements on attitudes towards SET study and careers:	All respondents <sup>a</sup> (1318)			Metro HS (690)			Non-metro HS (558)			Yr11/12 (507)			Yr10 (528)			Physics (274)			Chemistry (306)			Biology (158)			No senior science (86)		
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D
	Always shown an interest	79	9	12	81	8	11	78	9	13	92	6	9	81	6	13	92	4	4	93	3	5	90	5	5	65	12
SET are exciting and constantly changing	81	11	9	82	10	8	78	12	10	87	7	6	81	10	9	93	4	4	92	5	3	87	10	3	79	7	14
Only "geeks" or "nerds" study SET	10	8	82	10	6	85	10	10	80	9	3	88	9	9	82	7	4	89	6	2	92	8	1	91	16	2	81
Science too difficult	24	12	64	25	11	64	22	12	66	22	8	70	25	11	63	13	9	78	14	7	78	20	5	75	40	7	53
Science is boring	19	11	71	16	11	73	21	10	69	13	9	77	20	8	73	9	9	81	10	7	83	8	8	84	30	14	56
Science is irrelevant	7	7	86	4	5	91	10	9	80	6	3	91	6	8	86	4	1	94	2	2	96	1	3	96	12	7	81
SET suit boys more than girls	11	13	76	12	10	78	11	14	74	13	7	80	11	13	77	14	8	78	11	8	81	5	8	87	16	7	77
SET important for general education	72	13	15	72	13	15	73	12	15	73	13	13	73	10	17	72	15	14	75	13	12	78	8	14	70	14	16
Computer education important for all	72	13	15	72	13	15	73	13	14	72	13	15	73	11	16	74	14	12	70	17	13	63	14	23	84	5	9
I am interested in a SET career	64	15	21	67	14	20	62	16	22	75	12	13	60	15	25	87	6	7	83	9	6	79	13	8	51	14	35
Interested in SET career, not in teaching	54	19	27	52	20	27	57	18	25	57	17	26	56	19	24	64	15	21	60	16	24	55	14	30	37	21	40
SET are interesting but not for a career	34	16	50	33	15	51	34	17	49	27	14	59	37	15	48	20	11	69	16	14	70	25	17	58	40	14	47
There are wide variety of SET careers	76	17	7	75	17	8	79	16	6	79	14	7	75	18	7	84	11	4	84	10	6	79	16	5	72	19	9
Study in SET allows career in any area	42	31	26	39	31	30	47	31	22	46	29	26	41	31	28	51	25	25	53	26	21	50	30	20	37	30	33
SET jobs are difficult to get	30	40	30	31	38	31	29	43	27	32	40	29	27	40	33	30	36	34	27	33	40	38	30	32	23	56	21
I don't know enough about SET careers	55	19	25	57	17	26	55	20	25	62	13	25	50	21	29	54	20	26	52	15	33	68	7	25	67	12	21
Not interested in SET career but may include it in tertiary study program	38	23	39	38	24	38	37	22	40	35	20	45	40	24	36	28	26	46	28	23	49	34	14	51	53	5	42
Not interested in IT career but may include it in tertiary study program	41	22	37	38	23	39	45	22	33	43	19	38	39	22	40	35	20	45	36	20	44	39	18	42	63	9	28
What has influenced your attitudes?	All respondents (1200)			Metro HS (676)			Non-metro HS (524)			Yr11/12 (503)			Yr10 (510)			Physics (270)			Chemistry (302)			Biology (158)			No senior science (86)		
Positive primary school teacher	28			25			26			28			24			27			28			32			24		
Positive parents	41			43			35			49			31			52			49			53			44		
Positive high school teacher	69			66			64			66			67			73			74			66			60		
Positive friends	28			17			38			31			24			37			32			25			32		
Public spokes person (eg. Dr Karl)	29			30			20			27			27			27			30			24			25		
Participation in SET activity (eg. Science, engineering challenge)	44			29			56			50			36			53			58			46			49		
Negative primary teacher	8			12			8			9			11			4			4			11			5		
Negative high school teacher	15			12			26			14			19			7			7			13			17		
Negative parents	3			9			6			7			6			1			5			8			8		
Negative friends	8			5			10			6			8			4			4			4			8		
Boring school experience	24			27			18			22			21			18			17			22			32		
Positive hands-on experiments	64			62			59			65			60			63			71			66			68		
Intimidated by scientific jargon	22			23			16			16			23			7			13			16			29		
Require more exposure to form opinion	8			9			5			8			7			5			3			4			13		

a Numbers in parentheses are population size, numbers within table are percent respondents

Points of discussions indicated in grey and significant trends coloured orange

A= Strongly Agree + Agree

DK= Don't Know

D= Strongly Disagree + Disagree

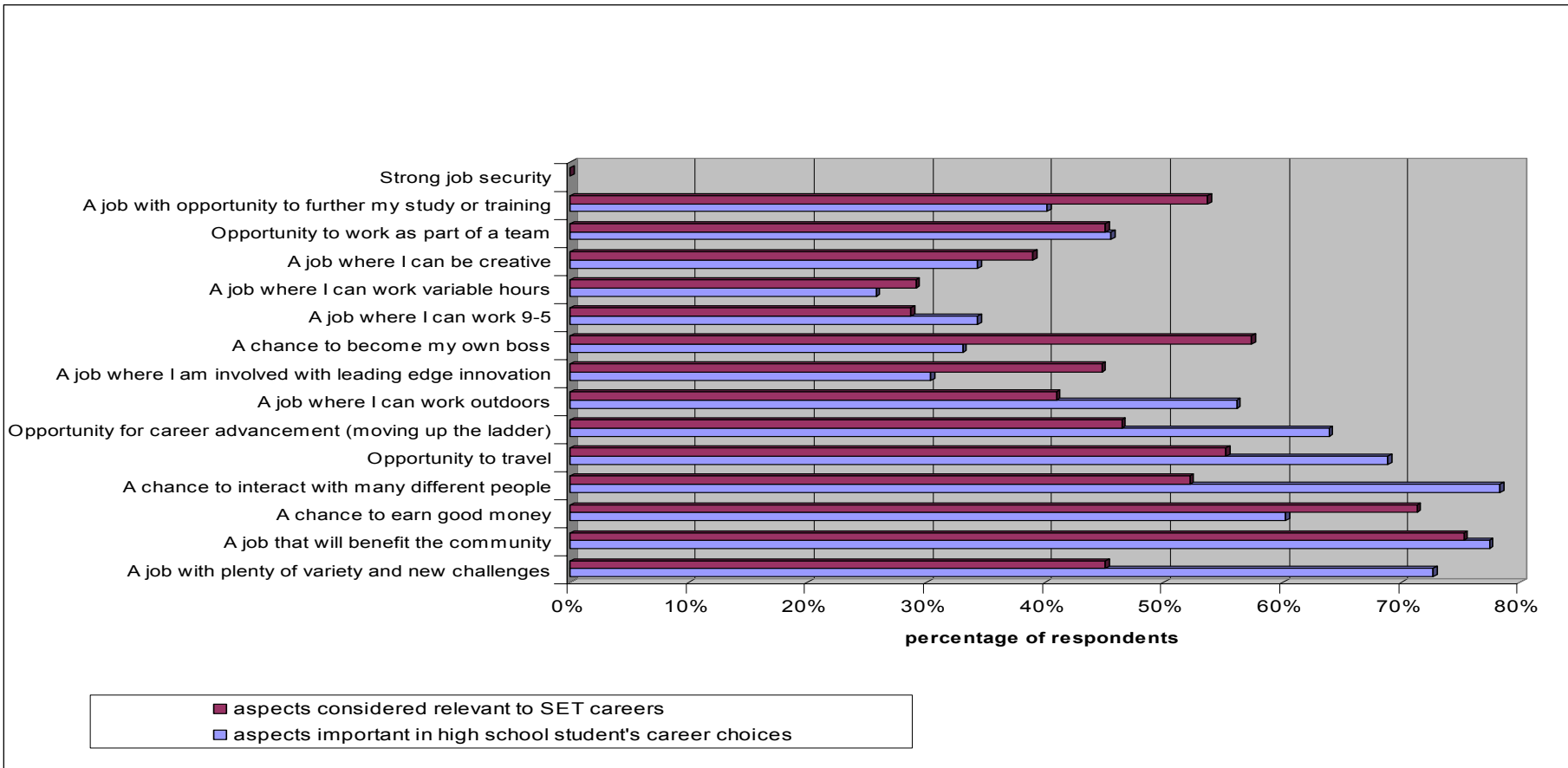
**Table Five:** High school student attitudes towards SET in general, SET study and SET careers and the influences for these attitudes

## High School Student SET Career attitudes

Students were asked to respond to a list of generic job characteristics. Multiple responses were allowed to indicate which of the given aspects were important to them when choosing a career. Against the same list students were asked to indicate which of the given characteristics they considered relevant to a SET-based career.

