

Top 250 Australian researchers > Entrepreneurial grads > Unis mix it with business

THE AUSTRALIAN

RESEARCH 2023



Climate
Change

Medical

Disability and
Rehabilitation

Technology

Food and

Agriculture

Media Technology

Healthy

Ageing

Cybersecurity

Renewable
Energy



Quantum
Technology

Indigenous Research

Ten tough challenges

Are universities ready?

P13-17

UniSQ Research: Regional presence, international impact.

Quality research outcomes, competitive funding success and strong international collaborators. The **University of Southern Queensland** is a regional university delivering world-changing results.

Leading Australia in a universal quest

Of the thousands of planetary systems discovered to date, our Solar System is exceptional. The Solar System hosts a diverse set of planets ranging from gas giants to rocky celestial bodies. UniSQ Research Fellow Dr Chelsea Huang has received a Discovery Early Career Researcher Award from the Australian Research Council for her research, which is advancing our understanding of the Solar System.

UniSQ's Mount Kent Astronomical Observatory is providing the key support role from the Southern Hemisphere for NASA's Transiting Exoplanet Survey Satellite (TESS) mission, which uses transit photometry to detect exoplanets near our Solar System. Dr Huang's project makes use of cutting-edge technologies and images of the sky from NASA's TESS Space Telescope, providing access to an array of interesting planetary candidates that is giving the project an Australian advantage amongst this global effort.

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Thermal insulation is essential to energy efficiency in modern buildings, however most traditional materials are made from highly flammable polymer foams.

UniSQ researcher, Professor Pingan Song is an expert in the development of flame retardants and fire protection materials and has received an Australian Research Council Future Fellowship to develop fire-retardant thermal insulation foams for safer buildings. Strong international collaboration with universities across the world is backing this potentially life-saving technology.

UniSQ is ranked
in the 301-350
band in the Times
Higher Education
World Rankings.



Foreword



Australian researchers are some of the world's best. Brilliant researchers doing cutting edge research that saves and changes lives. In August, I announced a review of the Australian Research Council. It's the first independent review of the ARC in 20 years.

That review is being led by Professor Margaret Sheil AO, vice-chancellor of the Queensland University of Technology. It also includes Professor Mark Hutchinson from the University of Adelaide and Professor Susan Dodds from La Trobe University.

They will report to me by the end of March next year.

I have also issued a new Letter of Expectations to the ARC. I know the way the national interest test has been operating has been causing problems. I think we need a national interest test, but I think we can make it clearer and simpler.

I think we also need to take the

politics out of research. When grants are delayed or rejected because the minister doesn't like the title page, it's harder to recruit and retain staff and it undermines confidence in our research system.

That's why I have said we need to make sure all future grant rounds are delivered on time, to a predetermined time frame.

Research will also form an important part of the Universities Accord. This will be a broad ranging review of higher education and an opportunity to build together a long-term plan for our universities.

Research done today helps build the country we will live and work in, in the next decade and the one after that. That's why what we do here matters.

It won't always work out or take us to where we expect, but it's big ideas and the research you do that will change the world and I thank you for it.

Jason Clare
Federal Education Minister

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Institution abbreviations

Australian Catholic University **ACU**
Australian National University **ANU**
Australian Nuclear Science and Technology Organisation **ANSTO**
Baker Heart and Diabetes Institute **Baker**
Central Queensland University **CQUniversity**
Charles Darwin University **CDU**
Charles Sturt University **CSU**
Commonwealth Scientific and Industrial Research Organisation **CSIRO**
Edith Cowan University **ECU**
QIMR Berghofer Medical Research Institute **QIMR Berghofer**
James Cook University **JCU**

Queensland University of Technology **QUT**
RMIT University **RMIT**
Royal Botanic Gardens Victoria **RBGV**
Royal Children's Hospital Melbourne **RCH Melbourne**
Southern Cross University **SCU**
University of Melbourne **Uni of Melb**
University of South Australia **UniSA**
University of Technology Sydney **UTS**
University of Queensland **UQ**
University of Western Australia **UWA**
University of Southern Queensland **UnisoQ**
University of the Sunshine Coast **USC**
Western Sydney University **Western**

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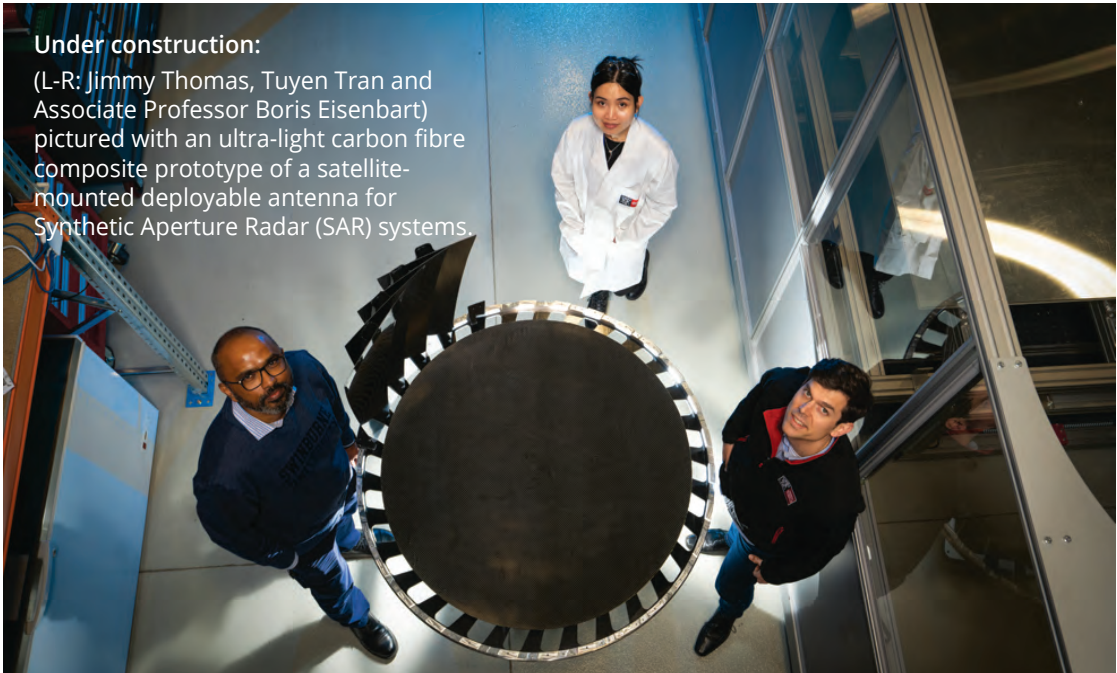
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Under construction:
(L-R: Jimmy Thomas, Tuyen Tran and Associate Professor Boris Eisenbart) pictured with an ultra-light carbon fibre composite prototype of a satellite-mounted deployable antenna for Synthetic Aperture Radar (SAR) systems.

Next gen technologies for Earth and beyond

We are applying novel materials with bespoke design to deliver cutting-edge solutions on Earth and in space.

Swinburne’s Space Technology and Industry Institute is combining our globally renowned capabilities in astrophysics, aerospace, aviation, advanced manufacturing, and artificial intelligence to produce innovative solutions for communities and industry.

We have access to state-of-the-art facilities such as the Swinburne-CSIRO National Industry 4.0 Testlab for Composite Additive Manufacturing and our very own Swinburne Supercomputing OzSTAR facility.

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From bushfire prevention research using artificial intelligence and satellite imagery to surface coatings, satellite components and helping mining companies create environmentally safer dams, we are paving the way for next generation technologies to have real-world applications on Earth and in space.

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FLINDERS RESEARCH

climbs even higher

Flinders University researchers have reached new heights with their unwavering dedication to achieving research excellence.

In recent years, we have more strongly emphasised research that makes a difference, particularly through engagement with key external research partners and stakeholders.

Our external research income has jumped 50% from two years ago and an incredible 70% from four years ago. In 2022 we are expecting this trajectory to continue.

Our outstanding achievements are a strong indication of the ambition that drives our discoveries, which we translate into practice to make a positive difference to people's lives.

Be it investigating better ways of providing renewable energy now and into the future or using paleontological and archaeological research to better understand what the past can tell us about our future, Flinders University researchers will be instrumental in finding the solutions to our most pressing priorities. Big issues need Fearless Research.

Read more
[Flinders.edu.au/fearless-research](https://flinders.edu.au/fearless-research)



RESEARCH HIGHLIGHTS 2021/22



External research income jumped 50% from two years ago and 70% from four years ago



Flinders ranked seventh in the country for National Health and Medical Research Council grants won by a university in 2021



Ranked 266 in the world (THE World University Rankings 2022)



\$34 million federal Department of Health contract



Construction began on the \$255 million Health and Medical Research Building



Launched our new \$2.5 million photo emission electron microscope



The nous that we need

Delving deep to find the best

The Australian and its partner, League of Scholars, analyse key data to identify the nation’s best research

This is “the moment” for Australian research. First came the pandemic, which focused attention on our national research capacity as federal, state and territory governments sought the best way through the crisis. Then came the rapid worsening in the geopolitical outlook as Russia invaded Ukraine and tensions in our region also increased.

Now more than ever Australia needs to strengthen its sovereign research and development capacity and fully harness the capacity of universities and other research institutions’ national benefit. We need to tackle the new problems stemming from the pandemic and international uncertainty, as well as the deep challenges we have been facing for many years such as environmental sustainability, and health and wellbeing in the community.

With this in mind, the 2023 Research magazine introduces a new feature. We name what we believe are the top 10 key research challenges that are critical for Australia’s economic development, future security and community wellbeing. In each of the 10 challenge areas we apply quantitative analysis to identify the five top universities or other research institutions in Australia which are best placed to make progress in each area.

Some of the 10 are “big picture” challenges we must meet to ensure a sustainable future, such as renewable energy, climate change, and food and agriculture. Others have clear community benefit such as Indigenous research, disability and rehabilitation, and healthy ageing. Technology challenges also feature, including quantum technology and cybersecurity, both of which cross over into national security. And some are particularly focused on new and growing industry opportunities for Australia, such as medical technology and devices, and media technology.

This new feature is in addition to the regular annual listing of the top researcher and top research institution in 250 different fields of research over eight different disciplines, which still lies at the heart of the Research magazine.

This fine-grained examination of the



Australia is relying on research expertise to speed the transition from carbon to renewable energy

research landscape, now in its fifth year, is a showcase for Australian excellence.

As in past years, we take a data driven approach analysing Australian research using the resources and expertise of our partner, the talent discovery and research analytics firm League of Scholars. The firm has assembled, and keeps up to date, a vast global database of researchers and of research that is published in refereed journals. Their data covers over 77,000 Australian researchers. This information is the basis for the lists in this magazine and the methodology we use to analyse it is explained on the opposite page.

Another current challenge for universities is to create the right environment for entrepreneurship to thrive. In the magazine we identify the 10 universities whose graduates have been most successful in founding start-ups that have reached the key milestone of winning venture capital funding.

We have also taken a close look at another

pressing issue for universities – the degree to which they successfully collaborate with business in research. We use data on research papers jointly published by academic and industry authors to examine the degree of collaboration, and find that international companies do more than Australian ones.

And we also bring you stories about some of our top researchers which offer insights into what drives them forward, why their work is important and the impact it has in the community.

We hope you will enjoy, and find useful, this deep dive into the data on Australian research.

Tim Dodd
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Research Awards are a mark of excellence

For five years The Australian has published a unique annual list which identifies the best researcher and best research institution in each of 250 fields of research. We use it to shine a light on the achievements of Australia’s researchers. Many of them, even though they are acclaimed in their field, rarely see their work gain the public recognition it deserves.

We are proud to present the list again in this magazine to honour the talent and diligence of Australian researchers whose work often has extraordinary impacts in the broader community.

This year we have gone a step further and also honour the top five universities or other research institutions that are making notable achievements in ten key research challenge areas of national importance.

The Australian’s Research Awards have been structured to recognise individual researchers in the top 250 list, as well as universities and institutions that are named in the list. They also recognise institutions which achieve in research challenge areas or as a top entrepreneurial university.

Research Award seals are available to

give immediate recognition to award winners and they can be used in email, on websites, in other documentation and for advertising and promotion. If you would like to know more about the opportunity to use Research Award seals and explore other benefits which are available please contact simon.banks@news.com.au



How our methodology finds the best

We take a data-driven approach to examine the fine-grained detail of Australian scholarly research, sifting the huge volume of quality information which is available online.

To harvest and analyse the data we partner with talent discovery and research analytics firm League of Scholars whose co-founders, Paul McCarthy and Rasika Amarasiri, are leaders in the field of using publicly accessible online information to assemble large information databases about published research.

Most of the data is drawn from Google Scholar and we largely follow its taxonomy in determining the 250 fields of research which we analyse.

Here is the methodology we’ve used to determine the top researcher and top university or research institution in each of the 250 fields.

Top researcher: The leading Australian researcher in a field is the individual whose papers published in the top 20 journals in that field (determined by the H-index of journals) over the past five years have had the most citations by other researchers. This is a measure which filters for both quality and impact.

Top institution: The leading institution in a field is found by summing the citations of all papers published in the top 20 journals in that particular field by researchers affiliated with each institution. The institution with the most citations is the leader in that field.

Ten research challenges: We use machine learning to establish a network of granular

research topics linked to each challenge area and then search for researchers who have listed that topic as one of their top areas of expertise in Google Scholar. We then count the cumulative five-year citations of these authors by their institutional affiliations to identify which universities and research organisations have had the most impact on that theme (see pages 13-17).

Entrepreneurial universities: Using data from Crunchbase we examine the companies founded globally in the past decade which attracted venture capital and count the number of founders who attended Australian universities. The count for each university is normalised by the number of graduates from the university over the past decade (see page 10).

University business collaboration: From the university side, collaboration is measured by the number of current researchers at a university who have co-authored a paper over their career with a researcher affiliated with a company (see graph on page 20). From the business side, collaboration is measured by the papers written by researchers affiliated with companies that are co-authored with researchers in Australian universities (see graphs on page 21).

