

## In2biotech Roadshow

### Wimmera, Victoria

30 Nov – 3 December, 2009



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## **In2biotech Roadshow**

### **Year 1**

### **Wimmera region, Victoria 30 November – 3 December 2009**

In 2009 **In2science** in conjunction with **Get into Genes** ran a biotechnology-based outreach program (**In2biotech**) to engage students in science through interaction with Peer Mentors from the **In2science** program. The roadshow went to schools in the Wimmera region in Victoria. The In2biotech program is offered to government schools and is free of charge.

As regional schools do not have access to the **In2science** Peer Mentoring program on a weekly basis, a roadshow was deemed the best method of allowing students to interact with Peer Mentors as science role models. **Biotechnology and climate change** were selected as themes for this roadshow. Teachers often find it difficult to incorporate biotechnology into their classroom teaching, citing lack of equipment and expert knowledge as limiting factors. Students and teachers alike need to know about the ways in which biotechnology is being used to help Australia adapt to climate change. Students in Year 9 and Year 10 were targeted for involvement as these are students making decisions about areas of future study at VCE and beyond. The program was also aimed at teachers to introduce them to the topic and build their interest and confidence in this area of science. School students also gain an opportunity to talk to the Peer Mentors about university and careers.

Materials for the In2biotech workshop were developed utilising some activities and research examples that are presented as part of the Get into Genes program.

The Wimmera is Victoria's prime dryland cropping area, where farmers grow wheat, barley, canola and lentils. Sixty per cent of all crop products in the Wimmera are exported. Many students at the schools we attended were from farming families. Travelling for the roadshow we passed many fields of wheat and barley, in various stages of harvest. December is a very busy time for farmers in the Wimmera!

### **Trip summary**

Seven schools were invited to participate in the incursion. Five schools accepted the invitation:

**Stawell Secondary College**  
**Murtoa P-12 College**  
**Horsham Secondary College**  
**(hosted by Murtoa P-12)**

**Dimboola Memorial Secondary College**  
**Warracknabeal Secondary College**

Schools were keen to be involved in the activity and were extremely grateful of the visits indicating these types of activity are rarely offered to the more remote and smaller schools. At each school there was a very warm welcome and support. School students seemed genuinely interested and exited about the activity.

Approximately 3 hours was spent at each school which included set up time, 2 hour workshop and pack up.

At each of the schools at least 80% of students participating in In2biotech indicated having 'some' or 'a lot' of interest in science prior to participating the workshops. These figures are particularly positive in light of the recent Australian Education Review which cites decreasing levels of interest in science across Australian secondary schools (Tytler, 2007). It must be noted, however, that many of the students who participated in In2biotech were selected by their teachers as having expressed interest in science.

Comments were extremely positive from teachers, students and Peer Mentors about the In2biotech experience.

The feedback quoted in this report comes from **evaluation forms** completed at the end of the workshop, by students and teachers.

**Trip leader:** Belinda Griffiths, Manager Get into Genes Victoria.

**Attending students (Peer Mentors):**

**Michael Wong**, Masters in Biotechnology and Bioinformatics (La Trobe University),  
**Shainie Jesurasan**, 3<sup>rd</sup> Year Bachelor of Biomedical Science (La Trobe University),  
**Vivien Gleeson**, 2<sup>nd</sup> Year Bachelor of Biomedical Science (La Trobe University),  
**Leonie Marshman**, 3<sup>rd</sup> Year Bachelor of Science (La Trobe University, Bendigo).

**Itinerary:**

date	AM (session time)	PM (session time)
Mon 30/11		<b>Stawell Secondary College</b> (13:45-15:30)
Tues 1/12	<b>Murtoa P-12 College</b> (9:00-11:00)	<b>Horsham Secondary College</b> (12:30-14:30)
Wed 2/12	<b>Dimboola Memorial College</b> (9:00-11:10)	<b>Teacher PD seminar Grains Innovation Park Horsham</b> (16:30-19:00)
Thurs 3/12	<b>Warracknabeal Secondary College</b> (10:00 – 12:30)	<b>Gregson Farm barley harvest</b> (14:00-15:30)

*(Approximately one hour spent setting up and packing up prior to and after each school workshop)*

**Activity Aims:**

- To engage high school students from regional schools in a hands-on science/biotechnology workshop that supports school-based learning
- To allow students to interact with role model science Peer Mentors
- To raise students' aspirations in science particularly agriculture and biotechnology
- To promote links between the schools and the three In2science universities
- Empowerment of teachers with new curriculum areas, through interaction with university students.
- To offer a free program to schools.