**Figure Two:** High School student career perspectives and opinions on SET career characteristics

- The three most important elements in choosing a career were:
  - A job that will benefit the community
  - A chance to interact with many different people
  - A job with plenty of variety and challenges
- The three main aspects considered relevant to SET careers were:
  - A job that will benefit the community
  - A chance to earn good money
  - A chance to become my own boss
- Aspects showing close relationship (less than 5 percent difference) in response rate:
  - A job that will benefit the community
  - Opportunity to work as part of a team
  - A job where I can work variable hours
  - A job where I can work 9-5
- Aspects showing 15 percent or more difference in response rate:
  - Desired by HS students:
    - A job with plenty of variety and new challenges
    - A chance to interact with many different people
    - Opportunity for career advancement (moving up the ladder)
    - A job where I can work outdoors
  - Considered as SET characteristics:
    - A chance to become my own boss
- Least desired aspects (less than 30 per cent response rate):
  - Strong job security
  - A job where I can work variable hours
  - A job where I am involved in leading edge innovation



**Figure Two:** High School student career perspectives and opinions on SET career characteristics

**Discussion points:**

- The chance to benefit the community is a strong requirement of high school students and also something they consider inherent in SET careers, so this can be a focus of future SET career campaigns
- Care should be taken when providing SET career information to students to attempt a reversal of the misconception by students that SET careers do not offer opportunity to interact with different people, new challenges and variety or career advancement
- Job security is of no concern for this generation a phenomenon that is well understood, recently reported on by Cubby and Delaney: It works for me, *Sydney Morning Herald* 18/2/2006

**High School Student Most Trusted and Preferred Resources for SET information**

Students were asked to indicate who they would trust and what resources they would use to provide them with information suggesting SET careers were fun, challenging, exciting and varied.

**Table Six:** Trusted sources of information and resources used by high school students when considering SET study and careers

- Science teachers are the most trusted and preferred source of information, particularly for students enrolled in HSC science subjects. Students not enrolled in senior science are far less likely to trust science teachers
- Family members are viewed on par with SET graduates and SET professionals when seeking SET specific study information
- Students studying HSC Physics significantly less likely to trust careers advisers
- University lecturers did not rate very highly, although students studying HSC Physics or Chemistry more likely than other groups to trust them

**Discussion points:**

- Once again, science teachers are indicated as a trusted and preferred resource
- Family members are also a strong influence

Responses to most trusted resource for SET career information:	All respondents <sup>a</sup> (764)	Metro HS (474)	Non-metro HS (290)	Yr11/12 (376)	Yr10 (304)	Physics (214)	Chemistry (254)	Biology (118)	No senior science (66)
Science teacher	95	89	92	93	88	93	97	95	48
Careers adviser	63	57	62	62	63	36	63	66	59
University school liaison officer	22	19	22	21	20	21	24	22	23
University lecturer	43	43	38	45	40	51	53	44	47
Current university SET student	90	86	88	90	84	91	93	88	89
Recent university SET graduate	68	65	64	71	61	73	76	69	69
Experienced SET professional	68	68	61	74	62	77	76	71	69
Family member	64	64	56	63	59	62	63	64	59
Friends	51	49	49	47	49	43	46	47	53

a Numbers in parentheses are population size, numbers within table are percent respondents

Points of discussions indicated in grey and significant trends coloured orange

**Table Six:** Trusted sources of information and resources used by high school students when considering SET study and careers

## High School Student University Choice

Students were asked to rate a range of statements pertaining to generic university characteristics they might consider important when choosing an institution. Multiple responses were allowed.

**Table Seven:** Points considered important by high school students when choosing a university

- Teaching styles and course content most important aspect for all student groups
- Scholarship opportunities and reputations of lecturers and graduates were also considered important by a reasonable majority of all students
- The majority of all students indicated the strength of a university in a given area could be inferred by the number of different courses offered in that field
- Students enrolled in HSC science were less likely to be concerned by high HECS costs associated with SET degrees
- Opportunity for multi-disciplinary study was most important for non-science students. This same group also cited the appearance of university grounds as a driving factor in their university choice

### Discussion points:

- Universities have the ability to develop the interest and enthusiasm of their students towards holding a general science education. The importance placed on multidisciplinary study coupled with earlier responses favouring inclusion of science or technology units within tertiary study programs bodes well for this opportunity

Responses to what aspects are considered important when choosing a university:	All respondents <sup>a</sup> (1116)			Metro HS (620)			Non-metro HS (494)			Yr11/12 (479)			Yr10 (478)			Physics (262)			Chemistry (298)			Biology (150)			No senior science (66)		
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D
Research reputation	59	24	17	64	23	14	51	26	23	61	21	18	59	22	18	66	19	15	66	18	16	64	20	16	64	18	18
Reputation of lecturers	62	20	18	66	18	16	57	21	21	66	18	17	61	18	21	69	16	15	67	14	19	68	12	20	58	30	12
Reputation of graduates	62	22	16	66	19	15	58	25	17	69	16	15	59	22	19	74	11	15	72	10	17	69	13	17	61	30	9
Teaching style and course content	83	11	6	85	10	5	80	13	7	85	9	6	82	12	7	89	8	5	85	9	6	87	5	8	85	9	6
Opportunity for multidisciplinary study	62	27	11	65	24	11	58	31	11	65	23	11	58	30	12	59	28	14	60	23	17	65	20	15	85	15	0
Scholarship opportunities	62	18	20	61	16	23	67	17	16	62	16	22	64	14	22	66	11	24	62	10	28	65	16	19	58	21	21
Proximity to home	45	18	34	51	15	34	46	19	34	47	15	38	54	15	31	44	13	44	50	9	41	55	15	31	36	21	42
Appearance of university grounds	56	20	23	57	15	26	56	25	19	59	17	22	57	19	22	60	16	22	55	17	28	60	18	22	73	12	15
<b>Responses to given statements:</b>																											
Universities with many courses in one area indicating strength	74	19	7	75	19	6	73	19	7	73	18	8	79	16	4	73	19	8	76	15	9	75	19	7	76	12	12
Specialists degrees are more desirable than general ones	46	32	21	52	28	20	39	36	24	50	25	24	47	32	21	56	26	18	56	18	26	49	21	29	36	30	33
I am concerned about high HECS of SET degrees	36	24	39	36	19	45	38	28	33	33	15	52	43	22	35	31	20	50	28	18	54	39	11	51	33	12	55
Courses with high UAI are of better quality than those of lower UAI	36	36	29	35	34	32	38	35	26	35	32	33	39	33	29	29	31	40	30	32	38	44	28	28	39	33	27

a Numbers in parentheses are population size, numbers within table are percent respondents

Points of discussions indicated in grey

A= Strongly Agree + Agree

DK= Don't Know

D= Strongly Disagree + Disagree

**Table Seven:** Points considered important by high school students when choosing a university

# Current Macquarie University Students

A total of 323 university students contributed to the online survey data base. One hundred and thirty five high schools are represented, offering a broad perspective from the range of schools across NSW, including a small proportion of respondents from interstate and international. Students are fairly evenly distributed throughout degree programs, with 49 BA, 49 BSc (ELS), 25 BSc (ICS), 57 finance or economics related (EFS) and the remainder mainly from Law, Psychology or postgraduate study. Following is a summary of significant results and trends.

**Table Eight:** Schools attended by current Macquarie University survey respondents

- Three hundred and twenty three participating current Macquarie University students represented 135 high schools predominantly in the Sydney metropolitan area with 39 international students represented

	Zone	No. of Schools	No. of Students
<b>Sydney Metropolitan</b>	Central	14	19
	East	1	1
	South	7	7
	South West	6	12
	West	29	60
	North West	28	84
	North	27	64
<b>NSW Non-metropolitan</b>	Central Coast	3	3
	New England	0	0
	North Coast	9	8
	Riverina	0	0
	South Coast	3	4
	Western NSW	2	7
<b>Interstate</b>	ACT	1	1
	SA	1	1
	VIC	3	5
	TAS	1	2
<b>Other</b>	International		39
	Unknown		6
<b>Total</b>		135	323

## Current Macquarie University Student General SET attitudes

Students were asked to respond to a range of statements covering general attitudes towards SET by rating each statement Strongly Agree, Agree, Don't Know/Not Relevant, Disagree, Strongly Disagree. For ease of display in the tables responses to Agree or Disagree have been pooled. Students were also supplied with a list of possible influences towards their held beliefs and were able to make multiple responses as to which of these applied to them.