The H-index of a researcher or a journal is the highest number H, such that a given researcher or journal has published H papers which have each been cited as least H times. So, for example, if a researcher has published 50 papers which each have at least 50 citations, but does not have 51 papers which have each been cited 51 times, then their H-index is 50.



Paul McCarthy



Rasika Amarasiri

Institutions with the X-factor

Our top entrepreneurial universities

These Australian universities are the best at producing successful entrepreneurs. We rate them by the number of venture capital funded start-ups founded by their graduates, adjusted for size of university



As Australian universities direct their focus to supporting innovation and creating the right environment for start-up companies to thrive, it's important to check how successful they are in this endeavour. Two universities – UNSW and Bond – stand well ahead of their peers on one measure of innovation, the proportion of successful entrepreneurs among their graduates in the past decade.

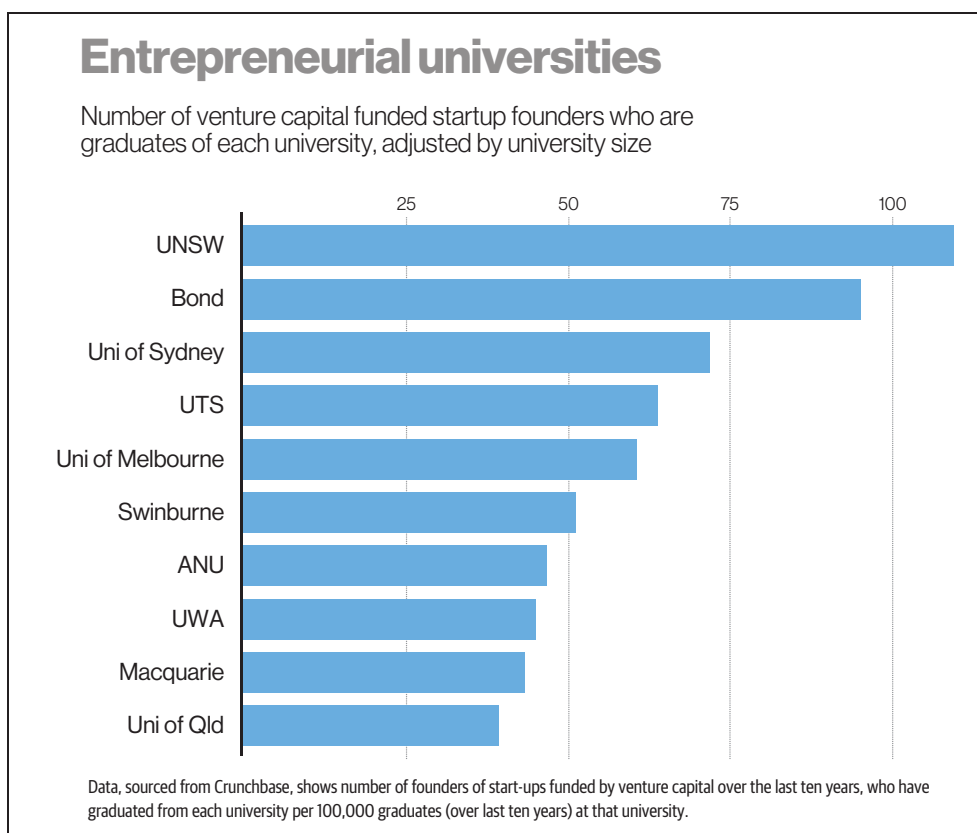
In other words, we are comparing universities by looking at their record of success in generating the next crop of start-up founders.

To compare universities on an equivalent basis, our partner League of Scholars used Crunchbase data to count the number of each university's graduates who have founded a start-up that has passed one key milestone of success – attracting venture capital funding. And, in the interests of fair comparison, the number of founders in each university is adjusted for the number of that university's graduates.

By the normalised measure, UNSW is the clear winner, with 105 VC funded founders per 100,000 graduates over the past 10 years. UNSW, which has made a major effort in recent years to boost the start-up community in the university, also has the highest raw number of graduate founders who have attracted VC funding – 143 in the past decade. UNSW is, of course, where Atlassian founders Mike Cannon-Brookes and Scott Farquhar graduated, and it has a strong culture of entrepreneurialism.

More recently UNSW's notable founders include brothers Aengus Tran, a UNSW medical graduate, and Dimitry Tran, a UNSW executive MBA graduate, who founded Harrison.ai, a start-up which uses artificial intelligence to interpret medical scans.

Another UNSW founder is Kim Kaplan, who returned to Canada after completing her masters in international business and



founded Snack, a video-driven dating app.

Bond University does nearly as well as UNSW, with 97 VC funded founders per 100,000, but from a very different base. It has had only 18 VC funded start-up founders over the past decade, but the much smaller size of the university means that it does nearly as well as UNSW when weighted by numbers of graduates.

Bond start-up founders include Julius Salerno, a Bond law graduate who founded Bellami Hair, a successful US-based firm offering hair extension solutions.

The next three universities after UNSW and

Bond are the University of Sydney, UTS, and the University of Melbourne – all institutions where entrepreneurialism is well embedded.

Sydney (with 111 founders) and Melbourne (with 121 founders) have had large numbers of successful start-up founders over the past decade, but their adjusted number is reduced because of both universities' large size.

They are followed by two smaller universities – Swinburne and the Australian National University – which each have a strong entrepreneurial and innovation culture and encourage commercialisation of research.

Tim Dodd

Supporting great science and industry partnerships

We're working with universities, industry and government to build new industries for Australia such as hydrogen.



We're also delivering programs to build the capability of Australia's researchers and SMEs to unlock industry collaboration and deliver solutions from science.

With strong and established relationships across the research community, CSIRO is uniquely positioned to help Australia innovate.

Let's connect.

csiro.au/InnovationCatalyst

Australia's National Science Agency



2032 Brisbane Olympics is an opportunity to shine



Griffith University Vice-Chancellor Carolyn Evans

For an event that lasts just a few short weeks, the Olympic and Paralympic Games have a significant and enduring legacy. The Australian tertiary education sector – and Griffith University in particular – has a unique opportunity to influence this legacy to create a brighter future for all.

Events such as the Games are, above all, a once-in-a-lifetime opportunity to benefit future generations. We learnt this first-hand as an official partner of the Gold Coast 2018 Commonwealth Games. Our partnership with the 2018 Games set a benchmark for the legacy opportunities made possible through a global sporting event.

The partnership was the first time a university had engaged so deeply with a major event of this scale. Through it, we were able to offer more than 1000 Griffith students unparalleled opportunities with both the organising committee and its many partners working to make the Games happen. In return, they gained practical experience working on Australia's biggest sporting event in a decade.

Beyond these unique student and engagement opportunities, the knowledge we gained through the Gold Coast Games has helped Griffith better understand and establish a best-practice method of working with partners.

We have leveraged our experience into burgeoning relationships with industry leaders such as Gilmour Space Technology and supply transparency company Everledger, among others.

We have also seen multiple legacy projects arise from our partnership with the Games and go on to have local,

national and even global impact.

One such project is Professor Michael Good's ongoing research into malaria vaccines through our Institute for Glycomics – an official legacy project of the Games. Nearly half of the world's population lives in malaria-endemic areas worldwide – many of them in Commonwealth countries.

Four years after the Games, Professor Good and Dr Danielle Stanisic are now commencing phase 1 clinical trials for a vaccine that can be freeze-dried for easy transportation to malaria-endemic countries.

The 2018 Games facilitated the growth of the Gold Coast Health and Knowledge Precinct, home to Griffith's Advanced Design and Prototype Technology (ADaPT) Institute. Drawing on our capabilities in health, 3D design and material sciences, ADaPT has used 3D-printed biological engineering constructs to help drive research into tissue engineering and regenerative medicine.

Also, within the Institute the Griffith Centre of Biomedical and Rehabilitation Engineering (GCORE) is developing miniaturised wearable sensors that quantify and interpret human movement.

Alongside this advancement, the development of our Digital Athlete – a 3D model that captures an individual's anatomy to allow athletes and coaches to design highly personalised training programs and more – is also pushing the boundaries of injury prevention and rehabilitation.

Our research into the cultural value of elite and community sport alike represents another vital area of investigation. As a leader in multidisciplinary research dedicated to advancing gender equity in

sport, our commitment to a more equal sporting landscape is augmented by the GAPS (Gather Adjust Prepare Sustain) program.

This initiative offers emerging Pacific athletes and para-athletes and their coaches access to the same skills, knowledge, and resources that benefit our own athletes. The program, and others with a similar community focus, promotes positive social change in sport and in disadvantaged communities beyond our borders.

These are just a handful of the legacy impacts our partnership with the Commonwealth Games yielded in the few years since the event. As we look ahead to the 2032 Olympic Games, universities must think about how they can accelerate critical social change, buoyed by the event's explicit focus on advancing human rights, climate action, diversity and inclusion. Griffith is already leading the way in many of these fields through our extensive industry collaborations and key research programs.

The projected social and economic benefit of the 2032 Games is estimated to be up to \$8.1bn for Queensland and \$17.6bn for Australia – but through collaboration between industry, government and researchers, the longer-term benefits can be much greater.

Together, we must do our part to ensure that long after that great enduring symbol of the competitive spirit – the Olympic flame – is extinguished at the closing ceremony, the legacy of the 2032 Brisbane Olympic Games burns brightly for decades.

Carolyn Evans
Vice-Chancellor, Griffith University

Australia's got talent!

Unis which can solve our national challenges

Problems abound in many areas and we identify the universities and research institutions that are ready to help us solve them



No question is more important for Australia's research community than where our nation's research resources should be directed. Because in these straitened times, with governments running large budget deficits, research funding is limited. At the same time, demand for quality research – particularly in fields which have rapid applied impact – is high and getting higher. There are a range of problems which have come together in a perfect storm. There is climate change and the need for an accelerated shift to sustainable energy. There is geopolitical uncertainty, concerns about national security, and growing political and economic divides. There are also ageing populations and numerous global health issues, including the pandemic.

Thinking about these challenges led us to construct a list of ten major research challenges for Australia. And we decided to analyse how well prepared our universities, and other research institutions such as the CSIRO, are to find useful solutions to these challenges

We took a data-driven approach to the problem. The Australian's partner, League of Scholars, used machine learning techniques to create a comprehensive set of research topics for each of the ten challenge areas. Using these lists of topics they looked for all the Australian researchers who had a self-identified research interest in a topic that is part of each challenge, and which university or institution they worked for. Finally, they counted citations to papers published in peer-reviewed journals by these authors over the past five years to identify the five universities, or other institutions, which have made the most contribution.

Of course this is not the only way to gauge how well institutions measure up to research challenges. But it is an objective method based on each institution's research capacity and research record. The ten challenge areas are:

- Renewable energy
- Climate change
- Quantum technology
- Food and agriculture
- Healthy ageing
- Disability and rehabilitation



- Indigenous research
- Cybersecurity
- Medical technology and devices
- Media technology

Clearly there are many other areas of research importance but these ten were chosen to reflect the breadth and depth of the issues Australia is facing in the 2020s. We included areas of red alert (renewable energy, climate change, cybersecurity), business opportunities (food and agriculture, medical tech, media tech), a new technology (quantum), and important wellbeing areas (healthy ageing, disability and rehabilitation).

Each research theme has been chosen because it requires experts from a wide variety of topics, fields and in many cases entirely different disciplines. For example, medical technology and devices needs expertise in advanced manufacturing, materials science and electronic engineering as well as medicine and surgery. And media technology spans expertise across many different domains including animation and 3D modelling, music, gaming, and digital video.

We included indigenous research even though it is quite different to the other nine challenges. The issues in indigenous research are to give it adequate resources, to give agency to indigenous researchers and research participants, and to recognise a First Nations perspective in other research areas.

In narrowing down the list we deliberately focused on multidisciplinary research areas even though this led to a decision to leave out a crucial area of applied research – artificial intelligence – which is covered in our separate analysis of 250 research fields. Another area of importance which we intentionally omitted is nuclear engineering. If Australia goes ahead with the plan to build and deploy nuclear submarines, then research in this area will be critical. We left it out because we currently have very little capacity in this area in Australia; so little that it's hard to measure. It needs to be rapidly expanded and that is a problem in itself.

Tim Dodd

Find out which universities and research groups are best equipped for these challenges - next four pages

Ten top challenges

Crucial research
for Australia

Climate Change

THE TOP FIVE

1. University of Melbourne
2. CSIRO
3. University of Queensland
4. UNSW
5. University of Adelaide

Climate change is the ultimate 'wicked problem'. It is extremely complex scientifically and has a web of interrelated consequences for people of all countries. These include sea level rise, new weather patterns, impacts on agriculture and food production, and changing environmental conditions which affect all living species.

These four universities, and the CSIRO, are leading Australia's



research response to climate change, increasing the world's knowledge of how to minimise it, helping to gauge its impact and developing strategies to deal with it.

For example the CSIRO, with universities and the Bureau of Meteorology, developed the ACCESS earth system model for weather and climate change forecasts.

The University of Queensland, at its Global Change Institute, is working with industry and government toward the goal of zero carbon emissions from agriculture. UNSW, at its Climate Change Research Centre, carries out critical research as well as educating the public about the risks and consequences of climate change.

Renewable Energy



Australia has broad and deep expertise in renewable energy, ranging from solar and wind power, to battery research, to hydrogen and biofuels.

For example UNSW physicist Martin Green, who is one of this year's top 250 researchers in the field of sustainable energy, was one of the pioneers in developing efficient photovoltaic cells.

The four universities and the CSIRO, whom we name as current leaders in this area, cover a wide range of expertise.

While photovoltaics is UNSW's flagship research program in renewable energy, its Energy Institute's work also encompasses hydrogen, electricity grid transformation and energy storage. We ask big questions and seek to achieve tangible long-term impact, the institute says.

The UTS Institute for Sustainable Futures has developed a realistic roadmap for a shift to renewable energy that will keep global warming to under the critical 1.5 degree threshold without resorting to costly and unproven technologies.

The ANU's Institute for Climate, Energy and Disaster Solutions has

THE TOP FIVE

1. UNSW
2. Australian National University
3. University of Technology Sydney
4. CSIRO
4. University of Sydney

a focus on energy transition to renewables and, as well as the science side, also researches energy economics, regulation, security, sociology and policy – areas that must be addressed to successfully introduce new energy sources while minimising social impacts.

