

# Advancing Science and Engineering through Laboratory Learning (ASELL) in Victorian Schools

---

*John M. Long<sup>1</sup>, Kieran F. Lim (林百君)<sup>2</sup>, Peta White<sup>3</sup>, and Ian Bentley<sup>3</sup>*

<sup>1</sup>School of Engineering, <sup>2</sup>School of Life and Environmental Sciences, <sup>3</sup>School of Education  
Deakin University, Victoria

**Abstract.** It is known that a need exists for improved practical and key science skills in students going into the Victorian Certificate of Education (VCE, years 11 and 12). And there is a shortage of interested students who elect to take studies in science and mathematics at VCE. As part of the federal government's Australian Maths and Science Partnership Program (AMSPP), ASELL (Advancing Science and Engineering through Laboratory Learning) for Schools has been successful in receiving funding to provide professional development to high-school teachers to assist them in improving the quality of teaching and learning in laboratory programs in science. Nationally, ASELL for Schools has development centres in Sydney, Melbourne/Geelong, Armidale, Adelaide, Perth, and Darwin. Progressing over three years, the authors are forming partnerships with Victorian schools to design, test, and implement a number of focused laboratory-learning activities for use in years 7-10. To accomplish this, several schools were invited to nominate a laboratory learning activity that needed either development or improvement. With the assistance of expert scientists and engineers, the ASELL team produced a number of activities that were tested by both students and teachers in a workshop setting. In addition to developing general activities in a variety of STEM fields, the authors have also focused on activities that help students develop inquiry skills.

## Introduction

A 2012 report by the Australian Academy of Science (AAS) shows a disturbing fall in the number of students studying science in years 11 and 12 (Goodrum, Druhan, & Abbs, 2012). To address this fall, the report recommended, among other things, that educators recapture the interest of students in years seven to ten, more professional development opportunities be available for science teachers, and a suite of digital curriculum resources be developed, especially for the 'new' national curriculum. In the same year, the Office of the Chief Scientist (2012) recommended that the Advancing Science and Engineering through Laboratory Learning (ASELL, Yeung, Pyke, *et al.*, 2011) initiative be extended to secondary science teachers. A further paper by Kennedy confirmed the findings of the AAS, noting that those findings are a serious concern (Kennedy, Lyons, & Quinn, 2014). Another national report noted that students themselves have called for increased practical and hands-on activities in the years prior to VCE (Lyons & Quinn, 2010). Teachers recommended that the curriculum needs to be placed in a suitable context in order to engage students. The report further recommended that improved links be established between scientists and classrooms, and students be made aware of their options in science-related careers.

This paper is about the Victorian contribution to the national education project, ASELL for Schools, which is aimed at enhancing teacher capabilities to improve student learning through laboratory activities in years seven to ten. ASELL for Schools is funded by the Australian Maths and Science

Partnership Program (Department of Education and Training), the member universities are Sydney, UNSW, Deakin, Curtin, Adelaide, Flinders, New England, and Charles Darwin.

The key objective of ASELL for Schools is to provide students with a robust, relevant, and interesting laboratory experience that supports their learning of science concepts. The result will be to increase their engagement and interest in science, and hold that interest in the years through VCE and beyond.

We do this by partnerships among various STEM groups:

- University academics
- Teachers and school administrators
- Practicing scientists and engineers
- Science teacher associations
- Other education research programs, such as the Reimagining Maths and Science Teacher Education Programs (ReMSTEP) project (Pesina & Carrol, 2014).

The basic process is:

