RESEARCH REPORT:

Literature Review of Science, Engineering and Technology (SET) Awareness Raising Activities

CONDUCTED FOR:
DEPARTMENT OF EDUCATION, SCIENCE AND TRAINING

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<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>EXECUTIVE SUMMARY</td>
<td>5</td>
</tr>
<tr>
<td>Section One: Initiatives to increase interest in Science, Engineering &amp; Technology</td>
<td>8</td>
</tr>
<tr>
<td>Section Two: Evaluations of initiatives to increase interest in Science, Engineering &amp; Technology</td>
<td>14</td>
</tr>
<tr>
<td>The Way Forward</td>
<td>26</td>
</tr>
<tr>
<td>Appendix A: Initiatives to increase interest in SET</td>
<td>29</td>
</tr>
<tr>
<td>Appendix B: Reference list</td>
<td>46</td>
</tr>
</tbody>
</table>
Executive Summary

The purpose of this review was to provide an audit of initiatives in Australia that have as their goal the raising of Science, Engineering and Technology (SET) awareness. This review has indicated that there are a large number of events in the community with this broad aim, 100 of which are detailed in Appendix A of this report. These have been developed by a wide range of organisations, ranging from large organisations with significant involvement in national efforts to raise awareness of SET, through to specialist organisations, as well as professional associations, corporations, universities, and museums.

The way that these initiatives have been developed also varies considerably as does their budget, location, target audience and objectives.

The landscape of SET initiatives in the community therefore consists of a large number of coordinated national efforts, events under an ‘umbrella’ which ties them together, institutions working together on initiatives which cross disciplines, as well as numerous initiatives and events which have been organised independently.

Detailed Initiative Objectives

While the stated objectives or mission statements of the initiatives clearly vary (as can be seen in Appendix A) there does appear to be a strong trend towards trying to increase the likelihood of students in particular going on to study and then work in SET related areas.

Many programs are aimed at high school students, and to a lesser extent primary school students, rather than the broader community or business employer targets.

There are numerous initiatives with the stated objective to ‘raise the profile’ of SET in general, or of a specific area of SET such as microbiology or electrical engineering.

Challenging stereotypes and dispelling myths around SET is also a common objective.

Another trend in objectives that was observed were efforts made to link science to everyday life, and accentuate this connection, thus making SET appear more relevant and appealing.

There were also initiatives that cross institutions and topics to try to connect science with other areas or fields in society, and there were also a few other programs with different objectives such as bringing professionals together to generate intelligent discussion and therefore increase public awareness of certain issues in science.

In terms of the fields of SET covered by these initiatives, it appears that wide coverage is being achieved and there are not any significant gaps. There does seem to be a focus on general science, however, there is also an emphasis on areas that are more practical, outwardly relevant or cutting edge such as nanotechnology, biotechnology or artificial intelligence.

Mode of Operation

The analysis of SET awareness raising initiatives for this Literature Review indicates that interactive-based initiatives are by far the most common mode of operation. This strong emphasis on hands-on, interactive, experiential programs designed to show science in action was generally linked to the objective of making SET appear relevant, fun and interesting.
While interactive experiences were clearly the predominant type of awareness raising activity due to their ability to engage and involve, there were also a variety of other types of initiatives in operation, such as prizes and competitions, professional forums, radio programs, performances and film events and a variety of popular science literature such as magazines and books.

Geographical Location

The geographical location of delivery of awareness raising initiatives generally falls in to three broad categories:

- Nationally based travelling shows covering at least several areas of Australia,
- Specific, fixed locations such as a university or telescope site, and
- Initiatives which are independent of geography,

(Note: Fixed location initiatives in rural areas tend to be under-represented and therefore these areas rely heavily on travelling shows).

Target Audience

The majority of the initiatives are targeting a mainstream audience – that is members of the general community as opposed to those already involved with SET, but as mentioned, from the number of initiatives we analysed, high school students were the most common target audience. Primary school and university students are also frequently targeted amongst the initiatives we found. Science teachers are another lesser target audience, however it appears little has specifically been done targeting business or employers.

Initiative evaluation methods

The second stage of this review examined available data to determine the success of SET awareness raising initiatives in terms of achieving their objectives, as well as their overall effect on public awareness, understanding and interest in SET.

From the articles reviewed evaluation of these programs seemed to be limited. The majority of articles commented on the need for evaluation of SET awareness raising initiatives rather than actual evaluation of the initiatives that has been conducted. The majority of articles we analysed explicitly stated that the need for evaluation was paramount as an effective way of learning how to do things better, providing direction, determining effectiveness and justifying the use of funds.

Existing Data

Existing data on the effectiveness of SET initiatives consists of the following types:

- Evaluations of specific initiatives, or umbrella events, such as National Science Week, conducted by the organisers of these events.
- General comments regarding initiatives in the media.
- Formal Australian evaluations, and
- International studies which can be used to shed some light on the situation in Australia.

Formal Australian Evaluations

The review revealed that formal, wide-ranging evaluations of SET initiatives in Australia were very limited. The Macquarie University Science, Engineering and Technology Study (2005) is the only recent study that was found in this review. Two other broad reviews were conducted in

**Evaluation Methodology**

Metcalfe and Perry (2001) outline a number of obstacles that need to be overcome for effective evaluation of science programs. These include:

- Perceptions of cost and difficulty,
- Unwillingness to undertake a process that may portray the organisation in a negative light,
- Complexity of the objectives of initiatives,
- The lack of practical tools for evaluation, and,
- The dynamic nature of science communication and perception that things are always changing.

While some of these issues, particularly cost, were perceived to be significant barriers, a number of evaluation tools were noted as available (Gascoigne and Metcalfe, 2001) such as:

- Focus groups
- Unstructured interviews
- Questionnaires
- Surveys
- Opinion polls
- Observing behavioural change
- Analysing feedback
- Desktop analysis of newspaper clippings.

To arrive at a clear national benchmark and conclusions about real changes it would seem there is a need for a study to be conducted which can both provide an update on some of the previously measured attitudes toward SET in Australia and current awareness levels of SET initiatives and their impact. A possible broad methodology for this is discussed in the body of this report. This would supplement the findings of other evaluations and studies such as the Macquarie University SET study (2005) and DEST’s Audit of Science, Engineering and Technology (2006).
Section One: Initiatives to Increase Interest in Science, Engineering and Technology

Overview

The purpose of this review is to provide an audit of initiatives with the goal of raising Science, Engineering and Technology (SET) awareness. This review has indicated that there are a large number of events in the community which are aiming to raise awareness of some aspect of SET. These initiatives, 100 of which are detailed in Appendix A of this report, have been developed by a wide range of organisations from large organisations with significant involvement in national efforts to raise awareness of SET such as the Australian Government Department of Education, Science and Training (DEST), through to specialist organisations including Questacon and Scitech, as well as professional associations (eg. Engineers Australia), corporations (eg. Siemens, Origin Energy), universities, museums and special interest groups.

The way that these initiatives have been developed varies considerably as does their budget, location, target audience and objectives. Due to the strong Commonwealth Government push to promote awareness of SET, there are a wide range of 'umbrellas' or coordinated events and programs developed by individual organisations, such as the Science and Technology Awareness Program, National Science Week\(^1\) and Australian National Chemistry Week\(^96\).

There are also numerous initiatives which have been developed by a number of organisations working together. Particularly in areas where there are multidisciplinary issues challenging science such as energy production, climate change, crime, transportation, biotechnology, healthcare and communications which contain aspects that lie outside the boundaries of established disciplines.

The landscape of SET initiatives in the community therefore consists of large number of coordinated national efforts, events under an 'umbrella' which ties them together (e.g. National Science Week\(^1\)), institutions working together on initiatives which cross disciplines (e.g. National Youth Science Forum\(^50\)) as well as numerous initiatives and events which have been organised independently (e.g. Dreamworld’s Education programs\(^5\)). Consequently, there is a plethora of often uncoordinated, overlapping initiatives from a wide range of institutions. Due to the large number of independent initiatives that are in existence this review has identified trends but is not an exhaustive picture of SET awareness raising initiatives in Australia.

The Initiatives

The SET awareness raising initiatives which have been identified in this review are outlined in Appendix A. This listing provides a brief description of each initiative as well as noting which area of SET it is aiming to increase awareness of, its location, target audience and timing.

Objectives

While the stated objectives or mission statements of the initiatives clearly vary (as can be seen in Appendix A) there does appear to be a strong trend towards trying to increase the likelihood of students going on to study and then work in SET related areas. For example, the Neighbourhood Engineering Scheme\(^8\) run by Engineers Australia links a member of the engineering workforce to a local secondary school to “place students in an informed position to consider a career in engineering”. Nonetheless, a broader aim of this program is also stated – that the students learn to translate technical knowledge into everyday situations. The aim of
increasing the likelihood of further study is often not stated explicitly as an objective but can be
inferred from the nature of the program – i.e. many programs are aimed at high school students
(e.g. the Siemens Science Experience\textsuperscript{2}, Flower Pirates\textsuperscript{10} and the CSIRO DNA and Genetic
Engineering student workshops\textsuperscript{13}) and to a lesser extent primary school students (e.g.
Australian Botanic Gardens Education Program\textsuperscript{18} and Phiggles the Flying Scientist\textsuperscript{20}) and offer
a range of activities to allow them to participate in and engage with science. Primary and
secondary school students could be seen as ‘potential science professionals’ yet to decide a
career path and thought to be open to opportunity and engagement.

There are numerous initiatives with the stated objective to ‘raise the profile’ of SET in general or
of a specific area of SET such as microbiology or electrical engineering. Awards and prizes
such as The Western Australian Premier’s Science Awards\textsuperscript{63}, Inventor of the Year\textsuperscript{64}, The
Eureka Prize\textsuperscript{65} and Fresh Science\textsuperscript{72} all aim to raise awareness of particular scientists or science
in general. In this way, such initiatives are aiming to instil a sense of community pride in science
education and research.

Challenging stereotypes and dispelling myths around SET is a common objective and may
assist in raising the profile of SET. For example, Science in the Pub\textsuperscript{61} (1998-2004) aimed to
take science to the wider community in an informal manner which demystified and humanised
science. Similarly, engaging, interactive and outreach initiatives are often intended to dispel the
myth that science is boring or a mass of facts. The Biology Madness Kit\textsuperscript{9}, that allows children to
carry out experiments at home, and the Flower Pirates program\textsuperscript{10}, a hands-on DNA
manipulation workshop, aim to engage children and teenagers and get them excited about
science through this interaction.

Many initiatives try to link science to everyday life and accentuate this connection, thus making
SET appear relevant and appealing. This is particularly noteworthy amongst National Science
Week\textsuperscript{1} events, for example ‘The Science of Underwear’ and ‘Shopping Trolley Science’, which
link everyday and household items to SET lessons and facts.

There are also numerous initiatives which cross institutions and topics and connect science with
other areas or fields in society. ‘Tall poppies: Science and the Law\textsuperscript{14} (a mock court trial with a
forensic science twist) and Scinema\textsuperscript{86} (a science film festival which combines science and art)
were both part of National Science Week\textsuperscript{1}. Other initiatives aim to achieve appreciation of ‘real
life’ SET with a focus upon careers and practical aspects. Flower Pirates\textsuperscript{10} involves a school lab
test to learn to tell whether a flower is ‘true blue’ or a pirated copy. In this way, students learn
that technology has real results.