The CSIRO tackles sustainable energy research including low emissions technology, energy efficiency, large scale use of hydrogen, carbon dioxide capture and storage, solar thermal systems, photovoltaic energy and wind power.

The University of Sydney's Centre for Sustainable Energy Development has a major research program in battery storage, and carries out modelling and simulations of sustainable energy systems.

Healthy Ageing

THE TOP FIVE

1. University of Sydney
2. Garvan Institute
3. University of Newcastle
4. Monash University
5. University of Western Australia

As the demographic hump of Baby Boomers move into retirement and their senior years, a whole new set of healthcare, community and social impact measures are coming into being, underpinned by research into how our society can best deal with larger numbers of older people.

These four universities, and the



Garvan Institute of Medical Research, are leaders in this area. For example, researcher Jacqueline Center at Garvan leads their program in overcoming skeletal disease, which has a strong focus on osteoporosis and developing personalised approaches to its clinical management.

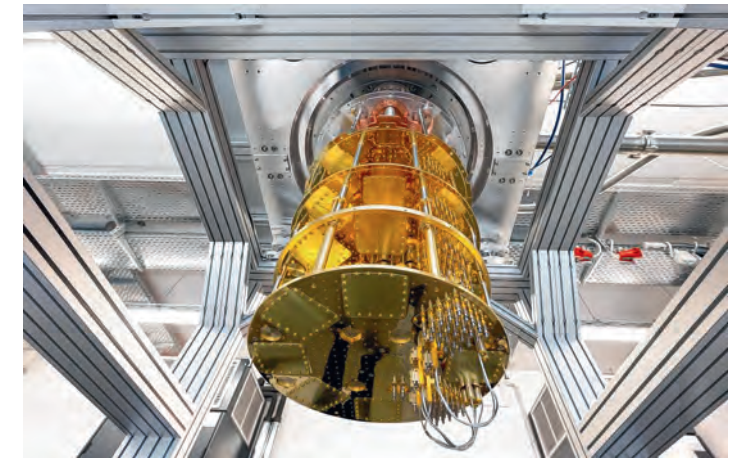
The University of Sydney has its

ageing and healthcare group, a multidisciplinary team that includes sociologists, psychologists and policy specialists, as well as those who research diseases with physical symptoms. "We apply our expertise to solving challenges and maximising opportunities that arise through population ageing," the group says.

Quantum Technology

THE TOP FIVE

1. UNSW
2. University of Queensland
3. Australian National University
4. Griffith University
5. University of Sydney



Quantum is a technology of the future in which Australia is well positioned to be a significant player. Many believe quantum applications will one day be as ubiquitous as electricity. One of Australia's strengths is quantum computing, something particularly due to physicist Michelle Simmons' work at UNSW on silicon quantum computers.

While quantum computing is the standard bearer of quantum technology, it has other very

promising applications including highly sensitive quantum sensing and highly secure quantum communication.

Both the University of Sydney and the Australian National University have spawned promising quantum technology start-ups. Q-CTRL, led by USyd physicist Mike Biercuk, develops control systems for highly delicate quantum systems. Canberra-based Quantum Brilliance, using technology from the ANU, aims to

build a room temperature quantum computer.

The University of Queensland's ARC Centre of Excellence for Quantum Computation and Communication Technology is working on optical quantum computer systems.

The research program at Griffith University's Centre for Quantum Dynamics includes work on a future quantum internet and using quantum effects to study biomolecules.

Indigenous Research

THE TOP FIVE

1. University of Queensland
2. Charles Darwin University
3. University of Adelaide
4. University of Western Australia
5. University of Sydney



Indigenous research is an area which is widely recognised as needing more resources and focus. Federal Industry and Science Minister Ed Husic said recently, in announcing a review of Australia's national science and research priorities, that the current priorities, set in 2015 "do not mention First Nations knowledge". That omission is expected to be dealt with in the government's new list of priorities.

Indigenous research covers a

very wide range of areas including health, education, housing, employment and social issues. It also covers art, language, literature, media, knowledge and story telling, and culture in general.

Others areas investigated under the broad descriptor of indigenous research include archaeology, history, geography, food, and land management. It also touches areas of economic and social development such as sport and tourism.

There is strong interest in all universities in broadening indigenous research in an appropriate way that is supported by indigenous people. Universities want to involve indigenous people as researchers, and as participants in research. The growing number of indigenous university graduates is creating a pipeline of future researchers from the indigenous community.

Ten top challenges

Crucial research
for Australia

Food and Agriculture

THE TOP FIVE

1. University of Queensland
2. RMIT University
3. CSIRO
4. University of Newcastle
5. Monash University

Food and agriculture is a research area which plays to Australia's traditional economic strength as an agricultural producer, while also offering major business opportunities in food manufacturing.

It gives universities and research organisations multiple opportunities to work in a beneficial way with industry, both by increasing agricultural yield, and



in helping the food industry to develop new products.

It also includes related areas such as nutrition, food science, allergies, food safety, preservation and packaging, and food sustainability and security.

The University of Queensland's Agri-Food Innovation Alliance works with food producers to create commercially viable products, particularly in high value,

premium foods and beverages.

RMIT's Food Research and Innovation Centre helps food manufacturers to become more innovative.

Agriculture and food is the CSIRO's largest research business unit. Its work includes genetic research, pesticide reduction, plant-based proteins, aquaculture and efficient farming practices.

Cybersecurity



As hacks of major organisations become more widespread nobody needs to be convinced of the importance of cybersecurity and the need for universities to work closely with business and government to strengthen cyber defences.

The UNSW Institute for Cyber Security is a multidisciplinary group which includes researchers from humanities, social sciences, psychology, business, law, and science. Humans and policy are not considered as an afterthought, the institute says. Its current projects include finding ways to thwart malpractice on apps, preserve privacy of data collected by internet of things devices, detect disinformation, and ensure cybersecurity for people working from home.

The RMIT Centre of Cyber Security Research and Innovation says it brings a truly multidisciplinary approach to the organisational, human and technology aspects of cybersecurity.

THE TOP FIVE

1. UNSW
2. RMIT University
3. CSIRO
4. Monash University
5. Deakin University

Monash University says its cybersecurity researchers assess, explore, develop and enhance cybersecurity and software to address the most pressing challenges. "Our researchers contribute to international quality standards and help countries assess and enhance their cyber maturity, culture, skills and capacity," it says.

The CSIRO's Distributed Systems Security Group works on a wide variety of cybersecurity issues and says there are currently too few professionals available to address the threats.

Deakin University's Centre for Internet of Things ECOSystems Research and Experimentation, includes research into security and privacy.

Disability and Rehabilitation

THE TOP FIVE

1. Griffith University
2. Deakin University
3. University of Sydney
4. UNSW
5. La Trobe University



Disability and rehabilitation research is a growing area for two reasons. The first is that our society is increasingly recognising the rights of disabled people. The other is the increasingly sophisticated treatments being developed for people who need rehabilitation after injuries.

Griffith University's Centre of Biomedical and Rehabilitation Engineering develops technologies to both manage and prevent various neuromusculoskeletal and

cardiovascular conditions. Its projects include improved implants, Achilles tendon repair, and a biospine.

Deakin University researcher Mark Stokes is a leading autism researcher whose work includes finding out how to best assist those with autism to successfully transition to adulthood.

UNSW's Centre for Healthy Brain ageing works to prevent and treat dementia.

La Trobe University's Centre for

Research Excellence in Aphasia Recovery and Rehabilitation develops ways to help those with aphasia – which is difficulty speaking, understanding speech, reading and writing, typically experienced after a stroke.

The University of Sydney's Centre for Disability Research and Policy aims for its work to actively influence policy and practice to improve the lives of people with disability.

Medical Technology and Devices

THE TOP FIVE

1. University of Queensland
2. UNSW
3. University of Melbourne
4. Monash University
5. University of Wollongong

Medical technology and devices is an advanced area of research, development and manufacturing that is emblematic of the challenges Australia faces across a range of advanced manufacturing areas. Nevertheless Australia has had notable successes in medtech, including the Cochlear bionic ear.

Now a new range of wearable



medical devices are becoming available. A project at the University of Queensland investigates wearable monitors to collect patients physiological and behavioural data to aid their treatment.

Bionics and prosthetics are also growing areas of research. The University of Melbourne's Bionics

Institute uses technology to help treat patients with conditions including Parkinson's disease, epilepsy, stroke, arthritis and diabetes.

Monash University's Institute of Medical Engineering focuses on translating medical technology research into practical applications.

Media Technology

THE TOP FIVE

1. University of South Australia
2. Monash University
3. University of Wollongong
4. University of Sydney
5. Queensland University of Technology



Australia has a rich and proven track record in pioneering media technology. From the Fairlight Synthesiser in the 1980s used by most musicians worldwide from Stevie Wonder to Kate Bush; to Animal Logic whose work on Academy Award-winning Happy Feet wowed the cinematic world through to today's design juggernaut Canva. It is a broad area that includes gaming, animation, audio engineering, virtual reality, digital art and imaging, computer

music and digital marketing.

The University of South Australia's Empathic Computing Lab explores new ways for people to better understand each other using digital technology, which includes using collaborative interfaces, augmented reality and virtual reality.

Monash University researcher Neil Selwyn is a leading international researcher in digital education used in schools, universities and adult learning.

The University of Sydney's Biomedical Multimedia Information Technology Research Group is bringing sophisticated image processing, computer vision and visual analytics to health care.

Queensland University of Technology's Digital Media Research Centre examines the transformation underway in media industries and how advances in computation and human-machine communication are changing our society.

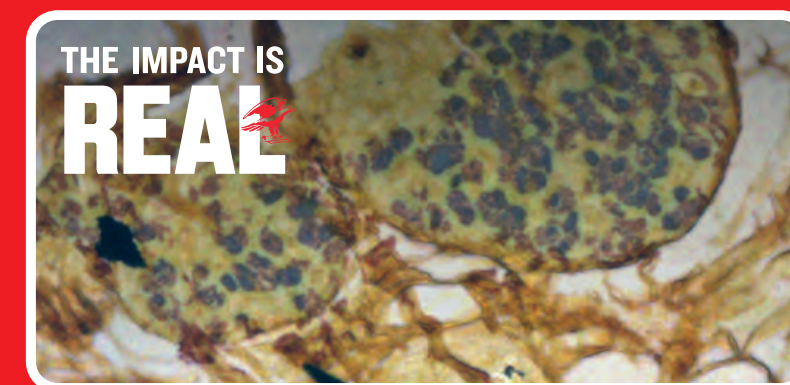
TWICE THE IMPACT AGAINST CANCER



La Trobe researchers are changing the way tissue imaging is done, with NanoMslide. By modifying the surface of conventional microscope slides at the nanoscale, biological structures and cells can be seen in bright colour contrast, helping us instantly detect disease. The NanoMslide has won our team a 2022 Eureka Prize for Innovative Use of Technology, and it's just one way La Trobe's making a real impact on real lives today.



TWICE THE IMPACT AGAINST CANCER



Latrobevirus. A virus that's for good.

Researchers at La Trobe have discovered a virus that attacks bacteria responsible for causing periodontitis – the catalyst for cancer growth – and it's named the Latrobevirus. Our discovery of the Latrobevirus is a game changer for treating a range of serious diseases, more effectively than antibiotics.



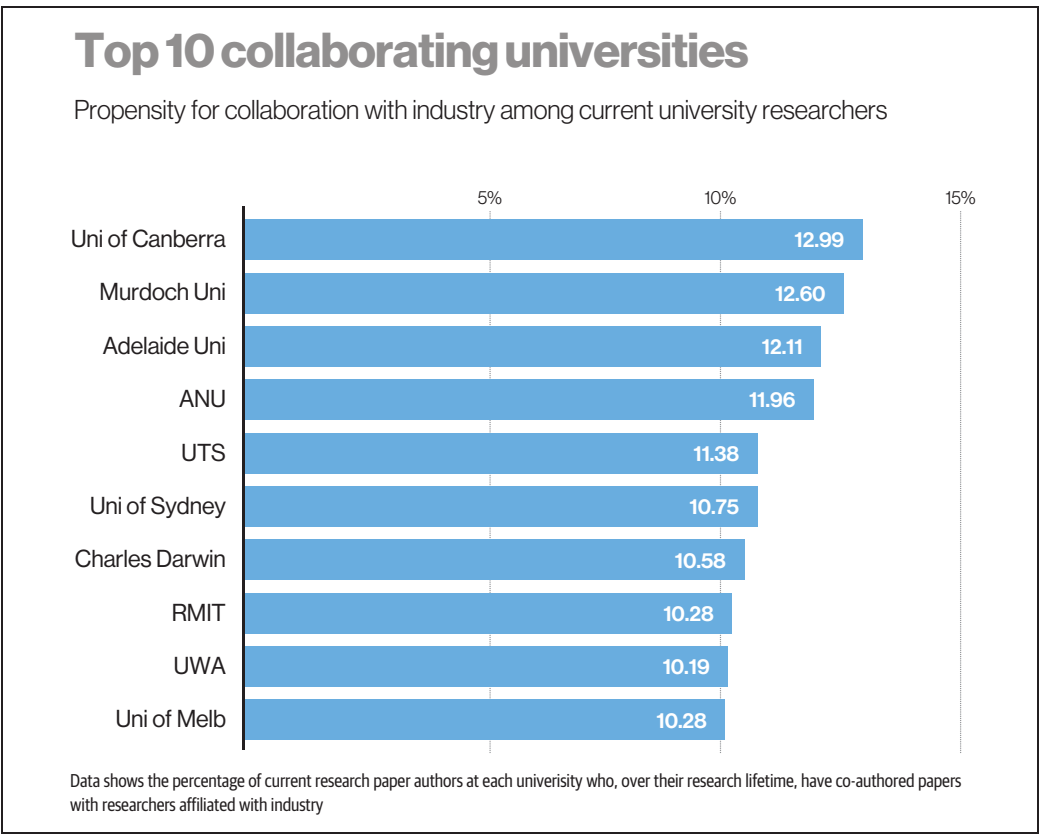
Working together: the power of two

The businesses and universities which collaborate best

Our data reveals which universities and businesses are heeding the calls for more research co-operation between industry and academia

