CAREER VIEW

CHEMISTRY

Chemicals are the building blocks of the material world. Food, drink, clothing, cosmetics, medicines, transport, fuels and devices are all products of chemical processes, so chemistry plays an absolutely vital role in the advancement and sustainability of national and international economics. It is fundamental to the development of new materials and products that shape our society and lifestyle. The possibilities are vast, from developing new types of beer, wine or milk products, textiles that repel bacteria and eliminate odour, to electronic equipment, high definition screens and displays, or sophisticated materials such as fibre-reinforced composites and superconductors. Developing new technologies is both challenging and fun.

WHY STUDY CHEMISTRY?

Chemistry is fascinating – the study of matter in all its forms; how living organisms are made and function and why nature and the universe behave the ways they do. It's a core science that underpins and complements many other sciences and major areas of technology. It's hands-on and there are many career applications. In fact most industries make use of chemicals and the products of the chemical industry. Some chemists produce the building block compounds we need for drugs and materials, others are employed in measurement or in monitoring and analysis - helping to ensure that the products we use and the environment we live in are pleasant, healthy and safe. The development of green (or sustainable) chemistry tries to reduce or eliminate chemical products and processes that are harmful to people and the environment.

The study of Chemistry can lead to many careers. For science-based careers, you will need to apply and develop detailed chemical knowledge. However your scientific training will also provide you with the transferable skills, abilities and knowledge required in a wide range of careers in commerce and industry. So although many chemists will obtain jobs in research and development, analytical chemistry, environmental research and monitoring, education and scientific management, others will make careers in information technology, government and business management.

WHAT SKILLS DO CHEMISTRY STUDENTS DEVELOP?

At university level the study of Chemistry has a strong practical emphasis. As well as laboratory skills it also develops theoretical knowledge, numeracy, the ability to analyse complex problems, rationality and practicality, as well as an appreciation of the power, applications and potential of modern technology.

Career View explores how degrees and courses relate to employment opportunities and to life/work planning. It includes graduate destination information and current employment issues. Your comments and suggestions are always welcomed.

Wellington Careers and Employment.
wgtn.ac.nz/careers

1897 VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA

Chemists are encouraged to be team players, to develop good communication skills and to bring a logical, enquiring and ethical approach to their work.

Observation and communication. Chemistry graduates have learned to pay attention to detail, observe closely and understand the effects of chemical processes. During practical laboratory sessions students learn how to explain what they intend to do in an experiment, interpret what they observe, then communicate results verbally and in writing. Complex ideas and procedures need to be conveyed in a clear and understandable fashion. All employers value people who can express complicated or detailed information in a straightforward and accurate way. Communication skills are at the top of almost every employer's 'must have' list.

Scientific method. Scientists have to be systematic in designing, researching, setting up and implementing experiments and projects. Degree studies teach skills in scientific process along with a work ethic that demands rigour, safe and responsible practices, tolerance for repetition and patience.

Technological and intellectual competence, as well as technical knowledge are used by Chemistry graduates to adapt to and make use of emerging technologies, for example, nanotechnology. The process of learning a discipline like Chemistry develops an intellectual 'toolkit' that can be transferred to more advanced study, other areas of study, or the acquisition of new knowledge for a range of work areas. Graduates can contribute their skills to exciting new areas of research and development and have the flexibility to adapt to rapid change in their respective fields.

Chemical experiments can be carried out in a computer rather than a test-tube. Some Chemistry students also study computing or information systems. Many discover that because they are both logical and creative problem solvers they develop good programming skills. Computing and information technology skills are highly transferable as they are central to almost every service and industry.

Analysis and problem solving. Problems in chemistry can be complex and their resolution requires a careful, disciplined approach. Generally, chemists think about problems in numerical terms, working on them theoretically before putting theory into practice. Students of chemistry gain high levels of abstract reasoning, accuracy and patience.

