CONASTA 62
Melbourne 2013

CONASTA 62 report by Paul Waldron, Kyneton Secondary College

The atmosphere was full of firing neurons at this year's CONASTA, the 62nd Australian Science Teachers' Association conference. It was a place of energetic collaboration and sharing of ideas. Socially and virtually connected, hundreds of science educators and laboratory technicians certainly resembled a neuroplastic brain creating and identifying new synaptic pathways as they learned, listened and networked with each other.

At the welcome function on the Sunday, I became deeply involved in conversations with members of the Quantum Victoria team. They are a team of enthusiastic and dedicated human resource representatives, scientists, educators, game developers and IT geeks, and I just-so-happened to have already booked into workshops that a number of them were presenting during the conference.

The conference delegates were welcomed in the mother-tongue of a Wurundjeri people's high elder, Aunty Joy, a 68 year old educator of her Aboriginal language at a regional school in Victoria. Once a long standing public servant, Aunty Joy started teaching when she was 63, a reminder that age is no barrier to what we have to offer one another. I had the pleasure of meeting her after the official welcomes from the leaders and hosts of the conference. We spoke of the power of language, culture, and identity with a particular focus on the crucial impact it has in our education system, not only for an Australian community but for a global society.

In his official welcome on the Monday, President of ASTA, Steve Zander asserted that the conference war cry was, "By the profession, for the profession." This ensures that our voice as educators is strong and heard, and that we can make a real difference to our classrooms and to the lives of the students' we teach. Brian McGraw from La Trobe University followed this by speaking of Australia's amazing wealth and broad spectrum of globally top rated scientific research. He highlighted how utterly crucial it is that teachers need to be engaging, so that they may pass on and perpetuate interest in scientific research and education for the present and future generations of the global world.

The concept of a global world (particularly in relation to Science) strongly linked with the ideas and research fields presented by the first keynote speaker, Professor Keith Nugent, the deputy Vice Chancellor of research for La Trobe University. His topic was entitled, *What Science will look like at the end of the 21st Century*. He spoke of the geographical lines between countries blurring with respect to research as a global community collaborates and shares ideas. The barriers between science disciplines, too, are blurring and breaking down.

The approach to research has moved through several phases: from a multi-disciplinary approach whereby research is viewed from different perspectives but lacks integration, to interdisciplinary whereby something new is created through combination. Yet the most ideal approach is what Professor Nugent regarded as "trans-disciplinary," which utilises stakeholders, defines research objectives/strategies and diffuses learning approaches. This trans-disciplinary approach was later echoed by the 2013 ASTA award winner, Anna Davis in her speech, *Building the Federation*, in which she said that it is only through building national (and arguably international) partnerships and relationships that we can develop a close-knit, sharing scientific community.

The question which arises from Professor Nugent's lecture is, "How do I apply the idea of trans-disciplinary research into a Science classroom?" The first workshop I attended on Monday presented some possible solutions for this. It was entitled, *Integration, STEM Instruction and Project-Based Learning* and was led by Matthew Kuhn from McREL.

Image 1: The conference included a trade display area where delegates could engage with new teaching resources. © Lance Taylor.

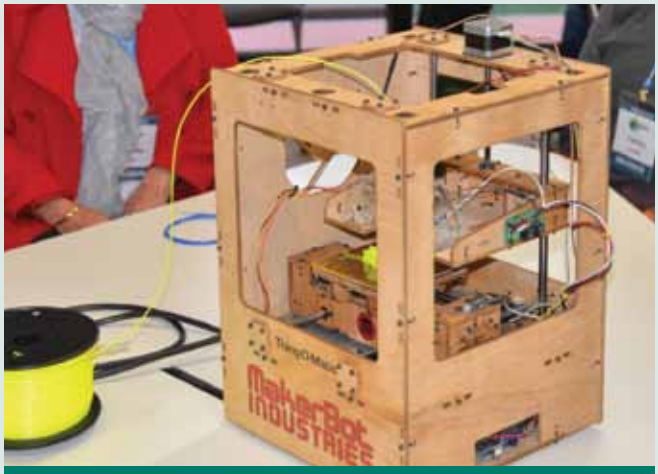

Image 2: A 3D printer demonstration. © Lance Taylor.

