Tertiary Teaching Excellence Awards

2013

Nomination for Associate Professor Cather Simpson

School of Chemical Sciences & Department of Physics
Faculty of Science
The University of Auckland

***Cover**. Simpson's students 'perform' laser machining at 1:1,000,000. They form a lattice (left), then the laser excites a plasma (middle) that resolves into a clean hole (right). Albert Park 2010.*

Table of Contents

Introduction – my role as a university teacher

My teaching philosophy is simple: my role as a university educator is to help people learn what they need to reach their own goals, to achieve in their own lives. When I succeed, students leave my office, the lecture hall, or the research lab equipped to take on their next challenge.

I realized this “mission” in one of the first classes I taught – advanced group theory to PhD students in 1995. As a newly minted postdoctoral fellow, I felt privileged but anxious about teaching such a challenging, mathematical class. Would I make a mistake? Will I know the answers to their questions? Twenty pairs of eyes will be staring at me. Will I do a good job?

I loved that class. The students were clever, engaged, and stretched my ability to explain complex material. It only took a few lectures to transform anxieties about <u>my</u> performance to a focus on <u>their</u> understanding. That class taught me that I derive great pleasure from my students’ success. When the student in my office (for the third time) “gets” it, when the “ah” smile lights up a face in the second row of a class of 400, when a research student publishes her first international paper – these are the reasons I teach in a university.

It’s not about me

My early experiences at Case Western Reserve University (CWRU) in the USA laid a strong foundation for and commitment to pedagogically-informed educational innovation. There, my most significant improvements to teaching and learning were (1) an inventive first-year chemistry curriculum and (2) a postgraduate fellowship program that garnered national interest for successful recruitment of underrepresented groups.

In New Zealand, I continue to work creatively to improve students’ classroom experience at The University of Auckland (UoA), where I lecture not just in Chemistry, but in Physics and English as well. Now I also draw more broadly upon my experience to influence teaching and learning at the institutional level, most recently by shaping a new Science Scholars program in the Faculty of Science.

Guiding research students is another reward. I direct a laser facility called the Photon Factory, where I oversee the research development of 20-25 Chemistry, Physics and Engineering students. We recently received major funding from Government that will allow these students to advance manufacturing in New Zealand using laser technology. Fostering students’ growth into successful, independent, creative thinkers and problem solvers at the most advanced levels is very fulfilling.

Increasingly, I also step outside the university to provide resources and training to science teachers at the primary and secondary levels, to inform the public, and do hands-on research with budding young scientists.

In the about 20 years since I first stepped into a classroom, I have taught thousands of students – some 6800 since I moved to UoA in 2007– from humanities majors to pre-medical students to advanced science students and researchers. At the core of all of my endeavors is the lesson I learned from that early class. It's not about me. I succeed when the people I 'touch' as an educator grow, when they walk away knowing more, asking and answering new questions, and having a positive impact on others through their lives and careers.

Slime with Year-2 students (2008). First, we do some chemistry, then we make a 'kid-polymer,' to show how it all works.

Overarching objectives

I have developed a set of core principles that stem from research in education and cognition and from my experience with students at two universities. They have evolved to meet four specific challenges:

- to improve the depth and breadth of chemical and physical understanding acquired by ***science students***;
- to raise the level of scientific understanding, particularly of conceptual material, for ***all students*** regardless of discipline or career path;
- to foster achievement in science by students from ***underrepresented groups and women***; and
- to improve the understanding and appreciation of science, technology and innovation in ***society***.

In this portfolio, I first describe the principles at the heart of my teaching. Then, I highlight examples from educating (1) advanced science students, (2) students in large 'service' courses, and (3) students in cross-disciplinary classes. Finally, I discuss sharing insights with school teachers, public outreach, and future challenges.

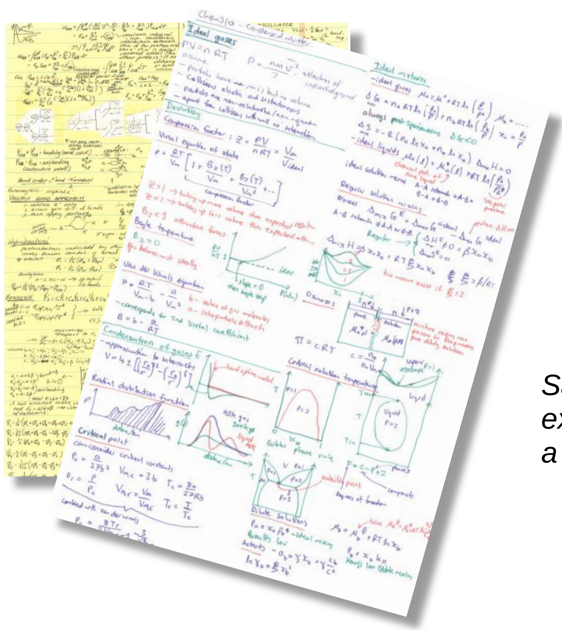
Guiding principles and common threads

Understanding is synthesized by the learner

The concept that knowledge is not learned passively, merely by listening, underpins my approach to course material. Students need to build their own knowledge through acquisition and synthesis[1].

For example, to understand reactions, we must know molecules; to understand molecules, we must know atoms. I guide students to assemble knowledge of how atoms are constructed, how they act, how they come together in molecules, and how those molecules interact with one another.

Each lecture begins with a "Last Time" summary, and ends with a "Next Time" preview. Students are shown how lectures connect, and how complex knowledge builds from simpler parts. I allow students to bring hand-written "knowledge maps" to tests and exams. Good "knowledge maps" require students to synthesize and organize material into a form that reflects their own understanding.



The [knowledge map] helped me learn. Having it made me study the content without having to panic.

CHEM-310, 2012

Sample knowledge maps. The yellow one is an example I show the students. The white one is from a student in CHEM-310 (2012).

Active learning promotes understanding

Active learning means engaging students in the material. In small classes, I use hands-on activities, like postgraduate lab exercises in "Watching Chemistry with Lasers." In courses with hundreds of students, active learning is as important, but more difficult to implement. I get the students to participate in demonstrations whenever feasible. For instance, in first-year physics "waves," the 300+ students contrast stadium (transverse) and pressure (longitudinal) waves by performing them in the lecture.

[1] Eilks, I.; Byers, B. (2010) Chem.Ed.Res.Prac.11:233-40. Herron, D.J. (1984) J.Chem.Ed. 61:850-854.

I challenge students to predict a physical phenomenon before seeing it, and then use three-minute "convince your neighbor" sessions to engage critical thinking. After the demonstration, we collect and analyse the data from the class, and discuss the predictions.