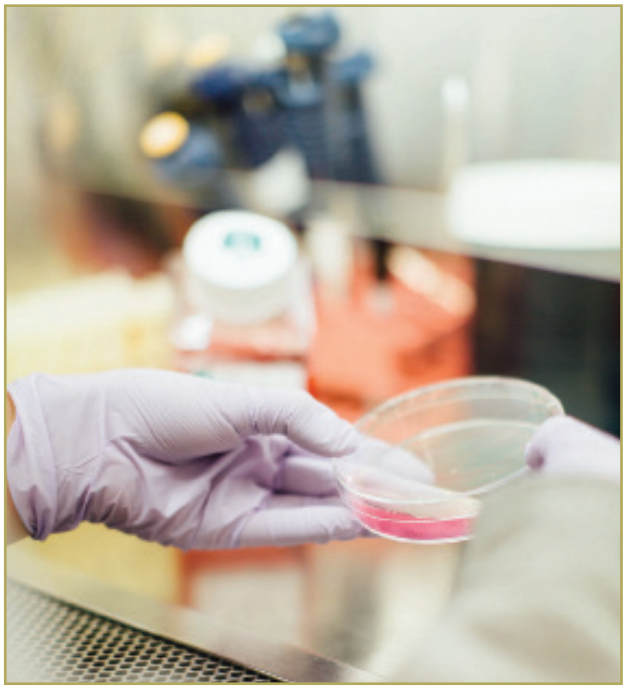
Information retrieval. Chemistry graduates have learned to retrieve information from a wide range of sources, using a variety of tools inside and outside the laboratory, including reading textbooks and current research journals, attending lectures or seminars, accessing computer data bases, and later on, attending conferences. Knowing how to find things out can be the basis of initiative and innovation in the workplace.

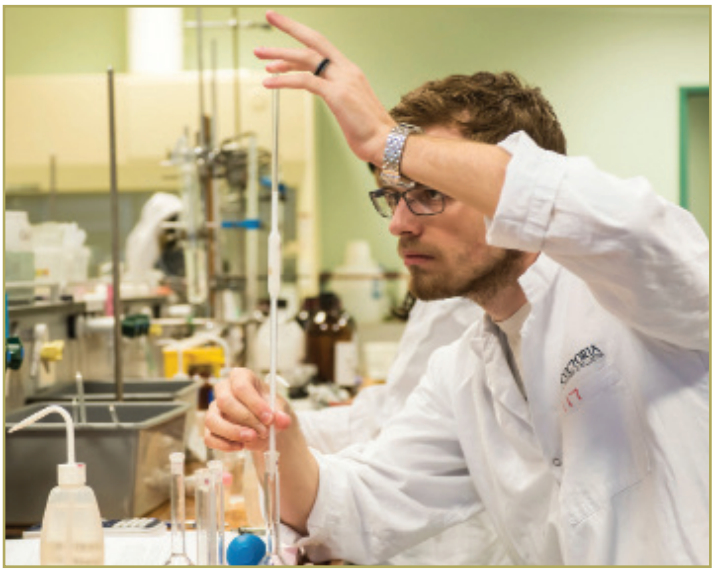
Numeracy. Chemists are able to translate physical problems into numerical ones in order to analyse and solve them. While needing to have a good grasp of basic mathematics, Chemistry students also learn to apply their findings to real materials in experiments. The ability to think numerically, and shift from abstract numbers to concrete examples, is essential in the sciences and also has many commercial and industrial applications.

WHERE DO CHEMISTRY GRADUATES WORK?

In New Zealand most researchers go into applied science areas taking up positions in various research organisations, including Crown Research Institutes (CRIs). As the pivotal science, chemistry links with most aspects of scientific research. Although the focus of some of the CRIs may not be specifically 'chemical', chemists are often important members of the multi-disciplinary research teams. Postgraduate degrees are usually required. Paid summer internships for students can be possible with some organisations, giving a taste of research and hands-on work experience.

Callaghan Innovation is made up of researchers, engineers, scientists, technologists, designers, entrepreneurs, advisors and administrators delivering services and tailored programmes to assist businesses with innovation through research and development.





Their areas of technical expertise include advanced materials, information and communication technologies (ICT), biotechnologies, manufacturing and design, sensing and automation, measurement standards and food technology. Callaghan Innovation also acts as an incubator for spin-off companies such as BDG Synthesis, a small company that competes internationally in the supply of high value specialist chemicals, for example, isotopically labeled compounds for drug testing. GlycoSyn specialises in the synthesis of drug ingredients for local and international markets. They also offer positions in their quality systems and analytical teams.

GNS Science employs chemists in areas such as geochemistry, petroleum exploration and analytical chemistry. GNS Science is active in environmental planning and management, the development of energy, mineral and ground water resources, manufacturing and processing, radiocarbon dating and other innovative isotope applications.

NIWA (National Institute of Water and Atmospheric Research) does precise monitoring of the atmosphere, oceans, lakes and rivers and provides advice to government and a range of other clients. Chemists are employed alongside other scientists in atmospheric, climate, freshwater and marine research.