Science, Technology, Engineering and Mathematics (STEM) integration doesn't mean going to a 'STEM class', but combining the STEM themes into existing classes. For example, in Science, adding Technology elements enables discovery, Engineering helps to apply knowledge and Mathematics reveals patterns and quantifies results. Creating STEM units does take time and in designing them you need to consider how they align best with the given curriculum, starting with the STEM theme, identifying the learning objectives and ensuring that the assessment links with those objectives. However, the 'wheel' needn't be reinvented as a number of schools have provided outlines of units that can be easily adapted and implemented into classes. Cooperation and collaboration within a school with greater integration across all domain areas, including the teaching of Music and languages, results in better outcomes and more engagement amongst learners. Arts can even be added into the mix through design elements and presentation.

The need for Arts and design was clearly discussed by the next keynote speaker, Vaughan Prain on, *Learning through representing in Science.* He spoke of how the capacity to generate, understand and extrapolate representations and images are highly important for the future of Science. One such historical finding that exemplifies this is Rosalind Franklin in her contribution in taking an X-ray diffraction pattern of DNA and discovery of its double helix structure. Learning from drawing enhances engagement, assists in learning purposes and rationale, develops reason, deepens visual and spacial understanding, and develops communication skills as learners explore ways to express meanings behind representations. Representations are not just trivial but powerful and useful tools in creating a broader understanding. The challenge as teachers in having good representation modelling in classrooms is to scaffold resources and open-ended tasks, have explanations with purpose, integrate past understandings whilst avoiding replication, and bridge those understandings to new claims. Having embodiment and emotional connections help to increase learners' retention of ideas and concepts.

What better way to embody an idea or concept than through three-dimensional printing? The second workshop I attended was *Rise of the Machines* led by Paul Taylor and David Feillafé from Quantum Victoria. 3D printing is a powerful tool in secondary school classrooms. The nature of 3D printing embodies a STEM model. The usefulness in science is clearly apparent through visualisations and concepts such as mass/volume/density ratios and structural strength analysis.

In Mathematics space, 2D/3D shapes, lines, curves and polygons can be explored. In ICT, there are computer assisted drawing and programming elements. Design and engineering elements are also involved.

The last of Monday's sessions was the Stanhope Oration presented by Barry Jones, A.O. Mr Jones was the longest standing federal Minister for Science and outstandingly, the only person in Australia elected to hold a fellowship in five separate learned academic disciplines (Science, Social Science, Humanities, Engineering and Education). He said that the only reason that he held that position for so long was because, "No one else wanted it." Although humorous, it reflects his long standing disappointment that the intellectual beauty and power of Science and Mathematics is not well reflected amongst our youth and a decreasingly science-related vocational community.

One such power of science, Mr Jones highlighted, is that since the 1840s, life expectancy has shown a rapid increase (approximately 2.5 years for each decade of the last century). Two factors which have dampened this trend are obesity and diabetes, problems which a stronger scientific community could arguably resolve. Mr Jones spoke of how our natural psychology resists the notion that our galaxy is expanding at an increasing rate and that we are orbiting around the sun at a faster rate. He also spoke of how it is easy to sell the climate change message during a time of drought but not when rainfall is adequate. The global warming issue is also difficult to sell in regions well-known for their electricity generation such as the LaTrobe Valley because of fears of job losses and uncertainty of re-employment. The key is the ongoing debate between evidence and opinion which he faced constantly during his time in politics. Opinion, sadly, often comes out the winner as it is a major factor in short term political movement; but this can be extremely hurtful in the long term.

Image 3: Barry Jones, AO, at the Stanhope Oration. © Lance Taylor.