This objective can be further seen in the efforts made to link the science profession and industry
to the classroom and ‘potential science professionals’. ‘Twinning Teachers with Scientists\textsuperscript{14}
matches teachers with scientists, bringing fresh ideas to the classroom and aiming to “make
lessons relevant to real-life laboratories and careers in science” (Anderson, 2005). The
Neighbourhood Engineering Scheme\textsuperscript{8} links a member of the engineering workforce with a local
secondary school, while some mentoring programs connect students studying science at
university to schools or to professionals already working in the industry.

There is also a raft of other programs with different objectives such as bringing professionals
together to generate intelligent discussion (e.g. National Biotechnology Conference\textsuperscript{63} and the
Fenner Population and Environment Conference\textsuperscript{56}) and increase public awareness of certain
issues in science. Interestingly, although it is not their primary function, these campaigns can
also be a part of making science more appealing to students by raising its profile and making it
seem more relevant and connected to everyday life. This review did not identify individual
initiatives which as a key objective try to change societal behaviour, such as by being sunsmart
or encourage healthy dietary behaviour although doubtless there is an abundance of such
programs. They however do not seem to be positioned as science awareness raising initiatives (instead they fit into other categories such as social marketing).

Coverage of Areas of SET

In terms of the fields of SET covered by these initiatives, it appears that wide coverage is being achieved and there are not any significant gaps. There does seem to be a focus on general science (e.g. science fairs, science experiences and science road shows such as Great Big Science Gig\(^1\), Scitech Roadshow\(^17\) and Science Alive\(^24\)) rather than a predominance of activities focused only on one specific area of SET. This seems to relate to an objective of getting students to pursue further studies in science (i.e. Bachelor of Science) rather than making specific career choices in one area of science.

However, there is also an emphasis on areas that are more practical, outwardly relevant or cutting edge such as nanotechnology, biotechnology or artificial intelligence. Additionally, there is also an interest in domains seen in popular culture which have captured the popular imagination such as forensics (e.g. Forensic Science in Action\(^1\) and CSIRO’s Labs On Legs Programs\(^11\)) and genetic engineering (e.g. Flower Pirates\(^10\)). Finally, there seems to be a declining interest in IT, despite this area becoming increasingly relevant in society.

Mode of Operation

An analysis of SET awareness raising initiatives for this Literature Review indicates that interactive-based initiatives are by far the most common mode of operation. This strong emphasis on hands-on, interactive, experiential programs designed to show science in action seems to be linked to an objective of making SET appear relevant, fun and interesting. It is thought that actively involving people using a variety of awareness raising strategies and giving them the opportunity to participate in, touch, feel or experience SET will create a sense of interest and excitement and more fully engage them in SET. In this way, interactive initiatives are often preferred as a way to present science as a lot more than just a mass of facts. For children and teenagers especially, initiatives that allow practical participation such as workshops, activities and challenges are often chosen over lectures (e.g. the PowerHouse Museum exhibition - ‘Toys: Science at Play’\(^7\) and the ‘Jason Project’\(^12\)).

To convey this ‘fun feel’, many of these initiatives, particularly those spanning across multiple science areas, promote themselves as highly involving experiences by using ‘big language’ and make frequent use of alliteration and puns in an attempt to establish a colloquial tone, for example ‘Celebration of Science’, ‘Inspiring Science’ ‘Mathemagical Mystery Tour’ and ‘Wild and Wriggling’ – events which are part of National Science Week\(^1\). The language is often mainstream and avoids sounding too technical.

There is also a strong emphasis on group work in interactive initiatives, for example in CREST\(^16\) (Creativity in Science and Technology), EngQuest\(^77\) and The SunSprint Model Solar Car Challenge\(^79\). This is most notable in SET-based competitions. By fostering social interaction while participants are engaging in science, it could be that organisers are aiming to dispel the myth that science is disconnected, isolated and inhibits your social life. Again, challenging stereotypes, myths and misperceptions about SET is a common aim or objective.

As outlined in Appendix A, the interactive experiences which have been offered are quite diverse and range across the spectrum of SET areas including many spanning across science generally (e.g. National Science Week events\(^1\), The Siemens Science Experience’ and Plasma newsletter\(^37\)) as well as specialist areas such as physics (e.g. The World Year of Physics events\(^98\), biology (e.g. Biology Madness Kit\(^8\)), genetic engineering (e.g. Flower Pirates\(^10\)), electrical engineering (e.g. Electronics Industry Association Information Events\(^46\)) and ICT (e.g Jason Project\(^12\)). Accordingly they are conducted by a wide range of organisations from
coordinated national efforts (for example National Science Week\(^1\)) to localised university-run programs (e.g. Edith Cowan University Peer Tutoring\(^{10}\) and Central Queensland University’s Women In Computing Program\(^{33}\)). While some require payment (such as the University of Sydney’s 2006 Summer School – the Art of Scientific Explanation\(^{98}\)), many interactive events (such as those offered by Questacon: The Indigenous Outreach Program\(^{29}\) and Smart Moves\(^{37}\)) are free.

While interactive experiences are clearly the predominant type of awareness raising activity, there are also a variety of other types of initiatives in operation, such as prizes and competitions, professional forums, radio programs, performances and film events and a variety of popular science literature such as magazines and books. These are outlined below. Prizes and competitions are a popular area of science awareness raising and in many cases, may be interactive. There are numerous different prizes offered within the SET arena, for example the Bob Squire Science Award\(^{92}\), Inventor of the Year\(^{84}\) and the Eureka Prize\(^{66}\) (for more information on science prizes see Appendix A). While those eligible for the prizes vary, the most common groups are students (e.g. WA Schools Environmental Education for Sustainability Awards\(^{74}\)) with prizes often being offered by science teachers associations, science teachers, and professionals in SET industries (ranging from junior researchers to senior and highly esteemed professionals).

The objectives of these prizes clearly vary depending on the nature of the prize. Prizes for science students and teachers are aimed at trying to improve the quality of or engagement in science teaching in order to increase the likelihood of students undertaking further studies in SET and subsequently going on to work in a SET related occupation. Prizes honouring professionals are more likely to be focussed on raising the profile of SET in the community (e.g. The Eureka Prize\(^{65}\) and Fresh Science\(^{72}\)) and/or specifically raising awareness of and understanding of a particular field (e.g. The Young Water Scientist of the Year Award\(^{70}\)).

The target audience for competitions (where participants enter and compete in specific activities) is generally primary or high school students with the field of science commonly including both general science (such as the RioTinto Big Science Competition, previously called the Australian Science Olympiads\(^{75}\)) and specific subjects such as the Mathematics Talent Quest\(^{80}\) and Spatial Technology in Schools competition\(^{81}\). While competitions involve participants receiving a prize, the nature of the prizes awarded differs – with some being given to the winning entries (e.g. The Science Fiction Short Story Competition\(^{76}\)) and others involving every entrant receiving at least a certificate to encourage participation (e.g. EngQuest\(^{77}\) and The Mathematics Talent Quest\(^{80}\)).

There are also a number of annual fora or conferences to raise awareness of SET. These fora are of two main types, students and professionals.

Youth conferences such as the National Youth Science Forum\(^{50}\) and the Youth Australian and New Zealand Association for the Advancement of Science National Conference\(^{51}\) are for high school students, who are considering careers in SET. They tend to also have an interactive, hands-on component, although the main focus is on other aspects such as lectures with leading scientists and discussion groups. Networking and sampling of different areas of SET are also components of such meetings.

Professional forums tend to address specific SET issues and include events such as ‘Campaign to Map Human Mutations’\(^{55}\), ‘Understanding the Population-Environment Debate: Bridging Disciplinary Divides’\(^{56}\) and ‘Action on Climate Change’\(^{57}\). These initiatives have a strong focus on trying to generate intelligent discussion as well as raising the profile of these issues and SET generally. Invitation is often extended to professionals in the relevant field only.
There are also fora which try to create linkages between SET and other themes, spheres or occupations in the community. For example, Science Meets Parliament\textsuperscript{43} is a two-day event designed to deepen the mutual understanding and linkages between science and politics. Creating linkages is also demonstrated through initiatives such as Twinning Scientists with Teachers\textsuperscript{4} and the Neighbourhood Engineering Scheme\textsuperscript{8}. These initiatives try to foster a closer relationship between scientists and schools to keep teachers up to date, thereby improving the quality of teaching.

Numerous radio programs have been developed to discuss and promote awareness of science, typically as would be expected on non-commercial radio stations such as ABC (national), SBS (national) and 2SER (Sydney and national). Due to their efforts to appeal to a wide audience and to be interesting and relevant, these radio programs tend to take a somewhat whimsical and quirky approach. For example the ‘Science Show’\textsuperscript{58} on ABC Radio discusses issues such as “the physics of cricket to prime ministerial biorhythms”. The Science in the Pub\textsuperscript{61} program from 1998 to 2004 was also typical of this mainstream and colloquial approach.

Performances and film are other ways that some organisations use to bring SET awareness raising efforts ‘to life’ by dramatising scientific endeavours to portray them as interesting and engaging. For example Scinema\textsuperscript{86}, which is a festival of science films shown during National Science Week\textsuperscript{1}, is described as a way to forge links between science and the arts. Likewise, the Science Fiction Short Story Competition\textsuperscript{76} and The Art of Scientific Explanation\textsuperscript{89} (a short course run by the University of Sydney) combine literature or multimedia with SET. This has potential to widen the audience of the initiative or program.

Our review did not yield many references to written materials as SET awareness raising initiatives. While there is certainly a large amount of written material about SET being distributed in the community such as Plasma\textsuperscript{91}, CSIRO’s Scientriffic and Helix magazines\textsuperscript{94} and the Australasian Science Magazine\textsuperscript{95} it seems to us that written material is being used primarily as a back-up to activities that are perceived to be more engaging and stimulating. From our desk research, these newsletters and other back-up written material appear to generally contain both details about upcoming outreach activities as well as other articles on the relevant area of SET.

There is also much written material in the form of articles in the press. This review did not examine the content of these in any detail, but it appears that print media on SET raises awareness by covering emerging research (such as medical advances), and other items of interest (e.g. the rides at Dreamworld\textsuperscript{5}) in SET related fields and also by informing the public about upcoming awareness initiatives.

Considerable written information promoting SET can also be found on websites. The majority of organisations involved in arranging these SET awareness raising initiatives have websites with further information supporting their public awareness efforts. The National Science Week\textsuperscript{1} website for example, has a guide for the public about events and a guide for event organisers about registering, running and evaluating their event. Many websites also have considerable resources such as interactive tools for teachers and students. For example, Origin Energy’s Home Energy Project\textsuperscript{19}, Sydney University’s ‘The Science of Bushfires’\textsuperscript{92}, The Australian Dinosaur Story\textsuperscript{92} (by the Department of Environment and Heritage) and Biotechnology Online\textsuperscript{93} (a resource maintained by the Australian Government Agency ‘Biotechnology Australia’).

Finally, some organisations use different ways of promoting SET, such as:

- advocacy groups (particularly encouraging women to engage with SET e.g. ‘Women in Computing’\textsuperscript{93} run by the Central Queensland University and ‘Women In Science and Engineering’\textsuperscript{34} run by the University of Western Australia);
• career information events (which involve displays, handouts, employer presentations and discussion groups as well as more interactive experiences e.g. Electronics Industry Association events\textsuperscript{46});
• peer tutoring (where university science students tutor high school students e.g. Edith Cowan University Peer Tutoring\textsuperscript{40}); and
• Events such as Science in the Pub\textsuperscript{61}, which brings discussion of SET topics into a relaxed, everyday setting.