Scion specialises in research relating to all aspects of forestry and the applications of wood and wood products. This includes research to enhance the key chemical and physical properties of wood using chemical processing technology which is also environmentally friendly. Scion is developing a strong focus on new biomaterials. Bio-adhesives created by Scion's green chemistry use chemicals from plant residues as building blocks instead of formaldehyde or petrochemicals. Their bioenergy research programme is developing renewable energy technologies to meet New Zealand's future energy demands. Many of the research projects require multi-disciplinary teams of scientists in which chemists play a key role.

Plant & Food Research and AgResearch are bio-focused research institutes centred on the horticultural and farming sectors. Many of the development projects these research institutes tackle, such as wool technology, food and bio-based products require the expertise of scientists from various disciplines including chemistry and biochemistry.

ESR (the Institute of Environmental Science and Research) is the largest employer of chemists involved in the general area of chemical analysis which includes forensic science. Forensic scientists examine and analyse physical and biological evidence such as paint and glass chips, or bloodstains. They identify drugs in connection with crimes, analyse body tissues and organs for traces of drugs and other toxic substances, analyse blood and breath for alcohol and may visit crime scenes to collect evidence. Forensic technicians provide technical assistance to the scientists. For both roles the minimum qualification is a BSc(Hons) in Chemistry, Biochemistry or Molecular Biology.

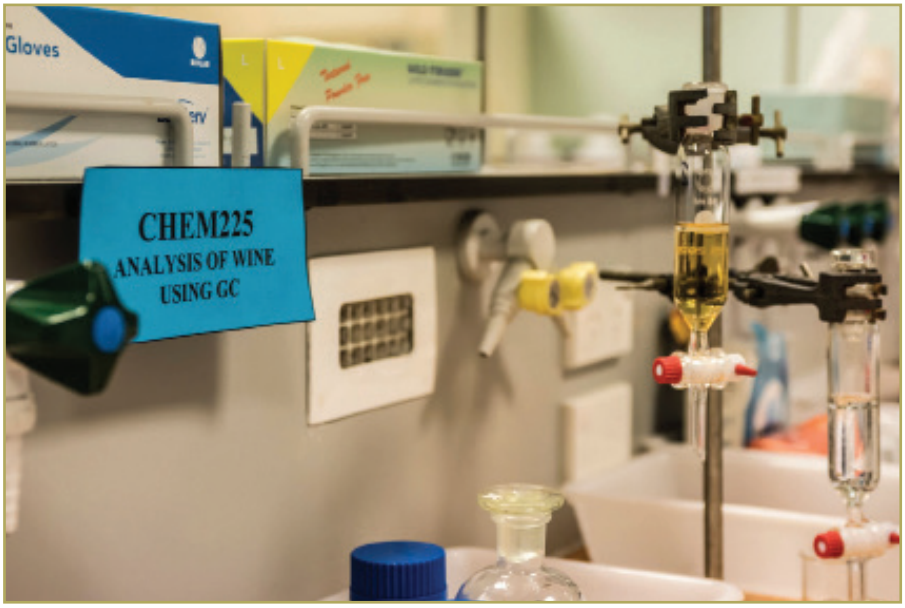
Research organisations that serve specific industries include Building Research Association of New Zealand (BRANZ), CRL Energy, Motu Economic and Public Policy Research and the Titanium Industry Development Association (TiDA). These are largely funded by the industries they serve and employ chemists in research and development, policy and analytical roles.

Large industrial and manufacturing enterprises employ chemists and technicians in various roles, from the research and development of new products and processes, laboratory quality control, to sales and marketing and senior management. Companies such as Carter Holt Harvey and Fletcher Building employ Chemistry graduates.

Fonterra is a multinational dairy company that exports to many countries. Chemists are part of multi-disciplinary teams that research the structural and functional properties of dairy based foods and their ingredients with a particular focus on their commercial applications. Fonterra has a range of opportunities for graduates, including the Fonterra Graduate Technical Progamme for those with scientific degrees and the Fonterra Summer Internship Programme.

LanzaTech is an innovative company in the area

of environmental science developing a process that converts gases containing carbon monoxide into fuel and chemical products. The gases are by-products of industries such as steel manufacturing, oil refining and chemical production, as well as gases generated by gasification of forestry and agricultural residues, landfill waste and coal. Possible roles for Chemistry undergraduates and graduates are in the fermentation, separation and conversion phases of the process depending on the company's requirements at the time. The company may employ undergraduate students for specific projects as laboratory technicians and assistants. Research type roles require chemists with PhDs and experience.