**Table Nine:** Current Macquarie University student attitudes towards SET in general, SET study and SET careers and the influences for these attitudes

Attitudes:

- Majority of respondents agree SET areas are exciting and important for a general education, with BSc-ICS students more likely to agree than EFS students
- More than half the respondents are concerned about an imminent shortage of SET professionals with the majority believing universities have a role to play in raising SET awareness
- BSc students are twice as likely to believe SET study may be considered “geeky” or “nerdy” compared with students enrolled in other degrees. Students with high UAIs also follow this trend
- As the UAI increases, students are more likely to agree with the term that science is boring, students enrolled in the sciences are more likely to disagree and non-science students more likely to hold no opinion on the relevance of SET
- EFS students are more likely to adhere to gender bias, with one third agreeing that SET are more male friendly
- BSc-ELS students and students with 75-85 UAI are more likely to agree to having a dearth of positive SET role models
- BA students are less likely to believe there is a risk of SET professional shortages but are more likely to believe SET awareness is not effectively promoted through mainstream media
- Students with >95 UAI are less likely to agree to the notion of a role for universities in SET secondary education
- BSc-ICS students are three times more likely to believe universities should offer funded reward schemes for outreach activities

Influences:

- High school experiences stand out as the major contributor to SET attitudes. The majority of students cite positive high school teachers and encouraging parents as influences
- Boring school experiences are also a major influence on attitudes
- Students who attended non-metropolitan high schools were more likely to cite primary school experiences as influencing their attitude compared with metropolitan students
- Students from non-metropolitan high schools were also twice as likely to be involved in specific SET activities, and are also more influenced by their friends in a negative way

- Students with a high UAI more likely to cite their high school teacher as a positive influence, with the same group more likely to cite the use of specific language or jargon as a turn off
- Students with 85-95 UAI more likely to cite negative high school experience both in terms of the science teacher and the classes being boring, along with negative primary school experiences
- Students with UAI 75-85 were less influenced by their friends and were less likely to cite positive experiences with SET experimental work
- Students with UAI <75 more likely to cite public spokespeople as a positive SET influence, and were less likely to be involved in SET specific activities
- Students enrolled in BSc are more likely to cite their high school teacher as a positive influence, along with their parents
- More BSc-ICS students cite their friends and public spokespeople as positive SET influences
- BSc-ELS are less likely to be intimidated by the use of scientific jargon
- The largest influence for BA students was a negative high school teacher experience

**Discussion points:**

- Large differences in attitudes between science and non-science students are evident
- Once again, high school science teachers are cited as an important influence
- Students enrolled in BSc cited parents as a positive influence

	All <sup>a</sup> (323)			Metro HS (187)			Non-metro HS (76)			UAI												Degree program											
	A	DK	D	A	DK	D	A	DK	D	<75 (26)			75-85 (25)			85-95 (102)			>95 (55)			BA (49)			BSc -ELS (49)			BSc -ICS (25)			EFS <sup>b</sup> (57)		
										A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D
<b>Responses to statements on attitudes towards SET study and careers:</b>																																	
Always shown an interest	67	8	25	66	6	28	74	7	20	58	19	23	68	4	28	71	2	27	67	5	27	59	4	37	86	2	12	80	0	20	54	9	37
SET are exciting and constantly changing	78	12	10	78	11	11	83	8	9	73	19	8	96	4	0	80	6	14	75	16	9	78	12	10	88	6	6	96	4	0	58	14	28
Only "geeks" or "nerds" study SET	31	14	55	32	13	55	32	13	55	23	12	65	16	4	80	32	14	54	45	13	47	22	18	59	47	8	45	40	8	52	26	18	56
Science too difficult	39	16	44	40	18	42	37	14	49	38	15	46	24	20	56	52	16	32	25	24	51	39	29	33	27	12	59	40	4	56	53	16	32
Science is boring	20	11	69	22	12	66	17	8	75	8	15	77	12	12	76	26	10	64	27	13	60	24	12	63	6	4	90	16	4	80	35	7	58
Science is irrelevant	3	12	84	2	13	84	4	11	86	0	12	88	0	4	96	3	13	84	2	18	76	0	24	76	0	0	100	4	8	88	7	18	75
SET suit boys more than girls	21	17	62	22	18	60	25	8	67	12	19	69	16	8	76	27	16	57	20	27	53	24	22	53	8	14	78	16	12	72	39	12	49
SET important for general education	74	7	19	72	6	22	71	11	18	77	8	15	72	8	20	69	6	25	55	9	18	65	10	24	82	8	10	76	0	24	60	4	37
Computer education important for all	84	5	9	86	4	11	86	5	9	81	4	15	88	4	8	90	3	7	78	5	16	92	4	4	82	6	12	100	0	0	88	4	9
SET suffer negative community image	36	25	38	36	25	39	41	24	36	27	42	31	44	12	44	32	24	44	38	29	33	22	29	49	61	18	20	36	16	48	40	21	39
Dearth of Australian SET role models	62	24	13	65	22	13	62	26	12	46	38	15	80	20	0	63	23	15	44	22	16	55	24	20	78	18	4	64	28	8	60	26	14
Risk of shortage of SET professionals in near future	58	31	10	58	34	8	54	33	13	58	35	8	76	20	4	54	36	10	55	36	9	45	39	16	69	24	6	68	28	4	67	26	7
Mainstream media effectively communicate SET	22	28	49	20	26	53	30	22	47	42	35	23	24	0	76	21	24	56	20	29	51	35	20	45	18	22	59	16	24	60	23	26	51
Universities have role raising public profile of SET	86	10	2	86	10	3	86	13	1	96	0	4	96	0	4	86	12	2	82	18	0	82	14	4	86	2	8	88	12	0	93	5	2
Universities have role supporting SET secondary education	84	8	7	84	9	7	91	4	5	96	0	4	88	12	0	86	5	9	75	15	11	88	6	6	92	4	4	88	8	4	81	9	11
Funded reward schemes required to assist universities in SET community outreach	81	11	7	80	13	7	87	7	7	92	8	0	88	12	0	80	11	9	69	16	15	86	8	8	84	8	8	72	24	4	84	9	7
Computers and IT not used to full potential by wider community	64	19	16	59	22	19	68	11	20	73	12	15	64	24	12	59	19	23	55	22	24	61	18	20	59	20	20	72	8	20	70	18	12
<b>What has influenced your attitudes?</b>																																	
	All (323)			Metro HS (187)			Non-metro HS (76)			UAI												Degree program											
Positive primary school teacher	25			19			39			23			20			30			22			22			27			20			35		
Positive parents	58			57			57			46			68			68			49			47			73			88			44		
Positive high school teacher	68			69			64			65			56			77			76			55			90			92			49		
Positive friends	29			28			32			27			8			36			25			24			22			44			23		
Public spokesperson (eg. Dr Karl)	27			28			26			46			36			25			24			27			20			44			28		
Participation in SET activity (eg. Science Engineering challenge)	33			28			41			15			48			37			24			24			43			36			35		
Negative primary teacher	16			13			24			12			4			23			11			20			12			20			23		
Negative high school teacher	41			42			39			31			28			54			44			61			27			40			47		
Negative parents	26			26			28			12			16			37			22			24			20			32			25		
Negative friends	44			39			53			38			36			48			31			49			39			36			44		
Boring school experience	57			56			61			31			56			75			47			55			53			72			51		
Positive hands-on experiments	28			29			22			31			12			29			29			39			10			28			26		
Intimidated by scientific jargon	18			19			12			19			8			14			29			18			2			16			26		
Require more exposure to form opinion	18			19			16			8			24			20			4			16			18			20			18		

a Numbers in parentheses are population size, numbers within table are percent respondents

b EFS: students enrolled in Division of Economic and Financial Studies

Points of discussions indicated in grey and significant trends coloured orange

**Table Nine:** Current Macquarie University student attitudes towards SET in general, SET study and SET careers and the influences for these attitudes