**Geographical Location**

The geographical location of delivery of awareness raising initiatives generally falls in to three broad categories:

• Nationally-based travelling shows covering at least several areas of Australia – for example ‘Great Big Science Gig\textsuperscript{11}, ‘Microscopes on the Move\textsuperscript{3}, ‘Shell Questacon Science Circus\textsuperscript{6} and ‘Scinema\textsuperscript{86}.

• Specific, fixed locations such as a university or telescope site (e.g. Dreamworld Education Programs\textsuperscript{5}, The Australian Telescope Facility at Narrabri\textsuperscript{31} and Rockingham Environment Centre programs\textsuperscript{49}).

• Initiatives which are independent of geography – for example many science prizes, The Biology Madness Kit\textsuperscript{9} which allows children to carry out biology experiments at home, ENGquest\textsuperscript{77}, written material such as Plasma\textsuperscript{91} and Double Helix\textsuperscript{94}, websites such as the Australian Dinosaur Story\textsuperscript{92} and radio programs such as those produced by the ABC and SBS.

Fixed location initiatives in rural areas tend to be under-represented and therefore these areas rely on travelling shows (which only come through periodically such as the Shell Questacon Science Circus\textsuperscript{6} or Phiggles the Flying Scientist\textsuperscript{20}) and other material and resources which can be sent or broadcast. Access to the Internet and radio reception may further limit access of individuals in regional and remote areas.

**Target Audience**

The majority of the initiatives are targeting a mainstream audience – that is members of the general community as opposed to those already involved with SET. This is reflected by the fact that the initiatives are predominantly concerned with general science such as Science Alive\textsuperscript{24} and some National Science Week\textsuperscript{1} events, with a lesser number promoting specific SET areas. However, an evaluation of Science in the Pub\textsuperscript{61} to be discussed in more detail further on in this report, found that the initiative failed to reach the non-scientific community but instead the audience consisted mostly of post-graduates and graduates of science.

From the number of initiatives we analysed, high school students are the most common target audience. It is evident that this is the stage at which decisions regarding future study and careers are generally starting to be made and therefore this provides an ideal opportunity to influence their career decisions. Primary school and university students are also frequently targeted amongst the initiatives reviewed. Science teachers are another common target audience due to their strong influence on their student’s experience of learning science and their consequent propensity to develop an interest in further study and working in SET. Some initiatives, particularly fora are focussed on a more professional audience of people already working in SET to further increase their awareness, raise their profile and generate discussion.
Section Two: Evaluations of Initiatives to Increase Interest in Science, Engineering and Technology

Overview

The second stage of this review examines data to determine the success of SET awareness raising initiatives in terms of achieving their objectives as well as their overall effect on public awareness, understanding and interest in SET. Additionally, this section explores the extent to which evaluations are being undertaken and the limitations of existing data.

Existing Data and The Need for Evaluation

The Need for Evaluation

Before reviewing existing data on the effectiveness of SET awareness raising initiatives, it should be noted that evaluation of these programs seems to be severely limited.

Through the course of this literature review, the majority of articles found related to the need for evaluation of SET awareness raising initiatives rather than actual evaluation of the initiatives themselves. The majority of articles analysed explicitly stated that the need for evaluation was paramount as an effective way of learning how to do things better, providing direction, determining effectiveness and justifying the use of funds (Boddington and Coe, 1995; Metcalfe and Perry, 2001; Parsons, 2001; Edwards, 2004). There is perceived to be a constant need to review the way science and technology are negotiated in society and evaluation is a key tool to support this (Edwards, 2004).

Boddington and Coe (1995) produced a leaflet and report in the UK as a guide to help organisers conduct evaluations of events, including information about how to write clear, neutral and concise questionnaires and the method for good interviewing and sampling. They note that the four main benefits of evaluation are that it:
- Crystallises ideas about the event and its objectives.
- Provides information about the outcomes of an event and suggestions for improvements.
- Provides information about who attended the event.
- Can provide encouragement by demonstrating that efforts made by organisers have been worthwhile.

In fact, Gascoigne and Metcalfe (2001) claim that the lack of resources devoted to evaluation seriously threatens the credibility of the programs designed to raise public awareness of science and technology.

Existing Data

Existing data on the effectiveness of SET initiatives consists of the following types:
- Evaluations of specific initiatives, or umbrella events, such as National Science Week, conducted by the organisers of these events.
- General comments regarding initiatives in the media.
- Formal Australian evaluations.
- International studies which can be used to shed some light on the situation in Australia.

Example of the types of evaluations above are summarised in Table 1.
<table>
<thead>
<tr>
<th>Author/Organisation</th>
<th>Year</th>
<th>Initiative Evaluated</th>
<th>Type of Evaluation</th>
<th>Method</th>
<th>Findings</th>
</tr>
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<tbody>
<tr>
<td>The Canberra Times</td>
<td>2005</td>
<td>National Science Week 2005</td>
<td>Informal Media Evaluation</td>
<td>Analysis of interviews with presenter Dr Karl, science publicist Niall Byrne and co-founder Dr Paul Waring.</td>
<td>The diversity of events in National Science Week is both a strength and a weakness. The participation rate is particularly high in Canberra. For the science road show, the audience needs to be widened although there are positive reports of audience enjoyment and numbers.</td>
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<tr>
<td>Science In Public</td>
<td>2001</td>
<td>Media Outreach Program of the organizing committee of the ASM 2002 conference</td>
<td>Media Evaluation</td>
<td>Records of mentions of microbiology in TV, radio and print.</td>
<td>The Outreach Program was highly successful from an awareness raising perspective, with comprehensive TV and radio coverage and generally accurate and responsible reporting. 100 TV mentions, 179 radio and 84 print.</td>
</tr>
<tr>
<td>Robyn Stutchbury on behalf of Australian Science Communicators</td>
<td>2000</td>
<td>Science in the Pub</td>
<td>Evaluation by Event Organisers</td>
<td>Short questionnaire distributed in each session (n=350). Established audience profile, source of awareness, rating of session/venue/presenters and whether they learned something new.</td>
<td>Positive response to the pub venue, novel modality and many accounts of new learning. However, the show failed to reach the non-scientific public and the local community (most participants were graduates or postgraduates in science).</td>
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<td>Wendy Parsons</td>
<td>2001</td>
<td>CSIRO’s activities in providing science information to politicians (e.g. National Awareness Parliamentary Information Program)</td>
<td>Evaluation by Event Organisers</td>
<td>Telephone and face to face interviews, focus groups and email journal entries with politicians and/or their advisers over a four-year period.</td>
<td>There are no quick solutions for raising awareness about SET but information for politicians must address their electorate and personal interests and be provided in their terms (quickly, without jargon and be well substantiated).</td>
</tr>
<tr>
<td>Researcher</td>
<td>Year</td>
<td>Description</td>
<td>Evaluation Method</td>
<td>Findings</td>
<td></td>
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<tr>
<td>Woolcott Research</td>
<td>1991-1998</td>
<td>Australia’s Science and Technology Awareness Program (STAP), plus attitudes towards SET in general</td>
<td>Qualitative (group discussions, in-depth interviews amongst students, industry leaders and communicators) and quantitative (telephone surveys amongst a random sample of the population).</td>
<td>Although it measured little change in the community’s perception of the importance of SET, there was qualitative evidence to suggest a range of positive and negative shifts in underlying attitudes. See Literature Review for more key findings.</td>
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<tr>
<td>Buchan</td>
<td>1999</td>
<td>Australia’s Science and Technology Awareness Program (STAP)</td>
<td>Research amongst stakeholders (e.g. organizers of SET initiatives, ABC staff, chief scientists, government officials, grant recipients) and evaluation of existing initiatives by written submissions and meetings.</td>
<td>Generally positive feedback on the major elements of the STAP program and “significant awareness outcomes”. STAP needs to focus more on collaboration, communication and coordination with new program structures and expansion of funding.</td>
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<td>Macquarie University</td>
<td>2005</td>
<td>Attitudes towards SET in general and awareness of initiatives</td>
<td>Large scale investigation including online surveys, focus groups and qualitative interviews with 1300 high school students across NSW, 300 Macquarie students, science professionals and employers.</td>
<td>The majority of respondents indicated dissatisfaction with the quality and quantity of SET promotional activities. It was concluded that promoting existing projects rather than developing new initiatives could best improve the effectiveness of SET initiatives. See Literature Review for more key findings.</td>
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<td>David Kumar and James Altschuld</td>
<td>1999</td>
<td>A Vanderbilt University project aimed at redesigning science and maths courses with the aid of interactive video technology.</td>
<td>Document review, development of interview protocol and semi-structured interviews. Observation of classes.</td>
<td>An environment conducive to innovation and development (strong faculty interest, commitment to furthering the cause and strong technical support) is needed for these types of programs to be successful. Stressed the importance of contextual and environmental</td>
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Evaluations of Initiatives Conducted by the Organisers

An evaluation by the organisers of the awareness raising initiative is seen as a very important form of evaluation. According to Boddington and Coe (1995) evaluation or review by science organisations is a way of understanding what works and provides them with the opportunity to improve their programs and events. This review, as well as other Australian and international articles (Gascoigne and Metcalfe, 2001; Edwards, 2004; OECD, 2006), have found that this type of evaluation is not being done to any significant extent.

One example of this type of evaluation was carried out by the Australian Science Communicators (ASC), a national association of over 400 journalists, scientists, engineers and editors interested in the communication of science and technology. Robyn Stutchbury (2000) evaluated the Science in the Pub initiative by distributing a short questionnaire to audience members in each live session (n=350). The questionnaire established audience profile, the source of their awareness about the event, audience rating of the session, venue and presenters and whether the audience had learned something new. A positive response was received to the pub venue, the novel modality and there were many accounts of new learning. However, it was reported that the show failed to reach the non-scientific public and the local community, as most participants were graduates or postgraduates in science. In the conclusions and recommendations of the report, increasing the audience size or developing Science in the Pub into a commercial package was proposed. Stutchbury (2000) stated the evaluation was being used to decide the future of Science in the Pub.

Evaluations by organisers of events also vary in their robustness. An example of a robust study was conducted by Wendy Parsons (2001), a Senior Communicator from the CSIRO. She evaluated CSIRO’s activities in providing science information to politicians that was used to forge stronger links and mutual understanding between science and politics. These initiatives included the National Awareness Parliamentary Information Program. Parsons (2001) details a methodology used over a four-year period including telephone and face-to-face interviews, focus groups and email journal entries with politicians and/or their advisers. Parsons (2001) concluded there were no quick solutions for raising awareness about SET. However, Parsons (2001) provided specific ways to improve the initiatives she evaluated, emphasizing that information for politicians must address their electorate and personal interests and be provided in their terms (i.e. quickly, without jargon and be well substantiated).

A less robust study was conducted on by Science in Public (2002), a largely web-based organisation that aims to get scientists to re-engage with society by improving means of communication. The organisation evaluated a media outreach program of the ASM 2002 conference organising committee to inform the wider public about the differences microbiologists make to our lives. This was conducted by using the number of mentions of the event in the media as a way of evaluating its success. The program was deemed to be “highly successful” with “comprehensive” and accurate media reports in radio, television and print.

In many cases it is possible that internal evaluations are being carried out, at least informally, which are not being made publicly available. Boddington and Coe (1995) suggest findings which are used to improve an organisation’s functioning and information may be used to secure further funding or maintain current funding and may therefore be considered sensitive and confidential.

