

NATIONAL INSTITUTES GRANT REPORT



Minister for Health, the Honourable Greg Hunt MP meets with researchers from the John Curtin School of Medical Research as part of an event to announce NHMRC funding in December 2017.

The Australian National University was set up in 1946 with a special charter – to give the nation a university that would ‘advance the cause of learning and research in general, and take its rightful place among the great universities of the world.’

The allocation of the National Institutes Grant (NIG) gives the University the ability to deliver on this momentous responsibility and to contribute to a world class tertiary sector.

It is the means by which ANU is able to maintain and enhance crucial concentrations of excellence in research in critical areas of national importance to Australia and its future.

It supports the development of Australia’s national unity and identity, of understanding the history, and culture of its Indigenous peoples, its neighbours in the Asia-Pacific region and how it fits into the world.

It allows the University to act as a national, regional and international public policy resource to address major issues confronting governments, business and communities. And it also allows ANU to be a nexus to maintain and further develop long-term strategic relationships with government, business, other universities, institutions and the public, both within Australia and internationally.

The NIG has enabled long-term and blue-sky research and has played a significant role in the University’s capacity to undertake research of strategic value to the nation.

It has provided the security and stability that has enabled ANU to make the discoveries that have proved transformational for Australian and global industries and has given business the confidence to engage with ANU over the long term.

The grant is what gives ANU the opportunity to live up to its unique charter – to create and keep creating a reservoir of great basic research, ideas, knowledge and expertise that will drive the development of this century and beyond.



Courtesy of Inamori Foundation

Case Study

ANU scientist Graham Farquhar first Australian to win Kyoto Prize

ANU distinguished scientist Dr Graham Farquhar AO is the first Australian to win a Kyoto Prize – the most prestigious internal award for fields not traditionally honoured with a Nobel Prize. Dr Farquhar won the 2017 Kyoto Prize in Basic Sciences for his life’s work in plant biophysics and photosynthesis, which has involved research on water-efficient crops and the impacts of climate change. With support of the National Institutes Grant funding, Dr Farquhar has helped develop new water-efficient varieties of wheat, improved global food security, and found evaporation and wind speeds are slowing as the climate changes. The prize is the latest in a string of accolades, including the Prime Minister’s Prize for Science in 2015 and Britain’s prestigious Rank Prize, which he shared in 2014 with CSIRO colleague Dr Richard Richards.

Dr Farquhar was appointed an Officer in the Order of Australia (AO) in 2013, and won the 2016 Australian Academy of Science Macfarlane Burnett Medal and Lecture. He was elected a Foreign Associate of the US National Academy of Sciences in 2013, and was a member of the United Nations Intergovernmental Panel on Climate Change which won a Nobel Prize in 2007.

Dr Farquhar first came to ANU as an undergraduate, completing his Bachelor of Science in 1968. He returned to the University to complete his PhD in Environmental Biology in 1973. He was appointed a Distinguished Professor at the ANU Research School of Biology in 2004, and he is a Chief Investigator at the Australian Research Council Centre of Excellence for Translational Photosynthesis, which is based at ANU.

Improving Australia's understanding of itself and the history and culture of its Indigenous peoples

- > Aboriginal and Torres Strait Islander Health Program
- > Indigenous Australian Dictionary of Biography
- > Songlines: Tracking the Seven Sisters
- > First Nation's Forum



Jack Dale painting, used with kind permission from Malcolm Allbrook.

Aboriginal and Torres Strait Islander Health Program

The Aboriginal and Torres Strait Islander Health Program conducts cutting-edge innovative and multidisciplinary large-scale research in areas across the social and cultural determinants of Aboriginal and Torres Strait Islander health and wellbeing. The Program has a strong focus on collaborating closely with policymakers, and generating policy-relevant evidence. The Program is rapidly growing and currently comprises more than 10 staff members within the Research School of Population Health, the majority of whom identify as Aboriginal and/or Torres Strait Islander. The program was influential in the establishment of the Indigenous Alumni Association and is the convener of the Indigenous Data Sovereignty Network for Australia. In 2017 the program conducted research into reducing cardiovascular disease (CVD) in Aboriginal and Torres Strait Islander people through increasing absolute CVD assessment and management.

Indigenous Australian Dictionary of Biography Project

The Indigenous Australian Dictionary of Biography Project will add 190 new Aboriginal and Torres Strait Islander biographies to the ADB which, although it has published nearly 13,000 biographies since its first volume in 1966, has tended to under-recognise the contribution of Indigenous people to the Australian story. A special stand-alone Indigenous ADB will be published at the end of the project.

Songlines: Tracking the Seven Sisters

The Centre for Heritage and Museum Studies delivered a public research outcome of a major exhibition at the National Museum of Australia *Songlines: Tracking the Seven Sisters*. This exhibition provides a national platform on which to present the research outcomes of Indigenous and scholarly essays, films, installations and curated artworks that communicated to the wider public the importance of Aboriginal songlines.

First Nations Forum 2018

As a result of the extensive work already done by the ANU National Centre for Indigenous Studies, ANU will host a major forum in July 2018 on national Indigenous policies and governance, taking in the lessons from First Nations around the world and including participation from Aboriginal and Torres Strait Islander federal politicians. The First

Nations Forum will provide solid policy options to help Australia advance Indigenous governance, recognition and policies. The Forum will be a significant opportunity to examine what's important for First Nations. As the national university, ANU is in a unique position to convene this debate.

