australian institute of biology

Newsletter

Volume 7 No 1 July 2007

In This Issue:

ABN: 71 266 532 502

- President's Report
- Bulletin Board
- Thoughts on Science Education 1 "Myths, Methods and Madness"
- Thoughts on Science Education 2 "Biology and the Inquiry Process – gifted children"
- News From FASTS
- Climate change in the Rain Forest
- Larval fish in the fast lane
- Executive Committee 2006-2007
- AIB Survey results.

President's Report

Lance Lloyd. President , AIB

From the President's Desk.....

Introduction

It's July 2007 and another year is rushing by, however your executive has been working on numerous tasks which have been required to improve the Institute's services to members. We have struggled with our professional commitments to find the time to put into the AIB and all the tasks necessary to ensure the AIB is an effective advocate for biology and biologists. That said, thanks to the committee and their energy, we have now been meeting every month and are slowly working away at a range of necessary tasks. The following points indicate decisions made and actions taken towards a rejuvenated AIB.

Compiled by Evan John for the Executive Committee. (evkayd@picknowl.com.au)

1. Newsletter

Evan has done a great job for the newsletter but he has lacked input of articles by the committee (sorry Evan) and members. He will continue for a bit longer but overseas trips and retirement activities do draw his attention away, so help him out and write an article or two. The Committee is trying to prepare or source more articles but you can assist too. Other members would be interested in your recent travels and work on biology – is there somewhere you have been recently which might be the subject of an article? I'm trying to write one on Lake Condah which I recently visited in South West Victoria to undertake some environmental flow assessments of the Lake Condah and Darlot Creek system. The trip was a heady mix of biology, archaeology, aboriginal culture, eels and underground rivers which yielded much more than the biological outputs we were required to achieve. So join me and see what information you can use to produce a short article which will be of interest to other members. I'm also developing a series of articles on the diverse jobs that biologists do, so let me know if you want your story shared with other members. These stories will help promote biology as a profession – we don't all work in a lab - you'll be surprised where biologists turn up!

2. Conference

The membership survey indicated that members wanted a national conference and we will work towards this in the next 6-12 months. In the meantime we will support smaller get-togethers, given sufficient interest.

3. Membership survey

Tom Holman, The AIB's Treasurer, through his Company "Ultra Feedback", recently analysed the extensive survey of members'opinions to ascertain and prioritise AIB's future goals and objectives.

343 respondents were invited to participate in this on-line survey and this report was prepared based on the response of those who participated in the survey. The response rate was approximately 40%.

The respondents were fairly evenly distributed across Australia with 62% in NSW, QLD and VIC. The majority (71%) of members rated their involvement in Biology as very high and 54% considered themselves to be professional biologists. 92% of the respondents had been members of the AIB for more than 10 years.

The report outlines the strategy the Committee is adopting to rejuvenate the AIB. It is an informative read and outlines the sort of information we are currently mining to produce better services for AIB members. Many of the initiatives suggested by members will be supported by the committee, but they also require input and actions by members. Establishing local or specialist groups will require a local or discipline-based co-ordinator (any takers?). Promotion of biology will require speakers in schools and elsewhere, seminars will need organising committees and expanding the newsletter will require articles from members.

Tom has produced a list of members who indicated in the Survey that they are prepared to talk to students in schools in different States. Contact Tom via email at tom.holman@ultrafeedback.com or on 0412566425 for further details about these people.

If you wish to offer some help please contact your committee and don't be surprised if one of the committee or Geoff contacts you to see if you can help.

(The results of the Survey are published at the end of this newsletter, for members' perusal.)

4. Meet the New Executive Officer – Dr Geoff Crawford.

Dr Geoff Crawford

The pressure of professional life these days, whether you're a university academic, teacher, private consultant or government worker, is extremely busy and your committee has not been immune from this problem. Basically, a volunteer committee can only achieve so much each month and we have come to the conclusion that without help we cannot achieve our aims. The help has come in the form of an Executive Officer. The committee decided to appoint an executive officer to effect the ideas generated by the AIB executive. Geoff Crawford, who previously sat on the executive has stood down from the committee, and has been approached to operate as an Executive Officer. This means a small retainer is paid to allow work to be undertaken every week to progress the various actions needed. Geoff has prepared an action list (under the direction of the committee) and he provides an overview of his thoughts and experience in the following paragraphs:

"I am very pleased to be appointed as the new EO of the AIB and would like to introduce myself to all members. I have been a member since 1990, and for your information, have outlined my career and experience below.

- After finishing school and prior to starting university in 1979 I worked in a range of industries including agricultural chemicals, printing inks, artificial breeding of cattle, petroleum, security and was even locked up in Pentridge Prison for 13 months (as a prison officer!)
- At Monash I did a BSc(Hons) in microbiology and a PhD in virology in the years 1979 -1987.
- From 1987 – 1991 I worked in avian vaccines and diagnostics with Steggles at Newcastle and with immunological reagents at Silenus, Melbourne before moving to Charles Sturt University in Wagga Wagga.
- From 1991 – 1998 I was a lecturer and senior lecturer in microbiology and quality management at CSU. My main research interest was the avian pathogen – chicken anaemia virus.
- In 1998 I returned to Melbourne and in 1999 started my own business - Access Academix. A consultancy in the broad areas of teaching, training, professional speaking and development of training materials. I also do a lot of work with gifted and talented children in science, maths and problem solving.
- In 2005 I joined the new Executive Committee of the AIB to help save our society along with Lance, Ann, Ian and Tom.
- In 2006 my son Matt joined the business to provide a completely new venture – Estate Experts that help families clear houses when loved ones move on to smaller accommodation or to their final reward.
- My interests include collecting Japanese Invasion Money banknotes, Samurai Cards and bankcard memorabilia. I have strong interest in the "Jack The Ripper" crimes and I am currently writing a book on Jack (very slowly). I also like metal detecting and fishing.
- I have moved into a semi-retirement phase and on 9th July 2007 I resigned from the Executive Committee to take up the position of EO and I look forward to working with you all to get AIB back on track as a professional society.

- I believe that our major strength is in our diversity that encompasses all aspects on "biology".

5. Updating membership.

A membership committee is now operating under the Leadership of A. Prof Anne Lawrie, AIB Vice President, and we have had many applications for new members. Anne is also putting the finishing touches to a Fellowship Committee to evaluate applications for new Fellows. A new membership certificate has been prepared to allow new members to proudly display their membership of the Australian Institute of Biology. Is your membership certificate being displayed prominently in your office and do you use "MAIBiol" or "FABiol" after your name? If not, please begin to, as it raises the Institute's profile amongst non-members.

We are looking for additional members of our committee as Deputy Vice-President, Area Representatives or for special projects - if you are interested, please contact me (ph. 9884 5559, lancelloyd@ozemail.com.au or via PO Box 3014, SYNDAL, Vic, 3149) or one of the Committee (listed elsewhere in the newsletter).

Bulletin Board

- **Science Education**

Julie Bishop initiated a 'stock take' of science education called the *Australian School Science Education Framework (ASSEF)* which has been described as an attempt to:

- map key school science education initiatives across Aus including identifying gaps,
- recommend actions to address needs; and,
- promote coherence in the development and implementation of school science education initiatives nationwide.

Professors Denis Goodrum (UCan) and Leonie Rennie (Curtin) are the key personnel developing the framework which will go to MCEETYA (the Ministerial Council of Sate and Commonwealth Education Ministers) with a view to co-ordinated national initiatives. It will be interesting to see whether the framework is, in fact, as

comprehensive as has been described and to what extent it leads to cleaning up the myriad pots of initiatives into a framework with rather less micro-management and inefficiency.

"In a related development I can report that a concept paper will be released in October looking at an initiative involving the AAS and CSIRO called 'learning by doing' which is targeting junior secondary school education. I will forward a copy when I receive the paper as the authors are keen for FASTS and individual society feedback."

Julie Bishop then referred to a paper from a Caltech Associate Professor of Biology, James M. Bower. (It is reproduced below, under the heading "Thoughts on Science Education 1," and includes some very interesting ideas for Science Teachers and Lecturers.)

(Editor's note)
As a former Lecturer in Science and Biology Methodology at Flinders University, S.A., I can commend this article

which follows on page 7. Tutorial material for University B.Ed science students??)

- **Conservationists welcome Toothfish plan**

Conservationists have welcomed the Federal Government's approach to managing the Macquarie Island toothfish fishery, about 1,500 kilometres south of Hobart.
(See article in AIB Newsletter Vol 5 No 2 December 2003)

For the first time, the Australian Fisheries Management Authority (AFMA) has called for tenders from companies wanting to trawl for the Patagonian toothfish around Macquarie Island.

The allowable catch this year is 341 tonnes.

AFMA's Trish Stone says calling for tenders allows new companies into the fishery, and it "isn't about trying to make money by selling these fishing rights.

Alistair Graham from The Tasmanian Conservation Trust says the process allows scientists to decide the catch limits. "It is very reassuring to see that the government is going to allocate fish in that precautionary way," Mr Graham said.

