

# 15 women changing our world



Research@UNSW

Never Stand Still

## Welcome message

In the latest of our “Change the World” series of Research@UNSW, we profile a selection of our top-performing female researchers whose stellar work is having an impact on challenges critical to the world’s future.

The professors featured are all research leaders, working across disciplines ranging from quantum computing and materials science to international refugee law and mental health. Six are Scientia Professors – a special honour given by the University to researchers considered to be at the very top of their fields.

While each professor has her own story of success, all share a particular trait: they approach their high-stakes research in decidedly creative ways, pushing boundaries, taking risks and tackling problems from a different perspective. For many of these women, the success they have enjoyed comes from being pioneers and forging new fields of academic endeavour.

That these women have risen to such prominence is, in many ways, unsurprising. UNSW has a rich history of innovation and research excellence, as we demonstrated in the first publication in this series – *10 Innovations that changed our world*.

The technologies and projects outlined in that volume laid the foundation for the success of our current generation of researchers.

I hope these success stories inspire a new generation of scholars to pursue their own exciting work and establish rewarding research careers. Watch out for the next publication in this series, which will focus on our rising stars.

Many of the achievements showcased here have been made possible by the support of our industry and government partners, including the Australian Research Council (ARC) and the National Health and Medical Research Council (NHMRC). We highly value collaboration and encourage you to contact us with any questions about the projects profiled here, or about other research underway at UNSW.

For now, please enjoy the latest in our Research@UNSW series: *15 Women changing our world*.



**Professor Les Field AM FAA**  
Vice-President and Deputy Vice-Chancellor (Research)  
UNSW Australia

# Research trailblazers

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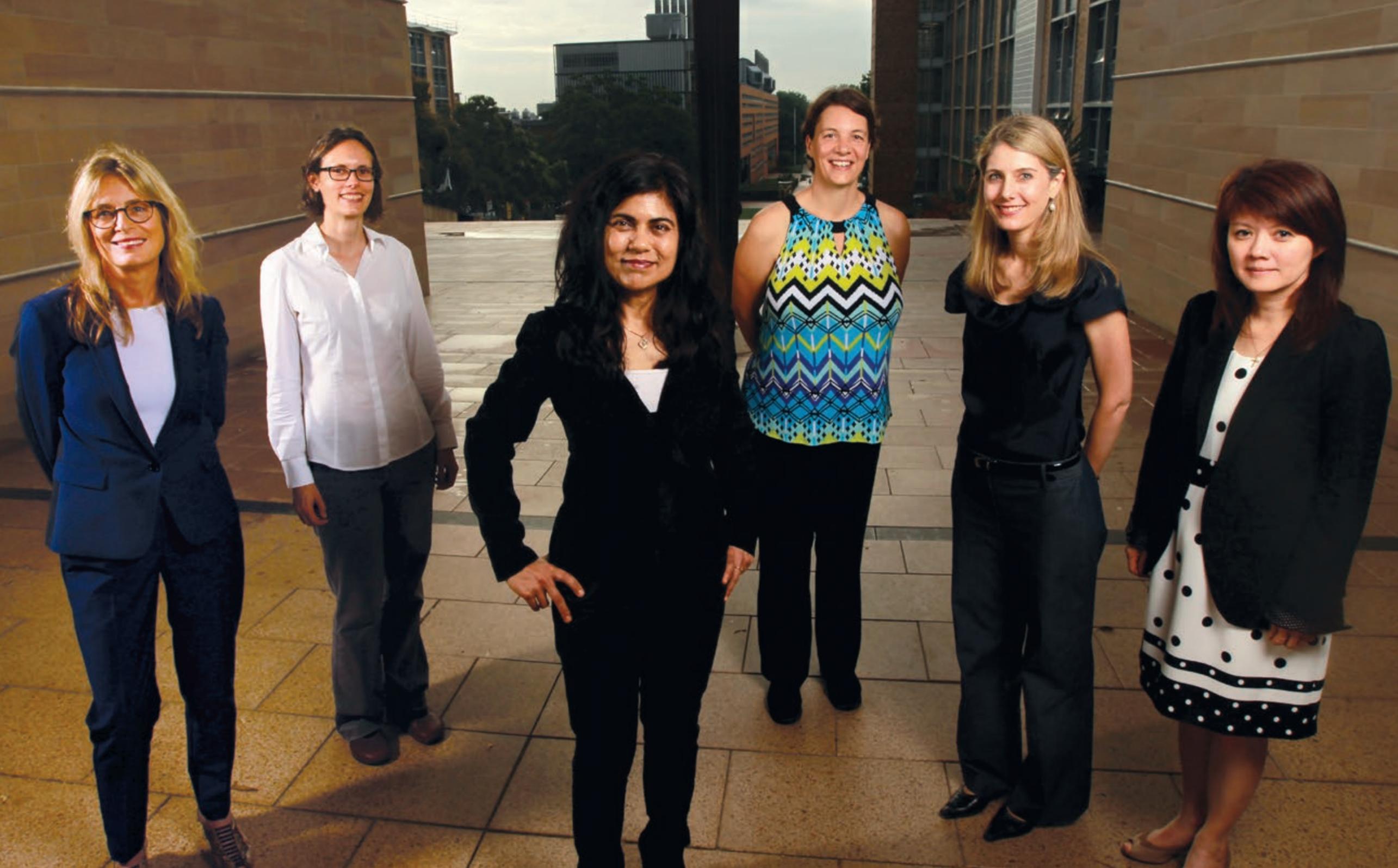
**Celebrating the work  
of 15 female professors  
who are stars in their field**