Those evaluations of internal initiatives conducted by organisations which are released, perhaps unsurprisingly, do tend to be overwhelmingly positive. As Edwards (2004) notes in his critique of evaluations of European public awareness initiatives, these internal evaluations seem to frequently contain “general statements of success…. that cannot be used as evidence without being tied to the specific.”
These evaluations also tend to focus on attendance and/or enjoyment and do not inform knowledge of changes in awareness, understanding of, and attitudes towards science or the impact on the likelihood of studying or pursuing a career in SET occupations. Edwards (2004) argued it was almost impossible for any single initiative to determine how they affected these broader objectives. This was because they were just one of many influences impacting people’s attitudes and the individual contributions simply could not be isolated. The limitations of attendance and enjoyment as measures will be discussed in more detail further on.

Media Evaluations

This methodology used by Science in Public (2002) is in fact a distinct category of evaluation data with either organisations assessing their effectiveness by determining the amount of media they are able to generate in their programs or commentators in the media evaluating events.

While media evaluations can provide an indication of interest in science by showing the amount of media generated over time, this form of data cannot be considered a rigorous form of evaluation. It also does not really assess the effectiveness of these SET awareness raising initiatives in meeting their objectives. Edwards (2004) notes that reporting of many successes is anecdotal and contains general statements which are of limited use.

An example of the latter type of evaluation is a review of National Science Week 2005 in the Canberra Times. This editorial-style, informal media evaluation contained quotes from interviews with presenter Dr Karl Kruszelnicki, science publicist Niall Byrne and co-founder Dr Paul Waring along with analysis and review of the week. It noted that the diversity of events in National Science Week is both a strength and a weakness because the outcomes of events are dependent on local interest. For example, Niall Byrne notes that Melbourne has a packed agenda but Geelong does not know that National Science Week exists. Likewise, the participation rate in Canberra is very high but Byrne notes that they start with a high base as approximately 40% of the ACT workforce are employed within SET. The Canberra Times article (2005) also refers to an awareness level of National Science Week of 86% in the population but does not reference this figure or its source.

Formal Australian Evaluations

As has been argued, the evaluation of single SET awareness raising initiatives and media coverage of events are insufficient to determine their effectiveness in meeting their objectives. The reason for this is because the effects of any single initiative on these broader measures are extremely difficult if not impossible to isolate. This identifies the need for formal on-going studies with baseline data, which can measure changes in awareness, attitudes towards, and intentions to pursue a career in SET. It should be noted though that these studies still face the difficulty of identifying causality due to the challenges of establishing links between any changes and local, state and national programs.

The review revealed that formal, wide-ranging evaluations of SET initiatives in Australia are very limited. The Macquarie University Science, Engineering and Technology Study (2005) is the only recent study that was found in this review. Two other broad reviews were conducted in the 1990s – a series of studies by Woolcott Research in 1991, 1994 and 1998 and a review of the Australian Science and Technology Awareness Program in 1999 by Buchan. The outcomes of these studies will be analysed further on.
International Studies

Similarly, there have been formal evaluations of science awareness strategies in other countries which take a similar methodological approach and contain similar objectives to these broad Australian studies. While these studies do not speak directly to the effectiveness of Australian SET initiatives, they were able to shed some light on some of the considerations and difficulties involved with evaluating such programs, and discuss some of the issues involved with interpreting the reported outcomes of these evaluations. Some, like the Organisation of Economic Co-operation and Development's (2006) report focus upon the evolution of student interest in science and technology studies, providing valuable data from OECD countries to build a context for the development of awareness raising initiatives.

One example of a study carried out abroad was conducted by Kumar and Altschuld (1999) who evaluated an interactive media-based evaluation project at Vanderbilt University which aimed to redesign science and maths courses with the aid of interactive video technology. The authors utilised a document review, interviews with a broad range of people associated with the project and observations of the classes themselves. They concluded that the project needed an environment conducive to innovation and development, including strong faculty interest, good technical support and a commitment to furthering the cause. While the evaluation was short term in focus, the evaluation model they utilised and their recommendations for such a program could potentially provide organisers with direction for development and evaluation of initiatives.

Comments from international evaluations are often general recommendations. For example, Edwards (2004) explains that for “public participation initiatives”, discussion and debate are most suitable for controversial and complex issues (e.g. biotechnology and GM food) as they allow engagement with science, confront ambivalence and encourage people to “get off the fence”. This could potentially inform new initiatives and provide a rationale for their chosen format.

Outcomes of Evaluations of Initiatives

The evaluation of individual initiatives conducted by their organisers, although rarely publicly available, report very positive results on the effectiveness of their initiatives through the media. Organisers of ongoing interactive and outreach events such as National Science Week¹ particularly tend to describe previous years as being successful in terms of having increased attendance, being exciting and fun and engaging people in science. While these are certainly positives, these measures alone cannot detect any effects in terms of higher order objectives such as generally increasing awareness of SET or increasing the likelihood of studying or working in SET.

Similarly, the studies which evaluated an initiative’s effectiveness by determining the amount of media interest it was able to generate, tended to report a significant amount of media mentions (e.g. Science in Public, 2001 recorded 100 television mentions of microbiology). Again, while this can be seen as a positive, it does not shed any light on the effect of this media on awareness and attitudes. A broader evaluation of the change in the amount of media coverage of SET as a whole would be helpful in understanding the change in profile of the area.

To really understand the effectiveness of SET initiatives then, there is a need to look to the broader studies. As mentioned there were two evaluations undertaken in the 1990s. In an overall sense the evaluation by Buchan (1999), which involved research among stakeholders (e.g. organisers of National Science Week, ABC staff, chief scientists, government officials, grant recipients etc.) and evaluation of existing initiatives and programs, concluded that the SET initiatives part of the national STAP program had been successful in reaching some awareness
outcomes with many of the initiatives themselves being highly successful in consistently resulting in positive feedback (in Gascoigne and Metcalfe, 2001).


The studies by Woolcott Research involved both qualitative and quantitative methodologies including group discussions, individual in-depth interviews (amongst school students in urban and rural areas, science and technology undergraduates, industry leaders, and media writers/producers and editors) and quantitative telephone surveys among a random sample of the population over the age of 14 years.

The fundamental conclusion to be drawn from the Woolcott (1998) study was that although it measured very little change in the community's perceptions of the importance of science and technology to Australia overall and amongst individuals in daily life, there was qualitative evidence to suggest a range of positive and negative shifts in underlying attitudes. That is, the qualitative findings amongst young people and their parents were indicating that the pursuit of science based careers was being viewed in a less restricting perspective than they had been in previous years, and group members were able to talk about a broader range of career options related to science and technology, including diverse areas such as sports science, political science and health science, as well as positive linkage to the environment, bio-medical and engineering areas.

At the qualitative level, Woolcott Research (1998) concluded that there were fewer barriers to young people pursuing studies in the whole area of science and technology compared to previous years, either from peer pressure or parents.

However, amongst those managing businesses, the 1998 Woolcott Research study indicated there was some concern about the risk of high research and development expenditure and this appeared to be getting worse, therefore potentially cutting off opportunities in these areas (Woolcott, 1998).

Slightly less encouraging signs in the 1998 research amongst industry leaders suggested that Australian-owned businesses in particular were increasingly cautious and risk averse unless they had achieved real world scale. They indicated this extended how willing they were to take risks and invest in research and development. The industry leaders in the research at that time felt that neither the investment climate, nor the regulatory environment, was particularly encouraging or supportive of organisations investing in research and development that had inherent financial risks regardless of the potential reward.

It was very clear from both the qualitative and quantitative phases conducted by Woolcott Research (1998) that Australians continue to believe that science and technology were becoming increasingly more important to our future and that the Government should be involved in the promotion of it. However, with regard to perceptions about the importance of science and technology in a range of areas and Australia's performance in these, there has in fact been a slight deterioration in perceptions of our performance in some areas. Although statistically the shifts were not significant, it is of some concern that there were some declines in areas such as astronomy, physics and chemistry.

Gascoigne and Metcalfe (2001) evaluated studies by Woolcott Research (1991, 1994 and 1998) and Buchan (1999) and concluded, "Both contribute to an overall picture of science awareness and attitudes in Australia. However, neither established a link between the activities supported and funded by STAP and changes in Australian attitudes to and understanding of science".

**The Macquarie University SET Study (2005)**
A recent study conducted by Macquarie University (2005) provided a more current picture of the awareness of, and attitudes towards SET. It involved a large-scale investigation including online surveys, focus groups, and qualitative interviews with 1,300 high school students across NSW, more than 300 Macquarie University students as well as science professionals and employers of SET graduates.

Some of the most relevant findings from the Macquarie study (2005) regarding the effectiveness of SET awareness raising initiatives are as follows:

- The majority of respondents believe that SET is an exciting and relevant area.
- The majority of respondents indicated dissatisfaction with the quality and quantity of SET promotional activities.
- Respondents spoke favourably about science media such as documentaries, magazines and public spokespersons believing that this is a key influence in raising awareness and interest in SET.
- High school science classes are extremely informative in terms of determining levels of interest in pursuing a career in SET.
- There is also a call for greater Internet access to information about SET such as study and career opportunities and current research.
- Hands-on activities are seen as the best way to engage and involve students.
- General awareness of SET initiatives was low (although this was assessed qualitatively).
- It was concluded that promoting existing projects rather than developing new initiatives could best improve the effectiveness of SET initiatives.

One of the emerging key issues concerning the effectiveness of SET awareness programs is that students do not feel they have a clear understanding of what a career in science clearly involves (Osborne et al, 2003; Macquarie University, 2005). While SET may be portrayed as interesting and fun, this does not translate to students really understanding how this relates to careers in SET and consequently they are left with a belief that SET would be unlikely to fulfil their career requirements (Macquarie University, 2005). There is also a perception that university study is a way to improve career prospects, so without really understanding what SET careers involve, many students fail to see how studying science will help with future careers (with the exceptions being well-known areas such as medicine, dentistry and engineering).

The Macquarie University study (2005) concluded that knowledge of SET awareness raising activities is low among high school and university students. It is thought that these activities could be better promoted. Ultimately while these activities are fun, interesting and engaging, they seem to be not quite achieving an objective of interesting students in pursuing careers in SET. This is due to a lack of concrete information on careers in science to give students a realistic picture of what they can base career decisions.

The International OECD (2006) study also supports this finding, concluding that SET communications focus on science itself and not on the reality of science professions. The OECD (2006) recommended that it would be more effective to provide information about science careers that was accurate, credible, reliable and avoided exaggerated or unrealistic portrayals.

Problems with Measuring the Effectiveness of SET Initiatives

As has become highly evident when reviewing the available evidence, and has been mentioned, there is a severe lack of evaluation of SET initiatives being conducted. Gascoigne and Perry (2001), Metcalfe and Perry (2001), Edwards (2004) and the OECD report (2006) all concur that a lack of evaluation undermines the credibility and effectiveness of initiatives.
Obstacles

Metcalfe and Perry (2001) outline a number of obstacles that need to be overcome for effective evaluation of science programs. These include:

- Perceptions of cost and difficulty – conducting evaluations can be costly and time consuming. This is a significant barrier, as organisations may believe their budgetary constraints won’t allow for evaluation.
- Unwillingness to undertake a process which may portray the organisation in a negative light.
- Complexity of the objectives of initiatives - some of the objectives, which are being communicated, are particularly complex, for example, encompassing awareness raising, information exchange, dialogue and adoption objectives. This in turn makes evaluation of their awareness complex.
- The lack of practical tools for evaluation (These are outlined below).
- The dynamic nature of science communication and perception that things are always changing.