He says the Macquarie Island plan should be an example for fishery managers in other areas, such as tuna fisheries in the Southern Ocean.

"There are huge problems in trying to negotiate with other governments to ensure that scientific advice is respected and precautionary catch limits are set," Mr Graham said.

"Generally we've been failing miserably with respect to both the southern blue fin tuna and other tuna stocks in the Indian Ocean."

- **Enzymes and auto-immune diseases.**

Researchers in Sydney have discovered that an enzyme only found in immune cells plays a role in promoting rheumatoid arthritis, a painful and debilitating condition that affects about one in 1000 Australians of all ages. The enzyme, PAC-1, is only one member of a whole family of enzymes, and researchers at the Garvan Institute of Medical Research believe the studies may lead to better therapies for many other autoimmune and inflammatory diseases.

- **Smelly frogs don't get insect bites**

The following discovery was reported earlier last year by Jacquie van Santen of ABC Science Online.

Researchers have found that some Australian frogs create their own insect repellent, resembling rotten meat and others roasted cashew nuts or thyme leaves.

The research team, which includes Associate Professor Mike Tyler of the University of Adelaide and entomologist Dr Craig Williams from James Cook University, has published its findings online in the journal *Biology Letters*.

Frogs produce a number of chemicals in their skin, including hallucinogens, glues and anti-microbials, to ward off infection and stop other animals from trying to eat them.
"We wanted to test Professor Tyler's [belief] that they should also produce an insect repellent," Dr Williams said.
The research team studied five species of Australian frogs, including the Australian green tree frog.
Using massage and acupuncture techniques, they stimulated the muscles beneath the frogs' skins to produce secretions.

"What we found was that frogs produce a variety of chemicals in their skin and these ooze out of the pores of their skin when they are stressed," Dr Williams said.
The secretions, some of which repel mosquitoes, have different smells depending on a number of factors such as what the frog eats.
"The frogs produce hundreds of chemicals and one frog's smell might be made up of six or seven different chemicals, so they all smell quite different," Dr Williams said.
"The chemicals evaporate very quickly from the skin and it's the volatile smell that repels [the mosquitoes]."

A new mosquito repellent?

The team found that skin secretions from an Australian green tree frog, for example, protected a mouse from mosquitoes when the secretion was applied.
The researchers say this is the first time a vertebrate has been found to have its own in-built mosquito repellent.
The frog secretion was not as repellent as DEET, diethyl-m-toluamide, the ingredient in most commercial mosquito sprays.
Dr Williams does not believe that a new brand of natural insect repellent will result from the research.
"The smell is just not very good ... some smell of rotting flesh, some of nuts, some of thyme leaves."
In 2005 the frog-sniffing research team won an Ig Nobel prize for its work on skin secretions. (See AIB Journal, Interim Issue, February 2006, pg 15)
The prizes honour "achievements that first make people laugh and then make them think".
At the time, the researchers talked about frog smells that reminded them of Bombay curry and cut grass.

- **Biofuel bugs**

Microalgae are being cultivated for biodiesel production as part of a research program by the South Australian Research and Development Institute (SARDI) which seeks to exploit the high oil content of the single-celled organisms. The program seeks to select species with rapid growth and high oil yields and also fund the development of culture systems.

- **Artificial plants**

A research team at the University of Sydney has created molecules that mimic those in plants that harvest light and power life on Earth. Dr Deanne D'Alessandro says that a leaf is an amazingly cheap and efficient solar cell that can harvest 30 to 40 per cent of the light falling on them while the best solar cells humans can build are between 15 and 20 per cent efficient and expensive to make. "We've recreated some of the key systems that plants use in photosynthesis."

- **Unintelligent Design**

Intelligent Design has found its way into the headlines, has been spruiked by Dr Brendan Nelson, and is now trying to slink into our schools. So where did this willfully ignorant sibling of creationism and its anti-scientific arguments spring from? And why is it refusing to go away?

ABC Science broadcaster, Robyn Williams has taken on the monster of creationism posing as science in his new book, ***Unintelligent Design.***

Robyn Williams presents science programs on ABC radio and television. A fellow of the Australian Academy of Science, he was a visiting fellow at Balliol College, Oxford, and is now visiting professor at the University of New South Wales.

- His book has been described as a "witty and wicked" debunking of intelligent design, and he argues that if God really

created the universe she made a hash of it. Why, for instance, do female koalas have a downward-opening pouch? And if the intelligent designer was so clever, why are humans plagued by sinus blockages, piles, bad breath, farting and a useless appendix?

- **Science Media daily Parliamentary news service.**

Are members interested in the sciences, technology, innovation, education or the environment? If so, they might like to trial a daily service from the Federal Parliamentary Press Gallery.
Science Media provides a daily email bulletin with hot links to announcements by Members of Parliament, Commonwealth agencies, lobby groups and other organisations. There is no commentary and no advertising; only short sharp summaries with direct links to the online primary documents. The service is now in its second year and subscribers include: Deans of Science, public servants, researchers, science communicators, specialist advisers and professional organisations.
Individuals or organisations may sample the service by registering for a free one-month trial. If they find it of value a one-year individual subscription will cost $275 (incl. GST). Discounted rates are available for multiple subscriptions.
To take the free trial or ask for more information, please email:
sciencemedia@incanberra.com.au
The Directors of Science Media are Simon Grose and Peter Quiddington. Simon is a freelance journalist who has been S&T Editor of *The Canberra Times* since 1994. He is also a contributor to *Australasian Science* and *Nature Medicine*.
Peter is a policy analyst, editor and publisher currently completing doctoral studies in higher education policy

- **Heron Island fire**

It was sad to hear in March 2007 that there had been a fire at UQ's Heron Island Research Station early one morning, in which buildings were destroyed, and some huge and expensive experiments and irreplaceable samples were lost. Fortunately no staff or students were hurt. Our commiserations to the marine science and GBR research community.

Thoughts on Science Education – 1.

1. Scientists & Science Education Reform: "Myths, Methods, and Madness"

James M. Bower, Co-Director,
Caltech Pre College Science Initiative.
Associate Professor of Biology,
California Institute of Technology,
Pasadena, California

Over the last several years, the deplorable state of public science education and the perceived consequences for our nation's economic and intellectual vitality has attracted not only the attention of educators and politicians, but also an increasing number of professional scientists and engineers. As a consequence a remarkable number of science professionals are becoming or are already involved in attempts to improve public science education. While, in principle, this increased involvement of the scientific community is encouraging, it is also the case that scientific training often includes little or no focus on science education itself. Instead, it is simply assumed that a PhD in

experimental science is adequate preparation for ones eventual educational responsibilities. Based on ten years of involvement in elementary science education reform, I can assure you that this is not the case. For the last eleven years, myself and my Caltech colleague Dr. Jerry Pine have been involved in a close collaborative partnership with the Pasadena Unified School District in an attempt to introduce and support high quality inquiry based "hands on" science teaching for all children. As of the fall of 1993, all 650 K-6 teachers in this large urban school district teach 4, 10-12 week science units each year. These units emphasize an open ended experiment-based approach to understanding science. We have also developed a substantial professional development program in science for all teachers in the district as well as an extensive materials support system. Program extensions are now being made into middle and high school classrooms as well as pre-service teacher training. Over the last five years, we have also transplanted this project into two additional school districts, one in California and one on the island of Maui. As a result of these successes, in the fall of 1994, the National Science Foundation established a center at Caltech intended to transfer our model for systemic reform to 14 new school districts in the state of California. At present we are working with 9 new school districts located throughout Central and Southern California.

"Myths" of science education reform

While I believe that our efforts to change science teaching in public schools have met with some success, this success absolutely required that I, as a scientist, reexamine many of the most basic educational assumptions I had developed as a result of my own science education. While I started these projects 10 years ago with enthusiasm and a sense of great need, I realize in retrospect that I was, in fact, poorly equipped for my role as a partner in change. I knew essentially nothing about education in general, or science education in particular. Many of the assumptions I had made about the change process, as well as what good science education looked like, were flat wrong. I also had little or no real understanding of the structure of school districts, teacher capabilities, or the effort really required to produce lasting change in public science education. Ten years later I continue to learn important lessons regularly, guided by our school district collaborators.

Nevertheless, based on the initial success of the Pasadena projects, I am increasingly asked to evaluate other science reform efforts involving scientists. From this exposure it has become clear that many of the incorrect assumptions I myself initially made are often evident in the plans of other science education reform efforts involving scientists and scientific organizations. In fact, these assumptions appear to be strong enough that scientists often invent nearly identical science education reform programs often with limited success. The purpose of this article is to explicitly identify some of these "common myths of science education reform". While several of the points made will probably be regarded as controversial, at a minimum this listing will expose potential reform advocates to several important program design issues. After all whatever the final structure of a particular program, no program, just as no research project, should be created or run in a vacuum.

Myth 1 - The problem with public science education is that a large percentage of teachers are incompetent.