Wine and oil industries. The wine industry is a multi-million dollar export industry for New Zealand. Wine production is a delicate chemical art demanding constant monitoring of enzymatic processes in order to produce recognisable taste qualities according to grape variety and region. Wineries employ laboratory technicians and there are opportunities to progress to winemaker. Qualifications in Viticulture and Oenology are also desirable. The olive and avocado industries produce more than table oil. The lipid (fatty acid) content of both fruits is similar and have applications for the food processing industry, the manufacture of hair and skin treatments and possibly medical uses. All these developments depend on rigorous chemical analysis and an ongoing supply of skilled chemists.

Manufacturing and Sales. Many manufacturing companies, such as Dulux and Resene Paints, have laboratories and employ Chemistry graduates for quality assurance and product development roles. There is enormous demand for chemical analysis from agricultural and food industries and in monitoring the environment. Hill Laboratories and AsureQuality are two of the leading providers of analytical services in New Zealand and employ many Chemistry graduates at various levels in the company. Industry and the larger scientific organisations often demand employees who are qualified in management, as well as a scientific or technical area. If you are interested in positions of this type you may consider doing a postgraduate management qualification.

Nanotechnology is a growing area of research and technology. Companies are applying the developments in New Zealand and overseas for example in sunscreens, self-cleaning glass, water and stain-proof fabrics. Nanoparticles are about 80,000 times thinner than the width of a human hair. Nanotechnology brings together chemistry, physics and mechanical design on a molecular scale. Izon Science employs chemists. The company designs and manufactures precision instrumentation for nano- and micro-scale particle analysis around the world.

Education. There are employment opportunities for educators and trainers in schools, colleges, polytechnics, universities and private training organisations. Chemistry is a key discipline within the education system. For secondary education teachers need a Bachelor's or Honours degree together with a teaching qualification. Permanent positions at university or polytechnics require a PhD and research experience. Some organisations employ people with a scientific background as education officers.

Museums and conservation. Some museums employ science communicators to develop and deliver exhibitions and programmes that promote science in the community. Te Papa Tongarewa, large art galleries, archives and large libraries employ conservators to assess, maintain and repair the collection. Knowledge of chemistry is normally required.

Government requires expert advice to draft policy and provide ministers and parliament with timely and accurate information. Government departments such as the Ministry of Business, Innovation and Employment (MBIE) recruit science graduates, including chemists. Science with Law or Commerce is useful for policy work. The Science and Innovation Group in the Ministry approves funding for research

and development, an essential part of the innovation process. The Group also encourages the science and innovation potential of Mäori knowledge, resources and people.

Patents and intellectual property. Patent work involves assisting clients to secure effective legal protection for their innovations and developments, and advising on intellectual property rights. Intellectual property includes patents, designs, trademarks and copyright. Because inventions often involve an understanding of mechanical, electrical and optical devices as well as chemical compounds and formulations, a qualification in Chemistry or Physics is very useful. You can often enter patent examining work with an undergraduate science degree. The Intellectual Property Office of New Zealand employs Chemistry graduates as patent examiners. To become a patent attorney, a combined Bachelor of Science and Bachelor of Law degree (BSc/LLB) would be the ideal combination.

Media and communications. There is a need in all media for writers, content developers and presenters with a background in science to be able to communicate knowledge in a clear and interesting way to a broad cross section of people. As with the other sciences Chemistry students develop the abilities to quickly learn new development methodologies enabling them to innovate and use emerging technologies and platforms. Journalism/science writing and editing may require further study in this area. Science communication courses can also be helpful for entry to the sector.

JOB TITLES

The following is a sample of job titles taken from our graduate destination surveys. Some roles may require postgraduate qualifications and training.

Analytical chemist • business analyst • content developer • entrepreneur • forensic technician • industrial chemist • instrument technician • laboratory technician • lecturer • management trainee • marketing planner • patent examiner • policy analyst • product development chemist • process chemist • product designer • product evaluator • quality control scientist • research assessor • research assistant • research technician • science communicator • science editor • service technician (software development, science) • teacher • technical officer • technical sales representative • technical writer • toxicologist • trade mark examiner • tutor • web developer.