## Current Macquarie University Student SET Career attitudes

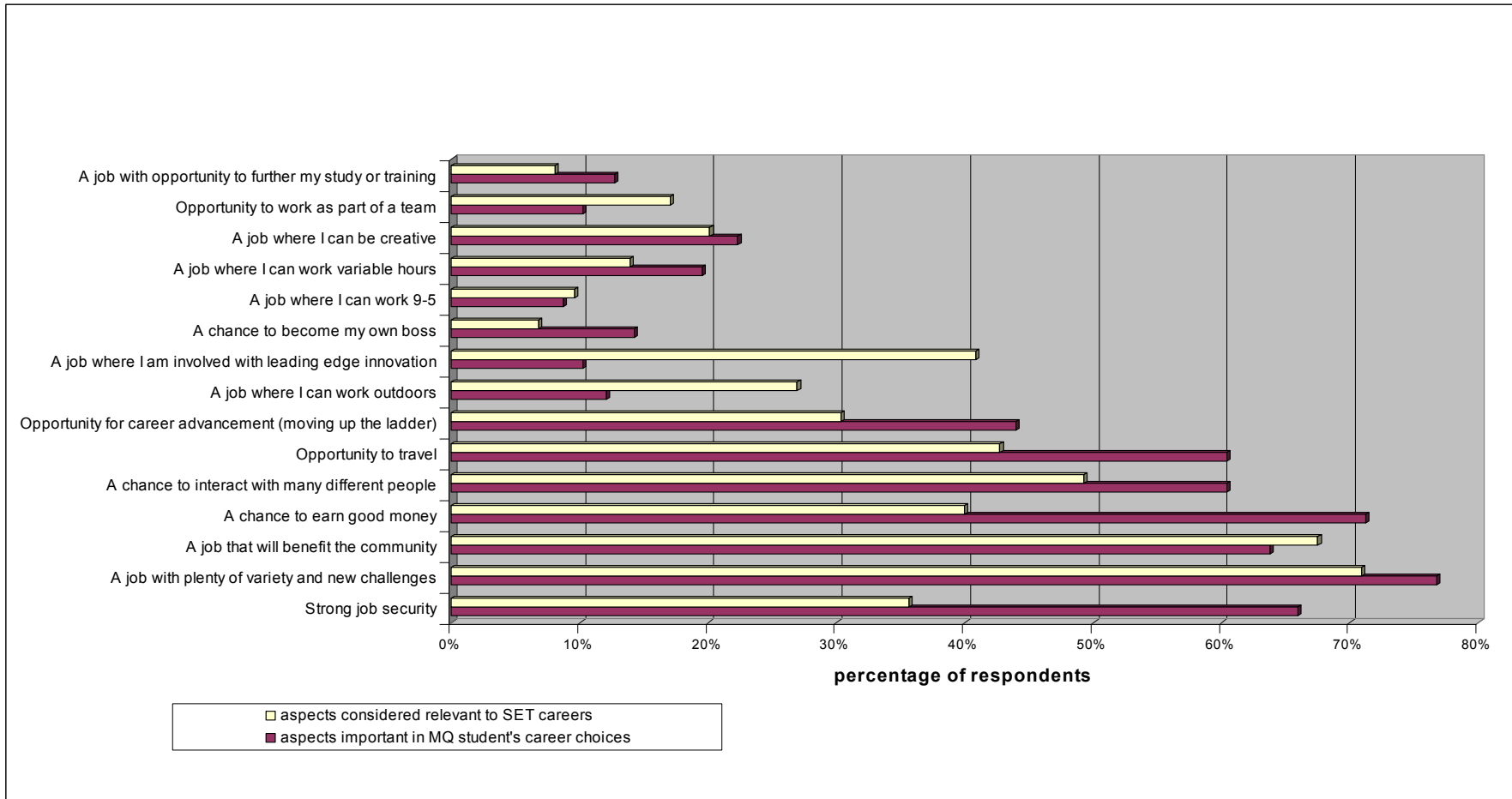
Students were asked to respond to a list of generic job characteristics. Multiple responses were allowed as they indicated which of the given aspects were important to them when choosing a career. Against the same list, students were asked to indicate which of the given characteristics they considered relevant to a SET-based career.

**Figure Three:** Current Macquarie University student career perspectives and opinions on SET career characteristics

- The six most important elements in choosing a career were:
  - A job with plenty of variety and challenges
  - A chance to earn good money
  - Strong job security
  - A job that will benefit the community
  - A chance to interact with many different people
  - Opportunity to travel
- The two main aspects considered relevant to SET careers were:
  - A job with plenty of variety and challenges
  - A job that will benefit the community
- Aspects showing close relationship (less than 6 percent difference) in response rate:
  - A job that will benefit the community
  - A job with plenty of variety and challenges
- Aspects showing 15 percent or more difference in response rate:
  - Desired by Macquarie University students:
    - A chance to earn good money
    - Strong job security
    - Opportunity to travel
  - Considered as SET characteristics:
    - A job where I am involved in leading edge innovation
    - A job where I can work outdoors

### Discussion points:

- Students may not be choosing SET careers as they consider job security and remuneration to be low. This is not necessarily the case for all SET areas and promotion efforts can focus on these issues



**Figure Three:** Current Macquarie University student career perspectives and opinions on SET career characteristics

## Current Macquarie University Student Attitudes towards University Choice

Students were asked to rate a range of statements pertaining to generic university characteristics they considered important when choosing an institution, multiple responses were allowed.

**Table Ten:** Points considered important by current Macquarie University students when choosing a university

- The majority of respondents considered multi-disciplinary study as important, along with teaching style and course content, university campus appearance, proximity to home and the reputation of graduates
- A large proportion of respondents agreed that the strength of a university in a given area could be inferred by the number of different courses offered in that field; students with UAI<75 less likely to agree
- Half the respondents considered specialist degrees as more desirable than general degrees, excepting students with a UAI >95 who were evenly split in their preference
- Students who attended non-metropolitan high schools were twice as likely to consider scholarships important compared with metropolitan students
- Students with lower UAIs more likely to consider research reputation of the university, and were less likely to factor in scholarship opportunities.
- Students with lower UAIs were also less likely to agree that high UAI courses inferred high quality
- As UAI increases the importance of scholarship availability increases
- Students with a UAI >95 and BSc-ICS students are less likely to be worried about high HECS of SET degrees
- BSc-ELS students less concerned by lecturer or graduate reputations
- More BA students appreciate the opportunity for multidisciplinary study compared to EFS students
- EFS students are more likely to agree that high UAI infers quality of course

### Discussion points:

- Multidisciplinary study options have been raised as an important factor for current tertiary students, particularly those not enrolled within a SET degree program, further reinforcing the opportunity to provide general science education for all

Responses to what aspects are considered important when choosing a university:	All <sup>a</sup> (323)			Metro HS (187)			non-metro HS (76)			UAI												Degree program											
										<75 (26)			75-85 (25)			85-95 (102)			>95 (55)			BA (49)			BSc -ELS (49)			BSc -ICS (25)			EFS <sup>b</sup> (57)		
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D
Research reputation	48	17	35	43	17	34	53	14	33	73	12	15	67	4	30	41	18	41	45	24	31	43	19	39	42	25	33	60	10	30	48	11	41
Reputation of lecturers	48	17	34	41	15	39	22	21	20	54	15	31	44	22	33	41	20	39	53	11	36	48	22	30	33	27	40	50	17	33	60	10	30
Reputation of graduates	59	16	25	53	15	27	68	12	20	42	19	38	63	15	22	64	13	24	55	16	29	63	20	17	35	19	46	57	27	17	78	8	14
Teaching style and course content	67	11	22	60	8	26	73	16	11	77	12	12	81	4	15	62	10	28	64	5	31	74	4	22	63	19	17	77	7	17	75	10	16
Opportunity for multidisciplinary study	72	12	15	69	10	14	70	15	15	69	4	27	78	15	7	71	15	13	73	11	16	89	4	7	73	10	17	80	10	10	59	17	24
Scholarship opportunities	24	19	57	18	18	58	36	16	48	8	23	69	15	22	63	25	14	61	29	16	55	17	20	63	17	23	60	23	13	63	32	22	46
Proximity to home	63	8	29	69	6	18	36	10	54	65	8	27	78	7	15	66	5	28	73	9	18	70	6	24	71	6	19	57	7	37	59	10	32
Appearance university grounds	64	8	27	61	6	26	59	12	28	65	4	23	70	11	19	67	7	26	62	13	25	54	6	41	71	6	23	77	3	20	73	6	21
<b>Responses to given statements:</b>																																	
Universities with many courses in one area indicating strength	82	13	4	74	14	4	88	10	2	69	15	15	85	15	0	82	12	3	75	22	4	85	15	0	79	15	6	87	10	3	86	5	3
Specialists degrees are more desirable than general ones	52	17	29	49	17	27	54	15	31	69	8	23	56	11	33	59	16	24	38	22	40	44	19	37	46	12	38	47	13	40	59	19	19
I am concerned about high HECS of SET degrees	40	25	34	35	23	36	46	27	27	42	19	38	56	22	22	41	24	34	22	27	51	37	30	33	46	15	38	60	20	20	24	29	44
Courses with high UAI are of better quality than those of lower UAI	29	19	51	27	13	54	32	32	36	4	19	73	22	19	59	35	13	50	35	13	53	30	15	56	17	15	67	20	27	53	51	13	32

a Numbers in parentheses are population size, numbers within table are percent respondents

b EFS: students enrolled in Division of Economic and Financial Studies

Points of discussions indicated in grey and significant trends coloured orange

A= Strongly Agree + Agree

DK= Don't Know

D= Strongly Disagree + Disagree

**Table Ten:** Points considered important by current Macquarie University students when choosing a university

## Science Professionals

A total of 74 science professionals responded to the survey. Each of the nine SET fields are represented with respondents largely from Biological or General Sciences. Responses from Engineering and Technology, Information, Computing and Communication Sciences and Mathematical Sciences were pooled (ICS cohort) due to low response rates from these groups. Following is a summary of results and trends, significance could not be calculated due to low population numbers.