It is remarkable how widespread the view is that teachers, especially in early grades, are minimally functioning human beings. It is also remarkable how rapidly this notion disappears when one becomes seriously involved with teachers and the worlds they

live in. Teachers in California public schools are now expected to manage the learning of 30-40 students per classroom with almost no outside help, and almost no budget. It is absolutely remarkable that more of them do not quit outright. The reason they do not, in our experience, is that almost all of them have a deep personal commitment to student learning. With such a commitment, and a rational approach to science education reform, we have found that the vast majority of teachers enthusiastically participate in improving the quality of science education.

Myth 2 - Teachers are under motivated to teach science because they do not understand how exciting it is.

When surveyed teachers actually report that they already consider science to be one of the most exciting contemporary fields of study. However, attempts to transfer the excitement of science through lectures never give teachers the opportunity to experience the thrill of doing science themselves. Instead, science is presented as the purview of the elite. Even programs that combine "science excitement lectures" with later "hands-on" experiments usually reinforce unproductive attitudes. For example, in most cases, the "hands-on" activities are do-it-yourself "cook-book" demonstrations of the sort professors design for their own undergraduates. These are usually primarily intended to assure that everyone gets the same, right answer. This type of lab is in sharp contrast to inquiries which give teachers opportunities for real open-ended scientific discovery. Obviously, they also reflect that fact that in "real science" the answer is often not simple, singular, stable, or in many cases even known.

Myth 3 - The primary reason teachers do not teach science well is a lack of science content knowledge.

It is perhaps not surprising that many programs run by scientists focus on increasing the scientific content knowledge of teachers. In my view this directly reflects the structure of undergraduate and graduate level science education which is most often predicated on the assumption that a strong understanding of science content is a necessary prerequisite for eventual success in research. While I personally doubt that this is true even in higher education, in the context of K-12 science education reform, there is no question that an inordinate upfront focus on science content only reinforces the inadequacy many teachers already feel about their own science content knowledge. This, in turn, reduces the likelihood, especially in younger grades, that teachers will actually teach science. When the focus of science education is changed from science content, to science process, the hesitation of teachers to teach science greatly diminishes. As teachers understand that the skills they need to teach science are not substantially different from those necessary to teach other subjects, their willingness to engage their students in real scientific inquiry increases dramatically.

Myth 4 - Supplemental teacher training is necessary because too few teachers especially in the early grades, have been required to take science classes in college.

We have found that a teacher with adequate materials, enough time, and good classroom and science experiment management skills can actually provide their students with an excellent science education with remarkably little science content knowledge. In fact, in general, the more college science courses a teacher has taken, the more likely they are to model their teaching on the lecture-based approach of most university science professors. Accordingly, teachers with fewer college lecture-based science courses are often more amenable to fundamental change to inquiry teaching methods than are those whose examples for science teaching come

from college and university professors. In our experience, as these teachers become involved in real science experiments in their classrooms, they inevitably seek additional science content knowledge. However, in this case the information they seek is directly related to their own needs as science teachers, not to lists of "what all teachers (or students) should know" generated by others.

Myth 5 - The key to scientist involvement with teacher training is to provide complex information in as digestible a form as possible.

It follows from my previous statements that distributing simplified scientific information is about the last thing that a scientist should do. Watered down lectures only serve to reinforce in teachers the sense that they are not really capable of understanding scientific principles, reinforcing the insecurity that many teachers already feel about science. As I have also stated, scientific information in this form is almost worthless to teachers in any event. Young students, unlike those in college and graduate school, have not yet learned what questions not to ask, and therefore will rapidly expose holes in the knowledge of a teacher trained to be a "mini-expert". In fact, these students regularly expose holes in my own scientific knowledge. On the other hand, if the role of the teacher is as a guide to students in their own scientific investigations, then the lack of detailed knowledge of the teacher is a source of motivation and ownership by students. Of course, this change also substantially alters the role of the scientist in educational reform. The "classroom management" skills now required to organize time and materials or help students work in cooperative groups are not something that most scientists know anything about. However, what scientists do know about is how to conduct investigations. Accordingly, in our programs the primary role of the scientist is to model inquiry, not to fill in teacher backgrounds. Just as we are comfortable guiding our graduate students to explore subjects for which we do not yet know the answer, teachers should be comfortable guiding their students' explorations.

Myth 6 - The problem with science education is a lack of good curriculum and therefore we must develop it.

If the emphasis of the reform project is on grades K-6, this statement is absolutely wrong. Over the last several years, numerous companies have begun marketing excellent early science curriculum. In fact, I believe that, at this point, there is almost no need for further curriculum development in K-6. Instead, reform programs should focus on how to implement and support the use of this existing curriculum.

Beyond the elementary school level, however, there is as yet almost no good, readily-available inquiry-based curriculum. This is one of the many reasons that I believe reform efforts should begin in elementary school. The vast majority of what is available in higher grades is either fundamentally lecture based, or based on "cook book" hands on activities intended (as in our undergraduate laboratories) to assure that every student gets the "right" answer. As I have stated, enforced "correct" answers should have no place in real science education.

This said, however, the answer to this problem is NOT to have reform efforts develop their own curriculum. Curriculum development is a much more costly and time consuming process than most scientists believe, requiring long-term revision, field testing and evaluation by a highly-talented, motivated, and educated development team. A reasonable estimate of the cost of developing a real 12-week curriculum module for elementary school, for example, is $400,000 and three years. Curriculum developed in the context of reform efforts is often mostly of

the demonstration variety that does not support good inquiry teaching. Further, an emphasis on curriculum development tends to underestimate the far more difficult problem of curriculum support and implementation. Many millions of education dollars spent on "grass-roots" curriculum development programs have not corrected the perilous state of science education in our schools.

Myth 7 - One reason to develop new curriculum is to introduce modern scientific techniques derived from current laboratory experiments.

It is my view that the drive to make curriculum "modern" is misplaced. While understanding the political and social implications of modern science is clearly important, a specific focus on this objective often indicates a hidden agenda. For example, a teacher training program in modern biology might be intended to directly counteract the effectiveness of animal rights activists. Such political considerations, when they are primary, often directly undermine the open inquiry process that is supposed to define scientific methods. It also places science training programs at risk of using the same tactics as those they are attempting to counteract. Further, modern experiments and experimental techniques are often not accessible to deep process knowledge or active exploration; instead, they infrequently come across as being more magical than scientific. Classroom activities developed from research laboratory experiments, in particular, are very often only simple demonstrations of previously presented science facts. Such activities bear little resemblance to real experimental science and seldom support inquiry-based learning.

In my view, any subject considered as a base for science curriculum should be evaluated for its value in teaching and learning, not solely for its degree of contemporary content. While questions of relevance are often important to teachers and students, especially in higher grades, we have found that any real scientific investigation, correctly conceived and supported is regarded as a valuable experience.

Myth 8 - Training a few highly-motivated teachers will produce "trickle down" reform when they return to their schools.

Regardless of the emphasis on content or process, the most common form of educational reform project is one that assumes that a small number of highly-trained teachers will transfer their abilities and enthusiasm to other teachers in a school or district. Again, this approach to educational reform reflects the hierarchical structure of science education in universities. In fact, there is little evidence that individual training courses have much effect outside the classroom of the trained teacher. Teachers that have elected to take these courses are often regarded as "special teachers" by other teachers, in effect isolating them from their colleagues, and reducing their effectiveness as reformers. Further, real teachers seldom have the means or time to support or transform the teaching techniques of their colleagues.
If systemic change is the objective, then it must be the specific target not an assumed side benefit. In Pasadena, our initial focus on all teachers, not just the recognized mentor teachers, in a single school produced the local proof of concept necessary to convince the rest of the district to make the change. The fact that the majority of teachers in the initial school were enthusiastic about the program, in effect, certified for the other teachers in the district that this was something that they too could do. As we now move into other school districts, the primary problem is slowing down the implementation, not convincing other teachers to try it.

Myth 9 - If teachers are motivated enough during training, they will find a way to obtain the material necessary to teach science in their classrooms.

Over the last several years, there has been a clear migration away from lecture-based instruction towards more hands-on approaches. Unfortunately, however, most programs supporting this change still do not take into account the need to provide material support to teachers back in their own school districts. In fact, far too many university-based programs seem to assume that participation in a summer workshop will provide the necessary teacher motivation to change classroom instruction. There is little evidence that this is true. Instead, to be effective a program needs to take into account, at the outset, that in-district support and follow-up will be necessary for success. This is particularly true with respect to science instruction materials. Very few public schools in the 1990s have budgets that can support the materials necessary to teach science well. Teachers often do not have the political clout necessary to obtain what minimal money is available. For most of our teachers today, teaching is a lonely and personally expensive occupation. If a program intends to maintain a lasting commitment from the teachers it has trained, direct and continuing school district support is essential. The lessons of the last 30 years make this absolutely clear. The wonderful hands-on materials developed in the 60's remained completely unused without support for the material and professional development needs of teachers. Unfortunately, this means that school districts as well as project coordinators have to deal with the nuts and bolts issues involved in supporting real experimental science at the beginning and throughout a project. Without this support it is well known that good science teaching can not be sustained.