# Scientia

## Recognising research excellence

The University's Scientia Professors are nominated by their peers and embody UNSW's highest values, including leadership, innovation, creativity, integrity, teamwork and, above all, excellence.

UNSW's female Scientia Professors are: (L-R) Helen Christensen, Katharina Gaus, Veena Sahajwalla, Michelle Simmons, Jane McAdam and Rose Amal.





“If we want to secure Australia’s future prosperity, challenging the stereotype of the scientist as a man in a white lab coat is a good place to start.”

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Scientia Professor Veena Sahajwalla, the leader of UNSW’s Science 50:50 program to inspire girls and women to take up STEM study and careers.

# Rose Amal

The Australian Laureate Fellow is developing a revolutionary way to use water and solar energy to recycle carbon dioxide into environmentally friendly fuels.

**Scientia Professor Rose Amal** calls her planned system for sustainable fuel production “deliberately ambitious”. Using only energy from the sun, she aims to split water to liberate its hydrogen and then to hydrogenate carbon dioxide in a second reaction to create a new generation of commercially viable, renewable fuels.

The implications are enormous. If hydrocarbon fuels could be produced using only environmentally friendly water and sunshine, and at the same time draw out carbon dioxide – a greenhouse gas – from the atmosphere, two critical global issues would be addressed simultaneously.

To achieve this, however, will require extraordinary creativity, innovation and

breakthrough knowledge. Amal – an internationally recognised pioneer and authority in the fields of particle technology, photocatalysis and functional nanomaterials – is embarking on a system-wide approach.

“That means understanding the basic science, developing new materials and engineering the right hybrid system to deliver practical, real-world applications,” she says.

A Fellow of the Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering, Amal is using her ARC Laureate Fellowship to demonstrate the feasibility of this approach. While it’s still early days, she says her team is well on the way to some promising results.

“New ways to convert solar energy into chemical energy would overcome the current limitations of solar power. Fuels could be stored and used when needed, not just when the sun is shining.”

/ [Find out more about Rose’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Eileen Baldry

The leading criminologist is showing that simply locking up ever-greater numbers of our most disadvantaged people won't keep us safe.