### Science Professionals General SET attitudes

Participants were asked to respond to a range of statements covering general attitudes towards SET by rating each statement Strongly Agree, Agree, Don't Know/Not Relevant, Disagree, Strongly Disagree. For ease of display in the tables, responses to Agree or Disagree have been pooled.

#### **Table Eleven:** Science professional's general attitudes towards SET

- The large majority of respondents agreed to the importance of further promotion of SET to the wider community, with almost total agreement in the importance of high school SET and support for secondary SET education
- Agriculture and Environmental along with Earth and Physical Science representatives were more likely to perceive a dearth of SET role models
- ICS cohort were less likely to agree to the notion of a negative image surrounding SET and more likely to consider current mainstream media as effective communicators of SET
- ICS cohort along with Physical Sciences were less likely to agree that computers were not utilised effectively by greater community
- Chemistry and Physical Sciences representatives along with those with teaching experience were more likely to agree to the implementation of compulsory secondary science
- Representatives from Chemistry and Earth Sciences were more likely to consider postgraduate qualifications as essential for a SET career

#### **Discussion points:**

- Support from the general science community further indicates a requirement for active involvement in SET promotion in high schools

	All <sup>a</sup> (74)			Teacher/ Lecturer (45)			Field of profession																										
							Ag & Env (8)			Bio (30)			Chem (12)			Earth (7)			ICS Cohort (10)			Physical (10)			General (27)								
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D						
SET suffer negative community image	58	8	35	67	7	27	63	13	25	57	3	40	58	0	42	43	0	57	20	40	40	70	10	20	93	7	0						
Dearth of Australian SET role models	70	9	22	67	7	27	88	0	13	67	10	23	83	8	8	86	0	14	70	10	20	90	0	10	67	7	26						
Risk of shortage of SET professionals in near future	84	12	19	87	9	4	88	13	0	77	17	7	92	8	0	100	0	0	90	0	10	80	10	10	93	7	0						
Mainstream media effectively communicate SET	23	4	73	24	2	73	25	0	75	10	7	83	17	0	83	29	0	71	40	10	50	30	0	70	33	0	67						
Universities have role raising public profile of SET	95	5	1	98	2	0	75	25	0	93	7	0	92	8	0	100	0	0	100	0	0	80	10	10	93	7	0						
Universities have role supporting SET secondary education	89	5	7	89	4	7	88	0	13	93	3	3	92	0	8	100	0	0	80	10	10	100	0	0	89	7	4						
Funded reward schemes required to assist universities in SET community outreach	93	7	1	93	7	0	88	0	13	97	3	0	92	0	8	100	0	0	90	0	10	100	0	0	93	7	0						
Computers and IT not used to full potential by wider community	70	16	14	69	18	11	100	0	0	73	17	10	75	8	17	86	0	14	50	20	30	50	20	30	67	19	15						
Secondary science should be compulsory	74	0	27	84	0	13	63	0	38	70	0	30	92	0	8	86	0	14	70	0	30	90	0	10	67	0	33						
HSC science essential prerequisite for tertiary SET study	89	3	9	96	9	0	88	0	13	90	3	7	100	0	0	100	0	0	80	10	10	100	0	0	85	0	15						
SET major essential for science teachers	99	0	1	98	2	0	100	0	0	97	0	3	100	0	0	100	0	0	90	0	10	90	0	10	93	0	7						
Science teachers pivotal influence on future science students	99	1	1	98	0	0	88	13	0	97	0	3	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0						
Science teachers important role models general SET promotion	99	0	1	98	0	0	100	0	0	97	0	3	100	0	0	100	0	0	100	0	0	100	0	0	100	0	0						
SET education important for general education	95	3	4	91	2	4	100	0	0	90	3	7	100	0	0	100	0	0	100	0	0	90	10	0	93	0	7						
IT study important for general education	93	1	7	87	0	11	88	0	13	90	3	7	92	0	8	86	0	14	100	0	0	80	0	20	93	0	7						
Postgraduate qualification essential for SET career	59	14	28	53	18	27	63	13	25	53	23	23	75	8	17	86	0	14	60	0	40	50	20	30	52	19	30						

a Numbers in parentheses are population size, numbers within table are percent respondents

Points of discussions indicated in grey

A= Strongly Agree + Agree

DK= Don't Know

D= Strongly Disagree + Disagree

**Table Eleven:** Science professional's general attitudes towards SET

## Science Professional's Career attitudes and Experiences

Respondents were asked to list the jobs held over the past decade. These were grouped into 13 broad categories.

### **Table Twelve:** Jobs held by SET professionals over last decade

- Main job type for all the SET areas is teaching, excepting the ICS cohort who were largely involved in research
- Research rated second highest for Biology and Physical sciences
- Management roles were second highest for the fields of Chemistry, Earth and Agriculture and Environmental Sciences
- Respondents from the ICS cohort were also more likely to have non-science career experience
- Physical science and ICS cohort held the most variety of job types, followed by the General Sciences, Biology and those with teaching experience

### **Discussion points:**

- The propensity displayed by survey participants towards management roles can be highlighted to potential students to fulfil their requirement for higher remuneration and a chance for career advancement

Respondents were asked to select which general career aspects pertained to their SET career experiences. Multiple answers were allowed.

### **Table Thirteen:** SET professional's general career experiences

- The largest responses (more than 50 percent) were for the following
  - A job with plenty of variety and new challenges
  - A chance to interact with many different people
  - A job that benefits the community
  - Strong job security
- Groups whose majority differed from the general results
  - ICS cohort did not agree to benefiting the community or strong job security
  - Earth sciences did not agree to interacting with many different people
- Most groups also believed they had experience to be creative, with Earth and Biological Sciences less likely to agree
- General Sciences, Earth Sciences, Biology and those with teaching experience also considered working as part of a team as characteristic of their profession

Jobs held by science professionals in past decade	All <sup>a</sup> (74)	Teacher/ Lecturer (45)	Field of profession						
			Ag & Env (8)	Bio (30)	Chem (12)	Earth (7)	ICS Cohort (10)	Physical (10)	General (27)
Research	28	15	25	37	0	29	50	40	7
Teaching	61	100	63	67	75	71	20	50	93
Volunteer	4	0	0	0	17	0	10	0	0
Management	26	15	38	20	42	43	20	20	15
Marketing	4	4	0	7	8	0	10	0	0
Health services	8	7	13	17	8	0	10	10	4
Industry scientist	3	0	0	3	0	14	10	10	4
Student	7	4	0	10	0	14	10	10	0
Product development	1	0	13	0	0	14	10	10	4
Consultant	5	7	13	0	0	14	0	10	7
Unemployed	1	0	0	0	0	0	0	10	0
Communications	4	2	0	7	0	0	0	0	4
Non-science	8	4	13	7	0	14	20	10	7

a Numbers in parentheses are population size, numbers within table are percent respondents  
Points of discussions indicated in grey

**Table Twelve:** Jobs held by SET professionals over last decade

	All <sup>a</sup> (74)	Teacher/ Lecturer (45)	Field of profession						
			Ag & Env (8)	Bio (30)	Chem (12)	Earth (7)	ICS Cohort (10)	Physical (10)	General (27)
Strong job security	54	74	50	57	67	57	40	70	78
Variety & challenges	82	83	100	80	83	100	80	90	93
Benefits community	72	83	88	80	92	71	40	80	89
Earn good money	26	26	50	20	8	29	30	30	41
Interact with different people	74	74	88	73	83	43	70	80	81
Opportunity for travel	32	20	25	30	17	57	50	50	19
Opportunity for career advancement	33	39	38	30	42	14	50	50	48
Working outdoors	16	15	50	27	17	43	20	10	11
Exposure to cutting edge innovation	14	11	13	23	17	0	70	60	11
Chance to be own boss	12	17	25	13	25	14	40	50	19
Work 9-5	7	15	13	17	17	14	10	10	19
Work variable hours	30	33	38	43	25	43	40	40	22
Be creative	34	57	63	50	58	43	80	80	67
Opportunity to work as part of team	25	57	50	63	50	57	30	30	56
Further study or training	13	46	63	53	50	57	60	50	48

a Numbers in parentheses are population size, numbers within table are percent respondents  
Points of discussions indicated in grey

**Table Thirteen:** SET professional's general career experiences

Figure four represents the combined expectations of high school respondents and current Macquarie University respondents towards general SET career characteristics against the actual experiences of the SET professional respondents.