Evaluation Tools

While some of these issues, particularly cost, are perceived to be significant barriers, a number of evaluation tools are available (Gascoigne and Metcalfe, 2001) such as:

- Focus groups
- Unstructured interviews
- Questionnaires
- Surveys
- Opinion polls
- Observing behavioural change
- Analysing feedback
- Desktop analysis of newspaper clippings.

Definitional Issues

Another issue identified by Gascoigne and Metcalfe (2001) relates to problems with definitions and the lack of clearly defined objectives. These authors describe how many initiatives have mission statements or the objectives have to be inferred from the activities involved in the program. Likewise, successes can often be reported in terms of morale and teambuilding, outcomes which are often not mentioned among the aims at the outset (Edwards, 2004). Without clearly defined objectives, evaluation is made difficult, as there are no clear criteria against which the initiatives can be assessed.

Gascoigne and Metcalfe (2001) use the example of STAP, Australia’s Science and Technology Awareness Program, which has the objective “to develop a greater understanding in the wider Australian community of the important roles played by science, technology and innovation”. Gascoigne and Metcalfe (2001) believe that this is more like a mission statement than an objective and needs to be fleshed out with operational and measurable statements.

Edwards (2004) notes that many SET initiatives are not formally written up and even few are evaluated against their aims. If organisations do evaluate their programs, they use questionnaires, interviews or data-analysis techniques which provide immediate but not necessarily representative results (Edwards, 2004).
Additionally, as noted by Osborne et al (2003), there is confusion over what is meant by ‘science’ with science in schools perceived to be theoretical and based on milestones, while science in society is seen as hi-tech, socially relevant developments in the world e.g. mobile phones and computers). This gap means that measuring attitudes towards SET is problematic. Furthermore, raising awareness of science, and even the enjoyment of it, does not necessarily lead to increased participation in studying or working in SET (Osborne et al, 2003).

There is also some confusion over the measures to be evaluated. It is very difficult to measure attitudes towards science and intentions to pursue a career in science. As Osborne et al (2003) has noted, there is a contradiction between expressed feelings and actual behaviours. For example, a student who may be interested in SET may avoid publicly demonstrating this interest among his or her peers who regard such intellectual interest as not being ‘cool’ or ‘popular’ (Osborne et al, 2003).

The Limitations of Statistical Data and Measures

Related to this is the issue of measuring actual behaviour in regards to pursuing education and science due to the inadequacies of statistical data about beliefs, preferences and behaviours (OECD, 2006). The report by the Organisation of Economic Co-operation and Development Global Science Forum (2006) noted that the current data that exists in OECD countries did not allow for a full analysis of why there was a relative downward trend in enrolments in SET courses. It noted that the data collected was incomplete, did not take account of the number of places actually available in higher education courses and did not reflect the actual interest of students in SET disciplines. Few nations had exhaustive data, often due to changes in classification or unavailability of breakdowns by scientific discipline (OECD, 2006). Interest towards hybrid disciplines, for example biomedical engineering, may be miscalculated, leading to overstated or understated numbers or growth rates.

In addition, limitations exist with regard to the measures that are more commonly being evaluated. Many evaluations conducted by the organisers of events tended to focus on attendance and enjoyment, which as Edwards (2006) argues, were insufficient - “It is possible to fill a hall to capacity but if these people are already interested and knowledgeable, does this really help to increase the public awareness of science? Alternatively, it is possible to draw in only members of the non-attentive public, but how do you ensure they leave with raised awareness and appreciation of science?” These questions are not answered with attendance figures. Similarly, he argues that while important, giving people a good time does not mean their awareness and attitudes have necessarily been changed. Likewise, raising knowledge levels does not necessarily directly lead to a more positive view of science.

Gascoigne and Metcalfe (2001) and Edwards (2004) note that possible valid measures could include:

- The number of high school students completing science courses.
- Science coverage in popular media.
- Changes in attitudes towards science.
- Depictions of scientists in popular film and television.

However, these were often quite different from the objectives stated in the initiatives.

There is also a lack of baseline data being collected. As Gascoigne and Metcalfe (2001) noted, baseline data is particularly helpful in trying to evaluate the effectiveness of initiatives on measures such as awareness and attitudes to science. This allowed changes to attitudes to be compared before and after the SET awareness raising initiative was run.
Similarly, there is a lack of ongoing data which allows changes in measures over time to be tracked. While the Woolcott Research studies were conducted repeatedly in 1991, 1994 and 1998, there have not been any similar large scale studies addressing awareness and attitudes to science since then to understand how these measures have continued to change. The OECD (2006) noted that motivation surveys, which measure actual interest in SET, were usually conducted as one-off studies or repeated at very long intervals. This did not permit adequate quantitative assessment of interest and motivation. The OECD (2006) stressed the need for ongoing, long-term studies of student motivation using specific indicators. This would in turn, improve the consistency, significance, scope and coverage of data about awareness towards SET.

Finally, as previously mentioned, it is very difficult to determine causality – there are so many other influences affecting peoples' decisions to study science that it is hard to isolate the effects of particular events or broad programs even when baseline data has been collected.
The Way Forward

This literature review has repeatedly indicated that whilst there have been many and varied SET awareness raising initiatives that may well have led to changes in the perceptions of SET, there are only a few (recent) evaluative data which confirms that this is the case.

The Macquarie University study (2005) found that SET was now clearly seen as an exciting and relevant area by high school students in NSW. However, the study suggested that general awareness of specific SET awareness raising initiatives was at a relatively low level, and that the overall positive feeling about SET was not being maximised and converted into career decision making. In fact it appeared there could be a gap between awareness raising and the linking of that to the perceptions of a career in SET, and what that might mean in reality.

In addition, as the Macquarie University study was a “one-off” study conducted primarily in NSW, it is not possible to conclude how attitudes may have changed over time, and how much has been achieved on a national level.

Depending on the survey administration, it may also be possible that the online methodology used for that study might have some inherent biases, given the still low Internet penetration amongst lower socio-economic households, and rural and regional areas.

The last Woolcott study (1998) also highlighted some positive views amongst the general population, but at that time there was some reluctance on the part of business, particularly Australian business, to totally be committed to R&D expenditure in SET related areas.

The Audit of Science, Engineering and Technology Skills conducted by DEST and released in June 2006, was informed by a comprehensive consultation process involving:
- meetings and discussions with key stakeholders;
- written submissions and reviews of relevant literature;
- analysis of existing research on supply and demand of SET skills;
- a study by The Allen Consulting Group on international demand for Australia’s SET skills;
- a survey on youth attitudes towards science, mathematics and technology study and SET careers;
- an industry survey on current and future demand for SET skills; and
- a series of industry studies for industries reliant on these skills.

The audit found that the proportion of domestic students in SET study across all education and training sectors had remained static or declined in Australia over the past decade. This was particularly apparent for enabling sciences, which include advanced and intermediate mathematics, physics and chemistry. In contrast, overseas students constituted an increasing proportion of enrolments and completions in Australian SET courses at the undergraduate and postgraduate level at Australian universities, helping to ensure the sustainability of some courses. The result of the downward trend in domestic school enrolments and vocational training and higher education SET commencements/enrolments and completions is a decreasing pool of applicants for SET positions in industry and the scientific research sector.

Feedback from audit submissions and consultations undertaken as part of the audit highlighted a perception among industry and the vocational and technical education and higher education sectors that many students leaving school were ill-prepared for tertiary study and employment in SET fields. There was also a strong perception that Australia lacked sufficient suitably qualified secondary school science teachers, which impacted adversely on student engagement in SET.
There was also a concern in consultations and submissions about a lack of quality SET careers advice. Negative community perceptions of careers in SET industries and the research sector were also reported as having had an effect on young persons' perceptions of SET careers. The perceived benefit of SET studies in schools, and the number of students considering SET careers, is relatively low compared to some other high profile areas (e.g. medicine, law).

The audit findings present Australia with challenges and suggests that Australia cannot be complacent about SET skill formation. Challenges in building Australia’s science, research and innovation capacity for the future were identified as:

- Improving information about and awareness of SET and SET career opportunities among students, parents, industry and the community to encourage growth in the number of school students studying SET and aspiring to SET careers.
- Facilitating more rapid SET skills acquisition by existing workers, apprentices and new entrants to the labour market to meet demand in a responsive way.
- Improving the capacity of the education and training system to deliver high quality SET courses. An adequate supply of well-qualified science and mathematics teachers was a key to success.
- Continuing to ensure that Australia had an adequate stock of scientists, engineers and technologists in Australia, including through emigration and immigration of SET graduates, to meet the skill needs of industry and the scientific research community.
- Enhancing the understanding of SET career opportunities among early to mid-career researchers and working with the public and private research sector to provide rewarding career paths for young researchers.
- Continuing Government and industry reforms to ensure that flexible employment practices were in place to facilitate the long-term supply of skilled SET workers.
- More effective staff retention strategies (especially for older workers), to reduce attrition of qualified SET workers either to retirement or to other occupations, and,
- Ensuring quality infrastructure was in place to support SET training and research.

In meeting these challenges, there will be a need for ongoing consultation with all the relevant stakeholders to ensure that practical solutions are developed to best meet Australia’s SET skill needs now and into the future.

It would seem there is now a need for a study which can both an update on some of the previously measured attitudes toward SET, in order to arrive at a clear national benchmark, primarily amongst high school students, but also amongst the wider community of “influencers” such as parents and school teachers, and careers guidance practitioners, as well as a selection of potential and current employer businesses.

Whilst this would possibly involve a repeat of a small number of the measures used in the DEST Audit survey, they would need to be worded to match the previous Woolcott studies, in order to track any real changes that have occurred.

However, to maximise the usefulness of this study, and to provide confirmation of the trend that appears to be evident regarding the perceived lack of information about SET careers, and what they involve in the real world, we suggest that specific questioning be included to measure this, and confirm or deny this finding, and to provide guidelines so that effective action can be taken to correct it.

In addition, it is suggested effort be made to record what actual SET initiatives participants in the studies are aware of and have participated in, as previous studies have collected this information under general headings only, and it would be useful to cross analyse this with findings on awareness.
It would also be useful to obtain at least a subjective view on the impact those initiatives might have had on attitudes and changes in intentions to pursue a possible career in this direction.

A mix of qualitative (focus groups, in depth interviews) and structured quantitative (telephone interviews) would be the best methodologies, designed to obtain some directly comparable measures to previous reads (that is the 1991, 1994 and 1998 measures) so as to allow for trend data on the key shifts to be produced, along with identification of any newer issues pertinent to this point in time.
Appendix A: Initiatives to Increase Interest in SET

1. National science week

National Science Week is Australia’s annual celebration of science and technology. Established in 1997, the event is a partnership program between DEST, the ABC, ASF Limited, ASTA and CSIRO. In 2005, there were 773 events registered and hundreds of volunteers organised to assist in running these events. In 2006, National Science Week took place between Saturday August 12 and Saturday August 20 with 608 events registered. There were a number of national events that occurred including a National Tour and the ‘Great Big Science Gig 3’, while each state and territory had its own events scheduled for metropolitan and regional areas. These events include science fairs (e.g. Top End Science Fair, Wild Science Festival), public debates and lectures (e.g. Science in the Bush, The Hydrogen Economy, ‘Is It Getting Hot In Here?’), workshops (e.g. Forensic Science in Action, SwinScientists, Water Wise to Water Wealthy) and numerous hands on, interactive activities (e.g. Wild and Wiggling, Celebration of Science). This year’s school theme was ‘Australia: Our Dry Continent’.