> *Cather continually put in extra effort into lectures, repeatedly reinforcing the concepts covered with fun and interactive demonstrations, which ranged from having the entire class doing a Mexican wave to show how a transverse wave works, to creating interference patterns with large speakers.*
>
> *PHYS-160 student, 2012*

<u>Collaborative projects offer pedagogical advantages</u>

Student cooperation shows clear learning advantages over traditional lecturing. Cooperative learning develops higher competence in reasoning and communication and reduced attrition rates[2]. Active involvement in the classroom helps students from under-represented communities, encourages respect for diversity, and breaks down stereotypes[3]. Modern jobs value teamwork, so students get real-world experience too.

My first experience using cooperative learning was in a first-year chemistry course I developed early in my career. Creative student-centered, team exercises guided students to self-directed learning in fundamental chemistry. Students worked together to use outside resources, form and test hypotheses, and synthesize what they learned into reports, presentations, and creative scientific writing. The results were very positive; this powerful experience with collaborative learning has influenced my teaching ever since.

From those "convince your neighbor" interludes, to lectures devoted to group problem-solving, to extended group work and "Problem of the Day" (PoDs) exercises, cooperative learning is now central in my classrooms.

> *Loved opportunity to do groupwork in class assignment.*
>
> *PHYS-220, 2007*

> *I really liked how a whole lecture was devoted to doing problem solving…*
>
> *PHYS-160, 2008*

[2] <u>Cooperative Learning in Higher Education</u>, Millis, B.J. (ed.) 2010, Stylus Publishing, Sterling, Virginia. Bowen, C.W. (2000) J.Chem.Ed. 77:116-119. Lewis, S.E. (2011) J.Chem.Ed. 88:703.
[3] Haak, D.C. *et al.* (2011) Science 332:1213-1216. Blosser, P.E (1992) CSMEE-Bulletin 92-1, (http://ww.ericse.org/Bulletins/SEB92-1.html). Cooper, M.M. (1995) J.Chem.Ed. 73:162.

Primary focus on the concepts

Many educational reformers assert science courses should focus on concepts and rely secondarily upon memorization and calculations[4]. I agree, and teach to an overall hierarchy of descending importance:

(1) learn the principle – gases behave like independent particles that speed up when they get hotter;

(2) apply the principle qualitatively – balloons in the freezer shrink because slower particles hit the rubber with less force; and

(3) apply the principle quantitatively – calculate the volume change for a given temperature change under constant pressure.

Unfortunately, mastery of the third task is easiest to test, easiest to rote-learn, and least relevant to students' lives after university. I ensure that marks reflect this hierarchy, and explore qualitative understanding with every numerical example in class.

Independence and self-motivation scaffold student achievement

Strong emphasis upon self-motivation is vital for students just out of high-school, as they learn life skills alongside chemistry and physics. In my courses, readings, practice problems, and online resources are recommended but not required. If a student complains about the text I advise them to find one that better suits their learning style; I provide a collection students can browse. The learning ethos I foster is student responsibility.

Successful students practice outside lectures, so I show correlations between exam scores and practice problem completion, and do a demonstration that shows large-lecture theatre education in a nutshell. First, I explain how to spin a basketball. Then, I demonstrate. Finally, we discuss how they would need to practice – a lot – before they could pass a test spinning the ball. The demonstration reinforces two ideas. Sitting in even the most cogent, sensible and beautifully delivered lecture is not where the most important learning occurs. Second, to be good at science, like sport, you must practice.

Finally, students must learn to teach themselves. The internet and mobile devices have transformed our work and play. Successful people find relevant information from reliable sources, and apply that knowledge effectively.

> *[I liked how] everything flowed in Dr Simpsons lecture series and how many helpful practice questions for her section were provided.*
> *CHEM-243, 2011*

[4] *"Transforming Undergraduate Education in Science, Mathematics, Engineering and Technology"* (1999) National Research Council, Washington D.C. Cooper, M. (2010) J.Chem.Ed. 87:231.

Clear expectations lead to better performance

Students care about grades. In challenging, competitive courses like pre-medical physics, students can be more strongly motivated by marks than by content. For some, success is a ‘C’ in a class previously failed. For others, it’s the ‘A+’ that gets them into medicine.

Anxiety is greatly reduced by clarifying the path to success. I set transparent expectations, and discuss these openly with the class. I provide sample test and exam questions, with model answers, depending upon course level. Student-written “knowledge maps” also reduce performance anxiety.

I feel strongly that students should be challenged, but not surprised, by material on tests and exams. I cannot learn the material for them, but I can be unambiguous about what knowledge I expect them to demonstrate.

PHYS-160 student evaluations, 2010

What was most helpful for your learning?

…it was useful to have a clear explanation of the Test with some helpful hints e.g. knowing that there would be 5 ‘easy’ questions (and being reminded to look for them!), types of theory questions that would come up. This made the test taking experience less stressful!

Having worked examples of a past test, with not just numerical answers but also having working and explanation as to why certain answers were wrong and not just why the correct answer was right.

Encouraging underrepresented communities and women

I am a woman in a disproportionately male discipline. I understand the effects of bias, follow the research, and actively focus on success for underrepresented groups in science. At CWRU, I served on the President’s Council on Minorities and co-founded and directed a Ph.D. Fellowship program so successful in bringing underrepresented groups to postgraduate studies that I was invited to the Department of Education in Washington DC to talk to academics from across the US.

In New Zealand, I have given the “Girls into Science” and “Futures” keynote lectures many times to hundreds of year 10-13 girls, many from Māori and Pasifika communities. I try to inspire them with the message that now is a great time to be a woman in science – the door is open, and they should walk through. I emphasize that they are certainly smart enough, we need them, and science can be a terrific career.

From my "Girls Into Science" keynote lecture in 2010 – "Top Ten Reasons to be a Woman Scientist."

From "Girls into Science," 2010

Evaluation Summary*:*

> *"On a positive note, Cather Simpson remains a highlight. The keynote address ranked very highly again this year and it was mentioned specifically by many as a highlight."*

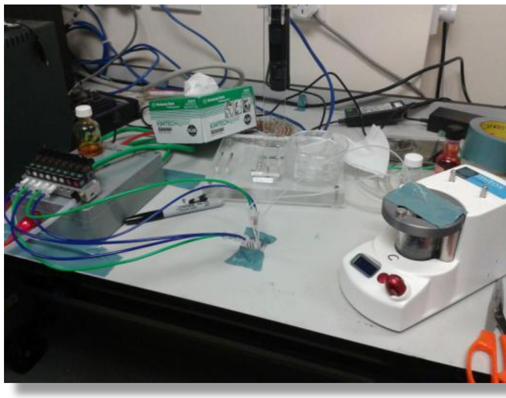
Student comment:

> *"Very informing day, had a great time. Dr. Cather Simpson is GREAT!!! A fantastic speecher!!! I would love to attend your uni!!!"*

Teacher comment:

> *Today I would have liked to "have coffee with Cather Simpson. She rocks!"*

I also engage with these students more deeply. In 2011-2012, we hosted over a dozen Epsom Girls Grammar students for RSNZ CREST Silver Medal projects in the Photon Factory. The girls competed very well at the NIWA Science Fair, and we will again host EGGS students in 2013.