Enthralled by the engaging speakers and workshops from the first day, I found myself hardly sleeping in my hotel room that night. I was set for another couple of stimulating days at the conference, begining with the first keynote speaker on the Tuesday, Dr Scott Watkins from CSIRO, who talked about Flexible Electronics. Dr Watkins described that the active layer in Organic Light Emitting Diodes (OLED) was only 200 nanometres, which is 200 times smaller than the thickness of a human hair. Once you add the packing material, the overall device is still very flexible.

OLEDs were first developed by Kodak in 1987. The Nobel Prize for Chemistry in 2000 was awarded for identifying conductive and emitting polymers. It is a crucial property that light emitting polymers must be able to emit light and conduct electricity. By engineering the structure of the polymer, we can alter the colours so all emission colours can be obtained. Emissive displays (e.g. televisions) have no white backlighting as with LCD so the efficiency is far greater as there is only the need to turn on/off the primary colours which thereby has a greater application for wide scale lighting. The design of these polymers is still an experimental science. As Dr Watkins described, "We don't really know what we're doing. We take a couple of polymers, mix them up and shove some electrodes on it – and suddenly get an electric current." I am certain that it isn't that simple, but it does shed light on the need for investigative skill development with students and the understanding of where those skills can be used in global research.

Dr Watkins went on to talk about the applications of such technologies in solar power. He promoted the idea that small steps make a huge difference and the example he gave was the possibility of attaching solar cells to a camel's back to power a fridge to keep medicine cool in rural areas or developing nations where access to other transport options is limited. Enough solar energy hits the Earth within an hour to power the Earth for an entire year. At 10% efficiency, flexible solar cells covering an area one quarter the size of South Australia would be enough to power the entire world.

Lastly, he echoed the sentiments of the conference in talking about science communications. Generally, scientists are often most comfortable in publishing research through conventional means such as academic journals as using other means may present the risk of losing control. However, connecting through new and emerging media outlets actually helps to build future partnerships and connect with different people. Through such means, CSIRO has developed a community outreach of more than one million people.

The fourth keynote speaker was Dr Sandra McLaren. Her lecture, *Making of the hot southern continent: Plio-Pleistocene climate change and the onset of aridity in South Australia*, talked about geological time which has always been a concept that has baffled me, which means that in teaching Geology I have been challenged to find the 'grab' for students to engage with. Partnerships with inspirational speakers such as Dr McLaren and programs offered by the Melbourne Museum help to enhance the '4 I' learning principles (Intellect, Inquiry, Imagination and Integrity).

Dr McLaren's research focuses on the last 20 million years, the Neogene period, throughout the Murray Basin which contains 'Lake Bungunnin', a 50,000 square kilometre paleo-megalake. Historical markers including salt lake remnants illustrate a significant climate shift. What I found to be a fascinating discovery was that by looking at how clay sediments line up, the Earth's magnetic polarity has been shown to have flipped. Dust grain shape and the size of sediments gives an indicator of the wind effects over time and analysis of the dust grains show from where those sediments originate.

The Tuesday afternoon session I attended was held at LaTrobe's AgriBio facility, a $288 million research facility and joint venture with the state government. It is the biggest research facility of its kind in Australia and houses over 400 researchers. It contains four main research quadrants incorporating a design promoting interaction through 'break out' spaces. They include 77 rooms with controlled environments having the ability to adjust lux, CO2 levels, temperature (4-50°C) and humidity levels as well as a number of PC2 (genetic modification) greenhouses.

The first core competency of the facility is in plant improvement and protection which particularly looks at protein biomarkers of specific genotypes of plants and pathogenesis to help improve and understand disease resistance. The second core competency is in livestock improvement and protection with one area looking closely at DNA analysis of cows to identify particular fertility or milk production traits. The remaining competency is in soil science and improvement. Here they look at both real plants and plant modelling. Key research to come out of the facility includes advancements in; managing physical, chemical and biological constraints in soil for carbon storage; a 10,000 cow genome project; identifying a powerful peptide antibiotic in wallaby milk; and cost-effective vaccination methods.