GRADUATE PROFILES

Brad White

QC Technician
NZ Pharmaceuticals

I came to study after a few years of doing temp work and I was focussed on where I could get the most challenge and learning. I started off majoring in Psychology with Chemistry and Biology courses on the side, but soon decided on the Bachelor in Biomedical Science degree with a Medicinal Chemistry major. Undertaking a second (conjoint) degree with the BSc left me room in my study plan to include as much Chemistry as I could. Chemistry complemented my Psychology study in terms of learning how the chemistry of the brain works but I most enjoyed the challenge of Chemistry, especially Organic Chemistry.

My role is the testing of starting materials, in-process samples, finished products as well as quality control of a supply chain of pharmaceutical products, including their packaging and labelling. I love working in a lab, using both my mind and my hands. The days go so fast! We are crazy busy keeping up with demand, at the tail end of a process. The key pressure is that if we don't test in time everything in the commercial operation is held up, so it is high stakes. However, I have the ability to plan my own days to some extent: the products that need to get out, balanced with other in-process work and equipment calibration.

You may not necessarily need a Chemistry or Biomedical degree to do the work I do, but there are points of difference the degrees have given me. We learned the correct in-lab protocols and practices in our Chemistry labs and these skills are useful right from the outset. I am the Health and Safety representative for my team and Health and Safety is a huge thing in any lab, especially in a commercial production environment. I had also developed the fine motor skills and ability to handle specialist equipment necessary to keep up with a high quality output at pace. It is like following a recipe to some extent, but when things go wrong it is the problem-solving abilities that I had learned in my Chemistry studies that help me work it out for myself. I am developing expertise as the trouble-shooter as I am learning more about driving the software that makes the instruments tick. The learning doesn't stop once you've finished your studies!

Stephen Tat

Policy Advisor
Ministry of Business, Innovation and Employment (MBIE)

I thought I would follow the Economics and Finance path at university as my siblings had, but I really enjoyed Chemistry at high school so I opted for a conjoint commerce and science degree to experience both worlds. It was a lot of hard work doing a conjoint degree, and I found that one of the joys of Chemistry was the informal discussion in labs - it's a really collaborative environment. I chose Honours in Chemistry because of that collegial and stimulating research environment. As I had enjoyed the practical lab aspect at undergraduate level I was most interested in the research opportunity in organic synthesis, making new organic compounds using novel processes.

After my studies I was all set to pursue a PhD and while I was waiting on funding applications, gained an internship at MBIE with their Science and Innovation group. I was then offered a job as part of MBIE's graduate programme. As it turned out I ended up getting a PhD scholarship as well, but I opted to stay with the Ministry, where I have had the opportunity to move around different policy teams, starting with Enterprise Policy and now Business Law. This meant moving from developing policy on how government can support businesses growth, to the regulation of New Zealand's intellectual property and corporate governance systems. What is great about these programmes is that you take the skills you learned in the previous role along with you and build on them.

There are a number of skills that I find I'm using from science research. First, the ability to synthesise; being able to draw on a wide range of sources and make objective inferences from information in order to present an argument in a coherent manner. Then there is work management. At postgraduate level a lot of the work is autonomous and I had to plan my activities well ahead. Chemical synthesis is all about problem-solving. There is continuous improvement that comes from trial and error. That ability to pivot from my approach has been crucial learning from past mistakes and failures. Quite an important skill from experimentation and research is reflection and sharing what's learned and this process is never linear.

Claire Turner

Private Secretary - Tertiary Education
Office of Hon Paul Goldsmith

People don't expect to see someone with a Master's degree in Chemistry being a Private Secretary– I would never have expected it myself! When I was younger, I wanted to become a secondary school teacher, but I wasn't sure which subjects I wanted to teach. So I always kept my subject choices broad. In my first year at Victoria, I chose to study English, Maths and Chemistry so I could go on to study these at degree level as teaching subjects. I found Chemistry to be particularly enjoyable – as well as being let loose in the labs with my peers, which made it different from my other largely lecture-based subjects, there was also a great sense of community and camaraderie within the department.

The point of difference that helped me choose a Master's degree was that it involved a whole year of practical lab research. I loved the freedom of coming up with and answering my own questions, and being able to start a project and see it through to completion. After my Master's, I continued on as a research assistant, but knew I still wanted to start working in education. I saw the Ministry of Education graduate policy programme advertised and, even though I had no idea what policy really involved, I thought - why not give it a go? I felt a bit like a fish out of water, wondering how I fitted among the law, economics, political science and humanities graduates. I soon found out that working in education policy allowed me to use the analytical, problem solving, and team work skills I had learned in my chemistry studies, as well as my passion for education.