**Predicted Outcomes for Schools:**

- Teachers with a greater knowledge of biotechnology applications for climate change mitigation and ideas for teaching biotechnology in the classroom
- Students with a greater awareness of climate change and applications of biotechnology in agriculture
- Scientifically motivated and enthused students
- Teachers able to interact with young scientists and update their skills (especially valuable where non-specialists are teaching science).

## Activity sequence

The program started with a 20 minute PowerPoint **presentation** to introduce the students to biotechnology and climate change. Safety considerations were outlined at the beginning of each session. Students wore lab coats, gloves and safety goggles for some workstations. This was followed by four **activity stations** each lasting approximately 20 minutes. The activity stations worked well with Peer Mentors introducing students to an aspect of biotechnology and its uses. The stations were:

### 1. Biofuels



Here students made biodiesel using vegetable oil, methanol and potassium hydroxide as a catalyst. They considered how burning biodiesel can produce energy. Students then worked together to create a list of 'advantages' and 'disadvantages' of using biofuels. This activity generated much discussion and argument!

### 2. Plant Breeding



At this workstation students played the 'Barley Survival Game', modelling the process of plant breeding and learning about the ways in which genetics and the environment influence plant growth. Students then imagined they were barley breeders and, examining photos of real barley crops, decided which traits they would select for in their own crops, e.g. resistance to disease or long roots to maximise water use.

### 3. DNA – get it out!



Students extracted DNA from wheat germ, using common kitchen chemicals such as washing detergent and methylated spirits. For many students this was their first time they had 'seen' DNA and they gained a sense of achievement and excitement as they precipitated DNA in the final step of the protocol. Many were amazed that the DNA was so long and stringy.

### 4. Gel electrophoresis



Students learned how to load DNA into an agarose gel and how different-sized fragments of DNA are separated by electrophoresis. Students enjoyed being able to use equipment that was not available in their own schools. They learned how to accurately use a micropipette, which measures volumes as small as one microlitre, or 1/1000<sup>th</sup> of a millilitre! At the end of the session students observed how the different coloured dyes moved at different rates through the gel, which acts like a 'molecular sieve'.

In all activities the students were encouraged to think about how the different applications of biotechnology can be used in solving the problems of climate change.

After the activity stations all the students were brought back together for a **plenary session**. Here they were asked about what they had learned that they didn't know before the session. Students were then presented with a different example of agricultural biotechnology – genetic engineering. Some students had heard about genetic engineering and the debate about its safety and usefulness. Students were encouraged to ask questions and engage in discussion.

## Summary of school visits in the Wimmera

### In2biotech session at Stawell Secondary College

Thirty Year 10 students were selected to attend the session at Stawell Secondary College, along with several staff members from a range of disciplines.

The teachers were extremely positive about the program and generously provided assistance with materials and set up. They were keen for the Peer Mentors to reveal to their students the positive aspects attending university in Melbourne.



*Belinda and Viv set up for DNA extraction*

Half the students indicated they had 'a little' prior knowledge of biotechnology before the session and half the students said they had no knowledge of biotechnology. Despite this low base of self-reported knowledge of biotechnology, most (83%) students commented that they had some or a lot of interest in science.

The initial 20 minute introductory talk was enthusiastically received, however the most popular aspect of the workshop was the hands-on activities, with 76% of students rating them 'interesting'. This pattern was repeated in all schools, providing evidence that the most effective way to engage students in science is to provide hands-on learning opportunities and minimise one-way 'transmission' of information.

At each workstation a Peer Mentor lead students through the activity. The aim was to spark students' interest in applications of biotechnology for mitigating the effects of climate change.

Teachers commented that the sessions were excellent and engaged the students.