The "microfluidic heart" CREST Silver Medal project, by three students from Epsom Girls Grammar. They won Second Place, Special Prize for "The Heart of Technology" at the NIWA Science and Technology Fair in 2012.

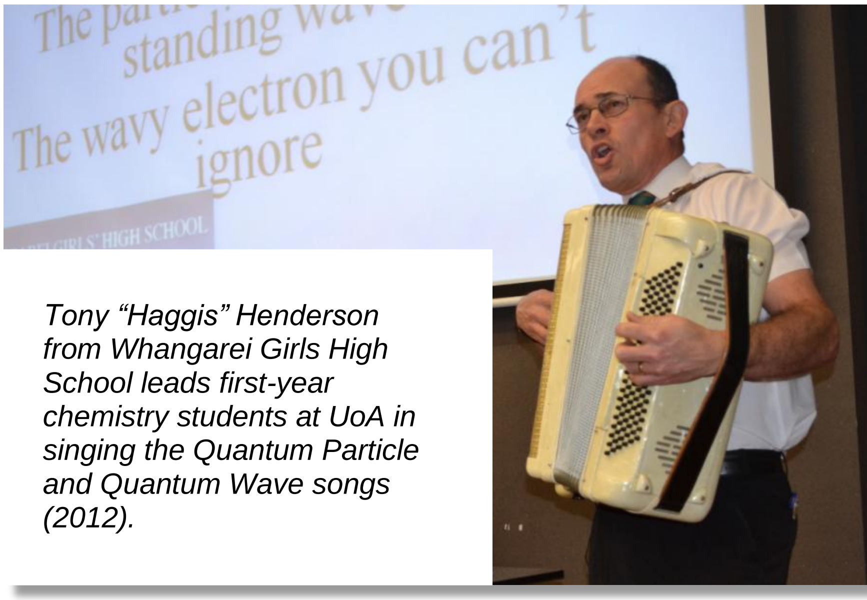
<u>The class environment should be positive</u>

Ensuring open lines of communication is essential. I am clear about my role. I tell every class, "It's my job to help you get where you want to go, but I cannot get there for you." Students should know that I care whether they pass, that I provide multiple opportunities for success, and that they should tell me how the class serves their needs.

I use summative and formative evaluation, from surveys to impromptu in-class discussions, even in large classes. Student suggestions are either adopted, or I explain why the suggestion would not improve learning outcomes.

> *Physics was never my strong subject, and throughout high-school I had difficulty grasping the subject. I never particularly enjoyed it. I was taught by Cather Simpson in 2011 for PHYS-160. Immediately my conceptions of previous physics classes were dashed. It was a welcome relief to have a teacher who has such an extreme passion in the subject coupled with an overwhelming vibe of actually caring about their students' learning experience. …*
>
> *Cather was always open to feedback on her methods, and would adjust her approach accordingly or re-clarify points that the class was struggling with. She was also available for questions after class or via email and actually took the time willingly to help you.*
>
> *PHYS-160, 2011*

I try to make classes fun and engaging, so students want to attend. This is easy – science is intrinsically exciting! I include material from recent scientific papers, use demonstrations, cartoons, You-Tube videos, humor and student participation whenever feasible. This is not entertainment; I place these at about 20 minutes in, because 50 minutes of unbroken concentration is not conducive to learning.



Tony "Haggis" Henderson from Whangarei Girls High School leads first-year chemistry students at UoA in singing the Quantum Particle and Quantum Wave songs (2012).

I have been part of the CHEM 120 teaching team since 1988, but my most outstanding "golden learning moment" with the CHEM 120 class occurred when I sang the Quantum Particle song (to the tune of "Tie Me Kangaroo Down, Sport") and the Quantum Wave song (to "Jamaican Farewell") as part of an interactive demonstration of wave particle duality, a notoriously difficult concept for students to grasp. The teacher in the class was Cather Simpson, and this experience summed up for me everything outstanding about Cather's teaching. She shows a real ability to engage students, to bring fellow academic staff along with her, to employ a range of innovative teaching techniques grounded in the pedagogical literature, and to adapt her teaching style from leading the learning in large classes to fostering critical, independent thinking in research students.

Colleague, 2012

"I want to be a Scientist" – teaching and learning with science students

Most of the third-year, advanced science students I teach are considering a career that involves science, in industry or academia. They are easy to convince of course relevance, but prefer to be doing science rather than attending lectures about it.

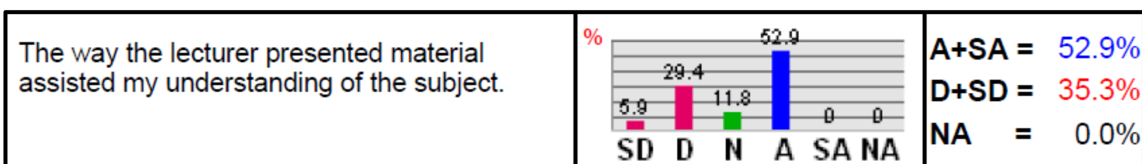
The key for this group is maintaining engagement, while developing critical thinking skills and helping students master advanced concepts. Students should find satisfaction in stretching themselves to succeed.

Here, I focus on one particularly challenging course, stage three physical chemistry (CHEM-310), and then highlight supervision of research students.

Adapting to Auckland – the CHEM-310 challenge

At UoA, the most significant adjustment I have had to make has been to the structure of the B.Sc. in Chemistry degree. The American B.S. Chemistry degree has a mandatory core of maths and physics. When I taught essential advanced topics like group theory and quantum mechanics, both intrinsically mathematical, I relied on all students having passed those core courses.

At UoA, the B.Sc. in Chemistry is not so rigid; students have the opportunity to study deeply in a wider range of areas. This rich flexibility, however, means the maths and physics preparation of advanced chemistry students is much more varied. When I started lecturing in CHEM-310, I significantly overshot many students' background knowledge. I received my worst ever student evaluations – clearly, I needed to adapt.



Excerpt from student evaluation of lecturer performance, CHEM-310 (2010).

In response to student feedback, I added math reviews, summaries, extra readings, and visualization software in 2011. I included sophisticated (and beautiful!) maths as asides, to keep the more mathematically inclined engaged. Collaborative mini-research projects in academic staff laboratories were introduced. As a result, student performance in group theory improved.