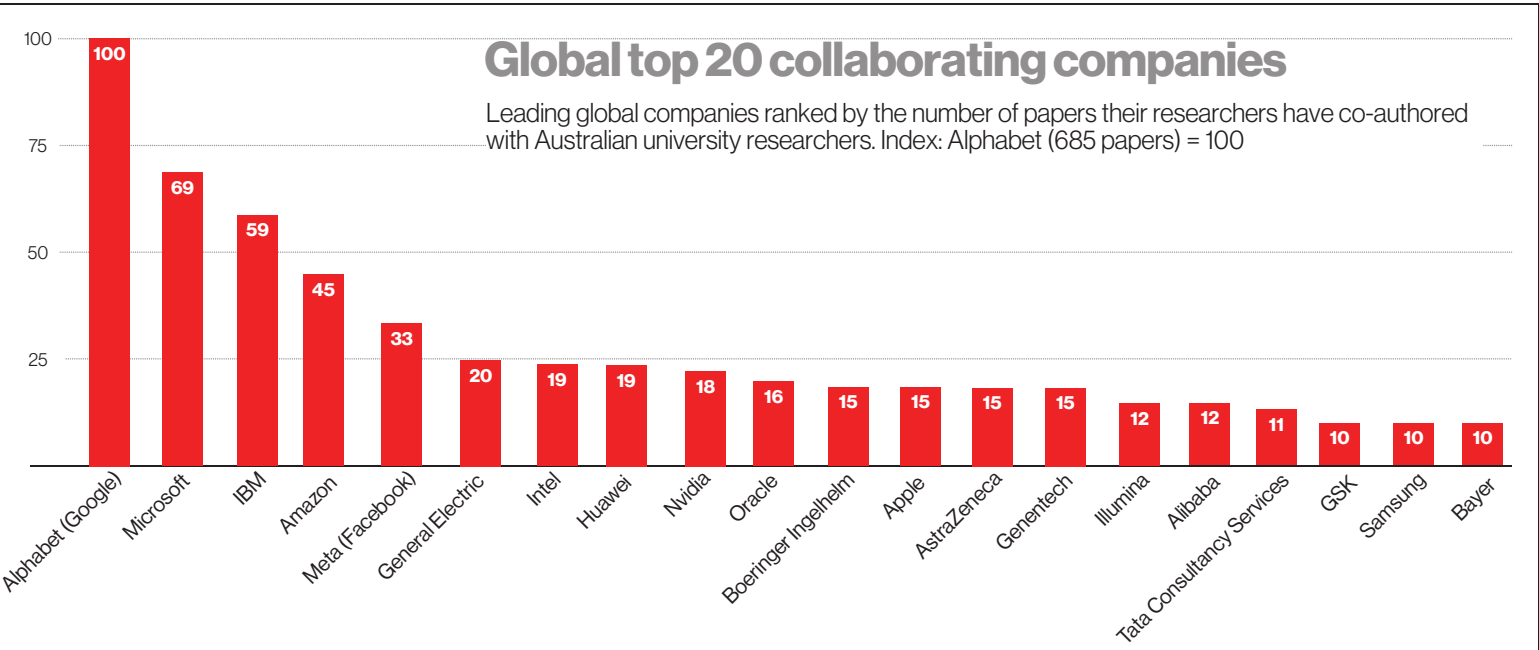
“Collaboration is key,” federal Education Minister Jason Clare told universities in his first major speech on higher education in July this year. Clare urged researchers, and universities as institutions, to increase the amount of joint investigative work they do with business and other groups. “I think there is more we can do together here to turn Australian ideas and discoveries into Australian jobs,” Clare said. He meant that collaboration would unlock the benefits of research, turning discoveries into innovation, commercialisation opportunities, new industries and jobs. But how much research are universities doing in conjunction with business? To gauge this, League of Scholars has sifted its database of Australian researchers to search for those currently in universities who have co-authored papers with researchers in industry and business over their careers. The result is a measure of how much Australian universities are collaborating with industry.

What does it tell us? One takeaway is that, when the data is adjusted for the size of a university’s research effort, the leading group in industry collaboration is not dominated by the research intensive universities. In fact the top institution is the University of Canberra, and Murdoch University is second. While several Group of Eight research intensive universities are represented in the top 10 (Adelaide, ANU, Sydney, Western Australia and Melbourne) the results show that some universities which are heavily focused on teaching are nevertheless well engaged with business on the research side. The data in the graph shows the degree of engagement of universities with business. Not shown on the graph, but worth mentioning, is that some non-university research organisations are more engaged with industry

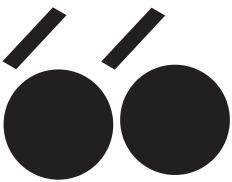


than universities are. For example, at the CSIRO 21 per cent of researchers (well over 1000 in number) have co-authored a paper with an industry researcher. The Australian Nuclear Science and Technology organisation is also a relatively strong collaborator with 15.5 per cent of its researchers having co-authored with an industry colleague. Compared to universities, researchers in many medical research institutions also have a high rate of collaboration with industry. For example the Garvan Institute has a rate of 17.7 per cent, and the Walter and Eliza Hall

Institute is at 15.5 per cent. League of Scholars has also used its database to come at the issue from the other side and identify the companies which collaborate the most with researchers in Australian universities. Their headline finding is a stark warning. Research intensive international companies collaborate far more with Australian university researchers than research intensive local companies. Measured by the number of research papers co-authored between industry and university researchers, Alphabet (Google’s holding company) is the biggest corporate research partner with Australian universities, with 685 papers. In



comparison CSL – the Australian firm which leads in collaboration with universities – has only 101 joint papers. In part this can be explained by Alphabet’s far greater size (15 times great market capitalisation) and the fact that it has a strong physical presence in Australia. But 13 other global companies – including Microsoft, IBM, Amazon and Meta – also do more research collaboration with Australian universities than does local leader CSL. Beyond CSL the Australian companies which have co-authored the most joint papers with Australian university researchers include major banks, large resource companies and many technology-oriented firms, large and small. Among the large ones are Canva



Unlock the benefits of research

and Seek, although Atlassian, the biggest tech of them all, does only a small number of co-authored papers with universities. Most interesting are the smaller tech start-ups whose work with university researchers has the potential to seed new cutting edge industries. For example quantum technology firms Q-CTRL and Quantum Brilliance are closely linked to the University of Sydney and ANU respectively, and many of their senior people are research scientists. Grok Learning is a start-up which teaches computer coding online and its CEO, James Curran, is a former University of Sydney academic with a strong research record.

MONASH BUSINESS SCHOOL RESEARCH INNOVATION STARTS HERE

Our vision is to create a thriving, equitable and sustainable future for all.

Through our globally renowned research, we're committed to addressing today's global economic, environmental and social challenges.

 monash.edu/business/research



Business, Economics & Management

Australia's research field leaders

These are the top researchers and institutions in the 16 fields of business, economics and management

Accounting & Taxation

Field leader: John Dumay, Macquarie

Lead institution: Macquarie

Business, Economics & Management (general)

Field leader: Rob Raven, Monash

Lead institution: Monash

Development Economics

Field leader: Paul Raschky, Monash

Lead institution: Monash

Economic History

Field leader: Laura Panza, Uni of Melb

Lead institution: RMIT

Economic Policy

Field leader: Paresh Narayan, Monash

Lead institution: Monash

Economics

Field leader: Kaveh Majlesi, Monash

Lead institution: Monash

Educational Administration

Field leader: Jessica Holloway, ACU

Lead institution: Uni of Melb

Emergency Management

Field leader: Jonatan Lassa, CDU

Lead institution: QUT

Entrepreneurship & Innovation

Field leader: Allan O'Connor, UniSA

Lead institution: QUT

Finance

Field leader: Paresh Narayan, Monash

Lead institution: Monash

Game Theory and Decision Science

Field leader: Haris Aziz, UNSW

Lead institution: UNSW

Human Resources & Organisations

Field leader: Alexander Newman, Deakin

Lead institution: Monash

International Business

Field leader: Paresh Narayan, Monash

Lead institution: Monash

Marketing

Field leader: Shahriar Akter, Uni of Wollongong

Lead institution: Monash

Strategic Management

Field leader: Shahriar Akter, Uni of Wollongong

Lead institution: Monash

Tourism & Hospitality

Field leader: Brent Ritchie, UQ

Lead institution: UQ



Roy VanDerVegt

Allan O'Connor

University of South Australia

Field leader in Entrepreneurship & Innovation

Allan O'Connor didn't finish high school and he doesn't have an undergraduate degree, but he is now an associate professor in enterprise dynamics at the University of South Australia, the co-executive director of the Centre for Enterprise Dynamics in Global Economies, and a recognised leader in his field of entrepreneurship and innovation.

In the early 1990s, armed with a mechanical engineering certificate, O'Connor worked in sales – really business development, he says. A worldwide economic downturn which led to the recession Australia had to have spurred him to think about different

Continued on Page 24

Business, Economics & Management Australia's research field leaders



Roy VanDerVegt

Continued from Page 23

professional directions. Studying for a graduate diploma in airconditioning, he saw a note on a Swinburne University of Technology noticeboard about an innovation and entrepreneurship course – and his path became clear to him.

From those small beginnings he went on to achieve a master's in enterprise innovation and a PhD in entrepreneurship education.

"Entrepreneurs are those who start businesses, but there's an entrepreneurial behaviour which can span a lot of things," O'Connor says. "Whether you're in government, a university, a small business or working for a large corporate: you can still be entrepreneurial within those contexts."

His research investigates the connections between entrepreneurship, innovation and socio-economic development, and more specifically the dynamics of entrepreneurial ecosystems. "I work on entrepreneurial

ecosystems, the systems within which we work," he says. "It's about businesses becoming transparent and responsible for not only their own bottom line, but for the environment and social conditions they create."

The world is moving through the fourth industrial revolution, he says, often referred to as Industry 4.0, an era known for increased digital capacity; smart manufacturing, smart machines and data analysis.

O'Connor says he is interested to understand more about how increasing digital capacities affect the landscape of business, the transparency of business and the connectedness of business. "Entrepreneurs and innovators will be on the front foot," he says. "They will be looking for the advantage and looking for the opportunity and the growth prospects that will come out of this."

Industry 5.0 is now on the ascendant, he says. According to the European Commission, as the world moves to the so-called fifth revolution, focus has sharpened on industry

goals beyond efficiency and productivity, placing workers' wellbeing at the centre of the production process while respecting the production limits of the planet.

"The changes over the past couple of years underlined the need for sovereign capability, the need for strengthening businesses, the need for global relations," O'Connor says.

The developed world's shift to accommodate environmental, social and governance concerns may take some time to filter through all big corporates, he says. "It's like most social changes, they take time to reach a tipping point," he says. "The environment and social responsibility angle, that is starting to add momentum to the discussion. These things are coming to the fore."

Individuals can take the lead on these sorts of innovations in larger corporations, he adds. "There is a cultural dimension to this inside a large corporate. They can enable and support people with change agendas."

Sian Powell

Creating the ultimate testbed for innovation

In this era of unprecedented change and global complexity, universities need to think and work differently – and that's exactly what we're doing at the University of Newcastle.

Our researchers drive discoveries that challenge conventional thinking, break new ground and change lives. And we're taking that work even further by using our expertise and collaborations to not only create new knowledge but use it to help reinvent our regions.

Our university, its cities and the regions we serve have always been looking ahead.

With roots in coal and steel, our communities have continually embraced new possibilities and become places where people of all ages and backgrounds want to live, work and play.

By drawing on the unique attributes of our regions – and supporting our communities with research and academic excellence – we are creating the ultimate testbed for innovation.

Examples of this are all around us. From harnessing the cold virus to fight cancer cells, to revolutionising the world's renewable energy systems through start-ups like MGA Thermal, to (literally) creating water from air, we are continually producing innovative solutions and start-ups that solve real-world problems.

The Australian Trailblazer for Recycling and Clean Energy (ATRaCE) Program exemplifies this commitment.

We are partnering with the University of NSW to accelerate new clean energy and recycling technologies from the research phase to the market.

This Australian government funded partnership will include a total investment of more than \$200m, including university and industry contributions.

And that's just the beginning.

We also have research and commercial



Researchers at the University of Newcastle

collaborations that will help produce new battery and energy storage technologies. We're helping transform biofuels and waste into energy, and we're building up our nation's hydrogen capabilities. All part of our commitment to creating next generation resources and growing our industries.

As a university long-known for its health-based research, we're also helping ensure the people of our regions live better, healthier lives – not just through new medical breakthroughs but in new ways of working with local health service providers.

We're partnering with the Hunter New England Local Health District to create a Healthcare Innovation Living Lab at the John Hunter Hospital campus in Newcastle.

It will bring clinicians, academics, industry partners, and medical and research students together to address unmet clinical needs across the Local Health District – which spans more than 132,000sq km and services nearly one million people.

And, we're creating opportunities for our students to be at the heart of innovative projects and innovative partnerships.

As part of the Healthcare Innovation Living Lab, the "Engineers, Scientists and

Scrubs" work integrated learning program will place University of Newcastle students – both undergraduate and postgraduate – in health innovation businesses and local hospitals where they'll work on applied R&D challenges identified by the Local Health District.

We've also created a unique Doctoral Training Centre model which connects PhD candidates with industry partners to not only produce impactful

research, but also create innovators of the future.

Our three Doctoral Training Centres (in food and agribusiness, resources, and energy) help improve the employability of our research students.

The centres also give them access to the expertise and resources they need to solve real industry challenges, and enhance industry-based collaborations for our university.

These are just some examples of how we're enabling our students to be part of our region's solutions.

Our sights are set firmly on the future, as we work to expand our research capacity and elevate our position as a competitive destination for the world's best researchers and global innovation leaders.

In creating the ultimate testbed of innovation, we will bring the best and brightest together to experiment with new ideas, technologies, policy concepts, learning approaches, and commercial innovations that deliver real-world outcomes and impact.

