

# ACELL: Improving Student Learning in the Laboratory Environment

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19<sup>th</sup> International Conference on Chemical Education  
Monday 14 August 2006

## Outline

- Aims of ACELL
- Brief History of APCELL
- Workshop Process and Student Learning
- Achievements to Date



## All of Chemistry – ACELL

- Three principal aims
  - Database of educationally and chemically sound experiments, that have been tested by both academic staff and students
  - Provide for professional development of chemistry academic staff
  - Facilitate the development of a chemistry education community of practice



## History – APCELL

- Project began 1999
  - Physical Chemistry focus
- Potential benefits from lab work
  - Develop technical skills
  - Make theory more concrete
  - Engage students in the practices of science
- Challenge: Providing a lab program that
  - Lives up to its potential
  - Doing so within existing constraints



## APCELL

- Bring departments together
- Build on established effective experiments
- Provide resources needed to implement new experiments easily
  - Technical Notes
  - Demonstrator Notes
  - Student Notes
  - Results Proforma



## Methods – Educational Template

- Section 1 – Summary of the Experiment
- Section 2 – Educational Analysis
  - Learning outcomes in areas
    - Theoretical and Conceptual Knowledge
    - Scientific and Practical Skills
    - Thinking Skills and Generic Attributes
- Section 3 – Student Learning Experience
- Section 4 – Documentation



## Educational Analysis

- For each learning outcome:
  - What should students learn?
  - How will students learn it?
  - How will staff and students know that students have achieved the learning outcome?



## February 2006 ACELL Workshop

- 33 academic staff
- 31 undergraduate students
- 27 universities from across Australia and New Zealand
- 33 experiments
- 3 very full days



## Workshop Program

	8:30 am to 9:00 am	9:00 am to 10:00 am	10:00 am to 1:00 pm	1:00 pm to 2:00 pm	2:00 pm to 5:00 pm	5:00 pm to 5:30 pm	5:30 pm to 6:00 pm	6:00 pm to 7:00 pm	7:00 pm to ???
	Lecture Theatre 4		Level 3 and Level 5 Laboratories	Lecture Theatre 2 Foyer and Chemistry School Courtyard	Level 3 and Level 5 Laboratories			"The Pub" Royal Hotel	
Monday 13 Feb	Registration	Welcome and Introduction	Experiments	Lunch	Experiments	Clean Up and Set Up	Review of Experiments	Corner at Royal Hotel	
Tuesday 14 Feb	Forum on Student Refereeing	Panel Discussion	Experiments	Lunch	Experiments	Clean Up and Set Up	Review of Experiments	Dinner at Royal Hotel	
Wednesday 15 Feb		Panel Discussion	Experiments	Lunch	Experiments, plus Clean Up	Final Discussion, LTA	Review of Experiments	Workshop Dinner at Innes Castle	



## Laboratory Testing



## Collaborative Work



## Group Discussion

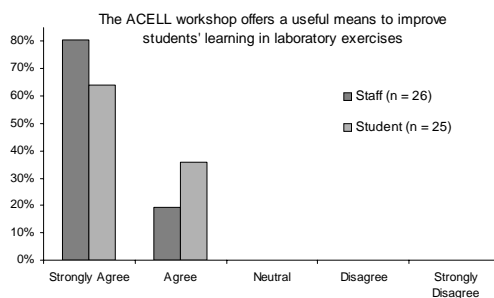


## Evening Debrief Sessions



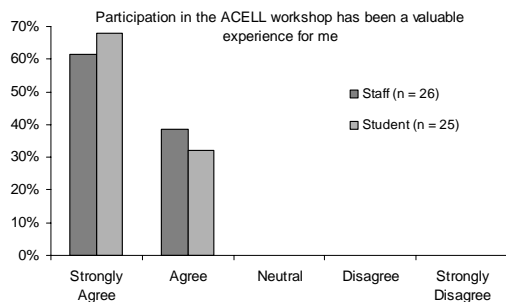
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## Improving Student Learning



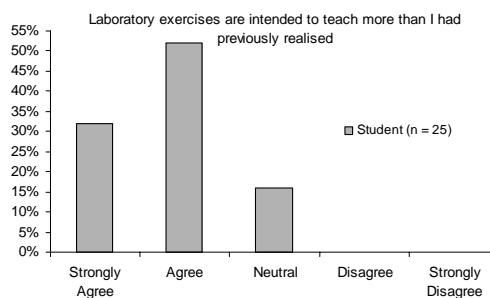
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## Valuable Process



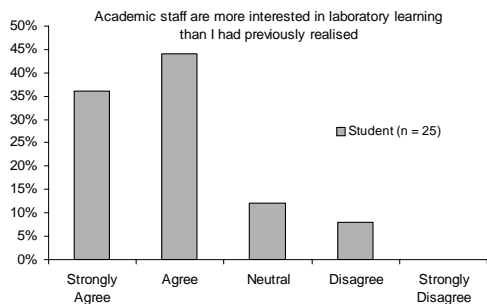
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## Content of Lab Exercises



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## Changing Perceptions



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## Delegate Feedback

- Staff: "It made me sit down and think carefully about what I wanted my students to get out of my experiment, and how I could judge if they had been successful"
- Staff: "The interaction of participants was excellent – so much better than a conference – 'learning in a fun environment'"

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## Perceptions

- Student: "I learnt that also there are teachers / lecturers that actually do care about their students and want to improve their learning experience"
- Staff: "That there were so many academics interested in education and student interests"
- Staff: "The enthusiasm with which students engaged in the activities and the thoughtful comments given"



## Improving the Experiments

- Student: "The debrief sessions seem to be the most valuable, since we were all able to critique the experiments and really get our opinion heard, and especially to get changes made to better the experiments"
- Student: "The templates showed me exactly what objectives lecturers were actually trying to get across in practicals"