If there were no other example to prove that teachers, education support staff, researchers and scientists are human, the conference dinner at the Melbourne Museum would be it. The dinner was a thriving opportunity for conference delegates to laugh, joke via Twitter about which table was superior, dance (giving a new meaning to the major groove protein involved in making up our DNA)and collaborate even further. A key example of collaboration in research was illustrated by the guest dinner speaker, Dr Tu'uhevaha Kaitu'u-Lino, the 2012 Victorian Tall Poppy Science Award winner. Dr Lino is a post-doctoral research fellow at the Mercy Hospital for Women. Her research involved looking at a particular protein that is released in the uterus among women suffering from preeclampsia during pregnancy. Her research team was able to connect with other researchers who had identified the same protein in their research in a type of colon cancer.

The third and last day of the conference continued to introduce more research and workshops. The final keynote speaker was Dr Erich Fitzgerald, with a talk titled *Putting the dead to work: the awesome power*

Image 4: Delegates at the Science Banquet. © Lance Taylor.

Image 5: Trudy Staines was the happy winner of one of the trade display giveaways. © Lance Taylor.

of palaeontology. Dr Fitzgerald sees palaeontology as the ability to explore evolution in real time particularly through looking at what is regarded as "living fossils" such as lung fish and humpback whales. These creatures are evidence of mammals returning to the sea as opposed to many evolutionary explorations that focus on the reverse. He sees humans as being the insignificant ones in the global evolution story. Whales are the poster child of evolution especially when we explore extreme biology – the extent and limits of biology and these mammals' ability to grow to enormous sizes. Darwin himself was fascinated by them.

Dr Fitzgerald showed examples of how whale skulls are superior to human skulls by having no bone to bone joint connection; and not simply having a vertical or side to side movement of the jaw but also partial rotational movement in the jaw – the central section of the lower jaw not being rigid allows for this to occur. This then greatly enhances the mouth surface area for feeding. A blue whale is known to consume 40 million krill in a single sitting. Historically, these whales' ancestors, such as the *janjucetus hunderi*, had serrated teeth. An illustration of this ancestral link is that embryos of baleen whales have the early developmental signs of teeth which are lost by birth. This type of study, Dr Fitzgerald explains, opens ups questions such as, "Are there ecological roles in the world which are not filled?" Studies like this are powerful and can change our understanding of evolution. This is the key to engaging and promoting sciences like palaeontology.

From palaeontology to poo, and whale to worm came my next workshop, *Who's pood in my food?* which was presented by Kay Lembo and Trudy Staines from the Primary Industry Centre for Science Education. The workshop's title came from research done into a type of animal feed from which a series of cows contracted hookworm. The hookworm was traced back to a farm overseas where a human had defecated into coconut husk that made its way into the feed mix.

Whilst strawberries and kiwi fruit are delicious and provide a lovely aroma when undertaking a DNA extraction, there is a certain engagement that comes from working with materials that are smelly. The workshop looked at symbolising DNA extraction of poo with liver instead in the context of parasitic infection. Parasites are incredible symbiotic creatures with interesting life cycles and characteristics. For example, some parasites have oocyst walls which are almost indestructible against heat, cold, chemicals and disinfectants making treatment tricky and research into parasites more important. Professor David Ferguson of Oxford University describes parasites as being, "Fascinating because of their intimate relationship to their host, which is a continual balance between life and death for both the host and parasite."

From poo to paintings, I arrived at my last conference workshop, *The Art of Chemistry*, presented by Carlie Alexander and Soula Bennett from Quantum Victoria. The workshop utilised the flat screen television displays in the LaTrobe's institute of Molecular Sciences (LiMS) facility, QR codes, iPads and traditional laboratory techniques. Using such a range of devices provides a highly engaging environment and brings out many questions as to how a laboratory class should be conducted to engage and excite learners into Science. The iPad application demonstrated contains check boxes which encourage learners to read through the steps carefully. It has the capacity to take photos of results and email you the report upon concluding the experiment. I cannot wait for the application to be made available publicly so that I can start to use that same idea in my science classes.