School students filled in evaluations on the day and their feedback was very positive. Following are some of the comments from students:

*"I enjoyed it a lot. Thanks for giving up your time to come teach us these exciting things."*

*"It was great to learn about things happening around the world today and how we are going to fix our problems."*

*"It was lots of fun and it was good to learn about things that involve science."*

*"The people were cool! I had fun!"*

Forty two percent commented that they were more interested in studying science beyond Year 10 after the session. Gel Electrophoresis was overwhelmingly popular amongst Stawell students with 80% rating it their favourite activity.

Prior to the workshop some teachers (33%) at Stawell were not confident teaching biotechnology, others reported average confidence (33%) and others were very confident (33%). All reported being more likely to teach biotechnology in their classrooms after the session. Teachers unanimously rated interaction with Peer Mentors as a worthwhile aspect of the workshop.

## In2biotech session at Murtoa P-12 College

Murtoa P-12 College was named a 'leading and innovative school' by the Victorian Education Department in 2005. The College is famous for its efforts toward becoming an environmentally-friendly school with a low carbon footprint. Science teacher David Coles helped design science rooms out of straw bale (for increased insulation and decreased reliance on air conditioning) and is currently constructing a wind power generator. The total number of students at the school is less than 300. Thirty students from Year 9 through to Year 11 participated in In2biotech. The Year 11 students had already finished school for the year, those attending were doing so in their holiday time!



*Murtoa teacher David Coles with the In2biotech team outside innovative straw bale science centre.*

Eighty-seven percent of students commented that they had some or a lot of interest in science. Eighty-eight percent said they knew 'a little' or 'a lot' about biotechnology prior to the session.



*Michael and Murtoa students debate the pros and cons of biofuels.*



*Viv teaches Murtoa students about gel electrophoresis.*

Students were enthusiastic and willing to ask questions during the workstations. Their teacher rated all aspects of the workshop as being 'excellent' and commented specifically on the benefits of his students interacting with 'young scientists' (Peer Mentors).

Again the activity stations were the most popular aspect of the program with 88% of students finding them 'interesting'. Murtoa students enjoyed the DNA Extraction and Plant Breeding activities and Gel Electrophoresis was rated favourite activity by 43% of students.

Thirty-seven percent said that they were more interested in studying science after the session.

Students commented:

*"Today's session was rather informative. I feel I learnt a lot and am more enthused to take part in science VCE."*

*"We've learnt a lot. It was good. Especially for the students doing (VCE Biology) next year."*

## In2biotech session with Horsham Secondary College

Twenty-five students and two teachers from Horsham Secondary College came to Murtoa P-12 College to participate in In2biotech. The visit provided teachers at Murtoa and Horsham the opportunity to meet and discuss science teaching, and they also floated the prospect of collaborating on new science projects in 2010.

Teachers gave very positive feedback during the event. They were asking questions and actively participated at each activity station.

This class was an accelerated Year 9 group. Some of the students had visited Horsham's Grains Innovation Park earlier in the year, to learn about plant plant breeding research being conducted there. When surveyed, just over half the students said they knew a little or a lot about biotechnology, with 48% stating they knew *'nothing'* about biotechnology prior to the session.

Once again the favourite aspect of the program was the activity stations, with 73% finding them *'interesting'*. Their favourite activity station was the Plant Breeding workstation (33%).

Students attending commented:

*"I enjoyed my time here a lot. The instructors were informative and easy to talk to."*

*"My experiences today have all been really good. I enjoyed learning about plant breeding."*

*"All stations were good because they were connected and made sense. The conclusion (plenary) was good because it told us something new things, instead of repeating everything."*

*"Very well set up, wasn't boring, interesting slide show presentation at the start was excellent."*

Although Horsham's science teacher was already very confident teaching biotechnology, she reported that after the session she is more likely to teach biotechnology in the classroom.



*Horsham students extract DNA from wheat germ.*



*Shainie and Horsham students discuss the impact of genetics and the environment on barley quality.*

## In2biotech session at Dimboola Memorial College

At this school the session was run for a group of thirty Year 9 students, with 3 staff members also attending.

Students were initially wary of the changes to their normal classroom room setup and potentially 'difficult' subject matter. Once students moved into their groups for the activity stations, however, they demonstrated good behaviour, high levels of engagement and asked many probing questions about biotechnology and its applications. One group became noisy as they argued over which traits would be most desirable in barley plants. Another group turned around and 'shooshed' them – they wanted to hear what their peer mentor, Viv, was telling them about extracting DNA!