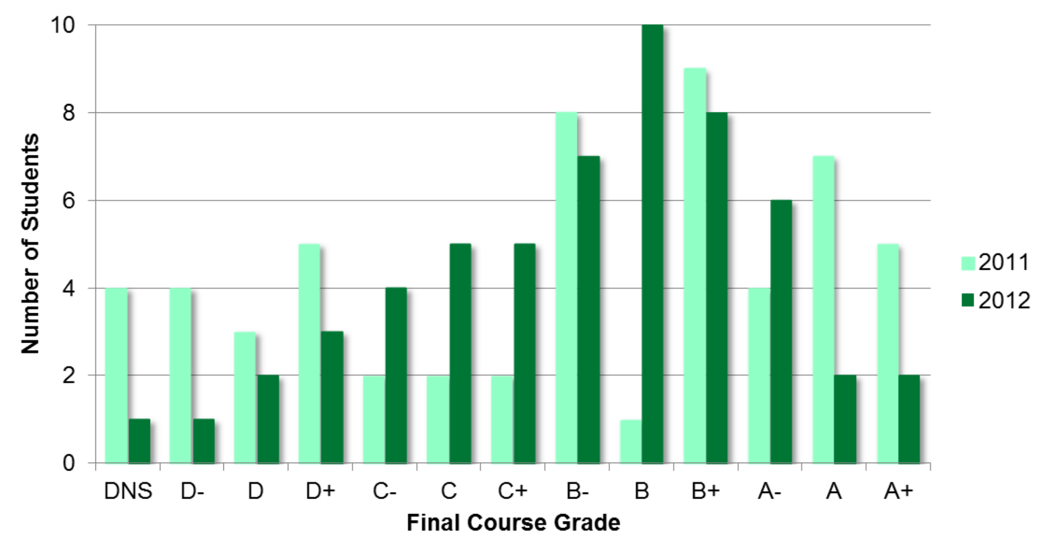
In 2012, I became course coordinator, and worked with colleagues to clarify performance metrics and revise the syllabus to include research-based material. I implemented "knowledge maps" for tests, provided model questions to guide student study, and encouraged in-class participation and feedback.

One important innovation was to recast collaborative project assessment as poster presentations, like scientists at conferences.

Student poster presentations in CHEM-310 to Chemistry staff and postgrads (2012).

It worked! The pass rate improved from 71.4% (2011) to 87.5% (2012), and the grade distribution adopted a more healthy shape.



Final course grades for CHEM-310 in 2011 (light green) and 2012 (dark green). The skewed normal distribution peaked at 'B' in 2012 indicates healthier alignment between learning outcomes and assessment.

Student course evaluations reflected these performance improvements.

	2011 *%A+SA*	**2012** *%A+SA*
Overall, I was satisfied with the quality of this course.	*57.1%*	*92.5%*
The course content was structured in a clear and logical manner	*64.3%*	*92.5%*
I had a clear idea of what was expected of me in this course	*64.3%*	*85.0%*
I was clearly informed how my learning would be assessed	*64.3%*	*90.0%*

%A+SA = percentage of students who agree or strongly agree with this statement

CHEM-310 student course evaluations, 2012

What was most helpful for your learning?

The mini-research projects were the best since they let us do our own practical work and gave us the ability to design and develop our own take on things.

I like the concept of mini-projects and poster presentation … the project was a success. LOVED IT ☺

The mini-research projects. See how the theory works in real life and what practical / physical chemistry is like in real life.

Undergraduate and Postgraduate Research

I enjoy guiding research students as they learn to acquire and apply knowledge independently, propose, perform and interpret experiments, evaluate results and form conclusions. In my group, students learn to make cogent, critical arguments and embrace scientific ethics in a cooperative environment. Through robust questioning, I help them see assumptions and defend conclusions – and I require that questioning be a two-way street.

At CWRU I began the practice of engaging students early in “real” research, where answers are unknown. One of my first undergraduate researchers is now an Assistant Professor at Harvard.

> *As a freshman, I was given my own research project… Having intellectual ownership of a project at such a young age was extremely formative in my scientific development and ultimately yielded a first author publication.*
>
> *Former student, 2012*

I have built on this experience at the University of Auckland. In the Photon Factory, over 15 undergraduates from Chemistry, Physics and Engineering have participated in a wide range of research projects. They show similar early success, including winning first prize at an international conference, and publishing in the peer reviewed literature.

Correy Tong, current 2nd year undergraduate in the Photon Factory, receives an award from Prof. McGrath, Director of the MacDiarmid Institute. Correy’s poster won First Prize at the 6th International Conference for Advanced Materials and Nanotechnology, 2013. (Photo credit: Godfrey Boehnke)

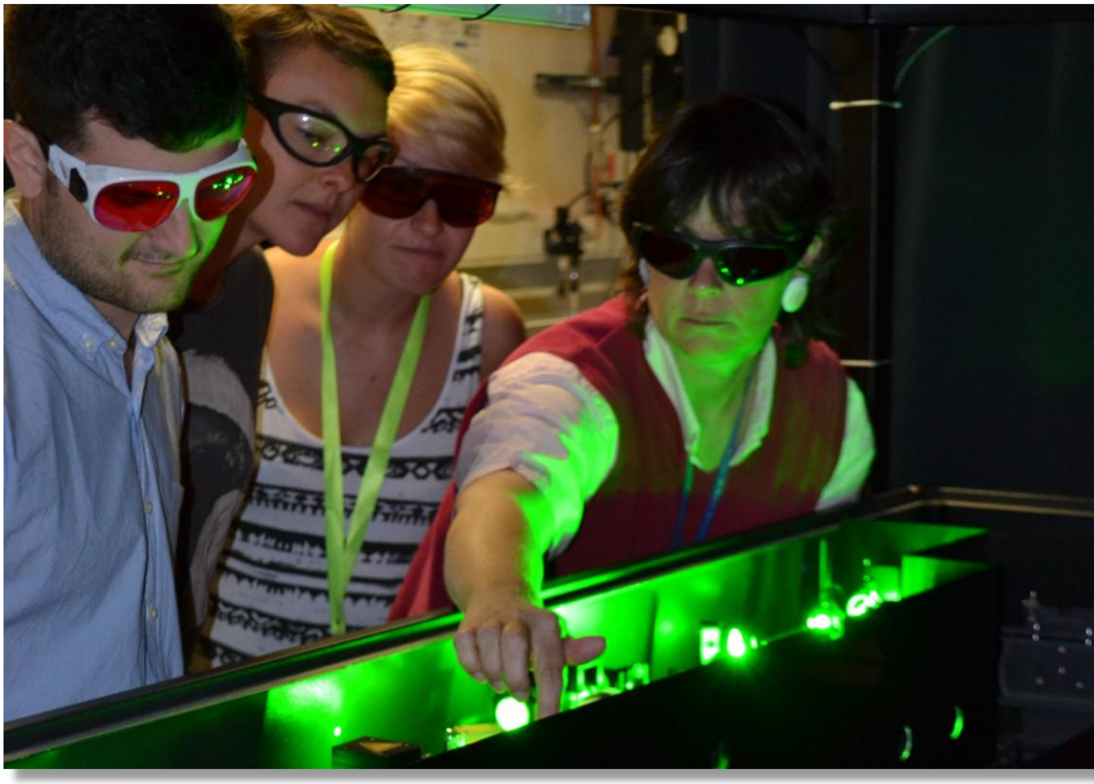
Cather's ability to offer guidance through my 4th-year-honours project with her was invaluable, whilst she still allowed me the freedom to foster my ingenuity and innovation to overcome challenges in my research. She truly understands the importance of taking Science out of lecture theatres and putting it in the hands of students, where we conduct 'real' science in cutting edge fields. Throughout my final year, working with her gave me a completely different outlook on working in a research facility and developed my passion for scientific research. This inevitably led me to where I am now, undertaking my Masters in Science with her as my supervisor.