**Every year, Australia jails more of its** people, with the number of prisoners increasing by 30% in the 10 years to 2013, according to the Australian Bureau of Statistics.

These incarceration rates might make us feel safer, but at what cost? In 2014, Australian states spent more than \$3.3 billion on their penal systems. And those being locked away continue to be our most disadvantaged. Half of the nation's 30,000 plus prisoners suffer from mental health disorders or cognitive impairment and 27% are Indigenous.

Social scientist Professor Eileen Baldry is investigating how and why otherwise privileged societies like Australia are

criminalising so many of their most vulnerable citizens. The research – using data sets to identify life events and circumstances common to vulnerable people – is identifying opportunities to intervene early to achieve better social outcomes and reduce crime rates.

Her study of 3,000 people in the criminal justice system laid the foundation for advances in policy and research around the world.

In 2009 the Law and Justice Foundation of NSW recognised Baldry's "indefatigable" support for justice-related causes by awarding her its highest honour – the Justice Medal – a noteworthy achievement for someone without a legal background.

**“The Holy Grail is to reduce the number of people with complex needs and disability being needlessly caught up in the revolving door of the criminal justice system.”**

/ [Find out more about Eileen's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Jill Bennett

The founding director of the National Institute for Experimental Arts is pushing the boundaries of her art to help scientists learn how memories are formed and recalled.

**Art that makes a practical contribution** to solving global challenges? It might seem like a big claim, but experimental arts professor Jill Bennett is leading an international research project to help alleviate the growing burden of debilitating memory loss.

As our population ages, global dementia rates are expected to triple, affecting some 900,000 Australians and their families by 2050.

Bennett is working with international cognitive and neuropsychologists in a project to investigate whether visual cues can help people retrieve memories that have become inaccessible due to dementia and other forms of clinical amnesia.

At the same time Bennett is developing and testing tools to help reinforce memory.

These include a sophisticated 3D browser – used with an automatic camera – that models a landscape and enables personal photos to be located in a virtual environment, testing the hypothesis that immersing people in a virtual spatial setting improves their memory.

“It might seem like a radical idea, but art has the capacity to use a whole range of aesthetic techniques to investigate how images can be used and so can contribute to the larger scientific enterprise.”

“We don’t have a cure for dementia, but we can equip people with a way of consolidating memories and enhancing memory retrieval.”

/ [Find out more about Jill’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)





“It is incredibly important to have female role models and recognition of women’s achievements. Part of being able to become a successful scientist is to have the confidence to try.”

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Professor Emma Johnston, the inaugural recipient of the Australian Academy of Science’s Nancy Millis Medal for Women in Science.

# Helen Christensen

The Black Dog Institute's chief scientist wants to reduce suicide rates by using the reach of the internet to deliver psychological therapies to people at risk.

**Scientia Professor Helen Christensen**

has long been aware of suicide risk, having led pioneering work in harnessing the power of the internet to deliver effective programs for depression and anxiety.

But it was an unexpected brush with the pain and tragedy of suicide close to her family five years ago that sharpened her research focus.

"I don't want to overstate my own experience, but it gave me insight into how real suicidal thoughts feel, how powerful they are and how they can ambush you."

As head of the NHMRC Centre of Research Excellence in Suicide Prevention she is using this recognition to amplify research into online suicide prevention tools.

With \$15 million in federal funding, Christensen's research teams are running more than 20 projects linking the internet and digital communications to mental health. They have developed five online psychological interventions for depression and anxiety and published more than 400 research papers.

Now Christensen is developing an app that delivers proven psychological therapies to reduce suicidal thoughts. Researchers are also investigating how stigma around suicide moves through online and other social networks, and how Twitter can be used ethically to provide real-time population data around mental health.

"Identifying people at risk can be like looking for a needle in a haystack, so we are using the wide reach of the internet and social media to cast our net as wide as possible."