Dimboola staff commented on the high levels of engagement of their students.

Twenty-six per cent of the students said they knew nothing about biotechnology before the session and 56% indicated they knew a little. This cohort had the highest proportion of students (20%) indicating they had no interest in science. Pleasingly, in response to the question "After having done this activity are you more interested in taking Science at VCE?", 33% of students said 'yes' and 48% of students said 'maybe'.

The workstations were again the most popular aspect of the session with 88% of students indicating they found it 'interesting'. Dimboola students found the Gel Electrophoresis activity the most enjoyable.

Comments included:

*"I learnt things and I never knew half the words they said. It was lots of fun. Thank you for coming."*

*"It was very interesting."*

*"It was quite fun... and interesting."*



*Dimboola students loading a gel.*



*Belinda encourages Dimboola students to consider the advantages and disadvantages of biofuels.*

## In2biotech session at Warracknabeal SC

Nineteen Year 9 and 10 students and 2 teachers participated in this workshop. The Head of Science initially had trouble coaxing the students to come along to the workshop as many of their friends were enjoying games in other classrooms as their subjects were winding up for the year.

Once students began getting their 'hands on', however, their enthusiasm was palpable. On leaving one student commented to her teacher "I'm really glad you made me come to this session"!

The majority (80%) of students said they knew a little about biotechnology prior to the session. When asked what their level of interest was in science, two thirds commented they had '*some*' of interest, and one third said they had '*a lot*' of interest.

All students reported that the activities were '*interesting*'. Thirty per cent of students expressed that their favourite activity station was DNA extraction, with 27% voting for Gel Electrophoresis.

Discussions with students revealed that they were applying what they knew from their own experiences of farming as they learned about novel biotechnology tools and techniques. During the plenary students asked thoughtful questions about genetic engineering and biotechnology in preparing farms for a changing climate.



*Warracknabeal students work in small groups to complete their biotechnology workbooks.*

Students commented:

*"The stations were fun and the information was interesting."*

*"It was fun because we got the chance to do some stuff that we haven't done before or stuff that we didn't know before."*

*"Found it very interesting and fun, loved getting the DNA out of the wheatgerm."*

*"Well organised, fun."*

Almost half (47%) of students stated that after In2biotech they were more interested in taking Science at VCE. This was the highest score for this question out of all the schools.

The teachers were very appreciative of the workshop being run for such a small group and they commented on the high quality of the activities and level of engagement of their students.



*Warracknabeal students extract DNA from wheatgerm at their favorite workstation.*

## Teacher Professional Development Seminar at the Grains Innovation Park, Horsham.

Utilising contacts with Molecular Plant Breeding CRC and the VCE Biology Teachers Network, Belinda co-ordinated a teacher professional development seminar at the Grains Innovation Park, Horsham. Ten schools in the region were invited to attend.

A small but enthusiastic group of 6 science and agriculture teachers attended the seminar from Edenhope College, Kaniva Secondary College and Warracknabeal Secondary College.

Following drinks and nibblies, Karen Cane (Department of Primary Industries, Horsham) presented a talk on the use of genetic markers in barley breeding and Dr Saman Seneweera (University of Melbourne) presented his research on plant responses to climate change and increased carbon dioxide.



*Dr Seneweera explains the FACE experiment to Wimmera teachers.*

After the formal presentations Karen and Saman lead teachers on a tour of the facilities at the Grains Innovation Park, including plant pathology, physiology and DNA laboratories as well as the glasshouses. Saman then drove us to the site of the FACE experiment, one of only 4 in Australia and 18 in the world. FACE technology is capable of providing a means by which the environment around growing plants may be modified to realistically simulate future concentrations of atmospheric carbon dioxide. Information from FACE research on how crop ecosystems react can help anticipate the impacts (both positive and negative) of future global change.



*Shainie aboard the combine harvester.*

Teachers and In2biotech staff alike learned a great deal from the professional development seminar and were very grateful to Karen and Saman for giving up their time and sharing their expertise with us.