The last keynote lecture was delivered by a series of researchers speaking on, *Innovation: transforming the future.* The first speaker was Associate Professor Paul Pigram. He spoke of nanotechnology lying in the overlap between Engineering, Biology, Chemistry and Physics, which echoes the idea of blurring lines of Science and the future theme of convergence. Future graduates need to be global citizens, and teachers need to build strong foundations among learners, supporting and promoting students into Year 11 and 12 Sciences (and Mathematics) to improve the transitions to universities.

The second speaker was Professor Gerard Milburn who spoke on engineered quantum systems. Schrödinger opened the doors to quantum science in 1926. Two of the main quantum principles are tunnelling and uncertainty. There is a shift in quantum research from old thinking (find 'stuff' and study it) to more recent methods where quantum systems are engineered, manipulated and controlled. One such area of research is in photosynthesis to better understand how it uses quantum transport so that we can create better energy harvesting devices.

The third and final speaker was Nick Hoogenraad speaking on magic bullets and biomarker discovery. He spoke of how antibodies make up the basis of vaccination. One of these antibodies was Herceptin, an antibody which originated from a mouse. As this antibody is trans-species, it cannot pass directly into humans as it will be seen by the body to be foreign and increase the risk of anaphylaxis. He spoke of the process by which you can take the antibody and humanise it through combining it with human DNA biomarkers. This particular "magic bullet" was found to significantly reduce cachexia (mass wasting) among mice with cancer but also reducing tumour size and growth of the cancer.

By the end of the conference, I felt almost overdosed on the drug called knowledge. My brain would probably have exploded from its fill of stimulating ideas had the conference been any longer than three days. I have great hopes that I will be able to attend CONASTA 63 in Adelaide, to further collaborate and connect with teachers and researchers from across the country. Until then, the challenge to take away from this conference will be to apply these new ideas and knowledge in my daily teaching so that all students at Kyneton Secondary and future students will benefit from such highly engaging and intellectually stimulating activities.

Ruth Dircks Scholarship report

by Louis Green

I applied for the Ruth Dircks Scholarship to attend CONASTA not knowing what to expect. CONASTA sounded like an excellent opportunity to learn about the current ideas in Science teaching, and not much else. But it was so much more than that. At CONASTA, I met so many wonderful, like-minded people who are just as passionate about science education as I am. I learnt so many things and took so much away that will assist me both directly and indirectly as a science educator.

Attending the workshops by teachers and other professionals gave some real insight into what other people are doing that works in their classroom, and it gave me so many good, tangible ideas that I've already started to implement into my classroom practice. One thing in particular that I personally took away from CONASTA was the importance of making science relevant to students so they can see its importance – because science is becoming more and more important as we move into the future.

The keynote presentations at CONASTA were very engaging and interesting. As a biologist, I especially enjoyed Dr Erich Fitzgerald's keynote about his work with palaeontology and baleen whales – it was very interesting and engaging, and is something I know my students would be interested in as well.

Perhaps the most valuable thing about CONASTA for me, is that it was a fantastic opportunity for me to network with others: my Professional Learning Network (PLN) has grown by a lot, and it's great to have people with whom I can discuss issues of science education and help to find solutions to the problems that I face with the teaching of science. Not only did I meet these people at the conference – but the all important social events, especially the dinner!

CONASTA has reinvigorated my passion for science and my passion for teaching science, and I am already excited to be making arrangements to attend CONASTA 2014 in Adelaide.

Louis Green and fellow Ruth Dircks Scholarship being presented with certificates by ASTA President, Stephen Zander. © Lance Taylor.

Above: Louis investigating the teaching tools at the conference trade display. © Vic Dobos.