National Science Week is designed to raise the profile of science, innovation and technology in Australia and to encourage young Australians to take an interest in and pursue opportunities in these fields. It also offers the chance to extend professional networks and partnerships and provides the opportunity for achievements and knowledge to be shared. More information about National Science Week can be found at http://www.scienceweek.info.au/

Interactive

2. The Siemens Science Experience

QLD

This annual program involves three days of science activities for school students in 33 universities across the country. It provides Year 9/10 students with the opportunity to participate in a wide range of science activities under the guidance of scientists as well as giving them information about further studies and informing them about career options in SET areas.

3. Sydney University's Microscopes on the Move

NSW

Microscopes on the Move is an interactive travelling program designed to make the world of microscopy more accessible to students by bringing advanced electron and optical microscopes into the classroom. It aims to encourage an interest in science, engineering and technology in students from Kindergarten to Year 12.

4. Twinning Teachers with Scientists

SA

Launched in 2005, this program teams K-12 school teachers with scientists to bring new science ideas into the classroom environment. It is designed to get more young people interested in science by making classroom science lessons more relevant to real-life laboratories and careers in science. Likewise, it aims to inspire teachers and boost their skills, experience and enthusiasm.
5. Dreamworld Education Programs

QLD
Dreamworld have a number of educational programs for primary and secondary students, which provide an opportunity to discover science outside the classroom and turn theory into practice. These programs have been running for six years with over 5,500 students visiting Dreamworld on the Gold Coast and participating per year. Students examine different instruments of scientific measurement such as clinometers, accelerometers and data loggers, which graph the acceleration, speed and g-forces involved in the thrill rides.

6. Shell Questacon Science Circus

National
The Science Circus tours regional Australia for 18 to 20 weeks every year, visiting local schools and presenting lively science shows using everyday materials and props. At each regional centre they visit, the Science Circus sets up an interactive portable science centre for the public. The Science Circus staff are young science graduates who are studying the Graduate Diploma in Science Communication at the Australian National University. The Science Circus is part of the practical component of the Graduate Diploma and aims to develop the students’ skills in communicating effectively with all Australians about science and technology. Furthermore, the Science Circus supports the teaching of science and technology by running professional development workshops for teachers. The teacher workshops are designed to give teachers confidence to try new ways of exploring science in the classroom. The Science Circus is a joint initiative of Shell Australia, ANU and Questacon.


NSW
The PowerHouse Museum in Sydney presented this fun and educational exhibition in 2005. It involved numerous interactive exhibits such as robot dolls and zoetropes which encouraged visitors to understand science while having fun. Visitors could also find answers to questions such as ‘what makes a spinning top stay upright?’ and ‘why do magnets stay upright?’ as well as finding out the favourite toys of Australia’s leading scientists.

8. The Neighbourhood Engineering Scheme

NSW
Engineers Australia’s Neighbourhood Engineering Scheme links a member of the engineering workforce with a local secondary school to provide information on careers in engineering and advise on scientific and technological input into the curriculum. The scheme is reported to be beneficial to both the school students and participating members of the profession. The students learn to translate technical knowledge into everyday situations and gain an appreciation of engineering. It is intended to place students in an informed position to consider a career in engineering.

9. Biology Madness Kit

National
This experiment kit aims to promote science and dispel the myth that science is boring by allowing school-aged children to carry out their own experiments at home. The kit includes 25 experiments covering biology topics from DNA technology to botany which can be done at home with minimum supervision from parents. It has been designed by a group of PhD students who formed a group called Scyance as part of the Young Achievement Australia program. In 2006, Scyance will sell the kits, which are aimed at children aged between eight and 12, through schools and hopes to distribute through retail outlets.

10. Flower Pirates
VIC
Flower Pirates is a hands-on DNA manipulation workshop run by the BioSkills Network (a consortium of five Victorians TAFEs) and Florigene, a flower-breeding company that uses patented biotechnology to create novel flowers such as the blue rose. Touching on the genetic manipulation technology that led to the blue rose, students learn how to tell if a flower is ‘true blue’ or a pirated copy. This program combines new technology with big business to demonstrate that technology has real results.

11. CSIRO Labs on Legs Programs
SA
The CSIRO Labs on Legs programs travel throughout South Australia to provide exciting and interactive science experiences to primary and secondary school students. A CSIRO staff member turns up to the school and sets up experiments. An example of a Labs on Legs program is ‘Forensic Frenzy’ which touches upon contemporary interest in forensic technology.

12. Jason Project
National
The Jason Project is an international interactive multimedia science education program for students in years 4 to 9. The program began in the USA in 1990 and ultimately aims to inspire students to take up a lifelong passion for pursuing knowledge. Event days and national conferences are held each year.

13. CSIRO DNA and Genetic Engineering Student Workshop
National
This workshop is an introductory course designed for students in Years 10-12 even if they are not actually intending to study biology in Year 12. The sessions take 2 to 2.5 hours and are modelled upon a course developed at the Green Machine Science Education Centre and the Australian National University. Students explore DNA theory and the latest applications of genetic engineering with hands-on demonstrations of micropipette use, DNA extraction and other techniques used in research.

14. Science in the City
NSW
The Science in the City Expo presents science exhibits, shows, workshops and talks in the Australian Museum in Sydney. Designed to be mostly hands-on, it aims to inspire budding scientists and engage high school and primary school students of all levels. DEST is the major supporter of Science in the City.

15. Young Achievement Australia Biology Entrepreneur Program (BEP) 2006
This program engages highly motivated and capable students in a 24-week awareness program about challenging business skills and commercialisation. Students stimulate the establishment of a real company and develop real products which they sell. Participants are exposed to the business aspect of science and have the opportunity to establish new professional networks. This course is predominately offered to biotechnology and nanotechnology students.

16. CREST- CREativity in Science and Technology
National
The CREST program engages primary and secondary students with open-ended science investigations and technology projects. It is non-competitive and in this regard, encourages the development of skills and processes while inspiring students to take up further studies in these fields. Teachers have an integral role in the CREST program as facilitators, coaches and assessors.
17. Scitech Roadshow
National
This year is the celebration of ten years of the Scitech Roadshow in WA. Since 1996, the Roadshow has visited approximately 580,000 people, taking interactive hands-on science programs to regional and remote areas. Scitech is a not-for-profit organisation whose mission is to increase interest and participation by Western Australians in science and technology. Funding comes from grants from the Government, corporate sponsorship, admission and membership fees.

18. Australian National Botanic Gardens Education Program
ACT
One educational program offered by the Australian National Botanic Gardens is ‘Water for Life’, emphasizing the importance of water and the management of this resource for the future. This program is for students aged 6 to 9 and as such, has a hands-on emphasis. Students can go pond-dipping to investigate plants and animals or investigate river erosion.

SA/VIC
The Home Energy Project (HEP) is a comprehensive resource for Years 7 to 9 which aims to put life into the science curriculum. It involves practical activities about home energy efficiency and includes teacher resources, classroom activities, a CD-ROM of resources and a participation awards program. It is available to any school in Victoria and South Australia.

20. Phiggles the Flying Scientist
National
In June and July 2006, 250 of Australia’s most isolated children living in Queensland received science lessons from ‘Phiggles the Flying Scientist’. This is the sixth annual hands-on science program from science teacher Phill Higgins who got a pilots licence to reach out to remote areas more effectively. Australia Post supports the initiative.

21. The Investigator Science and Technology Centre
SA
The Investigator is a not-for-profit centre in Adelaide. It is committed to fostering an interest in SET amongst young people. The Investigator runs numerous programs from robotics to microscopes, ‘Puzzlemania’, ‘Party Science’, Bioinformatics and ‘Sounds Sensational’. Most of these programs are interactive workshops with a hands on and technological emphasis. The Investigator was founded in 1990.

22. CSIRO’s National Scienceathon
National
The National Scienceathon involves hands-on activities conducted over two weeks in primary schools across Australia. Aligned with National Science Week, school classes are placed in an Australia-wide team. Students are required to be in Years 1 to 7 to be eligible.

23. UWA Year 10 Engineering Camp
WA
The University of Western Australia and Woodside Energy offers a free annual week-long educational camp for students in Year 10. Practical sessions include electronics, robotics, computing, bridge building, biomedical engineering and environmental dynamics.

24. Science Alive

WA
Science Alive is a range of interactive and outcome-based science and technology programs for primary school students. Seen by more than 190,000 WA students since 1995, Science Alive shows aim to blend excitement and education.

25. Triple S Science for School Students

WA
Triple S (Science for School Students) is a collaborative group which aims to encourage middle school students to continue their studies in science in a practical and fun way. The group holds two free interactive science fairs a year. In 2006, these are to be held in Kalamunda and Mount Lawley. Attendees do not necessarily have to be school students but the fairs are seen as an effective means of raising awareness through direct contact.

26. Australian Sustainable Schools Initiative

National
This initiative integrates sustainability education into the school curriculum and implements improvements in the school’s management of resources. The program is action-based and involves the whole school community in the sustainable management of the school. It ultimately aims to instil an understanding and concern for the natural environment in all its participants. Run through the Department of the Environment and Heritage, the Australian Government has committed $2 million to the initiative over four years.

27. Department of CALM (Indigenous Heritage Unit)

WA
The Indigenous Heritage Unit programs assists in fulfilling outcomes in the curriculum in all learning areas. Staff from CALM’s Indigenous Heritage Unit provide educational talks and activities for primary and secondary school students, on their Nyoongar culture, in the classroom, local bush and national parks.

28. The Science Challenge 2006

National
The Science Challenge involves a set of online experiments and questions designed to communicate key scientific concepts to upper primary school students. The Challenge encourages them to use up-to-date information communications technology while developing their ability to observe, predict and analyse. Students complete their work online and results are sent back to them.

Outreach, education and support

29. Questacon Indigenous Outreach Programs

National
Questacon has a number of outreach programmes which focus upon engaging Indigenous Australians in science. They are specifically designed for individuals living in rural and remote Australia. Presenters travel to events and schools in regional areas to deliver workshops, shows
and presentations in a fun and interactive manner. The ultimate aim is to inspire an interest about science in these students and highlight possible opportunities in these fields.

30. Science on the Go  
Science on the Go is Griffith University’s science outreach program. One component of the program is the Science and Engineering Challenge which aims to inspire young people through fun and practical hands-on activities. Another component, the Science Trivia Challenge runs during National Science Week. Additionally, Science on the Go has a van, which travels to schools to present science shows and hands-on activities.

31. Australian Telescope Outreach and Education  
NSW  
The Australian Telescope facility at Narrabri offers antenna tours, building tours, special displays, astronomer talks and helicopter rides.

32. National Centre for Mathematics and Science  
NSW  
This National Centre was launched by the University of New England in 2004 to ensure school students throughout regional Australia have every chance to excel in science and mathematics. In this regard, the Centre aims to improve the quality of regional students' learning and addresses disadvantages by encouraging the professional development of teachers. The funds for this program have been made available through the Government’s 'Regional Partnerships Program'.

33. Women in Computing (WIC)  
QLD  
The Women in Computing Program is based within the Faculty of Informatics and Computing of the Central Queensland University. It supports and encourages women to study and pursue a career in computing. The program runs a specially designed Bridging Course to assist female students to develop basic computing skills.

34. WISE  
WA  
The Women in Science and Engineering (WISE) Project aims to increase female participation in Engineering, Computing and Mathematics through awareness, information and support. WISE actively encourages girls to continue their study of mathematics, physics and chemistry in Year 11 and 12 and provides support services to female physical science and engineering students at the University of Western Australia. WISE offers seminars, workshops and other activities for school students at UWA. Additionally, the School Speakers Program provides student speakers for schools and establishes networks for women enrolled in these fields.