/ [Find out more about Helen's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)

# Julie Cogin

The director of the Australian Graduate School of Management is discovering what it takes to bring out the best in people at work.

**Managing people in the workplace** is about as complicated as it gets and many of the human resources practices we rely on are based on assumptions, not facts, says Professor Julie Cogin.

Cogin – the first female director of the world-class Australian Graduate School of Management – attracted global media attention with her far-reaching study into the elusive work-life balance. She and her team found that even companies with supportive policies in place could fail.

In the world-first study conducted across 27 countries, Cogin found traditional gender roles, which placed higher expectations of family involvement on women, often persist in workplaces with “high masculine

orientation” in management, regardless of company policy. “Organisational values cascade from the top down to impede employees from using the options available,” she explains.

More rigorous human resources management can help identify factors of success and ensure knowledge is translated into superior outcomes – in profits and non-financial benefits, such as innovation and customer satisfaction.

As a manager herself, Cogin says she is passionate about bringing out the best in people. She recently ranked sixth in the world for Organisational Behaviour teaching within an MBA program.

“The contemporary workplace is almost infinitely complex. We need much more rigorous research into managing our human resources.”



/ [Find out more about Julie's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Megan Davis

The first Aboriginal Australian elected to a United Nations body is leading the push for public law solutions to the nation's most serious and long-standing human rights issue.

“Addressing disadvantage is viewed primarily through the prism of health, welfare and schooling in Australia but it is equally a constitutional issue.”

**Professor Megan Davis has a seemingly overwhelming research agenda.** Her many roles include Australia's representative on the UN Permanent Forum on Indigenous Issues, adviser to UN Women and director of UNSW's Indigenous Law Centre where she oversees evidence-based research to inform policy reform on Indigenous violence, alcohol, housing, land and constitutional law.

Her decade-long public law reform research influenced the Prime Minister's expert panel on recognition of Aboriginal and Torres Strait Islander peoples for meaningful, substantive change.

Making this happen, however, is not so straightforward. The protracted failure to 'close the gap' is because it is primarily about statistical equality, Davis says.

“Australia ignores the challenge of accommodating cultural difference. This is where we are very different from NZ, Canada and the US because they have understood health reforms are inextricably linked to public law reforms. The evidence base is clear.”

Davis' research into violence against Indigenous women has proved globally significant; as UN Rapporteur for an experts group on the topic her work influenced action by UNICEF and UN Women.

This far-reaching agenda has prompted Aboriginal leader Noel Pearson to describe Davis as “a leading Indigenous legal intellectual”. It's a label Davis says she's more than happy to wear if it means driving real change.

[/ Find out more about Megan's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Louisa Degenhardt

The internationally respected illicit drug researcher is revealing the complexities of drug-related harm and ensuring policy makers, clinicians and the community have the right information to save lives.

“In an area as fluid and complicated as illicit drug markets, we need to keep working transparently and carefully to make sure we have reliable information at hand.”

People have very strong opinions about the best policy approaches to drug and alcohol use, but it’s a complicated problem, says Professor Louisa Degenhardt.

“What I am trying to do is ensure we have better quality data available,” she says. Only then can governments, clinicians, service providers and communities begin to estimate the prevalence of drug use and drug-related harm. And by using a similarly rigorous approach to policies and programs, researchers can identify what works and why.

Degenhardt is advising the World Health Organization’s Global Burden of Disease study and other international agencies, from UNAIDS to the UN Office on Drugs and Crime. In Australia, at the National Drug

and Alcohol Research Centre, she is playing a leading role in developing “strategic early warning systems” for illicit drug markets such as heroin and methamphetamine.

The efforts are saving lives. By looking at data for methadone and buprenorphine treatment programs, Degenhardt’s group has established the treatments’ significant role in reducing the risk of death, particularly from drug overdose.