**Figure Four:** Comparison of expected versus actual experiences of SET careers

- High school students exhibit limited knowledge of true characteristics of SET careers, differing from SET professionals by more than 15 percent in nine of the 15 areas
- Current tertiary students hold more accurate opinions of SET careers than high school students, differing in only 4 areas by more than 15 percent
- Top three desired job characteristics cited by high school students match the top three experiences of SET professionals
- Only half of the top four desired job characteristics for current tertiary students match those experienced by SET professionals

**Discussion points:**

- The main job characteristics experienced by SET professionals are in line with the desired job characteristics of high school students, and to a certain extent current Macquarie University students. This is beneficial information that can be used when promoting the uptake of scientific careers
- High school students require accurate information to bring their opinions on SET careers more in line with the experiences of SET professionals

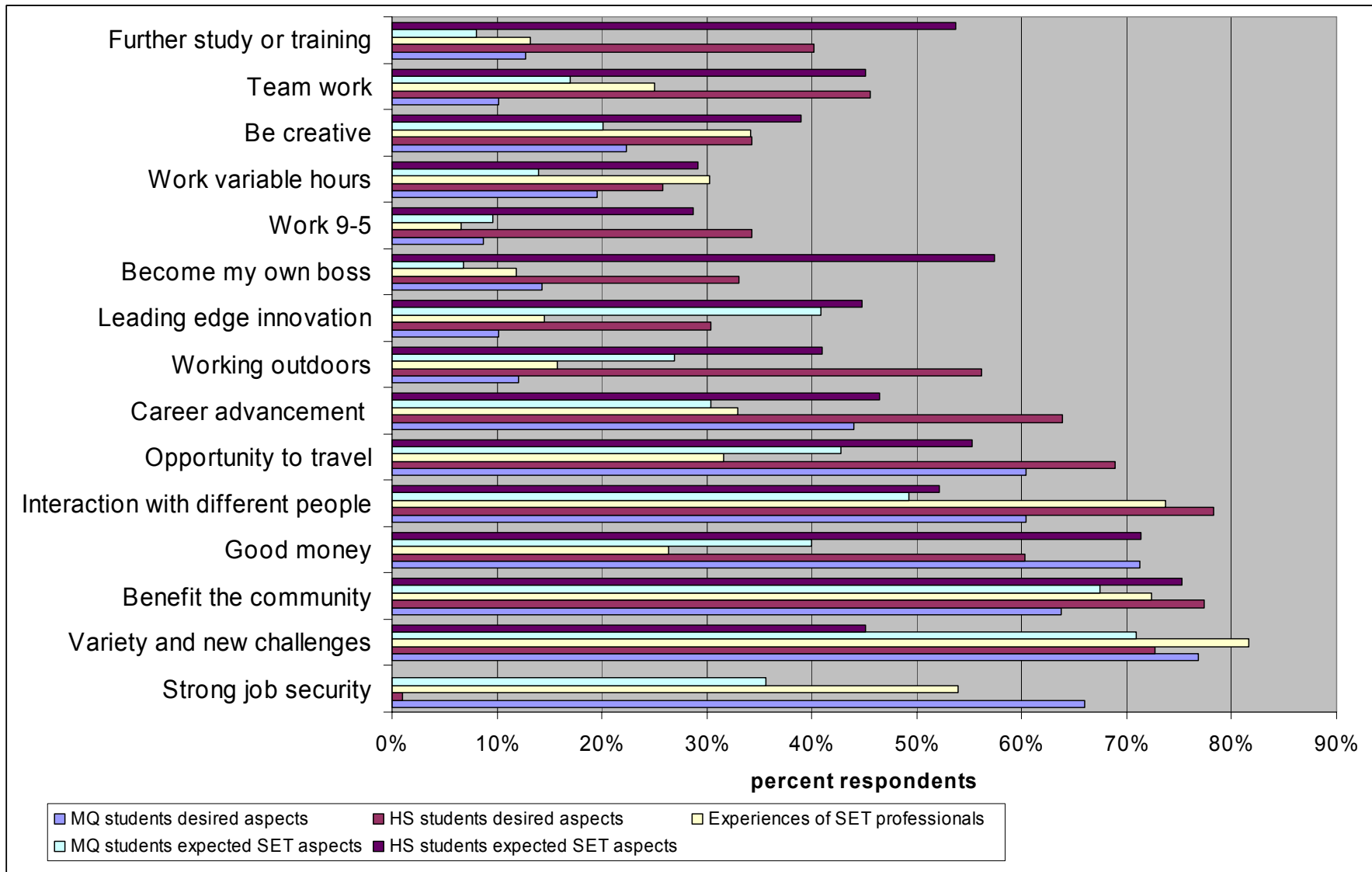
Participants were asked to rate statements relating to their experiences and attitudes towards SET, multiple answers were allowed.

**Table Fourteen:** SET Professional's attitudes towards SET careers

- Almost all respondents agreed they had always shown an interest in SET areas, and that there were a wide variety of SET careers to choose from
- More than half agreed that SET opportunities in Australia were limited having experienced difficulty in maintaining steady employment, particularly those from the ICS cohort
- Over half respondents were inspired through contact with a high school teacher or SET professional, particularly those from Earth Sciences
- Respondents from the Physical Sciences along with Agricultural and Environmental were more likely to agree that SET careers offered opportunity to earn good money
- Those within the ICS cohort were just as likely to discourage students into SET careers as they were to encourage

**Discussion points:**

- With such variety in both SET career types and experiences, it is important to obtain current and targeted information to feed to potential SET professionals to encourage their path in a SET area that will provide them with desired career characteristics



**Figure Four:** Comparison of expected versus actual experiences of SET careers

	All <sup>a</sup> (74)			Teacher/ Lecturer (45)			Field of profession																							
							Ag & Env (8)			Bio (30)			Chem (12)			Earth (7)			ICS Cohort (10)			Physical (10)			General (27)					
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D			
Always been interested in SET	96	0	4	98	0	2	100	0	0	97	0	3	100	0	0	100	0	0	90	0	10	100	0	0	96	0	4			
Inspired by teachers or other SET professionals	67	11	23	65	11	20	63	25	13	70	7	23	67	17	17	86	0	14	60	0	40	60	0	40	67	11	22			
Wide variety of SET careers	85	3	11	67	2	9	100	0	0	87	7	7	67	0	17	100	0	0	90	0	10	90	0	10	89	0	11			
SET careers offer competitive wages	44	3	53	46	2	52	75	0	25	30	0	70	25	0	75	43	0	57	50	10	40	70	0	30	52	4	44			
Encourage more people to pursue SET career	72	9	17	87	7	7	88	13	0	63	13	23	42	25	33	100	0	0	60	10	30	60	10	30	85	11	4			
Had difficulty maintaining steady SET employment	32	12	56	17	13	70	25	13	63	33	17	50	25	8	67	14	0	86	50	10	40	30	10	60	11	22	67			
Teaching careers not as rewarding as other SET careers	37	23	40	37	17	46	25	13	63	40	33	27	33	8	58	57	14	29	50	20	30	40	10	50	30	11	59			
Australia not competitive in SET opportunities	64	16	17	67	17	15	75	0	25	63	20	17	83	8	8	86	0	14	70	10	20	70	10	20	56	26	19			
Encourage tertiary SET study but not necessarily SET career path	28	19	53	22	13	65	13	25	63	23	27	50	33	8	58	0	0	100	50	0	50	30	30	40	26	11	63			

a Numbers in parentheses are population size, numbers within table are percent respondents  
Points of discussions indicated in grey

**Table Fourteen:** SET Professional’s attitudes towards SET careers

## Employers of Graduates

A total of 56 individuals responded to the survey, with all SET fields fairly evenly represented; Mathematics, Health Sciences and Life Sciences slightly under-represented. Education and training was the majority represented function, followed by research, then engineering and community services. Following is a summary of significant results and trends, for a full report and discussion of survey results see Supplementary Report 3 *Current Macquarie University Student-attitudes towards SET study and careers*.