Myth 10 - Reform can be accomplished with existing resources if they are simply allocated more efficiently.

In my view, this is perhaps the greatest myth of education reform. While it may be the case that 30 years ago resource allocation could fuel reform efforts, it is no longer the case today. Public school districts, especially those serving poor children (i.e. districts that can not rely on direct parental financial support) have been cut so close to the bone that there is little money left to support even the existing curriculum. With cuts in social services, these school districts are rapidly becoming social service agencies, rather than educational institutions. The basic health and safety of their students inevitably takes priority over something as relatively esoteric as science education, let alone its reform. For this reason, no matter what else happens, if public schools continue to be denied the resources they need, no reform effort will be sustainable, and the cultural, educational and political spiral we find ourselves in now will continue. As an advocate for science education reform, I now also spend considerable time evaluating educational projects in third world countries. It is becoming increasingly difficult to distinguish schools in these regions of the world with our own public schools. As the richest and most economically vital country in the world, there is no excuse for this situation.

What can I do as a scientist?

While the forgoing list of "don'ts" might be daunting, in fact, I believe that scientists should be encouraged to get involved in science education reform. Scientists can play a critical role in the process of reform, even if the role they actually play is somewhat different from the role they imagine they should play. The following partial list is based on our experience with several school districts

and the many scientists involved in our programs.

Program Validation:
Perhaps surprisingly I believe that the largest contribution the scientific community can make to science education reform is related to the popular perception of scientists rather than their scientific knowledge directly. Through involvement in a reform program, scientists can certify the validity of a program. For teachers, parents, administrators, students and even funding agencies, the involvement of real working scientists in a science education program can lend essential political support for a project. While this political clout may be a result of what, in my opinion, is the mistaken public impression that professional science content knowledge is a critical component of any science education reform effort, it provides scientists a tremendous opportunity not available to many other sectors of society (or members of the traditional educational community). Of course, this makes it especially important that we use the opportunity wisely.

Teacher support:
The involvement of working scientists can have a profound effect on teacher optimism. Changing teaching style and/or adopting new curriculum requires tremendous energy and commitment on the part of the teachers involved. Through supportive participation in the process, scientists can provide crucial emotional support for teachers and also advocate for teachers within a program, school district, and/or community.

Resource acquisition:
To be a professional scientist in today's world, it is necessary to have exemplary grant-writing and communication skills. Such skills, or the time to use them, are often lacking in school systems. As the current financial conditions of most public schools make the need for outside funding of reform projects critical, scientists can provide an extremely valuable service as grant writers and administrators. Without outside funding, today's reality in public education virtually assures that innovative programs can not exist.

Modeling the scientific process:
While scientists must be very careful in the use of their content knowledge, real science whether in the laboratory or the classroom depends substantially on the application of good scientific process. By scientific process I do not mean the famous four steps in the scientific method that are drilled into the heads of children from grade 3. Instead I mean the real scientific skills of investigation, critical thinking, imagination, intuition, playfulness, and thinking on your feet and with your hands that are essential to success in scientific research. We have found that trained scientists, properly prepared and with attitudes adjusted, can easily apply these skills independent of their particular area of expertise. In fact, in our programs we intentionally assign scientists to teacher training groups outside their area of expertise to reduce the likelihood that fun and exploration are replaced by a quickly offered factual answer. In our experience, when scientists and teachers are mixed together in inquiry teams where no one has the answer (or better yet, where a "correct" answer does not even exist), the result can be extremely valuable for teachers. There is no more effective means to convey the excitement of science than to let teachers and their students really do science where doing is dependent on involvement in an open-ended, inquiry-based, student-driven exploration of almost any subject.

In Conclusion

All Teachers, All Children:
The myths I have considered in the previous sections are obvious and understandable

given the type of science education most scientists themselves have encountered. However, there is another myth that is perhaps more sinister and deeply buried than these and that is that only a select subset of our society can really be involved in scientific exploration. In this view the rest of our society simply become consumers of scientific facts. Those programs that focus on exceptional teachers or on the so-called gifted, reinforce elitist views of who can and can not do science. Our experience in the elementary school grades of the urban and predominantly minority Pasadena Unified School District suggests that every teacher and every child can benefit from high-quality science instruction when given the opportunity. For these reasons, I believe that effective reform of precollege science education in our nation depends on supporting the professional development of all teachers in service to all students. To do this, it is necessary to explicitly design programs that involve entire school systems, all teachers, and all students. Any other approach effectively reinforces science as an elite subject for elite teachers and special students. We are already living with the educational and political consequences of this attitude.

Educate and Reform Thyself:

While most of the above discussion concerns scientist involvement in the public schools, perhaps the most important personal consequence of my involvement with science education reform has been a growing awareness of how poorly I have taught my own students (c.f. Bower, 1995, Systemic reform from the inside out: Look who's changing now. The Catalyst, #3, NRC Press, Washington, D.C.). Prior to involvement in this project, I knew remarkably little about good science education. After ten years of involvement with precollege science, I have become profoundly aware of the negative effect the poor teaching of science in colleges and universities has on the rest of the educational system. In many ways, colleges and universities set the standards for the entire educational system. So, while I wish to encourage scientists to contribute to the public schools, the most significant consequence for students of this involvement may very well be fundamental reform in the way we educate our own students. After all, the curriculum we ourselves control should be the easiest to change.

Thoughts on Science Education - 2.

2. Biology and the enquiry process – a guide for gifted students

This article, by the AIB's Executive Officer, Dr Geoff Crawford, is targeted at teachers and all those who work with children, e.g. tutors, convenors of Double Helix Club Chapters etc**.** Geoff has been working with gifted and talented children for the past eight years through organisations such as G.A.T.E.WAYS and CHIP in Melbourne and

Geelong. With a background in biology in general and microbiology in particular he often used biology and biological principles to challenge highly able children in many diverse ways. You can too and support your discipline and perhaps play an active role in stimulating the next generation of biologists.

In the classroom individual students often stand out as gifted. They may:

1. Have exceptional skills in one or a number of areas
2. Have a self-generated passionate interest in an academic area
3. Be able to undertake research in their area of interest
4. Study with great concentration and accumulate a "library" of information
5. Seek out like-minded individuals.

You may find that the student also has some behavioural problems:

1. Specific deficits, e.g. poor handwriting/practical skills or social problems
2. Is withdrawn, lacks confidence and may be bullied, or
3. Is disruptive or unruly at school due to boredom.

Behavioural problems may be linked to boredom and dissatisfaction with the education process. Imagine that you are sent on a training course for "Advanced English skills" and they put you in a class for beginners and you must attend the course for two weeks! How would you feel and how would you cope? Would you become noisy, disruptive or verbalise your feelings in the class? This is how gifted children may feel for their 13 years of the educational experience. So what can you do?

The simple answer is to provide higher level material for the child to work on but what? The simple answer is to start with what you are good at or have a passion for. For example I have used the following to challenge children in the year levels 3 to 8.

1. **Enquiry and discovery.** Growing monocot and dicot seeds to seedling stage and recording growth stages and patterns with an emphasis on the differences.
2. **Mathematics of "BIG Numbers".** Forget about chess boards and putting one grain of rice on the first square then doubling for each subsequent square to determine how much rice is on the 64^{th} square. Use the humble *Escherichia coli* bacterium. "If one *E. coli* bacterium can divide under ideal conditions every 20 minutes then how many do I have after 24 hours and what volume do they occupy?" Answer is 2^{72} and volume is somewhere in the 4000 – 5000 m^3 range!

3. **Life Search.** Find, draw and describe as many life forms as possible in a given area such as a playground. If too numerous then break children into teams such as plant, bird, insect…….

4. **Alien Life Forms.** An investigation of strange and unusual earthly life forms and comparing them to aliens as seen in the movies. It is relatively easy to find an earthly life form to match most aliens in at least one parameter. Termites and "Alien" comes to mind,

Always keep in mind the sensitivities of the school community (other teachers, parents, children and relatives) with regards to certain topics and materials that you may wish to use. The following topics are usually off the agenda: sex and sexual relations, IVF, murder (unless historical or fictional), real kidnappings (unless there is a happy ending), rape, religion, anything bad happening to a cute furry mammal with large eyes, unsupervised searching of the Internet for "dangerous" words and politics. The use of real human body parts, bodily fluids, many

chemicals, significant heat or smoke in the classroom (smoke detectors going off is a not a good look) or anything that is wet, messy or potentially explosive is not usually a good idea. Sodium bicarbonate and vinegar is a great way to demonstrate a chemical reaction and generation of CO_2 but in an unused urine container with the lid screwed on leads to a messy bang!

I have also found in working with gifted children for many years that they love to solve problems and that they often have a great interest in crime, especially the forensic science aspects. Putting these together generates a challenging and interesting extension activity for gifted children. And what a ripe field for biologist to mine!