Current M.Sc. student, 2013

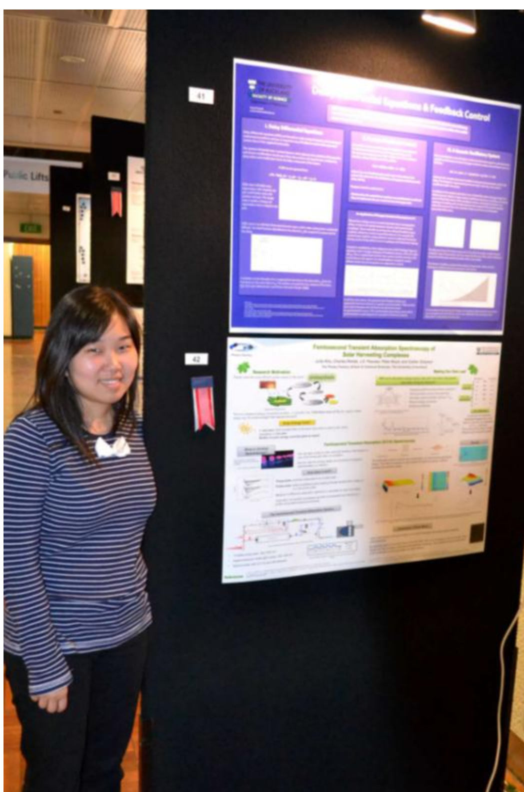
Working at the Photon Factory was great because I had the freedom to take projects in a direction that interested me. I gained 'hands on' experience with state of the art laser equipment and had the chance to work with students from multidisciplinary backgrounds.

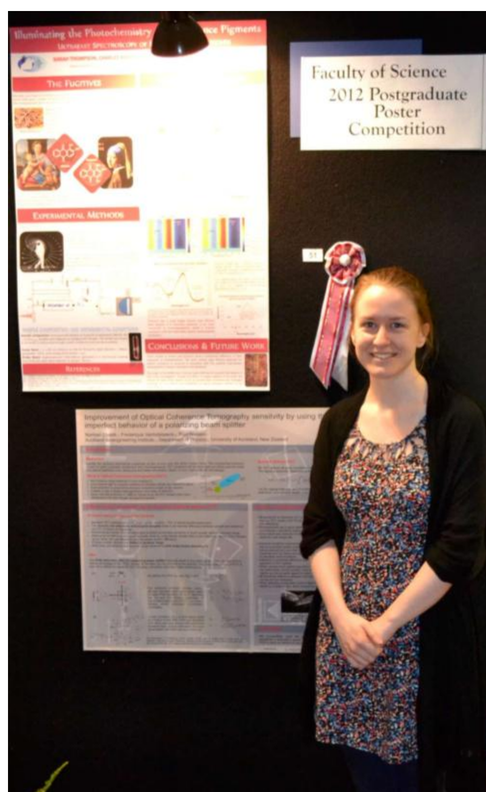
Former undergraduate, now colleague, 2013

I also continue the strong dedication to postgraduate supervision I developed mentoring Ph.D. students at CWRU. At Auckland, I have supported (or am supporting now) over 20 postgraduates in research towards their degrees, from studies of nonlinear optics and laser pulses for robotic surgery, to the distribution of tools in Māori sites around New Zealand. Our current Ph.D. students are studying ways to improve solar energy harvesting, convert light to mechanical motion, and understand colour fading in Renaissance art. Helping these students reach their goals is very rewarding.



A laser experiment in the Photon Factory (above). Current Ph.D. student prizewinners at the Faculty of Science Poster Competition in 2012 (below).





“I want to be a Doctor, Engineer, Pharmacist” – teaching and learning in ‘service’ science courses

Many large undergraduate science courses are components of professional degrees. Students in these ‘service’ courses are very motivated – just not to be scientists. My role is to help them learn what their school and/or boards of studies require. Many of my core practices have been honed in these classes.

Doing this right has far-reaching consequences – in a typical year, I lecture to 1200 UoA students or more. Over a 35 year career, that is 1% of the New Zealand population! My classroom may be the last time they actively engage with physics or chemistry. Getting these students past “OMG I hated physics/chemistry at Uni!” helps them make more informed decisions that impact us all.

> *I hate physics! But I would always look forward to your lectures because you always made them interesting and engaging.*
>
> *PHYS-160, 2011*

<u>*Improving undergraduate science teaching through research*</u>

Recently, I initiated a research project comparing the learning approaches and motivations of students in a compulsory chemistry course in Pharmacy, and one leading to a science major, with the aim of better serving the needs of both. Correlations with academic success will be evaluated and feedback provided to students.

The research is underpinned by certified assessment criteria, and collaboration with Dr. Richard Hamilton (Faculty of Education) ensures the project stays grounded in research. We are beginning the study’s third year; once complete, we will adapt courses accordingly, and submit publications for peer-review.

<u>*Curriculum development – The CHEM-243 example*</u>

In 2009, I led development of CHEM-243, chemistry for pharmacy and life science students. I worked with the School of Pharmacy to ensure the syllabus and practices were pedagogically sound and met Board requirements. I instituted many of the above practices: “knowledge maps,” practice problems, in-class discussions and exercises, and a focus on concepts. The most unorthodox was a series of online tests assigned a small amount of extra credit. Students appreciated earning marks, and deadlines structured studying. We also developed new laboratory experiments related to pharmacy issues, and tied goals to learning outcomes.

In 2011, CHEM-243 was evaluated and I was very pleased to see that nearly 80% of the respondents found it intellectually stimulating and expressed overall satisfaction.

CHEM-243 student evaluations, 2011

What was most helpful for your learning?