We invite you to partner with us.

Professor Zee Upton
Deputy Vice-Chancellor, Research & Innovation
The University of Newcastle



WHERE PURPOSE DRIVES PROGRESS

At Griffith University, we are committed to producing world-class research that matters. Research that creates lasting, positive and meaningful impact for individuals, families, groups and entire communities.

Our work occupies the nexus between societal impact and academic excellence, drawing together a network of disciplines and partners to find solutions to some of the most significant challenges of our time.

Across our more than 30 research centres and institutes, we are leading climate action, reimagining disability and rehabilitation, furthering our understanding of human origins and evolution, advancing equity and inclusion in sport, designing and discovering new drugs to combat disease, and so much more.

Brisbane's role as host city for the 2032 Olympic Games represents a key opportunity for Griffith—and the university sector more broadly—to effect widespread social change as industries, governments and communities prepare to welcome the world's premier sports event to South East Queensland. In line with the Games' founding values, researchers will have a unique chance over the next decade to tangibly move the needle on issues such as human rights, climate change, diversity and inclusion.

Aiming to create change at a societal scale is not a new pursuit for our university. We are proud of that history. But, more than that, we are propelled by the promise of what's yet to come. And that ensures our pioneering work in a range of socially and environmentally significant fields will continue to help shape the lives of people nationally and internationally for decades to come.

CREATING A WORLD WITHOUT MALARIA

Led by Professor Michael Good AO, researchers at Griffith's Institute for Glycomics have developed a whole-parasite vaccine that targets the stage of the malaria parasite found in the blood.

The optimised vaccine incorporates killed blood-stage malaria parasites, lipids and additional synthetic compounds to enhance the protective immune response stimulated by the vaccine.

The development of this broad-spectrum vaccine is a significant step forward in the fight against malaria as it can be freeze-dried. This makes it suitable for deployment into malaria-endemic countries—where nearly half of the world's entire population lives.

Alongside Dr Danielle Stanisc, Professor Good is now commencing Phase 1 clinical trials for the vaccine, putting his vision of a world without malaria one step closer to becoming a reality.



RESHAPING HUMAN HISTORY THROUGH STONE AGE SURGERY

An archaeological expedition co-led by Griffith academics has disrupted the accepted history of medicine, discovering evidence of surgical amputation that vastly pre-dates all previously known examples.

Discovered in Borneo, the unprecedented find—recently published in *Nature*—saw the team of Indonesian and Australian archaeologists unearth skeletal remains of an adult hunter-gatherer whose lower left leg had been amputated during childhood.

Found in the remote limestone cave of Liang Tebo, the remains date to a staggering 31,000 years ago—24,000 years older than any other known evidence of humans practising amputation.

Until the discovery, it was largely accepted that humans only started performing complex surgeries with the arrival of agricultural life.

However, the Borneo finding demonstrates that humans were practising amputation successfully long before we began living in permanent settlements, creating major implications for our understanding of medical history.

Engineering & Computer Science

Australia's research field leaders

These are the top researchers and institutions in the 50 fields of engineering and computer science

- Architecture**
Field leader: Samad Sepasgozar, UNSW
Lead institution: UNSW
- Artificial Intelligence**
Field leader: Seyedali Mirjalili, Torrens
Lead institution: UTS
- Automation & Control Theory**
Field leader: Peng Shi, Uni of Adelaide
Lead institution: Swinburne
- Aviation & Aerospace Engineering**
Field leader: Michael Smart, UQ
Lead institution: RMIT
- Bioinformatics & Computational Biology**
Field leader: Geoff Webb, Monash
Lead institution: Monash
- Biomedical Technology**
Field leader: Cuie Wen, RMIT
Lead institution: UQ
- Biotechnology**
Field leader: Philip Hugenholtz, UQ
Lead institution: UQ
- Civil Engineering**
Field leader: Hao Hong, Curtin
Lead institution: Curtin
- Computational Linguistics**
Field leader: Robert Dale, Language Technology Group
Lead institution: Macquarie
- Computer Graphics**
Field leader: Maxime Cordeil, UQ
Lead institution: Monash
- Computer Hardware Design**
Field leader: Xinghuo Yu, RMIT
Lead institution: RMIT
- Computer Networks & Wireless Communication**
Field leader: Derrick Wing Kwan Ng, UNSW
Lead institution: UNSW
- Computer Security & Cryptography**
Field leader: Willy Susilo, Uni of Wollongong
Lead institution: Uni of Wollongong
- Computer Vision & Pattern Recognition**
Field leader: Dacheng Tao, Uni of Sydney
Lead institution: Uni of Sydney
- Computing Systems**
Field leader: Rajkumar Buyya, Uni of Melb
Lead institution: Swinburne
- Data Mining & Analysis**
Field leader: François Petitjean, Australian Taxation Office
Lead institution: UTS

- Databases & Information Systems**
Field leader: Chengqi Zhang, UTS
Lead institution: UTS
- Educational Technology**
Field leader: Dragan Gasevic, Monash
Lead institution: UniSA
- Engineering & Computer Science (general)**
Field leader: Qing-Long Han, Swinburne
Lead institution: UNSW
- Environmental & Geological Engineering**
Field leader: Md Rabiul Awual, Curtin
Lead institution: Curtin
- Evolutionary Computation**
Field leader: Seyedali Mirjalili, Torrens
Lead institution: Deakin
- Food Science & Technology**
Field leader: Bhesh Bhandari, UQ
Lead institution: UQ
- Fuzzy Systems**
Field leader: Seyedali Mirjalili, Torrens
Lead institution: UTS
- Human Computer Interaction**
Field leader: Daniel Johnson, QUT
Lead institution: Uni of Melb
- Library & Information Science**
Field leader: Yi Zhang, UTS
Lead institution: UTS
- Manufacturing & Machinery**
Field leader: Ang Liu, UNSW
Lead institution: Uni of Wollongong
- Mechanical Engineering**
Field leader: Jie Yang, RMIT
Lead institution: RMIT
- Medical Informatics**
Field leader: Anthony Smith, UQ
Lead institution: UQ
- Metallurgy**
Field leader: Huijun Li, Uni of Wollongong
Lead institution: UQ
- Microelectronics & Electronic Packaging**
Field leader: Xi Zhu (Forest), UTS
Lead institution: Griffith
- Mining & Mineral Resources**
Field leader: Murat Karakus, Uni of Adelaide
Lead institution: Curtin
- Multimedia**
Field leader: Wanqing Li, Uni of Wollongong
Lead institution: UTS
- Ocean & Marine Engineering**
Field leader: Dong-Sheng Jeng, Griffith
Lead institution: Uni of Tasmania

Cuie Wen

Field leader in Biomedical Technology

A much-awarded biomaterials scientist and a leader in the field of biomedical technology, Cuie Wen began her academic career at the institution then called the Beijing University of Aeronautics and Astronautics, but she long ago shifted her gaze from aeroplanes to the human body.

Now a professor of biomaterials engineering at RMIT, she says that as well as their aeronautical utility, titanium alloys are used to make lightweight and strong replacement joints and other replacement parts for the human body, and work continues to refine the alloys and their applications.

“We borrowed titanium 6 aluminium 4 vanadium alloy (which includes small proportions of aluminium and vanadium) from the aerospace industry for biomedical use; it is not naturally compatible,” she says. “It has imperfect biocompatibility. So we added new alloying elements and we provided biocompatibility.”

The most biocompatible metal in existence, titanium is resistant to corrosion from bodily fluids. Altering the proportions of metals in the alloy can minimise the human body’s immune response and prevent rejection.

In recent decades, these strong alloys have put many millions of people around the world back on their feet and back in action – replacing eroded and broken body parts including hips, knees and shoulders with manufactured replacements.

Passionate about helping people with skeletal disease and injury to lead healthy, productive and independent lives, Wen says the use of smart biomaterials such as refined titanium alloys and biodegradable metals is becoming increasingly widespread in the medical field.

She is now working on new alloys with ever better biocompatibility,

including magnesium, iron and zinc, and their alloys. Her work also continues in fields including surface modification, nanostructured metals, metal foams, nano-laminates and battery materials.

On another front, Wen is developing research on refining methods for 3D printing implants.

“Printing is a very hot topic,” she says. “If we print a scaffold which is porous, then the human body’s fluids and nutrients can transport inside the scaffold and stimulate the cells to grow faster.”

Based on MRI and CT scans, 3-D printed implants can be manufactured to precisely match the patient’s internal architecture, promoting faster and more comprehensive recovery. Every individual has differently-sized and shaped bones and joints, Wen adds, with different amounts of porosity.

“If we use digital manufacturing, we

I’m very lucky. I have been given the funding I need

will be able to produce personalised implants.”

Born in Hunan in China, Wen has lived in Australia for almost 20 years, following a period in Japan at the National Institute of Advanced Industrial Science. She says she found it challenging to relocate from China to first Japan then Australia, setting up laboratories and learning to understand new cultures.

Now editor-in-chief of the Smart Materials in Manufacturing journal, an editorial board member on seven other journals in the field, and the winner of ARC Discovery, Linkage and LIEF grants, an NHMRC project grant and an Australia-India Strategic Research grant, Wen says her biomaterials work has been well-funded.

“I’m very lucky,” Wen says. “I have been given the funding to get the facilities I need for my research.”

Sian Powell



- Operations Research**
Field leader: Guilherme Luz Tortorella, Uni of Melb
Lead institution: Uni of Melb
- Plasma & Fusion**
Field leader: Boyd Blackwell, ANU
Lead institution: ANU
- Power Engineering**
Field leader: Yam Siwakoti, UTS
Lead institution: UNSW
- Quality & Reliability**
Field leader: Paul Salmon, USC
Lead institution: RMIT
- Radar, Positioning & Navigation**
Field leader: Jinling Wang, UNSW
Lead institution: UNSW
- Remote Sensing**
Field leader: Jeffrey Walker, Monash
Lead institution: UQ
- Robotics**
Field leader: Inkyu Sa, CSIRO
Lead institution: QUT
- Signal Processing**
Field leader: Yonghui Li, Uni of Sydney
Lead institution: Uni of Sydney
- Software Systems**
Field leader: Rajkumar Buyya, Uni of Melb
Lead institution: Uni of Melb
- Structural Engineering**
Field leader: Hao Hong, Curtin
Lead institution: Curtin
- Sustainable Energy**
Field leader: Martin Green, UNSW
Lead institution: UNSW
- Technology Law**
Field leader: Roger Clarke, Xamax Consultancy
Lead institution: Griffith
- Textile Engineering**
Field leader: Lijing Wang, RMIT
Lead institution: RMIT
- Theoretical Computer Science**
Field leader: Serge Gaspers, UNSW
Lead institution: Monash
- Transportation**
Field leader: David Hensher, Uni of Sydney
Lead institution: Uni of Sydney
- Water Supply & Treatment**
Field leader: Qilin Wang, UTS
Lead institution: UQ
- Wood Science & Technology**
Field leader: Xin Wang, RMIT
Lead institution: Monash

To make a real impact, research needs to go beyond the walls of the university. La Trobe University's focus is on real-world outcomes – utilising research to maximise impact on the economy, communities, the environment and society at large.

“[La Trobe] aims to redefine what it means to be a great university in the 21st century: deeply connected and committed to excellence, innovation, accessibility and relevance,” La Trobe Vice-Chancellor Professor John Dewar AO says.

“Whether it’s helping solve issues like global food insecurity, protecting the world’s biodiversity, understanding and preventing disease, or leading social change and equity, La Trobe is at the forefront of impactful research.”

La Trobe invests in researchers because it’s an investment in real-world benefits. From DNA visualisation to the establishment of flagship research institutes in agriscience and health, La Trobe researchers work at the forefront of science, health and technology to drive social change and innovation.

Creating social impact with research

Social impact and sustainability lie at the heart of La Trobe’s research. According to Professor Susan Dodds, La Trobe’s Senior Deputy Vice-Chancellor of Research and Industry Engagement, La Trobe’s research 2030 strategy aligns the university’s established priorities with the five research themes set out in the United Nations’ Sustainable Development Goals.

“These research themes focus our research investment in La Trobe Research centres and institutes, as well as our research infrastructure. The themes guide our industry, government and international collaborations. Our researchers work together across schools, colleges and campuses, using their expertise and knowledge to strive for common goals.”

La Trobe’s research impact reaches into the fabric of our society. Senior Lecturer Dr Tim Jones’s research on the harm of conversion therapy on LGBT people is provoking change to end conversion therapy across Australia and New Zealand,



Professor Susan Dodds

Research with real world impact

with Scotland recently adopting the Victorian government’s Change or Suppression (Conversion) Practices Prohibition Act 2021 model in their own process.

La Trobe’s commitment to impact is demonstrated by NanoMslide, which recently won the 2022 Eureka Prize in the Innovative Use of Technology category.

Developed by La Trobe University researchers in partnership with Peter MacCallum Cancer Centre and Garvan Institute of Medical Research, the NanoMslide enables pathologists to detect breast cancer at the earliest stages of development.

The real impact goes beyond breast cancer detection and is being explored for future diagnostic applications.

“The slide can be used on any microscope, anywhere – from a world-class hospital to a field clinic in a developing country – meaning the possibilities are endless,” Professor Brian Abbey says.

Breaking new ground with industry

La Trobe researchers work in partnership with community groups, government, and industry partners such as CSIRO, Cisco and Medibank, to address issues of local, national and international importance.

With its substantial landholdings and location at the gateway to Melbourne’s growing north, La Trobe provides unparalleled opportunities for collaboration through major investment in infrastructure and facilities.

La Trobe’s University City of the Future is a \$5 billion plan, with investments from private industry and government that will transform the Melbourne campus into a vibrant precinct. Revamping the 40ha Research and Innovation Precinct has already started. This will enable La Trobe’s researchers and industry partners to break new ground with game-changing innovation.

La Trobe rises in world rankings

At La Trobe, impact is about action. La Trobe University is in the top 20 worldwide for global impact, according to the Times Higher Education Impact Rankings 2022, which measures performance towards the United Nations’ Sustainable Development Goals (SDGs) from 1406 universities worldwide.