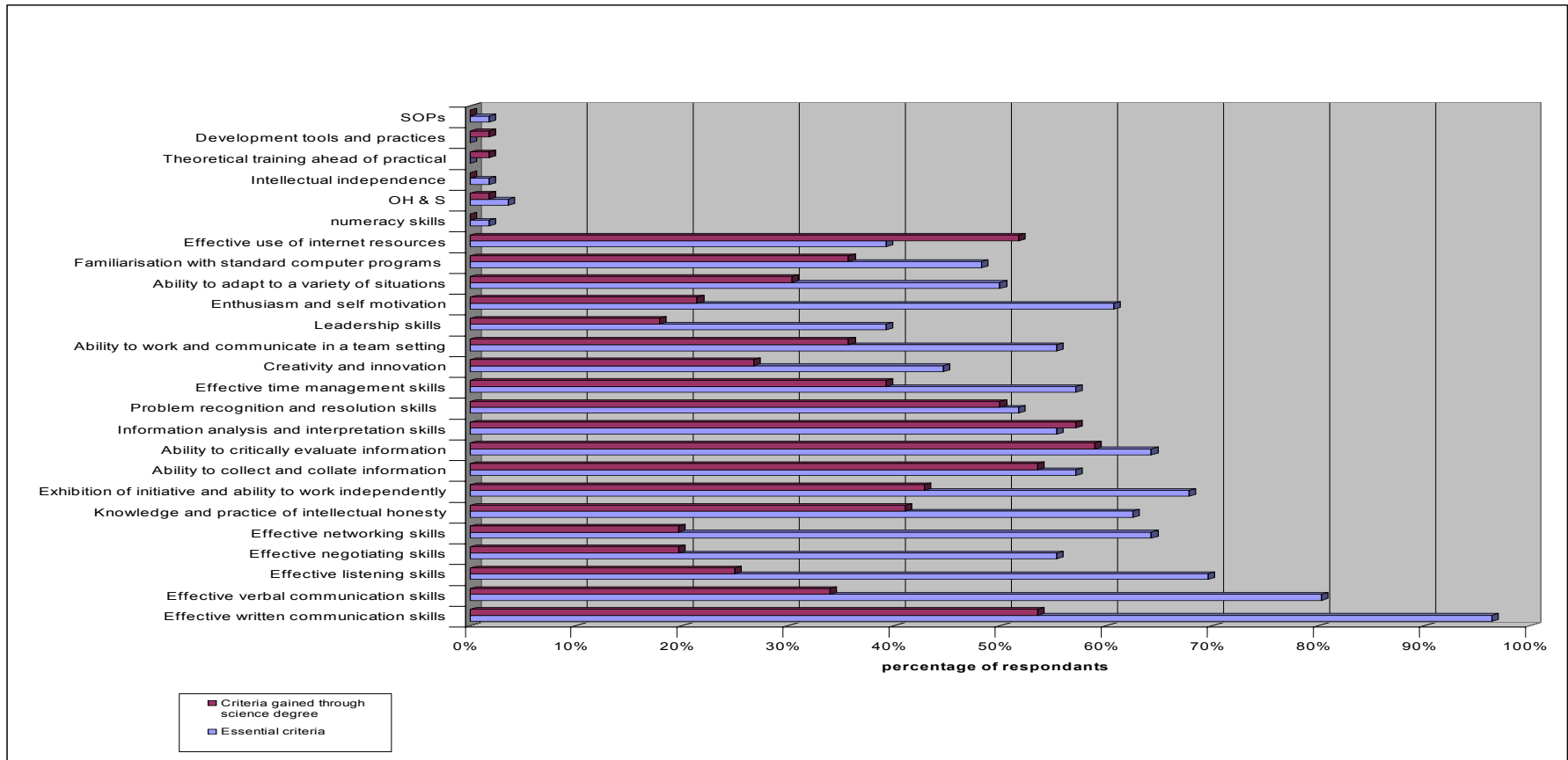
### Graduate skills requirements

Employers were asked if they employ university graduates, and were then presented with a list of all SET unit areas offered by Macquarie University and asked which areas were considered desirable in prospective employees. They were then presented with a list of generic skills and asked to indicate which skills were essential for prospective employees and then which of the same skills they considered to be present in graduates of a BSc

- Just over two-thirds of respondents indicated the availability of job placements to new graduates
- Just over one-thirds of respondents were happy with the number and quality of applicants for advertised positions with forty percent expressing dissatisfaction
- The top five areas of education indicated as desirable by over one-third of employers were (in order of popularity)
  - Physics
  - Biology
  - Chemistry
  - Information, Technology and Computing
  - Mathematics (equal 4th with ITC)

### Figure Five: Essential versus expected generic job skills as seen by graduate employers

- Effective written communication skills were deemed essential by nearly 100 percent of respondents, with 80 percent deeming oral communication skills essential also
- The next most desirable criteria for over 60 percent of respondents were (in order of preferences)
  - Effective listening skills
  - Exhibition of initiative and ability to work independently
  - Effective networking skills
  - Ability to critically evaluate information
  - Ability to work and communicate in a team setting



**Figure Five:** Essential versus expected generic job skills as seen by graduate employers

- The following generic skills were cited as being gained through a BSc degree by over 50 percent of respondents
  - Ability to critically evaluate information
  - Ability to effectively analyse information and draw appropriate conclusions
  - Ability to collect and collate information
  - Effective written communication skills
  - Effective use of Internet resources
- Aspects showing close relationship (less than 6 percent difference)
  - Ability to recognise problems or issues and apply effective problem solving skills in a variety of settings
  - Ability to effectively analyse information and draw appropriate conclusions
  - Ability to collect and collate information
  - Ability to critically evaluate information
- There were large differences (on average more than 20 percent) in response rates between desired and expected for all other generic job skills

**Discussion points:**

- Although many of the essential criteria match up with the main criteria thought to be achieved through a BSc education, the large differences in actual response rates indicate a level of dissatisfaction and a general lack of confidence in the quality of university graduates
- Employers appear to place more importance on generic skills than specific skills. The specific SET skills cited as most desirable by the majority of respondents fall under general SET skills rather than specialised disciplines

# Focus Groups

## High School Student Focus Groups

Table Fifteen shows the numbers of students involved in the discussions, across various year groups from participating high schools.

- Two hundred and fifteen students participated, representing 20 high schools across NSW
- Even spread across all school types, gender, year group and school area, with a slight preference towards schools in the north district of Sydney metropolitan area

## High School Student General Attitudes and Opinions Toward SET

- Responses to questions on general attitudes and experiences of SET were uniform across the participating schools; no differences in attitudes were seen between type of school, gender or year group
- Twenty groups raised high school experiences as their only contact with SET
- “Good science teachers” were raised as the major (and in most cases sole) positive influence to encourage interest in SET areas; main characteristic of a “good” teacher was cited as enthusiasm
- Conversely, science teachers displaying a lack of enthusiasm was raised as a major turn off in over half of the groups
- Majority of groups described strong positive attitudes towards practical experiments; describing them as exciting, engaging, and allowing for a deeper understanding and retention of the required knowledge
- The practice of copying notes direct from text book to exercise book was discussed in the majority of groups and seen as a major turn-off to students

### Discussion points:

- Again, science teachers have been raised as a major influence on the attitudes of high school students towards SET. School outreach activities can bear this in mind, in addition to the mention of positive attitudes towards practical exercises
- Once again, the style of teaching and school curricula was raised as a major influence in turning students away from choosing science in their senior years. This point will be expanded upon in the Supplementary Report 1

	Number	North	South	East	West	Regional	Country	Single Sex	Selective	Catholic
Year 10	109	42	15	9	20	9	14	29	16	20
Year 11	82	22	9	3	32	5	8	25	20	25
Year 12	24	9	0	0	3	8		4	8	1
<b>Total</b>	<b>215</b>									

**Table Fifteen:** High School Students involved in focus group discussions

## High School Student Expectations and Opinions Toward Tertiary Study

Responses to this discussion topic varied, depending on region of school, type of school and year group. These differences are outlined separately after the following comments pertaining to all participating students

- Without exception, responses to tertiary study choices centred on career paths, with students viewing a university education as a direct means to moving into a specific career
- Every participant expressed desire to attend university with only three individuals (from two metropolitan groups and one country group) indicating no interest
- All groups expressed a general desire to learn more about the day to day activities and requirements of university life, wanting detailed information about what they would be learning in each subject or course program, including how subjects were chosen and taught
- Friends and family members were cited as their main avenue in gaining this information; careers advisors were indicated as another resource only when prompted