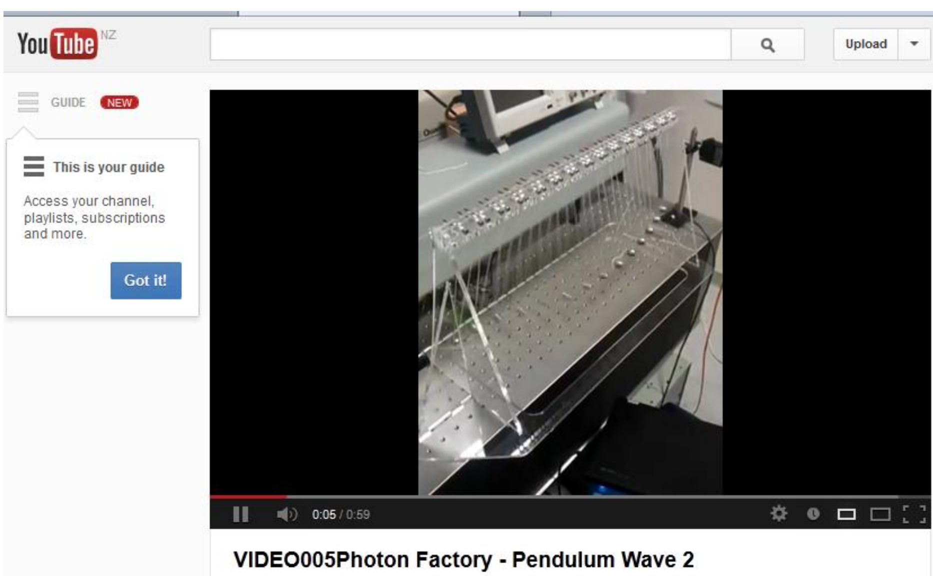
The fact that she gave us a lot of practice questions is the best!! this is because she gives us the knowledge we need during her lectures but also makes sure we can apply the knowledge very well.

The fun the lecturer had in teaching us and her concern for us to do well.

nothing to change! Keep up the great work! she is the best!!!!!!!!!!!! having her as a lecturer makes the hardest topic the easiest!.

<u>*Teaching in Large Lecture Classes*</u> – <u>*The PHYS-160 Example*</u>

PHYS-160, a UoA physics course for premedical students, exemplifies large 'service' course teaching. Of the 700+ students in the course each year, almost none want to become a physicist. I focus on providing clear, organized and interesting lectures on topics like optics, electricity-magnetism and mechanics, and testing in a rigorous but fair way. I provide practice problems, office hours, help sessions, PowerPoint summaries and lecture recordings, so students can revise according to personal learning styles.



Pendulum wave demonstration built in response to student suggestion. Students time the wave oscillations.[5]

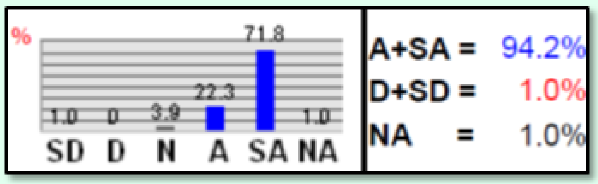
[5] http://www.youtube.com/watch?v=xu8aZeaEbq4

My lecturing style – relaxed, interactive, humorous –works well in large, first-year classes, and I enjoy finding creative ways to engage the students. Each year I include current research from top journals, such as ‘hearing’ stars and water droplet microlenses.

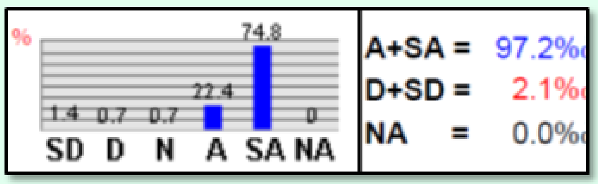
My lecturer evaluations in this course are very good. Nonetheless, I scour feedback for suggestions – revising the course guide is next on my list.

PHYS-160 student evaluations

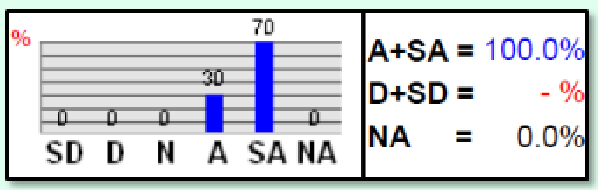
“Overall, the lecturer was an effective teacher”



2008



2010



2011

Phys-160 student evaluations

What was most helpful for your learning?

2008

-summary and template slides were awesome as it enabled us to make detailed notes as she goes along and draw diagrams also.
-clear objectives.

Dr Simpson was very funny and engaging for example involving the class in trying to explain transverse and longitudinal waves! Overall fab lecturer!!!

Great sense of humour, made the concepts intriguing and complex enough to get us really thinking about the subject. Very easy to talk to, and good at giving extra examples/places to look for more information.

I found the summary sheets very helpful. I also received excellent assistance via email. Overall a pleasure to learn from.

2010

Usually I know a lot of Biomed students just shrug off Physics as “yet another compulsory” subject we have to do before we can progress towards Medicine, but Cather really made us (me) interested in learning and finding out more about the Electricity/Optics sections. She balanced humour with strong information and knowledge which made us prepared for the test at the same time captivated by each Lecture.

Going over practice problems on the Friday lectures was great. It helped me to gain confidence for the Test and showed me ways to tackle problems.

Having worked answers posted on Cecil for the previous semester’s test was a useful resource: it showed me what to expect in the Test and prepare for it better.

The passion in the lecturer was incredible which made me more alert in class and more confident when doing questions as I knew that I would be able to easily approach her and ask for help.

Dr Simpson was really enthusiastic and made me feel good about physics. She made the work seem achievable and motivated me to work hard at physics when I hadn’t felt compelled to do so previously, Thanks very much. Great lecturer.

2011

I particularly liked the summary slide at the end of each lecture to emphasise main points, and a quick recap at the start of the following lecture, It ties everything together nicely.

-Recording all lectures so we could go back and review them easier
-lecturer had a very easy going approachable (and funny =)) nature which made the class interesting
-nice demos.

A mixture of fun educational youtube videos and information.

going through all the objectives at the end of a lecture. the way the lecturer taught the materials is very interesting. and the way she gives us examples from our day to day life makes the topic more captivating.

having in class experiments – most people are falling asleep in the 2pm stream (just after lunch and everything …) and it really keeps you awake and interested when you aren’t just being talked to.

“I want to be a Lawyer, MP, Business Owner, Artist” – cross-disciplinary teaching and learning

Scientists do much for society, but experts in arts, humanities and social sciences run countries, ensure justice and provoke thought about the human condition. Scientists and non-scientists alike should explore and appreciate this.

At CWRU, I created a small, general education seminar, "Gods, Monsters, or Innocents," on science and scientists in popular culture. We used cinema, literature, TV, readings from C.P. Snow and others, to explore scientists as holders of secret knowledge, evil manipulators, and strangers.

ENGL 241 – Cross-disciplinary Teaching.

“Gods, Monsters or Innocents” was excellent experience, and I jumped at the chance to teach in the English Department at the UoA with Professor Brian Boyd, an internationally-recognized scholar of science and literature.

> *Cather is a joy to teach with. She is highly organized but always looks relaxed and spontaneous. She was highly alert to the range of knowledge, skills, and interests in the students, whose focus ranged from literature, fine arts and music to science, medicine and law, and from second year to PhD. She uses Powerpoint and multimedia superbly, even turning the laser pointer itself into a theatrical prop, a magic wand to amplify the students’ already considerable attention, but her best tools are more timeless: pep, humour, clarity, and warm engagement, whether talking to the class or provoking them into articulating answers, opinions and explanations. The students were always fascinated during the lecture and would flood her with questions afterwards.*
>
> *Colleague, 2012*

“Literature and Science” stretched me to explore metaphor and science in a series of essays (*The Periodic Table*, Levi). We also discussed plays about ethics, truth, and the atomic bomb (*Copenhagen*, Frayn), and quantum physics (*Hapgood*, Stoppard). These trans-disciplinary ideas energize me and the students.