35. Spotlight on Science  
QLD  
The Spotlight on Science initiative is a package of education and training reforms designed to improve the scientific literacy of Queenslanders, encourage more young people to aspire to careers in science and improve the quality of science education in the ‘Smart State’.

36. The Australian Museum’s ‘Five and Under’ Outreach Program  
NSW
This program, run by the Australian Museum, aims to stimulate and promote social interaction and interaction between children and ideas while fostering a philosophy of scientific enquiry and interest from a young age. The children are encouraged to mentally and physically engage with people, objects and materials.

37. Questacon Smart Moves Program

ACT

The Questacon Smart Moves Program is an initiative of the Australian Government’s Backing Australia’s Ability - Building our Future through Science and Innovation package. The initiative aims to raise awareness of science among young Australians in rural and regional areas, hence inspiring them to pursue opportunities in these fields.

38. Girls in Mathematics, Technology and Science Summer School (GMTS³)

QLD

The GMTS³ is an equity program directed at Year 10 girls with an aptitude for science and mathematics who may not already be receiving support or encouragement to continue their studies in these areas. Based in the University of Southern Queensland, the program identifies contributions made by women in SET, increases awareness of the value of the female perspective and in this way, aims to influence subject selection. Every year, GMTS³ holds a number of activities and workshops on subjects such as bridge building, forensic science, robotics and careers.

39. Monash Science Centre

VIC

In 2006, the Monash Science Centre will be running its Science Students in Schools Program which offers final year science students the opportunity to work in primary or secondary schools for one to two hours per week over a school term. The final year students will be matched to a class and will work collaboratively with the teacher to enhance the experience of science for students.

40. Edith Cowan University Peer Tutoring

WA

The Faculty of Computing, Health and Science at Edith Cowan University offers peer tutoring by high achieving university students to teachers and students at schools surrounding the university. This is a free service which is supported by the university and Western Australian Government.

41. Women into Science and Technology (WIST)

QLD

WIST aims to encourage and support more women to study and pursue a career in Science and Technology. It is a home-based self-paced study program which enables women to ease into a university education. Women in remote areas are particularly encouraged to access this program. Courses available include Introduction Chemistry and Biology and Transition Mathematics.

42. CSIRO National Awareness Parliamentary Information Program

ACT
The CSIRO has developed two components for this program; science updates for electorates and science briefings. Science updates for electorates are a targeted service established in 1998, which delivers information about CSIRO scientific advances by email. It is sent to all Members of Parliament, which can then be used for policy development or inclusion in speeches or media releases. Additionally, briefings have been presented in Parliament House, Canberra since 1996. These send the message to politicians and the media that Australian science and technology can make a significant difference. Whenever possible, the briefings provide the participants with hands-on experience.

43. Science Meets Parliament
ACT
Run by the Federation of Scientific and Technological Societies, SmP is a two day event which connects science and parliamentarians. The first day is a briefing day which informs scientists on strategies, parliamentary processes and issues to give them a feel for the policy-making process in Canberra. The second day involves formal one-on-one meetings between scientists and Parliamentarians. The event aims to create networks between different sectors which ultimately will contribute to the promotion and understanding of the importance of science. SmP is now in its sixth year and has become a permanent fixture on the national scientific calendar.

44. Continuing Access Program (CAP)
VIC
The University of Melbourne’s Continuing Access Program is a continuing education facility through which a range of degree subjects are made available to the public. The Faculty of Science allows people not enrolled in degrees to study subjects such as biology, zoology, physics, chemistry and information systems. Individuals enrol in these subjects for professional development, preparation for further study or personal interest.

45. Science in Context (SIC)
NSW
The NSW Department of Education developed Science In Context, a program about schools working with Aboriginal communities, as a strategic response to the need for teachers to utilise appropriate teaching and learning strategies in science amongst Indigenous students. The initiative tries to foster an interaction between Aboriginal community perspectives and science to ensure that the curriculum is meaningful for these students. It is primarily targeted at students in Years 7 to 10.

46. Electronics Industry Association Information Events
The Electronics Industry Association has a number of free events designed to provide information about careers in the electronics industry and increase interest in the field. One such event allows participants to make their own LED torch as part of National Science Week.

47. The Edith Cowan University Mathematics Problem Solving Program
WA
In its eleventh year, this program is run for able and gifted school students aged 10 to 15 in the northern Perth Metropolitan area. Classes commence in February and run throughout the year. Students participate in a wide range of mathematics problem-solving activities with a focus on the effective presentation of solutions. Students in the upper levels of the program participate in the national program, Mathematics Challenge for Young Australians, organised by the Australian Mathematics Trust.

48. Curtin Mathematics Enrichment Classes
WA
Since 1998, Curtin University’s Department of Mathematics and Statistics has run a mathematics enrichment program for students in Years 5 to 11. The program is suitable for a broad range of mathematically talented students. It is designed to develop a sound mathematical understanding and problem solving skills in these students.

49. Naregebung: Rockingham Environment Centre

WA
Naregebung’s mission is to provide educational programs which promote the benefits of managing the environment to sustain quality of life. They offer school excursions on a range of environmental topics for students in primary and secondary school.

Forums/Conferences

50. National Youth Science Forum

ACT/National
The National Youth Science Forum (NYSF) is a two-week program for Year 11 students who are considering a career in science, engineering or technology. Students are introduced to researchers and research and helped to develop their communication and interpersonal skills while fostering discussion in major national and global issues. The NYSF places equal emphasis on pure research, applied research and engineering in both the physical and biological sciences. The emphasis in the human biology field is placed on biomedical research and biotechnology. This event takes place in January at the Australian National University.

51. Youth ANZAAS National Conference

National
The Youth ANZAAS is a national conference for science students Years 9 to 12. Every year, six students from each State and Territory participate in three days worth of science activities and experiences including behind-the-scenes tours, lectures from leading scientists and hands-on research. Youth ANZAAS is organised by the Australian and New Zealand Association for the Advancement of Science (ANZAAS) and is sponsored by DEST. In 2006, this conference was held in South Australia.

52. Professor Harry Messel International Science School

NSW
From 3-16 July 2005, 140 students from Australia, China, Japan, Malaysia, New Zealand, Singapore, Thailand, the UK and USA gathered at the University of Sydney for the International Science School, Waves of the Future. During these two weeks, students attended scientific lectures, activities and social events. This Science School was launched in 1962 to recognise and reward talented students and encourage them to pursue careers in scientific fields.


National
This conference will be held 19-22 November 2006 in Sydney with the theme ‘Bridging Innovation and Investment’. It is designed to provide a wealth of information and networking opportunities for those in biotechnology and related industries.

54. International Congress of Human Genetics

National
In 2006, the 11th International Congress of Human Genetics was held in Brisbane August 6-10. It is held every five years with the first congress held in 1956 in Copenhagen and subsequent congresses hosted by cities around the world. The 10th Congress held in Vienna in 2001 was
attended by 3000 delegates, primarily health professionals and genetic scientists from 79 countries.

55. Campaign to Map Human Mutations
National
From 20-23 June 2006, Melbourne hosted a group of international geneticists who met to plan a global project to catalogue human mutations and hence transform understanding and treatment of disease.

56. Fenner Population and Environment Conference
National
The Fenner Conference ‘Urbanism, Environment and Health’ was held 25-26 May 2006. It took a broad approach to the topic of physical and social environments in Australian cities. The conference brought together experts from academia, government, commerce and community organisations.

57. Greenhouse 2005: Action on Climate Change
National
This conference is a high-profile international event which was held 13-17 November 2005 in Melbourne. Representatives from research organisations, government, industry and the community met to discuss climate change, taking a multi-disciplinary approach to this issue.

Audio (eg radio)

58. ABC Radio: ‘The Science Show’
National
‘The Science Show’ with Robyn Williams on ABC Radio National looks at scientific issues, debates, events, personalities, discoveries and scientific frauds. It is designed to give Australians insights into all areas of science with a focus upon science linked to popular or everyday topics such as the ‘physics of cricket’. According to Robyn Williams, ‘The Science Show’s’ aim since it began in 1975 is “to produce a science program about ideas, not simply facts or bits of boffinry”.

59. Diffusion: Real Science Radio
NSW/National
Diffusion is on 2SER 107.3 in Sydney every Thursday morning and broadcast Australia-wide by the Community Radio Network. This show is a source of fascinating, weird, disturbing and fun science, with the motto of ‘spread the word’.

60. SBS Radio
National
SBS radio has a number of science segments with a diverse range of themes. In keeping with the focus on World Cup Soccer in June, SBS presented ‘The Science of the Ball’ and ‘Technology of the Boot’ looking at the science behind football. Another program explored the way modelling could predict the winners of the Melbourne Cup.

61. Science in the Pub
National
Winner of the 2000 Eureka Prize. Science in the Pub aimed to take science to the wider community in an informal manner, which demystifies science and humanises science. This was carried out through broadcasts on ABC Radio National and the establishment of a ‘SciPub’ Website. Programs included ‘Life, the Universe and Everything!’, ‘Science and Politics’, ‘Is DNA
testing a new crime fighting tool or an invasion of our privacy? and ‘What more does the Universe have to do?’ Science if the Pub ran from 1998 to 2004

Prizes

62. The Bob Squire Science Award  
National  
The ‘Bob Squire Annual Award for Excellence in Science Teaching in Rural and Regional Australia’ is a national award offered by the Australian College of Educators (ACE), in association with the Australian Science Teachers Association (ASTA), the Australian Academy of Science (AAS), and Questacon. The award is open to teachers in Government and Non-Government schools in rural and regional Australia with favourable consideration going to teachers with less than 10 years experience. The winner is selected on knowledge and experience in science teaching and the ability to create challenging learning environments based on current practice and scientific research.

63. The Western Australian Premier's Science Awards  
WA  
Organised by the Department of Industry and Resources, this award promotes outstanding scientists, science educators or science communicators. The awards recognise excellence in science by raising awareness and creating a sense of community pride in science education and research. Furthermore, the awards are designed to raise the profile of science and technology endeavours in Western Australia. In 2006, the Premier’s Science Communicators Award will be inaugurated which will recognise an outstanding group, individual or organisation for excellent works of science communication.

64. Inventor of the Year  
National  
Entrants can be nominated for these awards under the categories of industry, research organisation, government and schools. Only products or ideas at the pre-commercialisation stages of development are eligible for entry. The schools category is open to primary and secondary students from K-7. It aims to reinforce the value and importance of creativity and innovation in science.

65. Eureka prize  
National  
Established in 1990, the Australia Museum Eureka Prizes acknowledge and reward outstanding achievements in Australian science and science communication. These awards are a result of partnerships between the Australian and NSW Governments and a range of organisations, companies and individuals. Since its inauguration, there has been growth in the number, scope and value of the awards. A comprehensive range of research activity, leadership and innovation, high school science, science journalism and science communication is now rewarded. These prizes are intended to raise the profile of science in the community. Furthermore, the prizes have also become the country's largest single national award scheme for research into critical environmental and sustainability issues facing Australia.

66. Young Scientist of the Year  
National  
The Young Scientist of the Year is an award given by the Science Teachers Association. The winner will gain first hand experience in newsrooms enabling them to communicate more effectively with journalists and the general public throughout their research career. The award is open to fully qualified scientists or engineers at the start of their career.
67. Young Researcher Awards

*National*

These awards draw the best young cancer researchers from around Australia. It is a major event within the Australian medical and scientific communities.