### **Mentors visit the Gregson barley farm and ride the combine harvester!**

The Chairman of the Molecular Plant Breeding CRC Board of Directors, Dr Tony Gregson, runs a farm in Warracknabeal. He kindly invited the In2biotech team to visit him at the farm, where he showed us barley harvesting in action! We were treated to a 'tutorial' on the combine harvester, machinery designed to increase

harvesting efficiency and worth over \$500,000. The experience on Tony's farm was invaluable for the In2biotech team, completing the 'puzzle' of biotechnology and plant breeding and allowing us to see first-hand how gene technology has impacted on crop development.

### **Peer Mentors' contribution to the event**

The four Mentors did a fantastic job during the visits and were professional and enthusiastic throughout the roadshow. They ran the activity stations safely and with a high level of technical competency. They asked questions to determine students' prior knowledge and adapted their explanations accordingly. They demonstrated their passion for science and engaged students in discussions about careers in science and what it's like studying science at university.

Shainie Jesurasan has completed 3 years as a Peer Mentor and demonstrated the ability to finetune her presentations and to reflect maturely on her practice. Michael Wong had just completed his Masters in Biotechnology and he was able to challenge more able students to think deeply about complex concepts. Leonie Marshman is local to Horsham and she worked extremely well with the Murtoa and Horsham students. It was a happy coincidence that the teacher who inspired Leonie to pursue Science at university was one of the teachers involved in the roadshow! Viv Gleeson has not volunteered as a Peer Mentor previously and performed extremely well 'learning on the job'. He interacted effectively with the students and was a reliable and conscientious member of the In2biotech team.

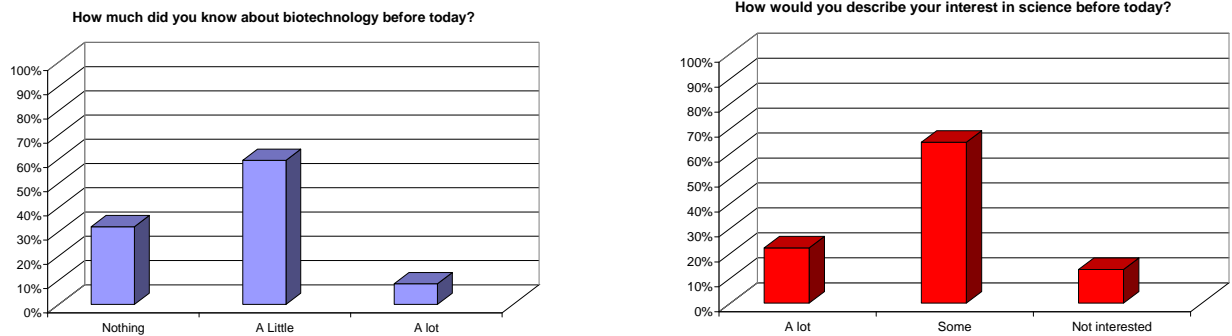
Mentors commented that the trip was challenging and tiring but great fun and they valued the opportunity to participate.



*In2biotech Peer Mentors (L-R) Leonie Marshman, Shainie Jesurasan, Vivien Gleeson and Michael Wong.*

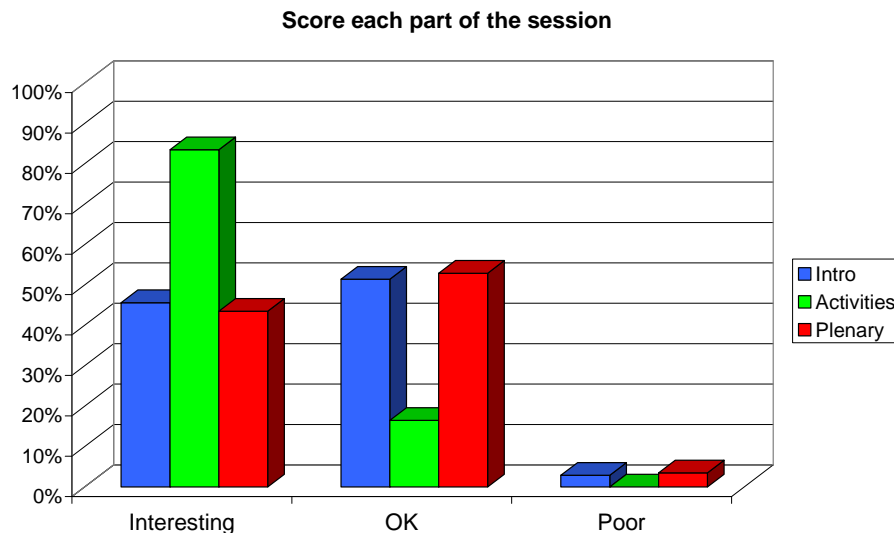
## Summary Results

Results from student feedback (n=106 students or n=7 teachers):