Give your student a written summary of the scenario. Depending on age you can make it as tricky and convoluted as needed and it may be a mystery and not a crime. For example:

"Gillian is missing. She was last seen by her neighbours at 7.00 pm last night coming home from work and entering her house. You (meaning the student) are the forensic specialist called in to search Gillian's home for clues. You find a syringe, a strange garbled note, the phone off the hook, a bag of lollies, some suspicious spots of blood and an address book with lots of names and phone numbers."

Depending on time and availability, set up a small area of a room and "seed" it with the evidence and anything else that you can think of such as coins, plant fragments, bits of thread, hairs…….etc. Alternatively give them to the student in a zip lock bag (looks like a real forensic bag). The evidence collection activity stimulates the imagination.

.

You may also provide typed "neighbour statements" that contain no clues, specific clues, spurious clues or confusing unhelpful detail or any combination of these. In this scenario Gillian is diabetic and was taken to hospital at 3.00 am by (a very quiet) ambulance, hence syringe, blood spots, lollies and phone off the hook.

This exercise is open ended and may last a number of weeks and can be developed to cover a wide range of "biology". You may ask the student to:

1. Find our what the word forensic actually means
2. Investigate modern forensic methods
3. Come up with hypotheses and see how these match the evidence
4. Consider each piece of evidence and determine what it might mean
5. Explain the forensic methods that may be used in this case such as fingerprints and DNA (from blood and hairs)
6. Solve the case
7. Investigate the criminal justice system and how biologists interact with it (if the exercise is an actual crime).

There may be problems associated with some evidence. The use of a syringe (of course without a needle attached) may not be appropriate (check first). Syringes without needles may be purchased at a pharmacy. Ink spots are best dried onto a piece of paper that can be removed and taken away by the student. Food dye or red ink may be dripped, spurted or spattered on to paper to make patterns consistent with your "crime". Similarly glue some hairs or fibres onto a piece of card that can be taken away. The evidence is only limited by your imagination. There is a wealth of biological material that can be used as evidence. DNA results can be mocked up to give the desired (for you) outcome.

Real cases are also very appealing especially if they are unsolved after many years. What a challenge for the child. There is a wealth of

information on the Internet for you to use but there are some cautions:

1. I never use a crime or situation that is contemporary or where relatives are still alive such as the missing Beaumont children
2. Crimes of fraud or theft with minimal injuries such as the Melbourne "Great Bookie Robbery" may be used
3. You would probably not want a crime involving sexual activity or undue violence (but see below)
4. If you cannot find a suitable "real crime" then make one up such as "Gillian" above.

I have successfully used "Jack the Ripper" with years five and six as a classroom only activity. It is very easy to bowdlerise the scenario so that it becomes something like "Jack the Ripper stabbed and killed five ladies in Whitechapel London in 1888. He was NEVER caught. Can you solve the crime?" The only proviso here is that a trip to the Internet would be very unwise for this scenario. To avoid this you could change some of the details but use the basic story. "John Tripper stabbed five women in Whitehall in 1788……. etc. "

Another approach is to give the student very limited information and set them the task of researching an aspect of biology. For instance, "Watson & Crick, Double Helix, 1950s". This would send the child off on a DNA adventure.

Biology, problem solving, mysteries, forensic science, crime and mystery are a great stimulus and challenge for gifted children. Please consider using this approach with your gifted children. You are only limited by your imagination and available time.

Dr Geoff Crawford is the Director of Professional Communication in his own business - Access Academix. Should you wish to know more about developing programs for gifted children, he may be contacted on (03) 9812-7280.

Report on the Activities of FASTS (The Federation of Australian Scientific and Technological Societies)

1. Scientists and science communication in Australia.

There has been a fantastic response to this questionnaire from FASTS members (about 1,000 responses).

The questionnaire is the first of its kind to give Australia's scientists, across the nation and

different types of organisations and disciplines, a voice about their current views and experiences of communicating with the general public.

The questionnaire - 'Scientists and Science Communication in Australia' - is part of a research project aimed to help scientists and others who want to facilitate a greater understanding of Australia's scientists and their work.

The research findings will be published and the project is endorsed by FASTS and supported by the Australian Academy of Science

2. Science Meets Parliament 2007

Science meets Parliament was held on Tuesday 27th and Wednesday 28th March 2007 and by all accounts seems to have gone down well with all participants.

The topics for this year's SmP were:

Australia's science and innovation capacity

- Improving science and mathematics education
- Australia's capacity to generate and maintain good environmental and climate data
- Internationalisation of science and technology – is Australia becoming irrelevant? What does it take to leverage global science and technology?
- Building business investment in Research And Development
- Cutting edge science and innovation: new technologies and new industries

Science: helping to understand and manage social and environmental challenges

- Climate science – atmosphere, oceans, greenhouse gas emissions and the findings of the 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)
- Climate change: energy and carbon mitigation:
    - Renewable energy
    - Clean fossil fuel technologies
    - Nuclear energy issues – fission, fusion, waste and skills
    - Emerging energy options – geo-thermal, fuel from fermentation
- Adaptation to Climate Change:
    - impacts on bio-diversity
    - impact on agriculture
    - impacts on disease, pests and human health
    - urban impacts – health, water and energy infrastructure
- Managing water and drought
- Science, agriculture, water and land use in Northern Australia
- Analysing and managing bio-security and security risks
- Research, prevention and management of chronic diseases (eg obesity and diabetes)
- Health and the ageing population
- The threat to human, animal and plant health of emerging antimicrobial resistance

Guest speakers included:
Dr Jim Peacock – the Chief Scientist
Professor Peter Schofield – Executive Director Prince of Wales Medical Research Institute and member of the Lockhart Inquiry
Dr Ralph Lattimore – Productivity Commission – Lead author of the current Review of Public Support for Science and Innovation

The Guest speaker at the SmP dinner, in the Great Hall, Parliament House, was Professor Will Steffen - an internationally respected earth scientist with a special interest in ecosystem interactions with global change and adaptation to climate change in agriculture. He was Chief Scientist of the International Geosphere-Biosphere Program in Sweden before returning to Australia to become the Director of ANU's Institute for Environment and Pro-Vice Chancellor (Research) at ANU.
The dinner was very well received - Will Steffen was an excellent keynote Speaker and John Doyle – 'Rampaging' Roy Slaven from Roy and HG – being a terrific (and delightfully acerbic) MC. We also had a special appearance and brief presentation from Piers Barnes and Nic Swensen – the 2006 Ignoble award winners for Mathematics which received appropriate laughs

On Wednesday, **t**he primary activity was the series of face to face meetings with Parliamentarians that went on throughout the day.

Other events included the Women in Science Breakfast, where the guest speakers included The Hon. Julie Bishop, and a Climate change hypothetical which was moderated by Robyn Williams.

Also of interest was a motion passed in the Senate on Wednesday, moved by Natasha Stott Despoja, that the Senate:

(a) notes that 28 March 2007 is the annual Science Meets Parliament event;
(b) congratulates the Federation of Australian Scientific and Technological Societies for organising this annual event since 1999;
(c)welcomes the attending scientists to Parliament House; and
(d) commends the Australian scientific community for its continued success in generating world-leading innovation.

3. Women scientists produce higher quality work, but men produce more early in their careers.

This media release from Melbourne Uni in January 2007 was brought to the notice of FASTS editors by Bradley Smith, FASTS CEO in Late February 2007.
It makes intriguing reading.

An international study led by the University of Melbourne reveals that, while female scientists produce better quality science, they are less productive early in their careers, and thus have to play catch-up to their male counterparts.

The study, conducted by Dr Matthew Symonds from the Department of Zoology at the University of Melbourne with colleagues from Australia and New Zealand followed 168 biologists from British and Australian universities, all of whose careers began in the early 1990s.

Results showed that the men in the study published 40 percent more papers than women, but that women's work is cited relatively more often by other scientists, a key indicator of quality.

The study also revealed that the differences in male and female productivity arise surprisingly early in their careers.

"Why men publish more papers than women,

known as the "Productivity Puzzle" has long been debated, "said Dr Symonds. "There is not one obvious explanatory factor, but we now have a better idea of when key problems for women arise," he said.

Dr Symonds said that a slow start to the women scientists' careers directly affects their subsequent success in job appointments, promotions and funding. "In Australia, we can see this scenario reflected in the continual higher success rate of men over women in obtaining Australian Research Council grants."

Dr Symonds said that women are discriminated against by current systems for measuring research performance, which are heavily based on quantity of output. "Even though women have their work cited relatively more frequently, their lower overall productivity means that this difference in quality of research is often overlooked."

"We propose a better system that is fairer to women. This does not mean one that is less stringent, but one that truly reflects the real quality of output, not just number of publications." "A shift in focus from overall quantity of output to relative impact of the science would help level the playing field for women."

Recommendations of the study also include that mentoring for women, which is typically provided later in women scientists' careers, be conducted earlier. "The first couple of years are a crucial time in women scientists' careers when they need to avoid falling behind their male colleagues," Dr Symonds said.