La Trobe’s progress has seen it rise 46 places to 316 globally in QS World University Rankings 2023 and five places to 296 in Shanghai Ranking’s ARWU rankings 2022, cementing the University’s standing as world-class in the areas of health, science and technology.

This makes La Trobe the strongest improver in Australia and secures its best ranking position in the last decade, which QS describes as “extraordinary”. According to Professor Dewar, this result is largely due to a strong increase in academic citations per faculty.

“Our talented academics are continually producing world-class research that makes a difference. La Trobe University has grown its research output by 377 per cent since 2016, nearly three times the national average (13.1 per cent).

“La Trobe is now at the highest level it has been for a decade in two of the world’s most prestigious and important rankings. This reflects the true breadth and quality of research produced by our talented academic community.”

Jess Zibung

Chemical & Material Sciences

Australia's research field leaders

These are the top researchers and institutions in the 17 fields of chemical and material sciences



Evatt Hawkes **UNSW** Field leader in **Combustion & Propulsion**

Evatt Hawkes has turned his childhood pyromania to good account – investigating fire and combustion at an elevated level of science. Now a professor of mechanical engineering at the University of NSW, he uses computational modelling to further the global understanding of combustion in renewable energy technology.

He is at the forefront of the race to decarbonise the economy and tackle the challenges of transforming transport and energy systems to work with renewables such as green hydrogen.

“We’re trying to basically understand what the hell’s going on with things like hydrogen combustion and provide fundamental knowledge and tools that industry can use to reliably design engines,” he says. “That’s our *raison d’être*.”

A chemical reaction that requires a mix of fuel and air and a heat transfer, combustion can be influenced by turbulence in the flow, which stirs things up and can have a knock-on effect. Turbulent flows are yet to be fully understood, Hawkes says, and turbulent combustion adds yet another layer of complexity to already complex scenarios.

“Believe it or not, despite using combustion

technologies for hundreds of years, or a million years if you consider just fires, we actually don’t understand it that well,” he says. “So we work on providing the missing understanding. There’s a lot of things we don’t get. The thing which I focus on, that we don’t understand that well, is how turbulent flows interact with combustion.”

Hawkes and his colleagues run extremely large simulations of combusting fluid on super computers. Their simulations are fundamental research; they comprise a long series of incredibly complicated calculations and they are expensive to run. It might take 20,000 CPU processor cores running for three solid weeks to complete one simulation on either of the two super computers the team uses, a machine called Gadi at the National Computational Infrastructure facility in Canberra, and a new machine called Setonix (the scientific name of the quokka) at the Pawsey Super Computing Centre in Western Australia.

“Our approach is a useful scientific tool and we can learn a lot about combustion with this tool, but it’s not a tool industry can use – because it’s too expensive to run those types of simulations,” Hawkes says. “In their design process, they need a much cheaper computation and we use our very detailed ones to try to help develop those cheaper ones that industry can afford to use.”

Hawkes and his colleagues work with industry, including gas turbine manufacturer General Electric and energy solutions giant MAN. “We target our problems so that they’re relevant to the development of engines,” he says, adding that experts in the field are now focused on the best ways to burn renewably produced fuels, including carbon-free hydrogen and ammonia, in heavy-duty compression ignition engines such as those used in aviation, in ships and long-haul trucks, and in stationary gas turbines that make energy.

Sian Powell

Analytical Chemistry

Field leader: Nam-Trung Nguyen, Griffith

Lead institution: Monash

Biochemistry

Field leader: Michael Jennings, Griffith

Lead institution: Monash

Ceramic Engineering

Field leader: Shujun Zhang, Uni of Wollongong

Lead institution: UNSW

Chemical & Material Sciences (general)

Field leader: Shi Zhang Qiao, Uni of Adelaide

Lead institution: Uni of Adelaide

Chemical Kinetics & Catalysis

Field leader: Shaobin Wang, Uni of Adelaide

Lead institution: Uni of Adelaide

Combustion & Propulsion

Field leader: Evatt Hawkes, UNSW

Lead institution: UQ

Composite Materials

Field leader: Tuan Ngo, Uni of Melb

Lead institution: Uni of Melb

Crystallography & Structural Chemistry

Field leader: Dylan Jayatilaka, UWA

Lead institution: ANSTO

Dispersion Chemistry

Field leader: Shaobin Wang, Uni of Adelaide

Lead institution: UQ

Electrochemistry

Field leader: Shi Xue Dou, Uni of Wollongong

Lead institution: UNSW

Inorganic Chemistry

Field leader: Nial Wheate, Uni of Sydney

Lead institution: Uni of Sydney

Materials Engineering

Field leader: Shi Xue Dou, Uni of Wollongong

Lead institution: UNSW

Medicinal Chemistry

Field leader: Christoph Nitsche, ANU

Lead institution: Monash

Nanotechnology

Field leader: Shi Xue Dou, Uni of Wollongong

Lead institution: UNSW

Oil, Petroleum & Natural Gas

Field leader: Reza Rezaee, Curtin

Lead institution: Curtin

Organic Chemistry

Field leader: Md Shahriar Hossain, UQ

Lead institution: UQ

Polymers & Plastics

Field leader: Cyrille Boyer, UNSW

Lead institution: UNSW

Health & Medical Sciences

Australia's research field leaders

These are the top researchers and institutions in the 66 fields of health and medical sciences

Addiction
Field leader: Louisa Degenhardt, UNSW
Lead institution: UNSW

AIDS & HIV
Field leader: Matthew Law, UNSW
Lead institution: UNSW

Alternative & Traditional Medicine
Field leader: Amie Steel, UTS
Lead institution: Western

Anesthesiology
Field leader: Lis Evered, St Vincent's Health
Lead institution: Monash

Audiology, Speech & Language Pathology
Field leader: Sharynne McLeod, CSU
Lead institution: UQ

Bioethics
Field leader: John Little, Uni of Sydney
Lead institution: Uni of Sydney

Cardiology
Field leader: Andrew Coats, Heart Research Institute
Lead institution: Monash

Child & Adolescent Psychology
Field leader: Cheryl Dissanayake, La Trobe
Lead institution: La Trobe

Clinical Laboratory Science
Field leader: Emmanuel Favaloro, NSW Health
Lead institution: Capricorn Coast Hospital

Communicable Diseases
Field leader: David Paterson, UQ
Lead institution: Monash

Critical Care
Field leader: Craig French, Monash
Lead institution: Monash

Dentistry
Field leader: Sašo Ivanovski, UQ
Lead institution: UQ

Dermatology
Field leader: Adele Green, QIMR Berghofer
Lead institution: UQ

Developmental Disabilities
Field leader: Cheryl Dissanayake, La Trobe
Lead institution: La Trobe

Diabetes
Field leader: Vlado Perkovic, UNSW
Lead institution: Monash

Emergency Medicine
Field leader: Dieter Weber, Royal Perth Hospital
Lead institution: Monash

Endocrinology
Field leader: Peter Ebeling, Monash
Lead institution: Monash

Epidemiology
Field leader: Mark Howard, Austin Health
Lead institution: Monash

Gastroenterology & Hepatology
Field leader: Gregory Dore, UNSW
Lead institution: UNSW

Genetics & Genomics
Field leader: Peter Visscher, UQ
Lead institution: UQ

Gerontology & Geriatric Medicine
Field leader: Christopher Rowe, Austin Health
Lead institution: Uni of Sydney

Gynecology & Obstetrics
Field leader: Daniel Rolnik, Monash
Lead institution: UQ

Health & Medical Sciences (general)
Field leader: Louisa Degenhardt, UNSW
Lead institution: UQ

Heart & Thoracic Surgery
Field leader: Silvana Marasco, Monash
Lead institution: RCH Melbourne

Hematology
Field leader: Constantine Tam, Monash
Lead institution: Monash

Hospice & Palliative Care
Field leader: Jane Phillips, QUT
Lead institution: UNSW

Immunology
Field leader: Robyn O'Hehir, Monash
Lead institution: Monash

Molecular Biology
Field leader: Edward Holmes, Uni of Sydney
Lead institution: Monash

Natural Medicines & Medicinal Plants
Field leader: Jerome Sarris, Western
Lead institution: UQ

Neurology
Field leader: Perminder Sachdev, UNSW
Lead institution: Monash

Neurosurgery
Field leader: Jeffrey Rosenfeld, Monash
Lead institution: Monash

Nuclear Medicine, Radiotherapy & Molecular Imaging
Field leader: Louise Emmett, UNSW
Lead institution: NSW Health

Nursing
Field leader: Navjot Bhullar, ECU
Lead institution: Griffith

Nutrition Science
Field leader: Elizabeth Isenring, Bond
Lead institution: Deakin

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You need to share your data as quickly and openly as possible

Louise Cooper

Edward Holmes

University of Sydney

Field leader in Molecular Biology

With the world's first public post of the Covid-19 genome sequence in January 2020, Edward Holmes launched a global avalanche of scientific endeavour and co-operation, as nations everywhere rushed to come to grips with a pandemic that has so far killed at least 6.5 million people.

The Sydney University biologist

had been working on a project in Wuhan with his Chinese colleague Yong-Zhen Zhang when a strange new disease started to take hold. By January 5, Zhang and Holmes could see it was a coronavirus with an ominous similarity to the SARS virus that swept through Asia in 2003, killing nearly 800 people.

Zhang wrote to China's health minister that day, warning the disease looked like SARS and was likely to be human transmissible, but the Chinese government had clamped down on information sharing.

Then Zhang, from Fudan University, had some biological samples sent by train to his Shanghai lab, and within about 40 hours he had sequenced the virus. China finally announced the disease was a coronavirus on

January 9, and rumours began to swirl that it had already been sequenced, with one eminent scientist pointedly declaring on Twitter that if a sequence had been found it should be in the public domain.

"I thought, oh shit, that's me," Holmes says. "I'd helped write the paper, but I didn't have the sequence myself; I didn't actually have the data. I got hold of Zhang and said we need to release this now."

Zhang was on a plane on the way to Beijing when Holmes rang and Holmes could hear the flight attendant telling him to turn off his phone. Zhang turned it off, but then called Holmes back one minute later and agreed to send him the sequence.

"I cleaned it up, wrote a little disclaimer and posted it on the free

access site Virological," Holmes says. "I had it in my possession for 52 minutes before posting it."

Back then, in January 2020, when he fired the starting gun, neither he nor Zhang had any idea the virus would engulf the world. China's decision to clamp down on information meant Chinese authorities waited to declare there was a risk of human transmission until January 20, three weeks later.

"The ball was definitely dropped early on," Holmes says. "I really honestly believe we could not have stopped the outbreak, but we should have stopped the pandemic."

He believes global scientific collaboration is essential to combat emerging diseases and prevent another worldwide pandemic.

"In China, the gut reaction is to keep it quiet and not tell people

what's going on," he says. "That's the worst thing you can possibly do for infectious diseases. Time is of the essence."

"One of the key lessons I took from the pandemic is you need to share your data as quickly and openly as possible."

A leader in the field of molecular biology and an ARC Australian laureate fellow, Holmes investigates the drivers of emerging zoonotic diseases, which he expects will become more prevalent with climate change, increasingly massive metropolises and natural habitat loss.

"Why is it that some viruses are able to jump species boundaries pretty easily?" he wants to know. "What drives this emergence? It's fundamental research."

Sian Powell

Health & Medical Sciences
continued

Continued from Page 32

Obesity
Field leader: Vlado Perkovic, UNSW
Lead institution: Monash
Oncology
Field leader: Georgina Long, Uni of Sydney
Lead institution: Uni of Sydney
Ophthalmology & Optometry
Field leader: Fiona Stapleton, UNSW
Lead institution: UNSW
Oral & Maxillofacial Surgery
Field leader: Zohaib Akram, UWA
Lead institution: UWA
Orthopedic Medicine & Surgery
Field leader: Kate Webster, La Trobe
Lead institution: Uni of Sydney
Otolaryngology
Field leader: Richard Harvey, Macquarie
Lead institution: Macquarie
Pain & Pain Management
Field leader: Michael Nicholas, Uni of Sydney
Lead institution: Uni of Sydney
Pathology
Field leader: Glenda Halliday, Uni of Sydney
Lead institution: Uni of Sydney
Pediatric Medicine
Field leader: Nigel Curtis, Uni of Melb
Lead institution: Monash
Pharmacology & Pharmacy
Field leader: Christopher Sobey, La Trobe
Lead institution: Monash
Physical Education & Sports Medicine
Field leader: Stuart Biddle, UniSQ
Lead institution: Uni of Sydney
Physiology
Field leader: Danny Green, UWA
Lead institution: Monash
Plastic & Reconstructive Surgery
Field leader: Anand Deva, Macquarie
Lead institution: Macquarie
Pregnancy & Childbirth
Field leader: Caroline Homer, Burnet
Lead institution: Griffith
Primary Health Care
Field leader: Sarah Dennis, Uni of Sydney
Lead institution: Uni of Sydney
Psychiatry
Field leader: Helen Christensen, UNSW
Lead institution: UNSW

Psychology
Field leader: Sharon Parker, Curtin
Lead institution: Uni of Melb
Public Health
Field leader: Stuart Biddle, UniSQ
Lead institution: Deakin
Pulmonology
Field leader: Peter Frith, Flinders
Lead institution: Monash
Radiology & Medical Imaging
Field leader: Thomas Marwick, Baker
Lead institution: Uni of Sydney
Rehabilitation Therapy
Field leader: Jennie Ponsford, Monash
Lead institution: Monash
Reproductive Health
Field leader: Helena Teede, Monash
Lead institution: Monash
Rheumatology
Field leader: Peter Nash, Griffith
Lead institution: Uni of Sydney
Social Psychology
Field leader: Jolanda Jetten, UQ
Lead institution: UQ
Surgery
Field leader: Dieter Weber, UWA
Lead institution: Monash
Toxicology
Field leader: Thomas Astell-Burt, Uni of Wollongong
Lead institution: UQ
Transplantation
Field leader: Daniel Chambers, UQ
Lead institution: Capricorn Coast Hospital
Tropical Medicine & Parasitology
Field leader: Una Ryan, Murdoch
Lead institution: Uni of Melb
Urology & Nephrology
Field leader: Allison Jaure (nee Tong), Uni of Sydney
Lead institution: Monash
Vascular Medicine
Field leader: Bruce Campbell, Uni of Melb
Lead institution: Monash
Veterinary Medicine
Field leader: Caroline Lee, CSIRO
Lead institution: Uni of Melb
Virology
Field leader: David Jans, Monash
Lead institution: Monash

Physics & Mathematics
Australia’s research field leaders

These are the top researchers and institutions in the 21 fields of physics and mathematics

Kamila Kochan
Monash University
Field leader in Spectroscopy & Molecular Physics

Kamila Kochan investigates microbial resistance to antibiotic treatment: essential to understanding a phenomenon seen as a looming disaster in health care. She uses a spectrometer to look deep into bacteria to determine how they respond to the world’s current arsenal of drugs.
With bachelor’s and master’s degrees in chemistry from a university in Poland, Kochan began her doctorate at Jagiellonian University in the historic Polish city of Krakow.
“Starting with my master’s I was already specialising in spectroscopy, specifically for biological materials,” she says.
She came to Australia for two internships en route to her doctorate. “I actually wrote my PhD while I was here,” she says. “Then during that last internship I got an offer from the group here to come back on a post-doc (fellowship).”
Kochan uses advanced micro- or nanoscale spectroscopy on biological materials such as blood to understand certain biological issues.