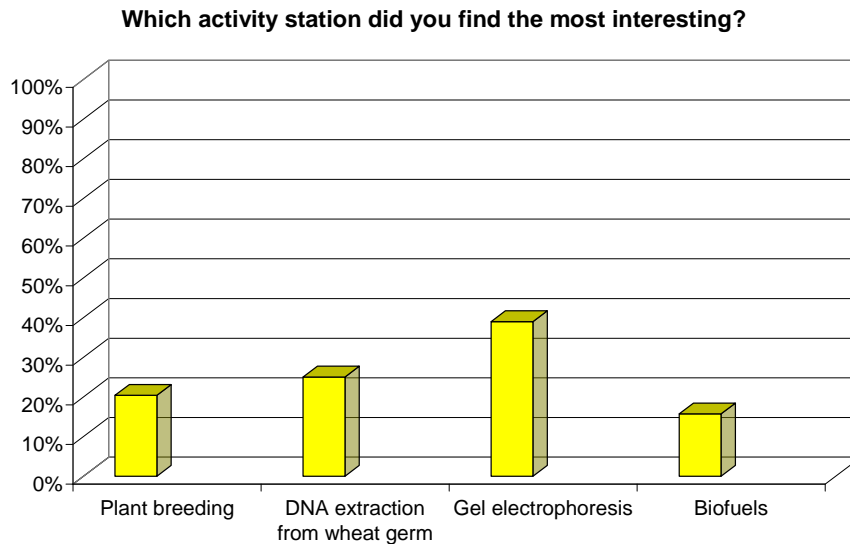


As has been found with other In2science Roadshows (In2nanotech, 2008 and 2009) students commented they knew little or nothing about the topic (in this case, biotechnology) prior to the visit. Across all 5 school just 13% of students said they were not interested in science with the majority having some interest (64%) or a lot of interest (22%). Many of the students who participated in In2biotech were selected by their teachers as having expressed interest in science. Data is not available on how the different schools selected participants for the program.

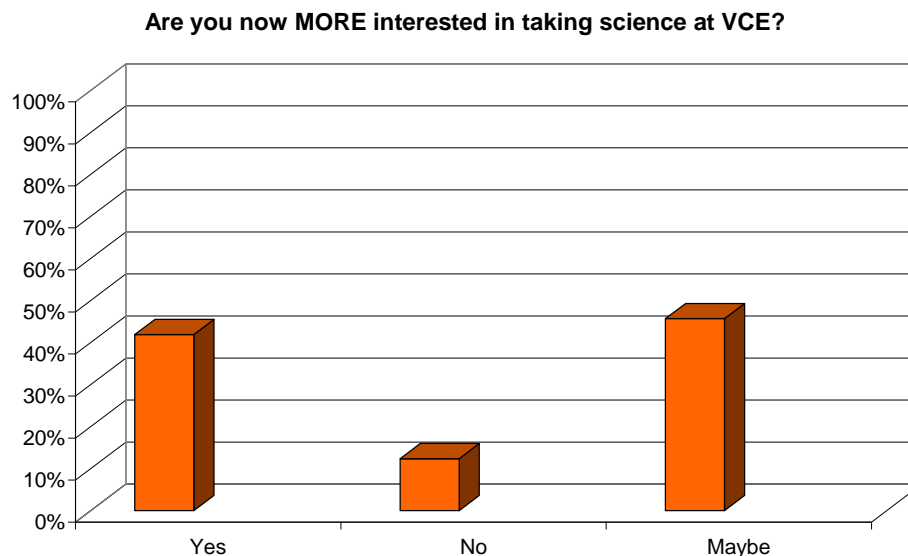
Students' attitudes to all aspects of the program (Introduction, Activities, Plenary) was positive. As predicted, almost all (88%) of the students found the activity workstations the most enjoyable aspect of the session.