The study was published in December 2006 in the international online journal PLoS ONE.

4. Intelligent Design and CSIRO Publishing

In July, Bradley Smith also informed FASTS Editors about the following.

“I understand Australasian Science picked this up ... CSIRO publishing are distributing a book on Intelligent Design. The book - *Dissent over Descent: Evolution's 500 Year War on Intelligent Design* – is by Steve Fuller. I know Fuller’s work from a previous life when I was allegedly doing a PhD in the history and philosophy of science. He is a Professor of Sociology at Warwick University and has written quite a number of books on the sociology of science including The Governance of Science (2000) and several books on Thomas Kuhn. Fuller is fun but knows little and cares less about how science actually works (if you are interested, this article by James Franklin is pretty spot on - http://newcriterion.com:81/archive/18/jun00/kuhn.htm#back3)

Why Fuller has backed the Intelligent Design lobby is a bit bizarre given he positions himself on the radical left – hardly a typical bed-fellow of the ID brand of fundamentalist Christian right. More to do with hostility to institutional science than anything else...?

But the point is why is CSIRO Publishing distributing this? They are not the publisher so maybe it is simply a contractual requirement. CSIRO publishing are commercial, they are still trading on the CSIRO name, and you can bet your life that the ID proponents will leap on the CSIRO brand as lending legitimacy to their claims.”

A fortnight later, Bradley followed up with the following memo:

“You may recall that I raised concerns about a week or so ago about CSIRO Publishing distributing a book by Steve Fuller on Intelligent Design.

Since those comments, there have been a number of conversations between CSIRO Publishing and various people within and

outside CSIRO (including FASTS). I am now advised that the book has been withdrawn from CSIRO Publishing's catalogue and CSIRO Publishing have reviewed their processes for selecting titles for distribution. A sensible outcome. As it happens, the author has not yet provided the UK publisher with the manuscript so publication is delayed indefinitely anyway".

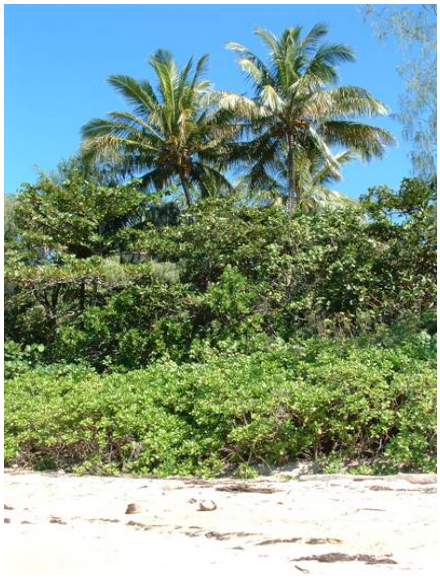
Climate Change in the Rain Forest

Rainforests in the Wet Tropics bioregion were listed as a World Heritage Area in 1988 primarily because of the high biodiversity value of a unique regional biota. Although the area of rainforest within the region is small on a global scale (around 10,000 square kilometres), there are 68 species of rainforest vertebrates that are regionally endemic. On a regional scale, patterns of biodiversity have been largely shaped by Pleistocene contractions in rainforest areas and subsequent expansion episodes (Winter 1988, Williams and Pearson 1997). The contraction of rainforests to cool, moist upland refugia probably imposed an extinction filter resulting in most of the remaining regionally-endemic species being cool-adapted upland

species (Williams and Pearson 1997, Schneider *et al.* 1998). These factors have predisposed the fauna to being particularly vulnerable to global climate change.

Climate change has already produced significant and measurable impacts on almost all ecosystems, taxa and ecological processes, including changes in species distributions, timing of biological behaviours, assemblage composition, ecological interactions and community dynamics (Parmesan 1996, Hughes 2000, Peterson *et al.* 2002, Walther *et al.* 2002). Globally, average temperatures have already risen approximately 0.6°C and are continuing to increase (Houghton *et al.* 2001). It is accepted that over the remainder of this century Earth will experience an increase in average temperature of 1.4-5.8°C combined with large increases in atmospheric carbon dioxide concentrations and significant changes in rainfall patterns (Houghton *et al.* 2001). Although predictions about the effects on rainfall patterns are more uncertain, it is widely expected that rainfall variability and dry season severity will increase (Walsh and

Ryan 2000). That is, rainfall will be more variable from month to month with longer dry spells and possibly with increased frequency of disturbance events such as flooding rains and cyclones (Easterling *et al.* 2000, Walsh and Ryan 2000, Milly *et al.* 2002, Palmer and Raianen 2002).



Join an Earthwatch team.

Team Dates

Dates	Contribution	Days
8th – 21st Sept	$A 5050	14
17th – 30th Nov	$A 5050	14

Earthwatch has over 130 expeditions around the world. For further information visit www.earthwatch.org.au

(Editor's note:

"The Great Climate Change Swindle"

Most of you will be aware the ABC has broadcasting an edited version of "*the Great Climate Change Swindle*" which was first broadcast in the UK in March.
The program makes various claims about the scientific evidence and motives of scientists which have been rebutted by a range of scientists and institutions.
David Jones, Andrew Watkins, Karl Braganza and Michael Coughlan from the National Climate Centre, Bureau of Meteorology have published a critique of the program which is available on line.
Rather than publish it in entirety here, it can be downloaded from the Australian Meteorological and Oceanographic Society website with additional resources/commentary: http://www.amos.org.au/BAMOS_GGWS_SUBMISSION_final.htm

Bradley Smith further writes:

"FASTS will be making some comment. However, whatever we might feel about the misrepresentations, the science community would be foolish to try and censor different viewpoints. That just gives the other side oxygen and creates suspicion that science is trying to cover up something. It does mean we need to keep on patiently explaining the evidence."

Larval fish in the fast lane

Marine parks are usually large areas set aside supposedly to provide marine life with a haven from fishing, pollution and other human impacts. But has anyone asked the fishes what they really need? Marine biologist Jeff Leis shares plenty of surprises in this article by Explore editor Brendan Atkins.

Coral reefs like those around the Australian Museum's Lizard Island Research Station are a living laboratory for marine scientists. Teeming with colourful and bizarre life forms large and small, most people would agree that these very beautiful habitats need to be managed and protected.

Jeff Leis should know – as a research scientist with the Australian Museum he's logged more than 28 years exploring the Great Barrier Reef and understanding its inhabitants, in particular its fishes.

'Many of the fish we see on the reefs around Lizard Island may have been spawned on other reefs far away', said Jeff.

'Most reef fishes have quite a complex life history, usually in two major stages. The one

we're most familiar with is the demersal stage, where juvenile fish settle on a reef and

then remain in the same general area for the rest of their lives', he said. 'But these same fish have reached the reef only after a long, open-water voyage called the pelagic larval stage.'

Larval fish spend several days to several weeks in the open water as they grow from microscopic transparent larvae to become more fish-like and a centimetre or two in length. This pelagic movement from spawning to settlement is called 'dispersal'. It

is because of this movement that reef fish populations cannot be managed like those of terrestrial vertebrates.

'A koala can complete its life cycle within the boundaries of a terrestrial national park, but a Blue Groper in a marine park may have been spawned far away, well outside the park boundary. Its present-day home might be protected, but what about its original spawning grounds, and the pelagic larval habitat in between?', Jeff said.

It's this 'in between' part that Jeff and his colleagues find particularly fascinating.

'We used to think that larval fish were passive drifters at the mercy of the ocean's currents. But then we began to study the behaviour of larval fish in Australian waters, revealing just how much we've underestimated them', he said.

'Working in the clear tropical waters of Lizard Island, we tried a very simple thing. We captured larval reef fishes and then released them individually, following them around underwater and recording their swimming speed, depth and direction.

'The results were amazing. We found the larvae could swim faster than the local currents. In fact they swam at an average of 20 body lengths per second – not bad when you consider that Olympian Ian Thorpe peaked at just 2 body lengths per second. Not only that, the larvae seemed to know where they were going, rather than simply wandering about at random.'

Working at Lizard Island, Jeff's colleague Ilona Stobutzki of James Cook University (JCU) found that some larval fish can swim for tens of kilometres, without food or rest – so much for passive drift! Geoff Jones, also of JCU, found that one fish species, the Ambon Damselfish, *Pomacentris amboinensis*, self-recruits, meaning that many of the larvae spawned on Lizard Island reefs find their way back there to settle. Both of these studies contradicted the traditional view that larval fish drift passively with the currents.

Ambon Damsel *(Pomacentrus amboinensis)*

The work of Jeff and his colleagues has continued to reveal the amazing capabilities of these tiny larval fish.

'We have also found that larval fish can distinguish the natural sounds of a coral reef from a mixture of artificial tones, and even use these reef noises for navigation. So, not only do the larval fish swim rather than drift, they can also control where they are going, such as towards the reef or out to the ocean', Jeff said.