## Potential of ACELL

- Staff: "Workshop was excellent and meetings of this type need to be a basis of communication between practitioners at Australian institutions"
- Student: "The workshop was fantastic. I have a deeper appreciation and outlook on practicals and my application to them. If every student could see what happened over these three days, I think all attitudes would change"



## The ACELL Website

- Experiments and their documentation
- Publications, including published papers
  - 13 published experiments from APCELL
- Information on ACELL events
- Education resources for ongoing professional development
  - Process information – content analysis
  - Theory information – constructivism



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Hydroboration-Oxidation of an Olefin: Octyl Alcohol

Experiment Details | Educational Analysis | Student Experience | Related Documents

Introduction

The hydroboration-oxidation of 1-octene to prepare the anti-Markovnikov addition product, 1-octanol, is performed in this experiment using  $\text{BH}_3 \cdot \text{THF}$  for the hydroboration and basic  $\text{H}_2\text{O}_2$  for the oxidation.

CCCCCCCC=C + BH3.THF -> C1CCCCC1C2CCCC2 + H2O2 -> CCCCCCCC(O)C

The ratio of anti-Markovnikov product, 1-octanol, to the Markovnikov addition product, 2-octanol, is measured by gas chromatography. Because the addition reaction known as "hydroboration" is general for all classes of acyclic and cyclic alkenes as well as alkynes, it is a powerful synthetic tool.

It provides an introduction to the handling of air-sensitive reagents and also gives students experience running a gas chromatograph (GC). The reaction is done on microscale (ca. 1.3 mmol) to give students experience carrying out synthetic transformations on small quantities of material. To make efficient use of time, students can be trained to run the GC standards of 1-octanol and 2-octanol after the hydroboration has been initiated.

Level of Experiment

experiment database login  
Justin is currently logged in.  
Account Administrator  
Last visited 10/09/2006

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- Learning Outcome: What should students learn?
- Process: How will students learn it?
- Indicators: How will staff and students know that students have achieved the learning outcome?

It is important to recognise that the indicators for any given outcome may be different for students and staff – for example, if an exercise includes questions which must be answered in a report, the answers themselves will be an indicator for staff, however, for students the indicator will come from the feedback provided on those answers – if the answer is not correct, then the answer itself is not useful for the student as an indicator of their achievement.

Finally, although an exercise may have many goals, some of these will be more important than others. ACELL authors are asked to mark at most five learning outcomes that they consider are the principal focus of the exercise (this practice was not in place for APCELL experiments). These outcomes are bolded below.

**Theoretical and Conceptual Knowledge**

<b>Learning Outcome</b>	Students will learn that light can be plane polarised by using a polarising filter. A second polarising filter will only let the plane polarised light through if it is at the correct angle.
<b>Process</b>	Students will learn this by investigating the two polarising filters in their polarimeter. They will rotate one filter in front of the other to see that there are angles at which the light does get through and angles where it does not.
<b>Indicators</b>	The students will know they have achieved this learning outcome when they see that the polarising filters behave as the theory predicted. Staff will know that their students have achieved this goal by their responses in the observation boxes in their report book.
<b>Learning Outcome</b>	Students will learn about the components of a simple polarimeter.
<b>Process</b>	Students will learn this by constructing a simple polarimeter for themselves.
<b>Learning Outcome</b>	Students will know they have achieved this outcome once they have constructed the polarimeter and used it to investigate the optical rotation of sucrose. Staff will

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Documents in the Demonstrator Notes, Technical Notes, Hazard and Risk Assessment, and Feedback categories are only available to users with Academic accounts. Users with Ordinary accounts can [ccell@usyd.edu.au](mailto:ccell@usyd.edu.au) to request an upgrade if they hold an academic appointment, or have another legitimate reason for requesting an upgrade to an Academic account.

Student Notes	
Student Notes (PDF format)	Acrobat PDF 716b
Student Notes (Word format)	Word Document 1164b
Demonstrator Notes	
Demonstrator Notes (PDF format)	Acrobat PDF 516b
Demonstrator Notes (Word format)	Word Document 5439b
Technical Notes	
Technical Notes (PDF format)	Acrobat PDF 294b
Technical Notes (Word format)	Word Document 590b
Additional Notes / Documents	
Tetraphos-2 (ChemDraw)	ChemDraw File 84b
Two representations of the structure of bis(2-(diphenylphosphino)ethyl)phosphine, tetraphos-2, $P(CH_2CH_2PPh_2)_2$	
Tetraphos-2 (GIF image)	GIF Image 84b
Full structure of bis(2-(diphenylphosphino)ethyl)phosphine, tetraphos-2, $P(CH_2CH_2PPh_2)_2$	
Educational Template	
Educational Template	Acrobat PDF 456b
Completed ACELL Educational Template	

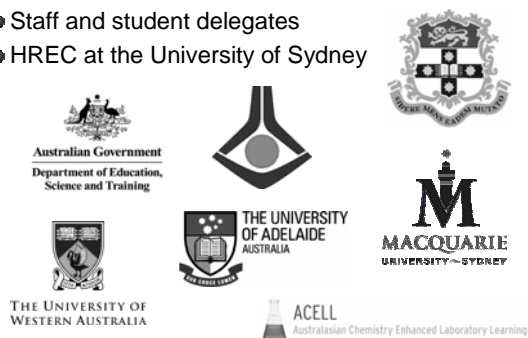
## Summary

- Database of student-tested, educationally sound undergraduate experiments
- Professional development of delegates
- Provision of educational resources
- Building a community of practice
- A model for other countries and domains



## Acknowledgements

- Staff and student delegates
- HREC at the University of Sydney



## ACELL Website

<http://acell.chem.usyd.edu.au>