“I mainly work on microbial resistance, trying to develop a rapid test for the quick detection of whether the bacteria that the patient is infected with is resistant or not. I also work with viruses; and I worked with Covid,” she says.
Now a leader in her field of spectroscopy and molecular physics, her specialty at the Monash University Centre for Biospectroscopy is infectious diseases.
Occasionally, she branches out to work on other projects that require certain kinds of nanoscale information, such as investigations into viruses and vector-borne diseases such as malaria. She has a side project collaborating on understanding more on why white

blood cells become active and provide an immune response.
She wants to continue with her work on diseases, she says, focusing on the detection of drug resistance.
“In my personal opinion, that’s still one of the most pressing issues, specifically when it comes to bacteria, because they have a tendency to develop resistance much quicker than we actually develop new drugs,” she says.
“The funding for the development of new drugs is going down because it’s not worth it. There are very gruesome predictions that in 50 years we might go back to the pre-penicillin era and the risks of infection and death related to surgery will increase significantly.”
Sian Powell

Acoustics & Sound
Field leader: Xiaojun Qiu, UTS
Lead institution: Macquarie
Algebra
Field leader: Aidan Sims, Uni of Wollongong
Lead institution: Uni of Melb
Astronomy & Astrophysics
Field leader: Richard McDermid, Macquarie
Lead institution: ANU
Computational Mathematics
Field leader: Fawang Liu, QUT
Lead institution: UNSW
Condensed Matter Physics & Semiconductors
Field leader: Robert Ward, ANU
Lead institution: ANU
Discrete Mathematics
Field leader: David Wood, Monash
Lead institution: Monash
Electromagnetism
Field leader: Yingjie Jay Guo, UTS
Lead institution: UTS
Fluid Mechanics
Field leader: Ivan Marusic, Uni of Melb
Lead institution: Uni of Melb
Geometry
Field leader: Xuan Duong, Macquarie
Lead institution: Macquarie
Geophysics
Field leader: Dietmar Müller, Uni of Sydney
Lead institution: ANU
High Energy & Nuclear Physics
Field leader: Robert Ward, ANU
Lead institution: Uni of Sydney
Mathematical Analysis
Field leader: Fedor Sukochev, UNSW
Lead institution: Curtin
Mathematical Optimisation
Field leader: Fred Roosta, UQ
Lead institution: Curtin
Mathematical Physics
Field leader: Dominic Williamson, Uni of Sydney
Lead institution: Uni of Sydney
Nonlinear Science
Field leader: Tonghua Zhang, Swinburne
Lead institution: Swinburne
Optics & Photonics
Field leader: Yuri Kivshar, ANU
Lead institution: ANU
Physics & Mathematics (general)
Field leader: Tony Murphy, CSIRO
Lead institution: Monash
Probability & Statistics with Applications
Field leader: Daniel Simpson, Monash
Lead institution: Monash
Pure & Applied Mathematics
Field leader: David Wood, Monash
Lead institution: Curtin
Spectroscopy & Molecular Physics
Field leader: Kamila Kochan, Monash
Lead institution: UQ
Thermal Sciences
Field leader: Jiyuan Tu, RMIT
Lead institution: Uni of Adelaide

Humanities, Literature & Arts

Australia's research field leaders

These are the top researchers and institutions in the 21 fields of humanities, literature and arts

Asian Studies & History

Field leader: Vedi Hadiz, Uni of Melb
Lead institution: ANU

Chinese Studies & History

Field leader: Haigong Yu, RMIT
Lead institution: ANU

Communication

Field leader: Jasmine Fardouly, UNSW
Lead institution: QUT

Drama & Theatre Arts

Field leader: Luke Hopper, ECU
Lead institution: QUT

English Language & Literature

Field leader: Subhan Zein, UQ
Lead institution: ANU

Epistemology & Scientific History

Field leader: Jelle Bruineberg, Macquarie
Lead institution: Macquarie

Ethnic & Cultural Studies

Field leader: Loretta Baldassar, ECU
Lead institution: Deakin

Feminism & Women's Studies

Field leader: Kim Toffoletti, Deakin
Lead institution: Monash

Film

Field leader: Stayci Taylor, RMIT
Lead institution: RMIT

Foreign Language Learning

Field leader: Alastair Pennycook, UTS
Lead institution: Macquarie

Gender Studies

Field leader: Leah Ruppanner, Uni of Melb
Lead institution: Uni of Melb

History

Field leader: Simon Ville, Uni of Wollongong
Lead institution: UTS

Humanities, Literature & Arts (general)

Field leader: Alastair Pennycook, UTS
Lead institution: Uni of Melb

Language & Linguistics

Field leader: Mark Antoniou, Western
Lead institution: Uni of Melb

Literature & Writing

Field leader: Paul Dawson, UNSW
Lead institution: Monash

Middle Eastern & Islamic Studies

Field leader: Benjamin Isakhan, Deakin
Lead institution: Deakin

Music & Musicology

Field leader: Emery Schubert, UNSW
Lead institution: Uni of Melb

Philosophy

Field leader: Jelle Bruineberg, Macquarie
Lead institution: Macquarie

Religion

Field leader: Lindsay Carey, La Trobe
Lead institution: Monash

Sex & Sexuality

Field leader: Anthony Lyons, La Trobe
Lead institution: UNSW

Visual Arts

Field leader: Yoko Akama, RMIT
Lead institution: RMIT

Luke Hopper

Edith Cowan

University

Field leader in

Drama &

Theatre Arts

Luke Hopper uses sophisticated motion capture technology to better understand the biomechanics of dance and to tailor advice to dancers in order to help them limit their injuries.

Originally developed for clinically analysing the way US children with cerebral palsy walk, and later perfected for use in films such as Titanic and Lord of the

Rings, the technology allows Hopper to create specialised computer video of an individual dancer which can then be studied in slow-motion detail.

To create the Gollum character in Lord of the Rings, actor Andy Serkis wore a soft Velcro suit with reflective balls attached to it in a certain configuration. The motion capture system recognised the shape and produced video of a moving skeleton which could then be used to drive an avatar. The technique is still widely used in film, television and for computer games, and Hopper uses it to help dancers avoid injury by determining exactly how their feet fall, their ankles turn and their knees bend – working out exactly where the risks lie.

“Science prioritises accuracy, of course, so the balls are typically

attached to the skin of the dancer or sportsperson,” he says. “There are endless applications of the technology.”

A leader in the field of drama and theatre arts at Edith Cowan University, Hopper is developing a health education and research program in collaboration with the West Australian Academy of Performing Arts staff and students. He completed his doctorate on the biomechanics of dance and injury prevention at the University of Western Australia, writing a thesis on how venue floors affect dancers. “If there was a way that injuries could be prevented by improving the surface dancers are on, that seemed to have an easier translation and social impact,” he says.

With a scholarship from UWA he spent six months developing his

doctorate project proposal and found that a British firm, Harlequin Floors, produces most of the dance floors for major ballet companies around the world.

He also discovered that Loughborough University in the English Midlands has a sports equipment research centre, including a small sports surfaces group. “In addition to being great collaborators, they had a kit to test the floors,” he says.

Hopper was also given an injury audit compiled by the chief physiotherapist of the Birmingham Royal Ballet, a company that tours frequently through the UK, visiting the same venues year after year. Analysis of the audit revealed that some venues were particularly hazardous.

Hopper tested the stage floors in

question and found they were either quite hard or inconsistent, with harder spots and soft spots, which were indistinguishable from each other from a dancer's perspective.

One floor, at a venue where most injuries had occurred, was inconsistent, he found. “Dancers agreed it was the most difficult floor to dance on,” he says. “I went on to do a couple more studies on dancers’ perceptions about how sensitive they were to different floor types.”

His research provided the first evidence that floor types should be a consideration for ballet companies to limit dancers’ inevitable injuries.

“We know that dancers get injured,” he says. “It’s an elite form of movement, and like any elite sport, it requires intense training to build up repertoire and skills.”

Sian Powell

Colin Murty

Social Sciences

Australia’s research field leaders

These are the top researchers and institutions in the 29 fields of the social sciences

Academic & Psychological Testing

Field leader: David Boud, Deakin
Lead institution: Deakin

Anthropology

Field leader: Michael Petraglia, Griffith
Lead institution: ANU

Archaeology

Field leader: Chris Turney, UTS
Lead institution: UNSW

Cognitive Science

Field leader: Ullrich Ecker, UWA
Lead institution: Uni of Newcastle

Criminology, Criminal Law & Policing

Field leader: Kristina Murphy, Griffith
Lead institution: Griffith

Diplomacy & International Relations

Field leader: Constance Duncombe, Monash
Lead institution: ANU

Early Childhood Education

Field leader: Michelle Neumann, SCU
Lead institution: Macquarie

Education

Field leader: David Boud, Deakin
Lead institution: Deakin

Educational Psychology & Counseling

Field leader: Andrew Martin, UNSW
Lead institution: ACU

Environmental & Occupational Medicine

Field leader: Thomas Astell-Burt, Uni of Wollongong

Lead institution: UNSW

Environmental Law & Policy

Field leader: Russell Smyth, Monash
Lead institution: CSIRO

Ethics

Field leader: Alexander Newman, Deakin
Lead institution: Deakin

Family Studies

Field leader: Alina Morawska, UQ
Lead institution: UQ

Forensic Science

Field leader: Duncan Taylor, Forensic Science SA
Lead institution: UTS

Geography & Cartography

Field leader: Michele Acuto, Uni of Melb
Lead institution: Uni of Melb

Health Policy & Medical Law

Field leader: Sue Brennan, Monash
Lead institution: Uni of Sydney

Higher Education

Field leader: David Boud, Deakin
Lead institution: Deakin

Human Migration

Field leader: Loretta Baldassar, ECU
Lead institution: Deakin

International Law

Field leader: Anthea Roberts, ANU
Lead institution: UNSW

Military Studies

Field leader: Charles Hunt, RMIT
Lead institution: Deakin

Political Science

Field leader: Robert Thomson, Monash
Lead institution: ANU

Public Policy & Administration

Field leader: Brian Head, UQ
Lead institution: Uni of Melb

Science & Engineering Education

Field leader: Lynn Monrouxe, Uni of Sydney
Lead institution: Monash

Social Sciences (general)

Field leader: Jolanda Jetten, UQ
Lead institution: UQ

Social Work

Field leader: Cathy Humphreys, Uni of Melb
Lead institution: Griffith

Sociology

Field leader: Francisco Perales Perez, UQ
Lead institution: UQ

Special Education

Field leader: Umesh Sharma, Monash
Lead institution: Monash

Teaching & Teacher Education

Field leader: Jennifer Gore, Uni of Newcastle
Lead institution: Monash

Urban Studies & Planning

Field leader: Md Liton Kamruzzaman, Monash
Lead institution: Uni of Melb

Chris Turney
UTS
Field leader in
Archaeology

Chris Turney is fascinated by the fertile interactions of disciplines and sectors in the overlapping fringes of academic fields and specialties where ideas are born.

An earth scientist by training and a leader in the field of archaeology, Turney has turned his hand to wildly different projects: from carbon dating the fossil “hobbits” of Indonesia’s Flores island, to founding a New Zealand-based company that turns biowaste into the graphite used in lithium ion batteries, to researching ice-sheet dynamics in Antarctica.

Now a pro-vice chancellor (research) at the University of Technology Sydney, Turney’s favourite book is The Medici Effect by Frans Johansson. “Inspired by the Medici family in Florence, the idea is that when you get together different disciplines, different cultures, different genders, a whole range of backgrounds, then things start to spark,” he says. “If you have engineers talking to historians talking to biologists, suddenly they just have a different approach to the way of thinking. That’s where those huge innovations happen. When you bring those disciplines together all sorts of things start flying around.”

Turney collaborated with colleagues from a range of scientific disciplines on a paper named to honour Douglas Adams, the late, great author of the science fiction novel The Hitchhiker’s Guide to the Galaxy. Adams famously wrote that the answer to life, the universe and everything was 42.

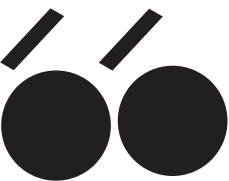
Turney and his biologist, archaeologist and climate scientist collaborators investigated the last time the Earth switched its magnetic poles, 42,000 years ago. North became south and south became north and, for a while, the Earth’s magnetic field effectively collapsed to near-zero, exposing the planet to a barrage of high-energy cosmic rays.



This bombardment drove extreme climate impacts, probably leading to megafauna extinctions, the growth of ice sheets in North America and an explosion of rock art in caves, where it was protected from the elements.

Turney is keen to foster interdisciplinary and inter-sector collaborations in order to find solutions to the manifest problems the world is now facing, particularly the multifaceted disaster of climate-change repercussions.

“The world is in such an extraordinary period of disruption



We don’t
have time to
wait 10, 20
years

and universities have such an important role to play in helping to get ideas out, or problem solve,” he says.