In short, in the view of scientists, dispersal moved from being a fairly straightforward and strictly physical process to a much more complex one involving both physics and biology.

These findings are causing Jeff and other reef scientists to rethink how best to protect reef fish in marine protected areas (MPAs). 'To get the spacing and location of MPAs right, park designers will need to include larval fish behaviour in their predictions of how far the larval fish can disperse', he said.

'Now that we know about these incredible feats of swimming, hearing and navigation, we can estimate dispersal distances far more accurately. We're working with computer modellers to include larval fish behaviour in considerations of MPA design and spacing.

'Our work suggests that for a given percentage of the coast put into MPAs, it is probably better to have more small MPAs rather than few large ones. Then the larval fish produced inside an MPA can replenish both the MPA and the non-protected areas in between and ensure plenty of fishes for the future', he said.

While this all sounds optimistic, Jeff is critical that some marine parks are compromised for political reasons. 'MPAs are there to protect the broodstock of future generations, yet few have more than a small fraction of their total area set aside as no-fishing areas. We wouldn't allow kangaroos to be hunted inside national parks on land – so why allow fish to be hunted within MPAs in the ocean?'

That's a scientist for you – always asking the tricky questions.

Jeff Leis is Principal Research Scientist, Ichthyology, and Brendan Atkins is editor of Explore magazine at the Australian Museum.

First published in Explore, *the Australian Museum magazine 2007, vol 29 number 4 pp 22–23. Reproduced with permission.*

Tel. (03) 9884 5559 Fax: (03) 9884 7405 Mobile: 0412 007 997 email: lancelloyd@ozemail.com.au	Eltham Victoria 3095 Australia Tel: (03) 9439 7789 (H) (03) 9439 7789 (W) Fax: (03) 9439 7122Mobile +61(0)412 566 425 email: tom.holman@ultrafeedback.com
Vice-President: Assoc. Prof Ann Lawrie Biotechnology & Environmental Biology, School of Applied Sciences RMIT University, Bundoora W. Campus, PO Box 71, Bundoora, VIC. 3083. Tel: (03) 9925 7157 Fax: (03)9925 7110 email: aclawrie@rmit.edu.au	**Public Officer:** Em. Professor Chris Bryant, AM, National Centre for the Public Awareness of Science, Faculty of Science, ANU, ACT 0200 Tel: (02) 6249 4815 (W) Fax: (02) 6279 8991 email: chris.bryant@anu.edu.au
Executive Officer: Dr Geoff Crawford Access Academix 89 Dellfield Drive, Templestowe, VIC. 3106 Tel: (03) 9812 7280 Fax (03) 9812 7280 Mobile : 0412 599 649 email : access@academix.com.au	**Immediate Past President:** Professor Colin J. Sanderson Molecular Immunology, Curtin Univesity of Technology, Level 5 MRF Building, Rear 50 Murray St, Perth WA 6000 Tel: (618) 9224 0352 Fax: (618) 9224 0360 email: c.sanderson@curtin.edu.au
Secretary: Mr Ian Rose Middletons, Level 32, 200 Queen Street, Melbourne, VIC 3000 Tel: (03) 9205 2001 Fax: (03) 9205 2055 email: ian.rose@middletons.com.au	**Newsletter Editor:** Mr Evan John 1/40 Esplanade, Christies Beach S.A. 5165 Tel: (08) 83260609 Mobile: 0408 804 289 Email: evkayd@picknowl.com.au
Registrar: Mr Ian Rose Middletons, Level 32, 200 Queen Street, Melbourne, VIC 3000 Tel: (03) 9205 2001 Fax: (03) 9205 2055 email: ian.rose@middletons.com.au	**Deputy Vice President:** Vacant

Area Representatives:

NSW : Dr Raimund Pohl
Phone: (02) 9871 2515
email: rpohl@optusnet.com.au

ACT: Mr Paul Story
Phone: (02) 6272 5176
email: p.story@daff.gov.au

QLD: Dr John Thorogood
Phone : (07) 3207 5135

email: john-thorogood@frc- environmental.com.au

Results of AIB Survey

Members indicated that they were overall happy with AIB's performance giving an average satisfaction score of 3.07 from a scale of 1 (very low satisfaction) and 5 (very high satisfaction). They were particularly happy with the use of the professional designations AMAIBiol, MAIBiol or FAIBiol and the newsletters keeping members up to date on matters of professional interest. 72% felt that the name of AIB should not be changed.

To help understand the performance of the individual activities and the respondents' views of prioritising future activities, 4 metrics were designed. They are the average activity performance[1], average performance gap[2], impact[3] and the priority to improve[4].

Overall Satisfaction: 3.07377

Description	N	Average Activity Performance	Performance Standard Deviation	Average Performance Gap	Impact	Priority to improve
Performance of AIB - Local activities organised by State branches of the AIB	113	**1.92**	0.95	1.15	0.35	**4.03**
Performance of AIB - Access to an extended network of leading biologists in Australia and overseas	113	**2.46**	0.90	0.61	0.45	**2.75**
Performance of AIB - Promotion of education in biology	121	**2.45**	0.91	0.62	0.43	**2.67**
Performance of AIB - Development of the biology profession in Australia	120	**2.33**	0.85	0.74	0.36	**2.66**
Performance of AIB - Enabling you to be part of the voice of biology in Australia	116	**2.53**	0.94	0.55	0.48	**2.64**
Performance of AIB - Representation of the biology profession in Australia	121	**2.47**	0.88	0.60	0.36	**2.16**
Performance of AIB - Opportunity to collaborate with other professional biologists in the Institute	111	**2.41**	0.98	0.66	0.32	**2.11**
Performance of AIB - Publication of a register of consultants in environmental biology	110	**2.35**	1.04	0.73	0.26	**1.90**
Performance of AIB - Improvement of communication between biologists	121	**2.69**	0.98	0.39	0.44	**1.72**
Performance of AIB - Promotion of research in biology	121	**2.67**	1.07	0.40	0.37	**1.48**
Performance of AIB - Speaking on behalf of biologists to other organisations and all levels of government	117	**2.44**	0.87	0.63	0.23	**1.45**
Performance of AIB - Opportunity to attend national and local AIB symposia and other events	113	**2.81**	1.02	0.27	0.35	**0.95**
Performance of AIB - Maintenance of a Directory of members	114	**2.89**	1.07	0.19	0.35	**0.67**
Performance of AIB - Use of the professional designations AMAIBiol, MAIBiol or FAIBiol	117	**3.31**	1.23	-0.23	0.24	**-0.55**
Performance of AIB - Newsletters to keep members up to date on matters of professional interest	117	**3.26**	0.99	-0.19	0.57	**-1.08**

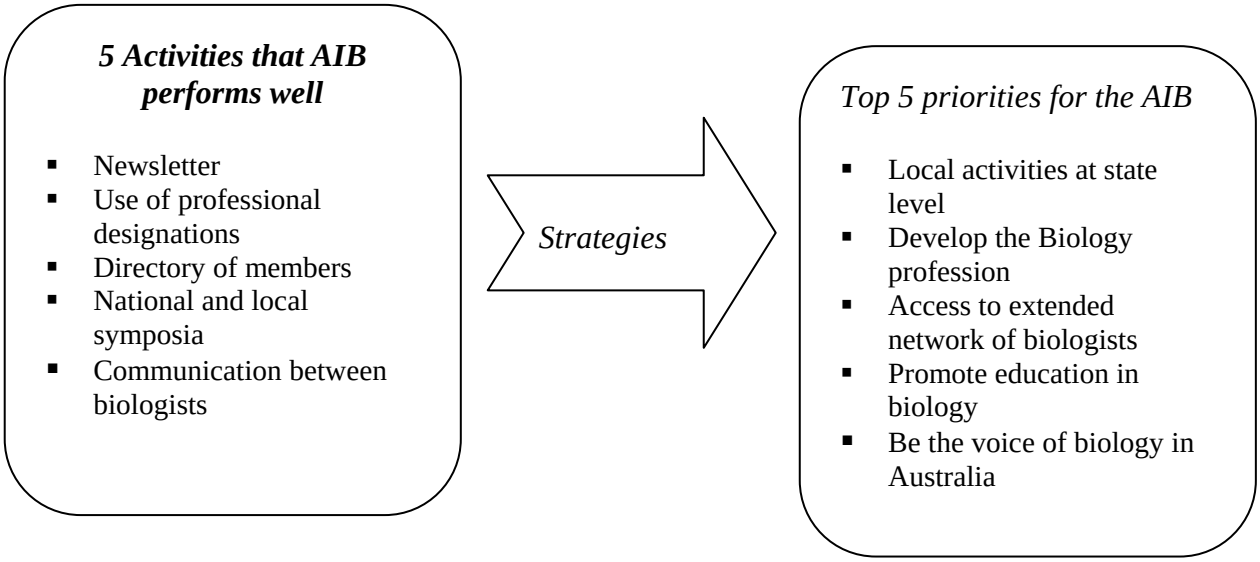
Accordingly the results are as follows:

The respondents felt that the current newsletter and the use of professional designations were the key strengths of the AIB at present. However going forward they appear to want a broader focus for the AIB and clearly felt that organising local activities by the state braches of the AIB was the highest priority. Some of the other main priorities were to develop the biology profession in Australia, organise an extended network of leading biologists in Australia and overseas and the promotion of biology in Australia.