More recently, Degenhardt has expanded her research to pharmaceutical opioids, used largely by older people. “We need to know whether or not these drugs are improving people’s quality of life, and whether people are developing problems with addiction.”

[/ Find out more about Louisa’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



“The opportunities for women in science are vastly different compared to 50 years ago. Women compete at the highest levels and good things happen.”

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Scientia Professor Michelle Simmons, director of the ARC Centre of Excellence for Quantum Computation and Communication Technology.

# Katharina Gaus

By unravelling how our immune systems make life and death decisions, the biomedical researcher is pioneering a new science at the molecular level.

**One of the intractable mysteries of** biomedicine is how our T cells – the ‘frontline soldiers’ we depend on to activate our immune systems – make the critical decisions that determine our health and wellbeing.

Overactive immune systems manifest in conditions such as diabetes, arthritis and Crohn’s disease, while underactive systems fail to protect against pathogens and cancers.

While we know the decision-making process is ‘read out’ across a large signalling network inside a cell, we don’t know how the signals are generated and how this information is processed, says Scientia Professor Katharina Gaus. Consequently, we don’t know exactly what’s going wrong when the immune system underperforms or overreacts.

Instead of looking at this complex system “from the top down”, Gaus and her team at the UNSW Centre for Single Molecule Science, a key node of the European Molecular Biology Laboratory, have forged a radically different approach, and are working from the ground up by trying to understand the rules that govern individual molecules.

Gaus says it’s “a road not travelled at all in terms of scientific discovery”.

Her breakthroughs, reported in *Nature Immunology*, were made possible using a new generation of super-resolution fluorescence microscopes that can capture even a single protein within a living, intact cell. The goal is a new class of drugs that alter the rate at which molecules interact to recalibrate compromised immune function.

“What’s really exciting is that we are at the beginning of a new science. For me, being able to do research at the cutting edge is an absolute privilege.”

/ [Find out more about Katharina’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Emma Johnston

The Australian Academy of Science medallist is working to ensure our vulnerable marine environments stay healthy for generations to come.

**For Professor Emma Johnston,**

Sydney Harbour is her laboratory and her passion. The underwater world brings together her childhood love of the ocean, an early fascination with science and the realisation – during her studies in marine biology – that applied ecology could help protect the marine ecosystems she so values.

The outcome is an exceptional research career, which includes leading the multidisciplinary Sydney Harbour Research Program at the Sydney Institute of Marine Science, where she works with government and industry to better understand the threats to our prized natural harbour, and helps devise sustainable management practices.

Johnston's innovative approach combining ecology and ecotoxicology – how various toxins affect individual species – is showing how different species are becoming more vulnerable as their ocean habitats change.

In parallel, she is bridging the gap between research and practice by raising awareness of the human impacts on marine systems, and by influencing public opinion and policy as an expert adviser and science communicator, presenting *Coast Australia* on Foxtel's History Channel.

In 2014, the Australian Academy of Science recognised Johnston's achievements, by awarding her the inaugural Nancy Millis Medal for Women in Science.

“We need to develop a system of marine estate management that preserves existing biodiversity and the evolutionary potential and integrity of ecosystems as our environment changes.”

/ [Find out more about Emma's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



# Jane McAdam

The World Economic Forum Young Global Leader is finding solutions to one of our most complex humanitarian crises.

**As the director of the Andrew & Renata Kaldor Centre for International Refugee Law, Scientia Professor Jane McAdam** is leading a series of projects investigating the legal issues that affect the fate of the world's 51.4 million displaced people – the highest number since the end of World War II.

At the same time, she is looking ahead to more frequent natural disasters and extreme weather caused by climate change, which could see unprecedented numbers of people on the move.

As an ARC Future Fellow she is examining potential legal responses to climate-related displacement, including the feasibility of the relocation of entire communities.

In all her work, McAdam seeks to show why international law provides a principled, accepted framework for addressing the challenges presented by the growing number of people seeking protection. To do that, rigorous, evidence-based research is needed, she says, which is why the Kaldor Centre fulfils such an important role.