68. Victoria Prize

*VIC*

Each year, the Victorian Government awards this $50,000 prize to an individual whose discovery or innovation has advanced knowledge or will produce commercial outcomes or other benefits to the community. In this way, the prize emphasizes the ways in which research and development of international significance is conducted locally.

69. Victoria Fellowships

*VIC*

Each year the Victorian Government awards up to six $18,000 Victorian Fellowships to enable early career researchers and innovators to travel overseas to pursue specialist training, develop a commercial idea or expand international networks.

70. Young Water Scientist of the Year Award

*National*

Established by the Water Forum Cooperative Research Centre in 1998, this award aims to promote excellence in the development of young scientists with a blend of high quality science, good communication skills and a genuine understanding of industry needs. Entrants must be post-graduate students.

71. The Tall Poppy Campaign

*National*

The Tall Poppy Campaign was established by the Australian Institute of Political Science to promote awareness of Australia’s intellectual achievements. A component of the campaign is the Young Tall Poppy Science Awards which recognise the achievements of young researchers in the sciences. In this way, the campaign aims to encourage younger Australians to pursue excellence in science. These awards are held each year in different states. The Tall Poppy Campaign also involves Educational Information Programs with award recipients visiting schools to talk to students about science opportunities.

72. Fresh Science

*VIC/National*

Now in its ninth year, Fresh Science aims to identify exciting, unexposed Australian research for presentation to the public and media around National Science Week. This national event based in Melbourne is designed to enhance reporting of science and provide role models for the next generation of scientists. The selected ‘Fresh Scientists’ receive a prize of a $4000 study tour of the UK.

73. Women in Engineering Scholarships

*WA*

To encourage women to undertake study in engineering, Edith Cowan University’s School of Engineering and Mathematics offers enrolling female students a scholarship of $1,500.

74. WA Schools Environmental Education for Sustainability Awards

*WA*
The WA Department of Environment recognises the work of teachers and students for a better environment with these awards. They are held annually and designed to complement the WA Environment Awards. There are nine award categories and each category has at least $1000 in prize money on offer.

Competitions

75. RioTinto Big Science Competition (prev. Australian Science Olympiads)

National

The RioTinto Big Science Competition is a challenging nationwide science competition for students from Year 7 to 12. It is the selection process for the Australian Olympiad Team. The International Mathematics and Science Olympiads are held every year in various nations around the world. Based upon the five disciplines of Biology, Chemistry, Physics, Mathematics and Informatics, the competition is open to secondary school students from 80 countries. The competition is designed to encourage bright, curious, young minds by allowing them to come together to socialise and compete for medals through university level science experiments and exams. For many, participation kick starts a career in research and allows them to build international networks as the basis for future collaboration.

76. Science Fiction Short Story Competition

NSW

Run by the Physics Society of the University of Newcastle, the Science Fiction Short Story Competition was inaugurated to promote science in written fiction. Involving all states, the theme for 2006 is ‘A Modern Scientific Romance’ with a first prize of $200 and $100 for the best High School entry.

77. EngQuest

National

EngQuest involves engaging and interactive student projects which allow primary school students to achieve key learning outcomes in mathematics, science and technology while also developing team work. While every student receives a certificate of participation, there are prizes for winning projects at state level. EngQuest is a program of Engineers Australia and is supported by the Australian Government through a Science Connections Programme grant administered by DEST. In 2005, over 4,000 students from 286 schools in 976 teams participated in EngQuest.

78. Murdoch University Challenge

WA

This is a competition for students in Years 8 to 12, to design and build a cheap but effective electric vehicle which is then used to compete against other teams.

79. The SunSprint Model Solar Car Challenge

NSW

Sponsored by the University of New South Wales, the SunSprint Model Solar Car Challenge is designed to encourage positive and useful skills and values. For example, the social skills needed for teamwork, the practical skills of model building, creativity and invention and hands-on experience of science, engineering, electronic, mathematics and physics.

80. Mathematics Talent Quest

VIC
Organised by the Mathematical Association of Victoria, the Mathematics Talent Quest was first held in 1982. It is open to all primary and secondary school students in Victoria and aims to promote interest in mathematics and foster positive attitudes. The activity focuses upon real life situations to demonstrate that mathematics is everywhere while allowing students to investigate the process of mathematics on an individual or group basis. All entrants receive recognition with the top entries forwarded for judging in the National Talent Quest.

81. Spatial Technology in Schools Competition
WA
The Spatial Sciences Institute (SSI) runs this competition for Western Australian schools. The competition is about students using spatial technology in challenging and fun ways to assist solving problems. The competition begins May 8 and ends October 31, 2006.

82. Western Power Solar Car Challenge
WA
The Western Solar Car Challenge is in its 13th year. WA secondary schools compete for the right to represent WA in the Australian-International Model Solar Car Challenge.

83. BHP Billiton Science Awards
National
The BHP Billiton Science Awards reward young Australians who have undertaken practical research projects with an innovative approach and thorough scientific procedure. Entrants can be individuals or groups in Years 1 to 7. The awards are broken into four categories: Biology and Microbiology, Chemistry and Biochemistry, Physics, Engineering and Technology and Earth and Environmental Sciences.

84. Robocup
WA
Robocup Junior Western Australia is an interschool tournament hosted by Scitech which encourages learning and sharing through participation. Students build and program robots to do tasks such as play soccer or perform a dance routine. The competition is open to all primary and secondary schools in Western Australia.

85. GenETHICS 2006
National
This competition is open to students in Years 10, 11 and 12 studying Biology, Sciences, English or Philosophy. It provides an opportunity for these students to discuss ethical issues associated with human genetics. The entrants must prepare an essay of no more than 1500 words. All participating students receive a certificate and finalists can win cash of up to $500. In 2006, it is proposed that the final will be held during National Science Week.

Written/Visual

86. SCINEMA Festival of Science Film
National
The SCINEMA Festival of Science Film screens annually around Australia during National Science Week. It was intended to forge links between science and art while raising public and stakeholder excitement and trust in science. Inaugurated in 2000, SCINEMA opened as an internationally competitive festival playing in Canberra. It was well-attended and has since been extended to other locations around Australia.
87. Engineering Our Future
National
This teaching resource on CD-ROM has been designed by Engineers Australia and the University of Newcastle to assist teachers in gaining an understanding of science, engineering and technology concepts. It provides exercises and materials for the classroom with the aim of presenting science, engineering and technology to students in a fun and stimulating manner. The focus is on hands-on projects and the technical ideas are presented in clear, simple language. It is primarily aimed at students Years 7 to 9. As a component of Engineers Australia’s school outreach program, one copy of the CD-ROM was distributed to each school.

88. Science Books for Children
National
The Australian Academy of Science has compiled an annotated list of selected titles for children. These books have extra sections of inspiration to challenge and extend the reader. Books exploring the Earth Sciences cover a wide range of topics: from the composition of the Earth and how it was formed, to environmental issues and natural disasters that threaten the planet.

89. The Art of Scientific Explanation
NSW
Run by the University of Sydney in 2006 (9-20 January), this intensive two-week course is designed to combine curiosity and creativity as students make movies about scientific research, record a science radio show or create a scientific model. Aimed at talented Year 11 and 12 students, the course provides a chance for these students to gain experience of university science study and ultimately aims to encourage further study in these areas.

90. The Science of Bushfires: An Internet WebQuest
NSW
Created by Uniserve Science (the University of Sydney), primary school students participate in a WebQuest by using internet sources to answer questions about bushfires. Students are encouraged to use multiple perspectives and participate in teams to research, analyse and present scientific facts and information with an emphasis on scientific process.

91. Plasma
VIC
Plasma is Melbourne’s Young Scientist of Australia (YSA) newsletter and contains information for anyone interested in participating in science activities. It contains professional and amateur science articles and welcomes reader contributions.

92. Australian Dinosaur Story
National
This website located at www.heritage.gov.au/dinosaur, is an initiative of the Australian Government Department of the Environment and Heritage and has been promoted as a pilot education project. It is hoped that the site will become a useful tool for students and teachers to increase their understanding of Australian dinosaurs.

93. Biotechnology Online School Resource
National
Biotechnology Online is produced and maintained by the Australian Government Agency ‘Biotechnology Australia’. It provides balanced, factual and up-to-date information about biotechnology that fits with school science curriculum. The first version of Biotechnology Online was produced in 2001.
94. Double Helix Science Club (CSIRO)

National
Launched in 1986, the Double Helix Science Club now has 17,000 members. Members have a choice of 'The Helix' magazine aimed at 10 year olds and above or 'Scientriffic' (7+). Delivered every two months, the magazines contain science news, hands-on activities, experiments, comics and competitions. Members of Double Helix also receive initiations to special events at the nine CSIRO Science Education Centres across Australia. A weekly email newsletter 'Science by email' also provides information on experiments and science news.

95. Australasian Science Magazine

National
This is Australia’s only monthly science magazine and is aimed at the general public, although with an older audience than ‘The Helix’ or ‘Scientriffic’. The Australasian features articles about a wide range of science issues from nanotechnology to astronomy and ethical concerns.

Other/Combined

96. Australian National Chemistry Week

National
The Royal Australian Chemical Institute organises this annual event to raise the profile of chemistry in the community. The organisers believe that an attitude that chemistry is responsible for the ills of the world has become widely accepted and chemists are often perceived as responsible for environmental problems. In this regard, the event emphasizes the importance of chemistry in the community and chemistry as a profession. The week is designed as a means of communication between the Royal Australian Chemical Institute and the community. The major activities of Australian National Chemistry Week include the Australian National Chemistry Quiz, chemical analysis competition, Cryptic Chemical Crossword Competition, short story and feature article competitions, displays in libraries, visits by chemists to primary schools, public lectures and national radio and television interviews. In 2006, this occurred from the 23rd to the 29th of July.

97. Earth Science Week

National
Earth Science Week involves a number of different activities run by Government and private organisations. In the 2005 program, Geosciences Australia ran the Canberra Schools’ Challenge (a competition to ‘build your own seismograph’) while the Minister for Mines and Energy offered a Scholarship to undertake university study in the earth sciences or geology. The Australian Academy of Science interviewed some of Australia’s noteworthy earth scientists. The scientists talk about their early life, how they came to be interested in science and their research. The transcripts of these interviews were made available on the Academy website as a way to appreciate Australia’s contribution to the earth sciences.

98. World Year of Physics (2005)

National
The International Union of Pure and Applied Physics declared 2005 to be a worldwide celebration of physics and its importance to everyday life. The year coincided with the centennial celebration of Albert Einstein’s ‘miraculous year’. It aimed to bring the excitement of physics to the public and inspire a new generation of scientists. A number of national events
were held including the Pirelli International Award, Ovaltine Big Adventure, IYPTAustralia Challenge, Macquarie University Physics Art Prize and the Einstein Rally.


*National*

The United Nations General Assembly adopted a resolution which declared 2006 the International Year of Deserts and Desertification worldwide.

100. Australasian Computer Science Week

*NSW/National*

This is an annual week for computer science researchers and educators held in the Australasian region. It occurs in conjunction with the Computing Research and Education Association. In 2005, it was hosted by the University of Newcastle and included conferences, interactive events and social activities.
Appendix B: Reference List


Macquarie University (2005). *Macquarie University Science, Engineering and Technology Study*: Insight into the attitudes and opinions of NSW secondary students, current tertiary students and science professionals towards SET study and careers.