I now work in the Beehive as a Private Secretary for the Minister for Tertiary Education, Skills and Employment – who also happens to be the Minister of Science and Innovation! Ministers' offices are fast-paced and fascinating environments. Private Secretaries are right on the interface of public policy and politics and the vital link between senior government officials and Ministers. Two key skills I have found invaluable are quantitative and communication skills. Every day I need to take in and analyse a large amount of complex information, distil it down to the key points and provide it as concise advice for the Minister or other decision-makers.

Kalpani Somarathne

Research Assessor
Royal Society Te Apärangi

After trying out different science disciplines at school, I was most fascinated with Chemistry as it is a central science with a good connection to the other sciences. The underlying rules are clear and there is a logic to it. As someone who was born and raised in Sri Lanka, I also find there is a universal language and culture with Chemistry that connects us all so not only is Chemistry a central science but it is highly portable. I found I was really good at organic chemistry and making new compounds. The aspect of lab work I enjoyed most was setting up and running an experiment using set techniques and then seeing if those techniques were going to work. It's like detective work really, and I enjoyed collaborating with my peers in the labs, discussing, drawing up formulas and coming to solutions.

After completing my PhD and a year as a Research Assistant with a company based at Callaghan Innovation's campus, BDG Synthesis, I moved to my current role as an Assessor. I had had an introduction to this type of work in a summer internship with the Ministry of Business, Innovation and Employment (MBIE), where I was finding referees for research funding applications in various disciplines.

While I missed working in the lab at first, I enjoyed the transition to an office environment. There is more flexibility and it is a different - the lab is actually quite physically and mentally demanding though that can also be exciting. In an advisory or regulatory work environment, we take a broader approach. One of the roles of the Royal Society Te Apärangi is to administer the Marsden Fund on behalf of the government. During that process, I find referees, check conflicts, monitor the funded projects and help to publicise the Marsden Fund.

I still feel as though I am part of the research community and I get to keep up to date with current trends in terms of research and practice. The work is interdisciplinary, meaning we receive a wide variety of research proposals; a mixture of biomedical, physical, organic and physical chemistry as well as social science and humanities research. I find I often have to go outside of my subject 'comfort zone' but I apply the same skills such as problem-solving and communication and knowledge of research methodologies.

David Herman

Patent Executive
FB Rice Patent and Trade Mark Attorneys, Australia

Based on my interests it seemed a natural choice to pursue an undergraduate degree in Biomedical Science as it balanced both Chemistry and Biology into one degree. I realised that Chemistry was academically my strength, and the subject that intrigued me the most, so I kept going and pursued an Honours degree, then a PhD in Chemistry. In my PhD, I investigated new synthetic routes to develop magnetic nanoparticles for cancer therapy and diagnosis, which evolved further into a two-year postdoctoral research position, building on my previous work.

What I enjoyed most about studying Chemistry was the hands-on practical experience in the laboratory. All the theories and fundamental principles you learn in lectures play a part in the experiments you are doing at the bench. From seeing these theories in action, I understood how even the most simple of materials can be manipulated to afford significant changes in their properties and practical applications. It also allowed me to critically analyse complex systems by breaking them down into their fundamental components, a skill that can be applied in nearly every real world scenario.

Chemistry played a significant part in leading me into my current career in Intellectual Property (IP) Law, where I am a Patent Executive finishing my training to register as a Trans-Tasman Patent Attorney. Becoming a patent attorney requires a strong scientific education, and many of the top IP firms in Australia usually require a PhD in Chemistry to enter the profession in this particular discipline. While New Zealand IP firms favour candidates with law degrees, Australian firms do not consider it essential. Having another degree in Biomedical Science, however, meant that I could also offer credibility across all aspects of the Life Sciences to the role.

My role involves liaising with clients and foreign attorneys across a range of issues, such as prosecution, opposition, drafting, searching and opinion work. There is a lot of researching, reading and writing (often in a very formal manner), and both require a high level of attention to detail. You also have to be able to switch your attention to different tasks quickly and efficiently. It is a desk job, but I don't ever feel chained to my desk with all the meetings and networking going on, and after 11 years in the lab, having a desk job is still a novelty I enjoy.