ENGL 241/241G student evaluations:

2009

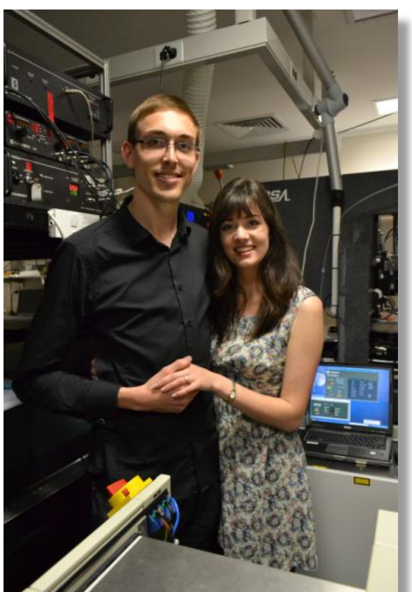
> *I found her interest & enthusiasm for science, interested me. Her teaching style was very enjoyable & she mixed the science and literary elements well. It was fresh to see a scientific approach focusing on the texts.*

2010

> *Cather Simpson was…very animated, had a very interesting approach to the topics and despite the fact that I am not a science student, her explanation and teaching was still as clear and interesting to me, as if I were a science student.*

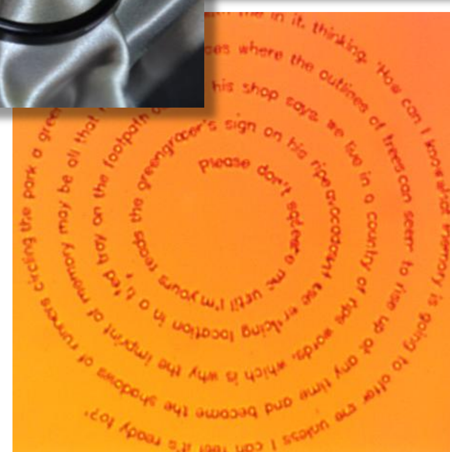
<u>*Lasers meet language*</u>

In another cross-disciplinary project with English, “Poetry off the Page” students chose objects that reflect imagery in a poem by NZ Poet Laureate Ian Wedde, and Photon Factory students microscopically machined the words on them. The results will be displayed in the UoA library, and on the Poet Laureate’s website; and the project was highlighted on TV3[6].



Jake proposed using the laser to write letters smaller than a grain of sand on the ring. She said “yes!” We used the same technology to write “Poetry off the Page.” (below)

[6] http://www.3news.co.nz/The-beautiful-world-of-nanotechnology/tabid/312/articleID/286162/Default.aspx



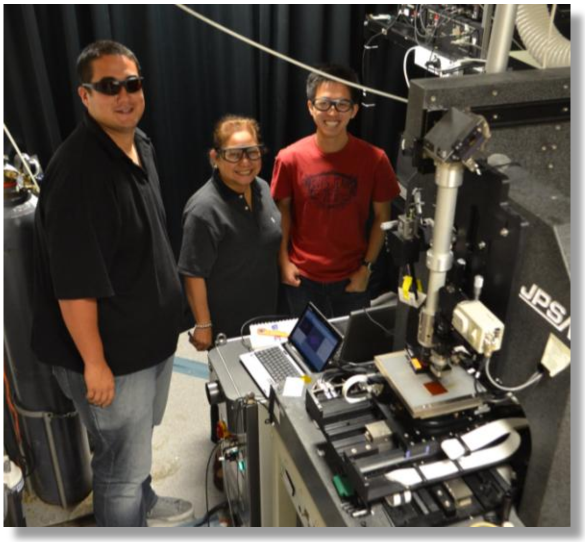
Three of the ten objects onto which stanzas from Ian Wedde's "Shadow Stands Up" have been microscopically inscribed with the lasers in the Photon Factory.

Our Poetry off the Page students learned how lasers can take poetry farther than the eye can see, while the Photon Factory team discovered the challenges of machining microscopic words onto unusual objects such as paua shells and lumps of coal. Cather and her student Jake were fantastic partners – enthusiastic, curious, playful – in our mutual quest to find new ways of bringing science into conversation with literature.

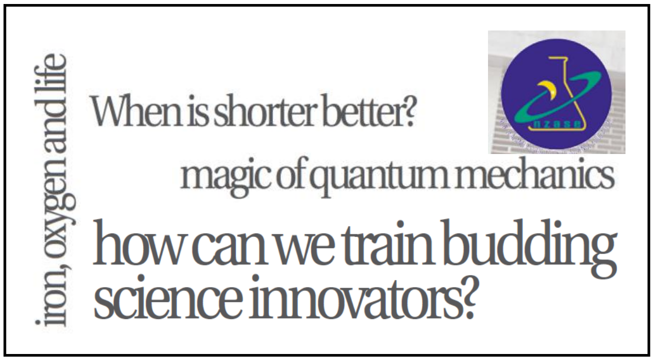
Colleagues, 2013

"I teach science too" – sharing ideas with school teachers and their students

I have learned a lot by sharing experiences with teachers in the primary, secondary and tertiary sectors. I serve on the New Zealand Institute of Physics Council, spoke at the 2012 Tertiary Chemistry Education Symposium, and have published several articles for New Zealand science teachers. I also run interactive teacher workshops during National Primary Science week, SciCon and NZ Physics Teachers days, and ensure ample time for feedback, so I can learn from them.



Christina Cochrane, 2013 RSNZ Primary Science Fellow, in the Photon Factory with her student team (left). Articles written for the NZ Science Teachers journal in 2009, 2010, 2011 and 2012 (below)



I do experiments in primary schools, when I can. Slime (polymers), volcanos (three states of matter, chemical reactivity) and bottle rockets (force, measurement) suit the New Zealand curriculum.

In visits to primary schools, I help school children explore science hands-on.

In 2012, the Photon Factory hosted “Kids Visiting Venus,” a blog[7] inspired by my son, his mate and their class, who were fascinated by the Transit of Venus. The blog received 1129 hits from 831 computers, over 90% of them during its short active time before the transit, and garnered international attention.