Gel Electrophoresis was the most popular activity with 39% of the vote. DNA Extraction was the next most popular with 25% followed closely by Plant Breeding (20%) and Biofuels (16%).



The sessions had a positive impact upon the students with 42% of them saying they were now **more** interested in pursuing sciences beyond Yr10 and 46% saying they '*may be*' more interested. Only 12% of participants said they were not more interested in taking Science at VCE after the In2biotech workshop.



Teachers were appreciative of being offered the In2biotech program and gave positive feedback on its quality and effectiveness. Most teachers (86%) rated the program '*Excellent*' in terms of student learning and engagement. Over half (57%) of the teachers were already '*Very confident*' teaching biotechnology in the classroom, but even so 83% said they were more likely to teach biotechnology as a result of participating in In2biotech.

The **planned outcomes** were listed at the start of this document and the extent to which they were achieved is noted in the table below:

Predicted Outcomes for Schools	Evidence of achievement
Teachers with a greater knowledge of biotechnology applications for climate change mitigation and ideas for teaching biotechnology in the classroom.	Teachers had the opportunity to learn about the topic and 83% stated they were more likely to teach biotechnology in their classroom after the workshop. They also gained an understanding of resources available and how to use them.
Students with a greater awareness of climate change and applications of biotechnology in agriculture.	32% of students said they knew nothing about biotechnology prior to the sessions. Many students made positive comments about having a better understanding of biotechnology and the potential benefits it could bring in mitigating climate change.
Scientifically motivated and enthused students.	Students were enthusiastic and engaged in the activities and many described the workshop as 'fun' and 'interesting'. 42% of students said they were now <b>more</b> interested in pursuing sciences beyond Year 10 and 46% saying they ' <i>may be</i> ' more interested. 86% of teachers rated In2biotech as ' <i>Excellent</i> ' in terms of student learning and engagement.
Teachers able to interact with young scientists and update their skills (especially valuable where non-specialists are teaching science).	All teachers participated in the activity stations and gained an insight into the topic and the kinds of learning activities that students find most engaging.

## Conclusion

Based upon feedback from all stakeholders the program of visits this year was deemed a success with all planned outcomes being achieved.

This is the first time Get into Genes and In2science have collaborated on a roadshow. Planning and preparation ran smoothly with effective communication between John McDonald (In2science) and Belinda Griffiths (Get into Genes).

The numbers of students participating in the sessions at each varied from 19 to 30. Some of the schools only had a small student population and this had an impact upon the numbers involved. Most of the schools selected students to participate in the activity rather than involving whole year groups.

Peer Mentors did an excellent job of presenting material and engaging with the students and teachers in the schools. The quality of these undergraduate students in both their knowledge and their communication skills was imperative and for this event appropriate students were selected. All were a credit to their university.

All schools participating in In2biotech were government schools.

## Acknowledgements

Thanks to staff at **Stawell Secondary College, Murtoa P-12 College, Dimboola Memorial College and Warracknabeal Secondary College** for hosting the In2biotech workshops and providing some materials and consumables.

In2biotech gratefully acknowledges Dr Heather Bray from the **Molecular Plant Breeding CRC**, author of **The Barley Breeding Game**.

Consumables and equipment for the Gel Electrophoresis and DNA Extraction activities were provided by **Get into Genes**.

Thanks go to the **School of Botany at La Trobe University** for providing advice and materials in the development of the Biofuels activity.

Car hire was provided by the **La Trobe University's Department of Agricultural Science**.

Many thanks to **Karen Cane (DPI Victoria)** and **Dr Saman Seneweera (University of Melbourne)** for hosting the Teacher Professional Development Seminar at the Grains Innovation Park in Horsham.

And special thanks to **Dr Tony Gregson and his son Tom** for treating the In2biotech team to a ride on a combine harvester!



*Barley harvest in Warracknabeal. L-R: Tom Gregson, Vivien Gleeson, Shainie Jesurasan, Michael Wong.*

## Reference

Tytler, R. (2007) *Australian Education Review. Re-imagining Science Education: engaging students in science for Australia's future*. Camberwell: ACER Press.