“We don’t have time now to wait 10, 20 years for these ideas to get from the lab out into society, we need to accelerate it, rapidly, in the next couple of years.”

Decarbonising the economy to slow global warming will require a herculean effort of co-operation and hard work, Turney says.

“We don’t have any time; industry and government see that. Internationally other nations are

ahead; we have a lot of catching up to do.”

He firmly believes cross-discipline university partnerships with government and the private sector are the way to tackle climate change. “Industry is saying you have to get this sorted, otherwise the economy will fall off a cliff,” he adds.

“Some studies show that for every one degree of warming you knock 1 per cent off GDP. So anything beyond two degrees is basically permanent recession. That focuses the mind.”

Sian Powell



any of the social and environmental challenges currently facing Australia are also impacting much of the world. Recovery from the global

pandemic, managing increasing climatic uncertainty, the major challenge of decarbonisation of the economy, and food and water security concerns are just a few of the urgent priorities affecting communities across the world.

Over the past five years, the University of Southern Queensland (UniSQ) has delivered world-class research, a broad education program and meaningful engagement with communities, both domestically and internationally.

The university punches above its weight, and was ranked first in Australia, and eighth globally, in the 2022 Leiden CWTS Rankings for the proportion of top one per cent of cited papers published by UniSQ authors.

Focused across four targeted flagship areas, UniSQ's research expertise is well positioned to enable a targeted response to address these major challenges.

Space and defence

UniSQ is a leading institution in the development of Australia's sovereign space capability. Recently announced as one of Australia's Trailblazer universities, UniSQ is working in partnership with the Australian National University, the University of South Australia and more than 15 industry partners to lead the Innovative Launch, Automation, Novel Materials, Communications and Hypersonics (iLAUNCH) Program. iLAUNCH will deliver the industrial and R&D ecosystem that is essential to ensuring that emerging technology manufacturers can capitalise on commercial opportunities, improve Australia's skills in the space sector, provide new jobs and boost the economy.

The university is home to world-class infrastructure and equipment, including the Mount Kent Astronomical Observatory, Queensland's only professional research and teaching observatory for astronomical space sciences. The observatory is providing the key support role from the southern hemisphere for NASA's Transiting Exoplanet Survey Satellite (TESS) mission, which uses transit photometry to detect exoplanets near our solar system.



Professor John Bell

Regional presence, international impact

Regional development

UniSQ's Institute for Resilient Regions leads the university's Regional Development Flagship by focusing on social science research supporting regional communities to embrace change, adapt and innovate, all while maintaining their identity. The institute is leading the Southern Queensland and Northern NSW Drought Resilience Adoption and Innovation Hub (SQNNSW Innovation Hub) under the Australian government's Future Drought Fund program, drawing together the university's strength in agriculture, climate science and regional economic development to address one of the long-term threats to Australia's economic prosperity – drought!

Agriculture

Complementing the SQNNSW Innovation Hub, UniSQ's Centre for Applied Climate Sciences' core business areas cover climate risk management and innovative insurance systems for government, agribusiness, and smallholder farmers throughout most of Southeast Asia, as a key collaborator in the International Climate Initiative supported by the German government.

The centre is heavily engaged in major

international drought and agricultural climate research and management programs within the United Nations' World Meteorological Organisation and the associated Integrated Drought Management Program.

As an internationally recognised leader in improving the profitability, environmental sustainability and socio-economic wellbeing of rural industries and their natural resource base, UniSQ's Centre for Agricultural Engineering has enabled Australian farmers to be among the first in the world to benefit from innovative technologies that are shaping the farms of the future. Through a longstanding partnership with American agricultural machinery manufacturers John Deere, the centre has developed machine vision applications that are revolutionising modern farming.

Health

Researchers from UniSQ's Centre for Health Research have received \$5m in funding from the Medical Research Future Fund to develop interventions that improve access to evidence-based psychosocial and mental health care for vulnerable populations, such as children and people in geographically isolated regions.

UniSQ's Professor Jeff Dunn AO was voted president-elect of the Union for International Cancer Control (UICC). This is a prestigious appointment to the world's top cancer control organisation and recognises Professor Dunn's extensive career and dedication to working towards eliminating cancer. As chair and program director of UniSQ's Centre for Health Research's Social and Behavioural Science team, Professor Dunn is tackling a globally significant health issue through the application of evidence-based strategies to improve the quality of life for people who have been diagnosed with cancer, particularly in rural or regional communities.

UniSQ will continue to build capacity in industry, produce the next generation of future research leaders and help global communities to embrace change and alleviate the uncertainty of the future.

Professor John Bell

Deputy Vice-Chancellor (Research and Innovation)

University of Southern Queensland

Life Sciences & Earth Sciences

Australia's research field leaders

These are the top researchers and institutions in the 30 fields of life sciences and earth sciences



Jodi Rowley
Australian Museum
Field leader in
Zoology

As a biologist with a keen interest in amphibians, particularly frogs, Jodi Rowley is hit with seemingly never-ending bad news: increasing numbers of frog species under threat, frog habitat destruction and spreading disease.

Yet she is heartened by the enthusiasm of tens of thousands of Australians prepared to stand in swamps and other waterways to record frog calls and contribute to the massive citizen science FrogID project which she leads.

Amphibians are one of the least understood and most endangered groups of animals on the planet, Rowley says, noting that according to the authoritative IUCN Red List, 41 per cent of amphibian species worldwide are threatened with extinction.

"Habitat loss and modification globally are probably the biggest threat to amphibians," says Rowley, a leader in her field of zoology. "They are very sensitive to any kind of environmental disturbance."

Also adversely affected by pollution, global warming, extreme weather, invasive species and exotic diseases, amphibian species can sometimes begin

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Agronomy & Crop Science

Field leader: Rajeev Varshney, Murdoch

Lead institution: CSIRO

Animal Behaviour & Ethology

Field leader: Martin Whiting, Macquarie

Lead institution: Macquarie

Animal Husbandry

Field leader: Jennie Pryce, La Trobe

Lead institution: Uni of Sydney

Atmospheric Sciences

Field leader: Pep Canadell, CSIRO

Lead institution: CSIRO

Biodiversity & Conservation Biology

Field leader: James Watson, UQ

Lead institution: UQ

Biophysics

Field leader: Sharon Robinson, Uni of

Wollongong

Lead institution: Uni of Sydney

Birds

Field leader: Leo Joseph, CSIRO

Lead institution: ANU

Botany

Field leader: Kadambot Siddique, UWA

Lead institution: UWA

Cell Biology

Field leader: Lei Jin, Uni of Newcastle

Lead institution: Uni of Sydney

Developmental Biology & Embryology

Field leader: Rebecca Lim, Monash

Lead institution: Monash

Ecology

Field leader: Jane Elith, Uni of Melb

Lead institution: UQ

Environmental Sciences

Field leader: Lidia Morawska, QUT

Lead institution: UQ

Evolutionary Biology

Field leader: Bui Quang Minh, ANU

Lead institution: ANU

Forests & Forestry

Field leader: David Forrester, CSIRO

Lead institution: CSIRO

Geochemistry & Mineralogy

Field leader: Nigel Cook, Uni of Adelaide

Lead institution: Curtin

Geology

Field leader: Peter Cawood, Monash

Lead institution: Curtin

Hydrology & Water Resources

Field leader: Albert van Dijk, ANU

Lead institution: CSIRO

Insects & Arthropods

Field leader: Phil Taylor, Macquarie

Lead institution: CSIRO

Life Sciences & Earth Sciences (general)

Field leader: Edward Holmes, Uni of Sydney

Lead institution: UQ

Marine Sciences & Fisheries

Field leader: Navid Moheimani, Murdoch

Lead institution: CSIRO

Microbiology

Field leader: Philip Hugenholtz, UQ

Lead institution: UQ

Mycology

Field leader: Tom May, RBG Victoria

Lead institution: Uni of Sydney

Oceanography

Field leader: Alistair Hobday, CSIRO

Lead institution: CSIRO

Paleontology

Field leader: Anthony Romilio, UQ

Lead institution: UQ

Pest Control & Pesticides

Field leader: Bhagirath Singh Chauhan, UQ

Lead institution: UWA

Plant Pathology

Field leader: Bhagirath Singh Chauhan, UQ

Lead institution: UQ

Proteomics, Peptides & Aminoacids

Field leader: David Greening, Baker

Lead institution: Monash

Soil Sciences

Field leader: Budiman Minasny, Uni of Sydney

Lead institution: Uni of Sydney

Sustainable Development

Field leader: Jian Zuo, Uni of Adelaide

Lead institution: UQ

Zoology

Field leader: Jodi Rowley, Australian Museum

Lead institution: JCU

Life Sciences & Earth Sciences Australia's research field leaders



Jodi Rowley shows a green tree frog to school children

John Appleyard

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to recover with a little assistance.

Rowley wrote her doctoral thesis on whether the differing behaviour of certain frog species in Far North Queensland rendered them more or less susceptible to chytridiomycosis, a deadly fungal disease which has spread around the world and which is responsible for the extinction of hundreds of species globally and at least four in Australia.

She attached tiny radio transmitters to a number of frogs with waist belts and then stalked them through the rainforest for weeks to determine whether natural “friendly” behaviour, such as touching one another and bathing with one another in pools, contributed to the disease spread in certain species.

She found it did, and other species, with

individuals happy to spend time alone sunbathing on a hot rock or up high in the tree canopy, were less affected by the disease.

Now living in Sydney, with a joint appointment at the Australian Museum (80 per cent of her time) and the University of NSW (20 per cent), Rowley researches amphibian and reptile biodiversity and engages the public with the Museum’s FrogID project.

Hundreds of thousands of people have downloaded the FrogID app since the project began five years ago and more than 30,000 people have contributed about 450,000 audio recordings of frog calls to the database so far, Rowley says.

“It has been a massive game-changer,” she says. “There’s not so many frog biologists or herpetologists around. We’re at this moment in history where frogs need rapid conservation

decisions based on real information and we don’t have enough of that. We’re making guesses.”

Data provided to FrogID by interested citizens can help scientists understand how frogs are faring, the sorts of habitat they’re breeding in, how they’re affected by bushfire, drought, climate change and urbanisation, and, over time, frogs’ rate of retreat in Australia’s wild places.

“It has revolutionised our understanding of frogs while at the same time raising the profile of frogs in Australia,” Rowley says. “We managed to write a scientific paper based on FrogID data after the bushfires. It was the first paper anyone had published with real, extensive, data on the impact of the Black Summer bushfires on Australia’s biodiversity.”

Sian Powell

People around the world are facing more challenges than ever before. The broad issue of decarbonising our economy and improving sustainability, enduring extraordinary weather events, the rising cost of living and having the resources to support a growing population are just some of the issues we are grappling with.

Such unprecedented times are driving increased uncertainty and triggering a need for change across diverse areas, from climate to health, from economics to politics.

Research plays a crucial role in informing and transforming the way we respond to evolving circumstances, helping us recognise critical issues early and developing sustainable solutions that ensure a better future for us all.

Flinders University's talented researchers and innovators play a pivotal role in this mission, having long challenged conventional wisdom while creating new ways of thinking.

Be it bio-engineering living brain cells to find solutions to incurable brain disorders or investigating better approaches to sustainability, Flinders researchers are instrumental in finding solutions to our most pressing priorities.

As need expands, so must our effort. Flinders' research activity and income continues to grow – by some 70 per cent in the past four years. In 2022, Flinders will surpass its previous annual record of research funding from nationally competitive grants, and our strong history in building and maintaining leading partnerships has seen us continue to work closely with industry.

Our enormous success in research endeavours also proves fruitful for our international rankings, including the influential Times Higher Education rankings where we sit comfortably within the leading 350 universities globally.

Our research successes are driven in part by our determination to be ranked within the top one per cent of universities worldwide.

Several outstanding achievements over the past year stand as powerful evidence of our progress in research. For example,



Deputy Vice Chancellor (Research) Professor Robert Saint

Research is on the rise, in times that matter most

Flinders ranked seventh in the country for National Health and Medical Research Council grants won by a university.

We've seen recent success in transformational research proposals, including a Flinders-led successful bid for a Cooperative Research Centre that is designed to create a major sustainable Australian marine bioproducts industry.

Flinders recently won a \$32m federal Health Department contract to establish a national centre for research in aged care management. The centre – Aged Care Research and Industry Innovation Australia (ARIIA) – is radically boosting the quality and depth of aged care research. We have also helped accelerate growth in advanced manufacturing through our Line Zero Factory of the Future manufacturing growth accelerator in our Tonsley innovation district, thanks to new commitments of \$14m from the South Australian and federal governments.

Flinders University, working alongside BAE Systems Maritime Australia and a

range of other industry partners, shares a bold vision to boost our country's high-value manufacturing industry and unlock 4000 jobs over five years, adding to the economic prosperity in this state for generations to come.

We recently secured our first ARC Discovery Indigenous grant, bringing together a team of extraordinarily talented Indigenous creative art practitioner women to examine the generational impacts of colonial institutions and archives on Indigenous culture.

Together with outstanding recent success in young

Indigenous researcher-led health research funding and new health research initiatives through the central corridor of Australia, from Adelaide to Darwin, Indigenous research at Flinders will continue to have a huge positive impact on Australians. Recently, we launched our new \$2.5m photoemission electron microscope that will be instrumental in progressing research into biofuels, the hydrogen energy industry, and help local companies develop their next generation of hi-tech products and services.

On an even grander scale, a new \$255m Health and Medical Research Building is currently under construction.

This is the first building in our Flinders Village initiative – a community hub in the heart of our health and medical research precinct on the Bedford Park campus in South Australia.

As a leading biomedical research facility, the Health and Medical Research Building will enable collaboration between researchers, healthcare and industry partners.

These achievements of the past few years are testament to our research excellence. The work of persistent and committed researchers continues to improve the lives of Australians and people around the world, and Flinders University is proud to play a leading role in securing a prosperous and healthy future for generations to come.

Professor Robert Saint
Deputy Vice Chancellor (Research)
Flinders University

PARTNERING FOR A **SUSTAINABLE** FUTURE



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