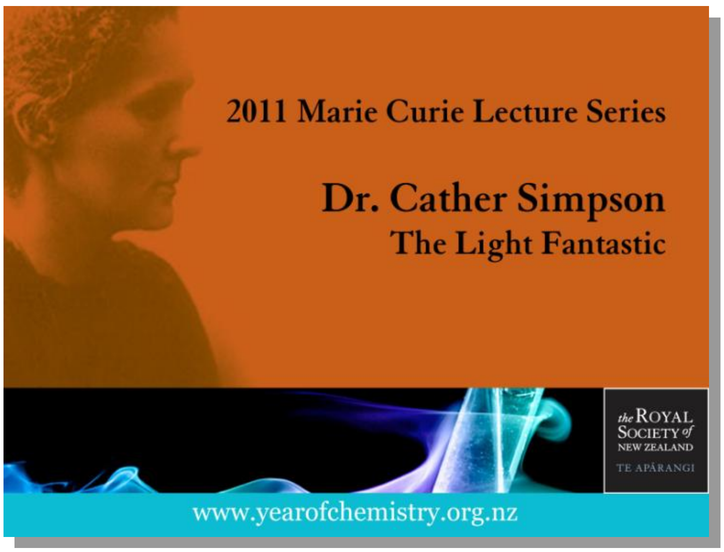
Some activities associated with Kids-Visiting-Venus. The blog went ‘live’ on May 24, 2012 and the transit occurred June 6 in New Zealand.

Turning young minds onto science is important. They are the generation that will solve problems like global climate change and clean drinking water. The smiles also make it fun and rewarding.

[7] http://kidsvisitingvenus.auckland.ac.nz/

“I’m not at Uni, but I’m keen on science” – outreach to the general public

Science must be relevant to the community. Since moving to New Zealand, I have given several public talks, including an invited RSNZ lecture to honour Marie Curie. I have also spoken at venues from Cafe Scientifique and Nerdnite to a Michael King Writers Workshop and the Gus Fisher gallery. Radio interviews include a piece on RadioNZ to celebrate the 50th anniversary of the invention of the laser. In 2012, I was science advisor for a production of *Copenhagen*.



With these activities, I get to share the power, beauty and impact of science with the community, and give people the knowledge to help them make better, more informed choices. I am gratified to be able to contribute.

Plans for the future

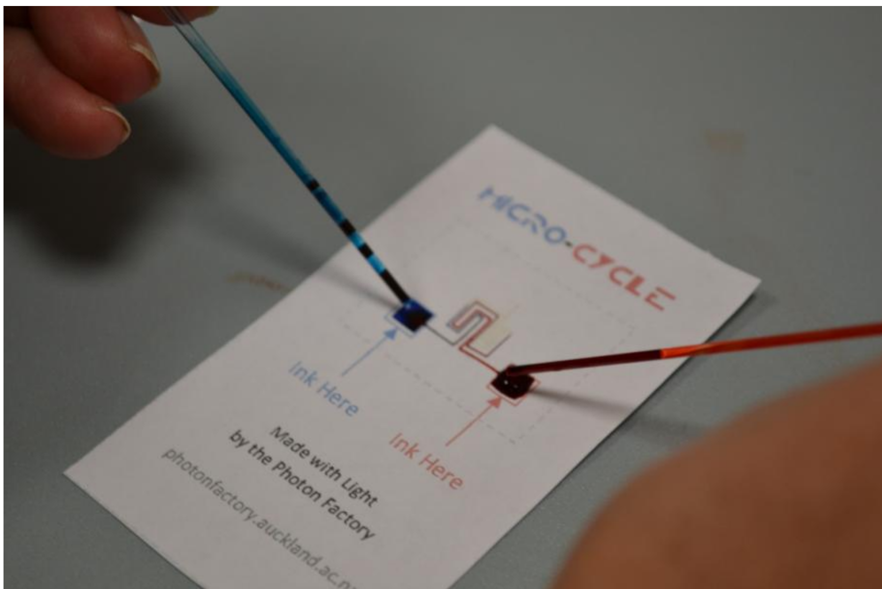
Of course, I have future plans, from continued improvement of courses to completing our research on student motivations. Here, I outline two new projects.

Broadening Engagement with School Students

Inspired by experiences like the Transit-of-Venus blog, I want give more teachers and students hands-on opportunities in the Photon Factory.

We are developing a web-portal, where students can upload ideas about microfluidic flow, our initial topic. We convert these ideas to paper widgets with our lasers, and send them back so students can test their hypotheses, draw conclusions and report findings.

I imagine collaborative, classroom-led projects linking diverse primary, secondary and tertiary students and teachers across New Zealand. In 2012, I trialed the idea in physics teacher workshops – the next step is inviting teachers to pilot the project.



Example of a paper microfluidic "Tron race" that tests how far a liquid travels in a given period of time, for a particular shape of track.

The University of Auckland Science Scholars Programme

I am also working on a new, competitive, enrichment programme in the Science Faculty that I co-proposed to encourage our best students to reach their exceptional potential. The vision is a cohort of students in an intellectually-vibrant, scientifically-focused community, who collaborate effectively and graduate with the knowledge, experience, and critical reasoning skills to lead the next generation of creative scientists. Over the next two years, I will collaborate with colleagues from across the Faculty to transform this vision into reality.

It is *about …*

Early in my career, I found I could ground my teaching in educational and cognitive research and see new approaches succeed through improved student performance and feedback. What I have learned about rigorous, thoughtful evaluation and how to implement change continues to inform my innovations in teaching and learning, as they expand from the classroom to faculty, institutional and community engagement.

What drives me to succeed is that the people I touch are not just tomorrow's scientists, but its doctors, lawyers, politicians and school teachers. So it’s about ensuring that they too know the science they need to do their jobs. It’s about conveying passion for science, and appreciation for the tremendous positives science brings to our lives. It’s about giving them tools they need to engage in critical thinking and meaningful debate. In the end, it’s about the future that <u>they</u> will shape.

Summary: student evaluations of lecturer performance

Course / Year	2008 CHEM 240	2008 PHYSICS 160	2008 PHYSICS 220	2009 ENGL 241	2010 CHEM 120	2010 PHYSICS 160	2010 ENGL 241	2010[a] CHEM 310	2011 CHEM 243	2011 PHYS 160
No of responses/No enrolled	181/265	106/562	18/45	34/64	63/411	143/589	15/68	18/72	31/128	51/588
Statement	**% who Agree and Strongly Agree with the Statement**									
Overall, the lecturer was an effective teacher	97.8	94.2	77.8	97.1	83.6	97.9	86.7	70.6	96.0	100
The objectives of the lectures were clearly explained	91.2	81.6	72.2	88.2	75.4	93.0	86.7	64.7	76.0	96.0
The lecturer was enthusiastic about the subject	96.1	98.1	94.4	n/a	n/a	n/a	n/a	n/a	n/a	n/a
I was clearly informed about how my learning would be assessed/ The lecturer made assessment requirements clear	82.3	73.8	72.2	n/a	n/a	n/a	n/a	58.8	n/a	n/a
The lecturer responded to students' questions in a constructive way	96.7	86.4	77.8	88.2	86.9	92.3	80.0	82.4	92.0	100
The lecturer stimulated my interest in the subject	90.1	88.3	77.8	97.1	80.3	95.1	93.3	41.2	88.0	94.0

a. Refer to pages 17-19 for details about these anomalously low ratings.