### Discussion points:

- Information and support for students needs to be presented in the context of future career paths
- Targeted information for parents is warranted, as they are a strong influence for potential students

## Expectations and opinions towards careers and study areas

### Attitudes towards SET Careers:

- Twenty two students across all the groups expressed an unprompted desire to pursue study in a SET-based area at a tertiary level, with seven of those indicating a preference for medicine.
- SET study areas cited were (student numbers in parentheses)
  - Medicine (7)
  - Engineering (4)
  - Information Technology (3)
  - Psychology (2)
  - Biology (2)
  - Physiotherapy (1)
  - Marine Biology (1)
  - Telecommunications (1)
  - Robotics (1)
  - Nursing (1)

- In contrast 33 students expressed interest in business or economics related study and careers and 19 students indicated law would be their first preference
- When asked what factors were important when choosing a career the following were raised (in order of frequency and importance)
  - Enjoyable or interesting
  - Job availability
  - Money
  - Prestige
  - Benefiting the community
- Without exception, each participant agreed that they had limited knowledge of the opportunity and variability of career options within SET areas
- Unprompted career options raised when questioned were very limited:
  - Medicine was offered as one of the only known career options for more than half the respondents
  - Engineering was cited in just under one third of groups
    - Students had limited understanding of the variation within engineering careers in addition to the actualities of what engineering entailed
  - Except for the few individuals who had direct family contact with someone working in a scientific area, students could not name any occupations involving the areas of Chemistry, Physics or Mathematics

**Discussion points:**

- Focus on providing accurate and detailed information on the variety of possible SET careers, particularly in the areas that are showing demand for graduates

Resources used for information on SET careers:

- When questioned, a very limited number of unprompted suggestions were offered as desired information resources (student numbers in parentheses):
  - Career specific days with access to a range of professionals in different science areas (1)
  - Individual access to current university students or recent graduates for detailed, personalised information and feedback (2)
  - Internet sites with detailed information on the day-to-day activities of various individuals in SET careers (3)
- When prompted, students welcomed the idea of receiving information on career options from their science teachers, linked to the various study areas covered throughout the year
  - This exercise was seen as a way to directly link an interest or enjoyment of a particular activity with possible future study or career choices in that same area

**Discussion points:**

- There is opportunity for Web-based collaboration between secondary and tertiary education institutions and industry to aid in the transfer of information on current job opportunities or updates on particular SET industries

## **Influences on students' attitudes and opinions**

### Attitudes towards SET:

- Without exception, students identified their high school science teacher as the strongest influence on whether they were interested in or enjoyed SET, thus whether they would consider further study or careers in these areas
- The majority of students indicated they enjoyed most or all of the science classes throughout Years 7-9
- The major focus on scientific-theory and the requirement to memorise facts, figures and specific terminology in the year 10 syllabus, was raised as a major turn off in over two-thirds of the groups
- Students who had not chosen science in their senior years indicated on the most part this was because they did not enjoy science in Year 10, with a secondary reason that they could not see further science education benefiting their chosen career path
- Students discussed the direct correlation between the enthusiasm displayed by different teachers throughout year 10 and their level of enjoyment of that subject area, irrespective of the particular subject
- If students had a particularly engaging science experience, such as a university visit, unique or novel experiment experience, or interesting/passionate anecdotal accounts, they would continue to draw on this positive experience when deciding future study or career options

### **Discussion points:**

- Once again this is a clear indication that high school SET experiences are instrumental in shaping the long term study and career paths of high school students; the shift in enjoyment between junior and senior years is largely due to the decrease in opportunity for practical experimentation and the large focus on rote learning large amounts of information
- The changing science curricula has been implicated as a considerable turn-off to many of the high school students involved in the focus group discussions. This point is expanded upon in the Supplementary Report 1
- Short of adopting further change to the official science curricula, activities that highlight the practical nature of science and relate the true feeling of discovery will go a long way in re-engaging high school students and keeping their interest in SET areas
- Support for high school teachers is also necessary to aid them in their very important role

## **Science Faculty Focus Groups**

### Issues facing high school science teachers:

- Without exception, science teachers cite time pressures as their major concern
- Most teachers are aware that maintaining the interest of high school students requires involvement in engaging practical lessons, but they do not believe the current curricula allow adequate time for such exercises
- Many teachers did not feel confident they had appropriate and relevant information with which to support high school students, particularly with regards to providing career information

### **Discussion points:**

- Teachers require assistance to allow them to expand upon the range of engaging class activities and experimental lessons offered to their students in order to increase retention rates for HSC science
- Any support or contact with science teachers to assist them in gaining current and relevant careers information would need to be mindful of their restricted time schedules

# Conclusions

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## General perception of Science Engineering & Technology

- Majority of all respondents agree that SET are exciting and relevant to the wider community
- Drop in popularity of SET-based subjects both secondary and tertiary is an international phenomenon
- NSW HSC subject enrolment data indicate students are turning away from these areas early in their education
- Enthusiasm of high school science teachers cited as very important influence; unengaging science classes and a theory-heavy senior school science curriculum with limited experimental exposure contribute to students turning away from SET
- General belief that SET can be interesting and fun but prospective students have very limited understanding of the opportunities available thus do not see SET areas as fulfilling their study and career requirements
- Science professionals express disappointment at the lack of support and awareness towards SET from the greater community
- Universities seen as important players in promoting SET areas to high schools and the greater community
- Science media such as documentaries, magazines and public spokespeople have positive influence in raising awareness and interest in SET
- All surveyed groups support access to centralised, Internet based information with general updates on SET areas, research, study and careers
- Collaboration with government or other tertiary institutions is desirable to promote interest and awareness of SET in general

## Attitudes Towards SET Study and Careers

- Education in the SET areas seen as important and relevant to majority of respondents but many high school students believe SET tertiary study is beyond their intellectual capacity
- Hands on activities and a focus on the relevance of information given are important to hold interest of high school students, particularly through the Year 10 science curriculum
- Large proportion of all respondents believe exposure to some SET tertiary study important, regardless of primary area of study
- Prospective students view tertiary study as means to gain experience to directly improve career prospects, thus awareness of SET study options limited to well-known SET career areas such as medicine and, to a certain extent, engineering
- High school and current tertiary students' understanding of SET career characteristics do not match with desired job characteristics, thus SET careers are not considered as a fulfilling future

- High school students exhibit fairly inaccurate opinions towards general SET career characteristics, differing from the actual experiences of the SET professionals in most of their attitudes
- Majority of respondents had limited understanding of most SET careers and expressed interest in learning more about range of available possibilities
- General interest in a specific area is the main influence for study and career choice along with desire to benefit community, job availability, financial security and exposure to new and interesting experiences

## **Closing Remarks**

Results from this study support much of the previous research on the current state of SET, particularly in relation to the importance of secondary SET education (Dekkers, & De Laeter, 2001; Lyons, 2004; Mattick Report, 2002; Science teaching and research, which way forward for Australian universities?, 2004; TFW, 2005; Harris, Jenz & Baldwin, 2005). The impetus for this study came from the observation that tertiary student enrolments in SET were declining, however it is recognised that this phenomenon is but a single manifestation of a multi-faceted situation. Responses to the survey support the widely held notion that SET suffers from a general negative image in the community. Combine this with the dissatisfaction of many of the science professionals towards the activities of main stream media and, to a certain extent government, with respect to support for general SET issues, and it is clear that this situation is beyond the scope of a single entity such as Macquarie University to address. Universities, however, do have a role to play in supporting SET education and promotion, a view point supported by the majority of survey respondents. Targeted collaborative exercises, combining the resources of universities with that of relevant government or industry bodies would be the most effective response to many of the points raised within this study.

Although there is evidence to indicate that many of the SET areas are suffering there are positive points that have arisen from this study. The majority of respondents indicated a general interest for SET and agreed to the relevance of these areas to society as a whole. The requirement for effective and accurate information, however, has been continually cited; in the case of future students and their study and career options, through to broader communication and promotional activities for the greater community. Not surprisingly the majority of recommendations arising from this study centre on increased communication; between universities and industry and government bodies, universities and high schools as well as universities and the community at large. There are already many positive initiatives that support this requirement so efforts can be focused on improving the impact and overall awareness of these activities. Issues raised with respect to science education, particularly at the secondary level, are more complex and require focused collaboration between the relevant government bodies, schools and, to a certain extent, universities.

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