1. A school signs up for ASELL for Schools and nominates a teacher to work with the ASELL team. This person is called a 'teacher-scholar'
2. The teacher-scholar, after consulting colleagues, nominates a practical or laboratory activity for development with the team. The teacher-scholar also identifies where the activity fits within the school's program.
3. Working together, the ASELL team and the teacher-scholar develop a laboratory learning activity (LLA) that suits the school's needs. The team also consults outside experts (practicing scientists and engineers) for advice to ensure that the science is accurate and the activity is placed within an engaging and contemporary context.
4. Once the activity is developed, the team prepares class notes and procedures for students, teachers, and laboratory technicians.
5. The LLA is presented to a group of teachers and students at a workshop, hosted by the teacher-scholar's or another school. The workshop serves as a testing ground for the LLA. Participating teachers and students try out the activity and give feedback about the activity, and suggest further improvements.
6. The ASELL team and teacher-scholar further develops the activity, taking into account the feedback obtained from the workshop.
7. Once the activity is ready, and all the documentation is prepared, the LLA is published in an online library of LLAs. The library is in the form of two websites: one for Victoria and also a national website.
8. Several schools implement the LLA in their curriculum.
9. The Schools are re-visited after one year and also two years to determine the activity's effectiveness in their classes.

Several LLAs are currently at various stages of development as described in steps 6-8 above. The process also builds up a community of educators whose focus is on improving lab activities for students across all fields of science. A parallel goal of ASELL for Schools is that all LLAs incorporate aspects of inquiry learning, which is one of the most challenging aspects of developing an LLA. The Victorian part of the project is distinct because of our collaboration with the ReMSTEP project (Pesina & Carrol, 2014), with ReMSTEP's focus on contemporary STEM.

# Structure of a workshop

A typical ASELL-for-Schools workshop runs for a day, hosted by a participating school. We aim for an equal mix of teachers and students, totaling 40-50 attendees. Two or three laboratory sessions of about 70 minutes each are conducted. One session presents a well-developed LLA that supports students learning inquiry skills. One or two sessions present the newly developed LLA. All LLAs are tested and evaluated by both teachers and students. The students have their own program while teachers discuss inquiry, representation construction, or other aspects of good-teaching practice with the ASELL for Schools team.

## Results

The project is about half-way through its life cycle. In this time, the team has developed 12 or more new LLAs in varying stages of development and fields of science. Activities presently come from biology, chemistry, physics, earth sciences, and ecology, including:

- Electrochemistry of coupled metals and the basics of batteries
- Rocks and their properties
- Composite materials
- Batteries in series and parallel
- Motion on an inclined plane
- Fruit-juice-based inquiry
- Observations of chemical reactions
- Energy transformations
- Strength of materials in plastic bags
- Adhesives in materials testing
- Adaptations and habitats
- Mucus and its usefulness.

## Conclusion

In Victoria, our team has conducted 13 workshops to secondary teachers, mostly in the Melbourne/Geelong area from late 2015 to now (early 2017). These workshops tested 12 or more new LLAs. In addition to testing the new laboratory activities, participating teachers gained valuable professional development. More workshops (including several in regional and rural areas) are planned for 2017 and beyond. Details on the workshops and the LLAs developed can be found at the ASELL-Victoria website: <https://blogs.deakin.edu.au/asell-for-schools-vic/asell-for-schools/>.

# References

- Department of Education and Training. Australian Maths and Science Partnerships Program (AMSPP). <https://www.education.gov.au/australian-maths-and-science-partnerships-programme-amspp>.
- Goodrum, D., Druhan, A., & Abbs, J. (2012). *The Status and Quality of Year 11 and 12 Science in Australian Schools*. Canberra: Australian Academy of Science.
- Kennedy, J., Lyons, T., & Quinn, F. (2014). The continuing decline of science and mathematics enrolments in Australian high schools. *Teaching Science* **60**(2), 34-46.
- Lyons, T., & Quinn, F. (2010). *Choosing Science: Understanding the Declines in Senior High School Science Enrolments*. UNE: SiMERR Australia.
- Office of the Chief Scientist. (2012). *Mathematics, Engineering & Science In the National Interest*. Canberra: Australian Government.
- Pesina, J., & Carrol, G. (2014). Is it time to start reconceptualising maths and science teacher education? *Professional Educator* **13**(5), 8-11.
- Yeung, A., Pyke, S. M., Sharma, M. D., Barrie, S. C., Buntine, M. A., Burke Da Silva, K., . . . Lim, K. F. (2011). The Advancing Science by Enhancing Learning in the Laboratory (ASELL) Project: The first Australian multidisciplinary workshop. *International Journal of Innovation in Science and Mathematics Education*, **19**(2), 51-72.