McAdam also serves as non-resident Senior Fellow at the US-based Brookings Institution and has advised the UNHCR and the World Bank. She is also contributing to international efforts, through the Nansen Initiative, to develop a protection agenda for people displaced across borders by natural disasters.

**“The debate is often reduced to slogans and value judgements that characterise asylum seekers as good or bad, lawful or illegal, but this is far too simple when the issue is as complex as humanity itself.”**



/ [Find out more about Jane's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



“It’s a modern-day struggle with ‘plenty’, but it is a struggle we can win. The impacts of junk food are preventable and reversible.”

# Margaret Morris

By revealing the impact of junk food on our brains, the medical biochemist is helping to tackle the world’s worsening obesity epidemic.

**Professor Margaret Morris feeds her lab rats the cheapest processed food money can buy. In doing so she’s showing how junk food changes the brain’s chemistry, affecting behaviour, health and wellbeing.**

In research published in *Nature* in 2010, Morris showed the role of diet is so profound that when male rats are fed high-fat foods to induce obesity and glucose intolerance, their female offspring exhibit similar glucose intolerance and impaired insulin secretion as adults. This finding offered new insight into the science of epigenetics.

More recently, Morris’ team in the Environmental Determinants of Obesity group demonstrated that eating junk food inhibits interest in healthy

food and overrides the mechanisms that normally protect against overeating. They also found that just one week on a poor diet impairs memory.

Understanding how and why these changes take place is the key to informing new approaches to managing and reversing the major diseases associated with diet. Of particular interest is the communication between brain, liver, muscle and fat.

“Our studies show even moderate exercise is effective as an intervention and can lead to significant improvements that would reduce our dependency on medication and make an enormous difference to our health and the national health budget,” Morris says.

[/ Find out more about Margaret’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)

# Veena Sahajwalla

The Australian Laureate Fellow is creating a new industrial revolution, transforming rubbish into commercially viable 'green' materials.

**Scientia Professor Veena Sahajwalla**

is using high-temperature reactions to transform some of the world's most problematic and toxic wastes into viable new 'green' materials.

The head of UNSW's Centre for Sustainable Materials and Research Technology (SMaRT @UNSW) also leads an \$8.8 million ARC green manufacturing research hub that directs waste back into industrial production. Automotive cast-offs are transformed into metal alloys, agricultural waste is integrated into ferrous processing, and throwaway plastics become new ceramics. The 'modern-day alchemist' is also devising cost-effective solutions for e-waste – the world's fastest-growing waste stream.

The materials scientist and engineer's initial breakthrough came a decade ago when she

began investigating carbon reactions at high temperatures, leading to her famous 'green steel', which is now in production around the world. The process dramatically reduces coke consumption, cuts electricity use and absorbs millions of waste tyres.

By considering waste in terms of its elements, and investigating how to recombine them at high temperatures, Sahajwalla's approach opens up enormous possibilities for creating value-added materials.

It's not quite alchemy, as understood in the Middle Ages, but Sahajwalla is succeeding in transforming rubbish into valuable resources. That, she says, amounts to a manufacturing revolution and is "just as satisfying".

**"We've had success with green steel-making, and we can do so much more through green manufacturing. There are so many opportunities."**

/ [Find out more about Veena's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)





“It’s a tremendous privilege to be able to influence legislative reforms and shape policy at the national and international levels. Our work offers enormous opportunities to make a difference.”

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Scientia Professor Jane McAdam, World Economic Forum Young Global Leader and founding director of the Andrew & Renata Kaldor Centre for International Refugee Law.



# Michelle Simmons

So impressive is her work to build the world's first quantum computer, the Australian Laureate Fellow has been honoured alongside Albert Einstein and Stephen Hawking.