The AIB will formulate strategies in order to achieve the change of focus.

---

[1] *Average activity performance is the average of all the Activities in the survey. Minimum poor rating of 1 and maximum good of 5.*
[2] *Average performance gap is the difference between the satisfaction average and the activity performance average for each Activity. A high or positive figure, generally 0.3 or more, indicates a performance gap that places an Activity below the expectations of the respondent. A lower or negative figure generally means that the Activity is being performed better than expectations.*
[3] *The Impact is the degree of correlation between the performance rating of an Activity and the satisfaction rating. A high Impact means the Activity is highly correlated with satisfaction. Figures above 0.23 show significant correlation.*
[4] *The product of Performance Gap and Impact to produce a rank order suggested for improvement. The higher figures show those activities that have the greatest correlation with satisfaction and the highest gap. E.g. the Activities that are drivers of satisfaction that are being least well performed.*



Local activities at state level

Based on the feedback received from the members some suggestions for increasing local activities were to organise regular meetings of biological interest at state level, organise workshops for teachers in collaboration with the Science Teachers Association in the respective states and increase the level of interest in biology by providing a forum for discussing and publishing articles of interest to biologists.

Members also suggested that states should also create their own chapters and conduct activities to promote the profession and encourage the participation of young people. Holding the AGM in different states will also help promote the AIB in that state.

Developing the Biology profession

There were many suggestions for developing the biology profession in Australia. Providing resources and necessary tools for its members (e.g. online discussions, journals, conferences), sponsoring events that contribute to the growth of biology, recruiting high profile names, raising awareness of new areas of biology and new developments in existing areas in biology were some strategies suggested by the members.

Members also felt that the AIB should raise the awareness of new areas of biology among its members and set up broad discipline groups that cater for specific interests e.g. Aquatic Biology Group; Terrestrial Biology Group; Microbiology Group; Health and Medical Group etc. Another suggestion was to develop linkages

between other associations active in the areas of biology e.g., Australian Institute of Agricultural Science, and collaborate on issues of mutual interest such as potential impacts of GM crop production.

Finally some members were of the opinion that the AIB should have a charter similar to the British Institute of Biology to establish an identity and purpose of the AIB and promote professional standards amongst biologists.

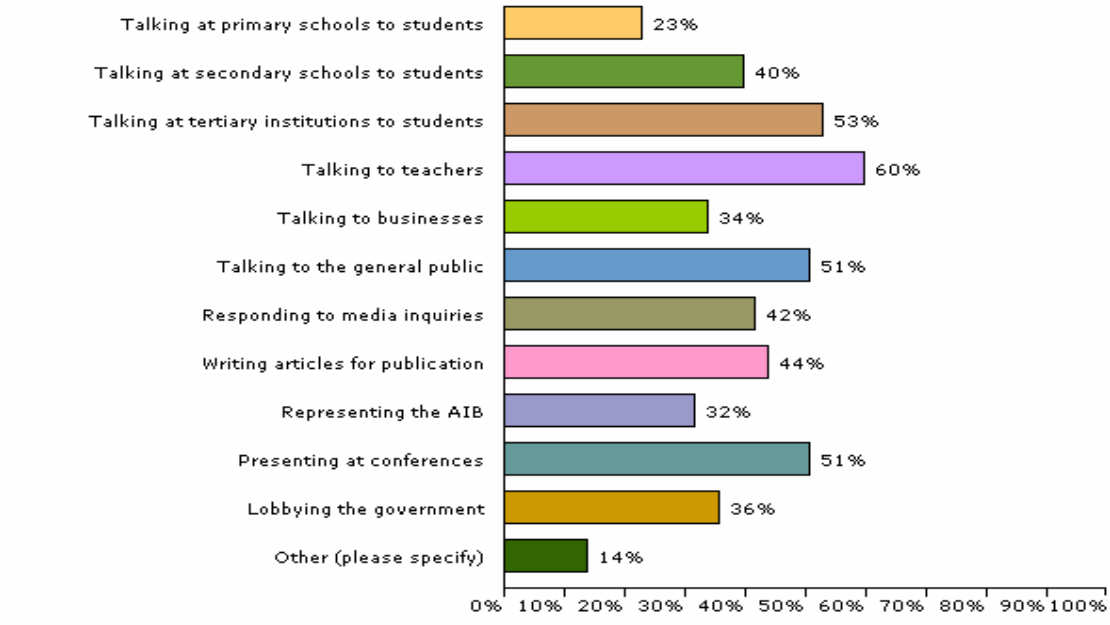
Access the extended network for biologists

A key message from the members was to increase communication between members. Some of the methods suggested by the members include arranging seminars/conferences for interaction among the biologists and providing networking opportunities for members that act as contractors/consultants in biology. 68% of the respondents were prepared to have their names and areas of interests listed as a potential resource for contact by others.

Promotion of education in biology

The members who provided feedback were rather passionate regarding this particular aspect and it generated a lot of feedback.

The members felt that the AIB should promote the education of biology in universities, schools, and the general public. Some members suggest that the AIB should get involved in the science curriculum at schools and high school teaching. The following chart represents the way members would like to get involved based on the feedback of approximately 75 respondents.



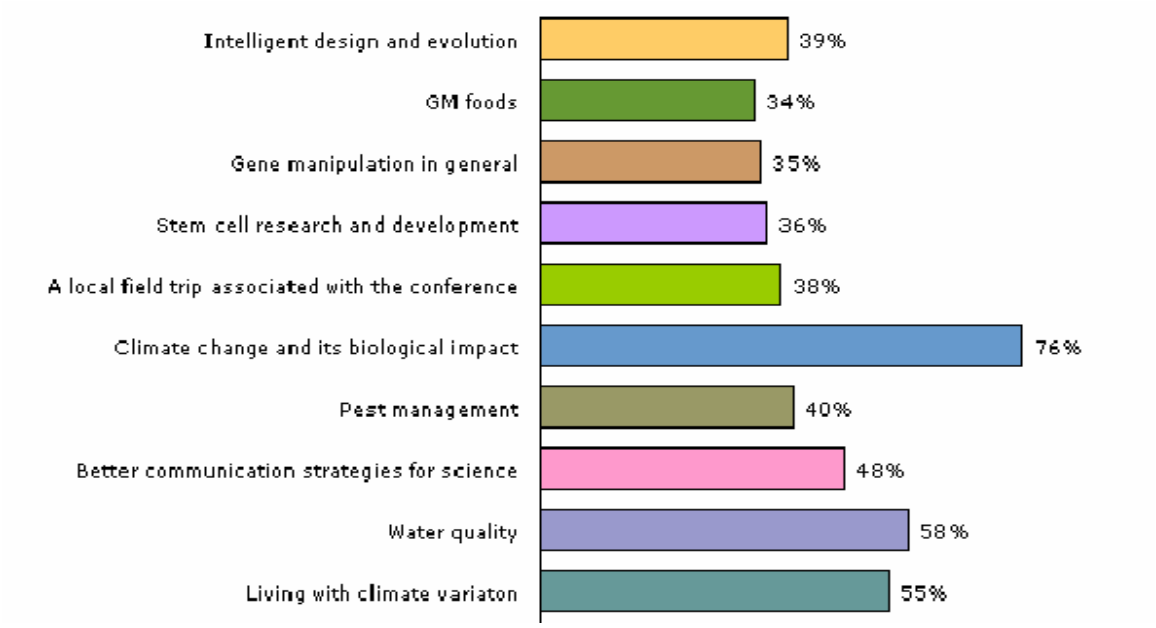
Some of the other strategies include creating national competitions and providing training opportunities.

Being the voice of biology in Australia

Members also felt that the AIB should be more visible in the Australian media and provide advocacy and public comment for issues such as environmental risk management. They felt that the AIB should provide an understanding of the importance of biology to a range of audiences including the community, scientists and government.

The National Conference

There was overwhelming support for the topic of climate change and its biological impact for the National conference, although members were divided as to who would be a guest speaker.



Communication

Based on feedback, although majority members preferred the newsletter, members also suggested alternative forms of communication such as web-based communication. The respondents indicated their preference to receive more information on environmental biology, climate change and global warming, water resource management and stem cell research.

Conclusion

Based on the response to the survey, the members of the AIB are generally dissatisfied with AIB but wish to continue membership and strengthen it. They would prefer to have a shift in focus going forward. Based on member feedback some alternative strategies for achieving those goals have been given above.

The online report is available for members at www.ultrafeedback.com/survey/316 , using user name: report7 and password: nilhug

Tom Holman, MAIBiol
Senaka Ladduwahetty www.ultrafeedback.com