**“We are on the road to building a functional quantum computer and it’s hugely exciting. Where will it take us? We don’t know yet, but there’s a massive international race to get there.”**

**Scientia Professor Michelle Simmons** believes the future of computing lies in an entirely new system built with single atom engineering. Just one of these next-generation quantum computers will likely exceed the combined power of all the computers now on Earth.

But in order to get there, we need to create the building blocks of these futuristic computers. Simmons and her team at the UNSW-based ARC Centre of Excellence for Quantum Computation and Communication Technology are creating these components – or quantum bits – in silicon.

In 2012, Simmons’ team created the world’s smallest single atom transistor,

a feat achieved a decade ahead of industry predictions. They also fabricated the world’s thinnest conducting wires, 1,000 times narrower than a human hair. The breakthroughs were published in *Nature Nanotechnology* and in *Science* respectively.

Just as significant was the team’s 2014 success to transfer individual electron spins from one dot to another placed just 10 nanometres apart – the basis of a future quantum integrated circuit.

This extraordinary progress saw Simmons recently elected to the American Academy of Arts and Sciences, alongside the likes of Albert Einstein, Stephen Hawking and Alexander Graham Bell.

[/ Find out more about Michelle’s work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)

# Martina Stenzel

By developing 'smart' nanoparticles to deliver powerful anti-cancer drugs, the polymer scientist is revolutionising the way we target and treat disease.

**At UNSW's Centre for Advanced Macromolecular Design**, Professor Martina Stenzel leads a research team building a range of remarkable polymer nanoparticles, precisely engineered to distinguish between cancer cells and healthy tissue.

By identifying and attaching to cancer cells, these nanoparticles – with diameters more than 1,000 times smaller than the point of a needle – show promise as new, non-toxic drug delivery systems that could overcome the debilitating effects of conventional cancer treatments.

The group's polymer nanoparticles are loaded with the right 'key' – often something

as simple as a sugar molecule – to latch onto the cancer cell's receptors. Delivered into the bloodstream, the nanoparticles remain intact, only releasing their pharmaceutical load once they reach their target.

"I have always been interested in the medical aspects of polymer science, so making the jump to drug delivery systems is very exciting," says Stenzel, who is acknowledged as the leading expert in the synthesis of novel polymer architecture.

Stenzel's research has been recognised with two major accolades: Le Fèvre Memorial Prize from the Australian Academy of Science and a NSW Science and Engineering Award.

**"Polymers are usually associated with household and industrial plastics, but they can be particularly useful in medicine because they respond well to environmental signals like heat, light and pH levels."**



/ [Find out more about Martina's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)

# Carla Treloar

By better understanding the thousands of people infected each year with hepatitis C, the deputy director of the Centre for Social Research in Health is working to combat the disease's devastating effects.

**Biomedicine has found a cure for hepatitis C**, yet combating the debilitating and potentially deadly virus that causes liver damage and cancer will take a lot more than hard science.

Despite readily available treatment and knowledge about prevention, more than 5,000 people are newly infected in Australia every year, and some 220,000 are living with the disease.

Professor Carla Treloar's cross-disciplinary approach – at the intersection of healthcare delivery and individual psychology – is revealing why the disease continues to impose such a burden.

Put simply, knowledge about the risks of hepatitis C is dangerously low and complex social barriers still exist that prevent people from seeking treatment.

Treloar says she hears two words frequently in her research – “stigma” and “trust”. Stigma because injecting drug use is the main way hepatitis C is transmitted, and trust because many people report blatant discrimination – and the distressing breakdown of the patient/caregiver relationship – when they reveal their infection status. Consequently, many people only seek treatment long after they have been infected and, potentially, have passed on the virus to others.

“Across all risk groups, prevention and treatment can only be effective with a deep understanding of the individuals involved.”

/ [Find out more about Carla's work and other important UNSW research at 15trailblazers.unsw.edu.au](https://15trailblazers.unsw.edu.au)



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