Indigenous Justice

The Centre for Aboriginal Economic Policy Research (CAEPR), a multidisciplinary Indigenous policy research team is a unique national and international centre and leading research think-tank on Indigenous policy issues. It has an unrivalled reputation and track record in difficult public policy debates of national significance. CAEPR engages with the Indigenous welfare reform agenda with published analysis of welfare reform initiatives, directly impacting Indigenous employment and welfare policy debate. In 2017 CAEPR hosted an international workshop on Indigenous Justice attracting both government and academic attendees and international visitors from the USA and New Zealand.

National Centre for Indigenous Genomics

Study of the human DNA code is leading to breakthroughs in our understanding of health and disease at the level of specific population groups. The National Centre for Indigenous Genomics aims to create a repository of Indigenous bio specimens, genomic data and documents for research and other uses that benefit Indigenous donors, their communities and descendants, the broader Indigenous community and the general Australian community. ANU established the National Centre for Indigenous Genomics in 2013 on the recommendation of an external committee of Indigenous Australians. In 2014 NCIG commenced a process of consultation with Indigenous communities, families and individuals represented in the collection. Since late 2016, a framework is being created to ensure that Indigenous Australians are included, in ways that they decide, in the health, economic, educational and social benefits of advances in genome science. ANU Council approved the *National Centre for Indigenous Genomics Statute*, acknowledging the University's respect for the principle of Indigenous decision making with regard to the collection. Extensive policy and protocol development and review has been undertaken in 2017. Consultation with the Indigenous community on the NCIG was ongoing in 2017, with discussions in the Tiwi Islands and Cape York undertaken to date.

Indigenous Admissions Pathway

In 2017, following extensive consultation and engagement with Indigenous people from the community and medical student body, ANU academics and ACT Health representatives, the ANU Medical School successfully implemented an Indigenous Admissions Pathway into the Doctor of Medicine and Surgery (MChD). As a result, the number of Indigenous applicants increased more than three-fold in 2017. The Indigenous Admissions Pathway was implemented to provide greater opportunity and access to medical education for Indigenous persons who may not have otherwise thought it possible to gain entry into postgraduate medicine, given the increasingly high entry requirements.

Summer School for Indigenous Science Students

The Tjabal Indigenous Higher Education Centre, the ANU Joint Colleges of Science and the ANU College of Engineering and Computer Science run a Summer School for Indigenous Science students to provide learning experiences to help inform education and career aspirations and goals.

Repatriations

The School of Culture, History and Language supported the repatriation of language recordings to the Kaiadilt community of Northern Australian and ancestral remains to the Barkindij people. The ancestral remains were reburied in the Kinchega National Park and an apology to the Barkindij people was delivered.

Improving Australia's understanding of its Asia-Pacific neighbours and its place in the international community

- > ANU Asian languages that are rarely taught nationally will be made available online
- > Launch of the Pacific Research Program
- > 21st Century Regulation and Governance Challenges
- > Challenging accepted development models in Southeast Asia



Asian languages available online

ANU Asian languages that are rarely taught nationally will be made available online through Open Universities Australia (OUA) from 2018. This will help build on the University's position as Australia's primary tertiary education provider of less commonly taught Asian languages. Making the courses available to more students through OUA is a positive step which will help Australia better understand the unique history, language and culture of our geographic neighbourhood.

Pacific Research Program

The Pacific Research Program (PRP), started on 1 October 2017, is designed to be a globally pre-eminent centre of excellence for research on the Pacific. ANU would not have received the PRP funding without the University's continued investment in Pacific research, utilising NIG funding as a primary source to build critical mass in this area. The PRP provides five core research programs addressing key policy issues in the region across research themes, economic development in the Pacific including research capacity building such as the research colloquium, fellowships and broad outreach and engagement through media and MPs.

Expertise in Asia and Pacific Affairs

- > ANU became a member of the Non-Traditional Security Consortium based at RSIS Singapore.
- > ANU continues to host the Australian arm of the Council for Security Cooperation in the Asia Pacific.
- > ANU commenced a new multi-constituency study to examine the operation of Constituency Development Funds in the Solomon Islands.



- > Academic staff of the University participated in a roundtable with officials from Singaporean intelligence agencies to discuss the implications of the Trump presidency for Asia.
- > The School of Regulation and Global Governance held the 21st Century Regulation and Governance Challenges event, where the former President of Kiribati spoke and took part in a radio panel recorded by ABC Radio National.
- > Academic staff from the ANU College of Asia and the Pacific took part in a delegation to the University of the South Pacific (USP) to renew and strengthen collaborations with the University. A delegation from the USP met scholars and officials of the College at ANU in April 2017. The two universities are collaborating in a number of research areas including climate change, sustainable development and marine governance.
- > A new collaboration agreement with the Mongolian Ministry of Education, Culture and Science will promote and teach the Mongolian language and culture.
- > Professor Robert Cribb of Coral Bell School of Asia Pacific Affairs won the prestigious General History Prize at the NSW Premier's History Awards.

Southeast Asian Resources Project

The Southeast Asian Resources Project, commenced in 2017, is a collaboration between the School of Culture, History and Languages and ANU Archives to systematically document the vast collection of materials collected by staff and students in recent decades to develop a resource for future generations.

Challenging accepted development models in Southeast Asia

Research on water and agricultural development in the Mekong region has quantified the trade-offs among hydropower development, fishery production and food security in the Mekong region and found considerable perverse food security, livelihood and environmental impacts from intensification of rice production, challenging accepted development models in SE Asia. This has sparked academic and policy debates over better models for sustainable development in SE Asia in the energy, water and food sectors given unexpected cross-sectoral trade-offs. The import of replacement foods to increase the protein supply (given the loss of wild fish) has caused the Vietnamese Government to revise its agricultural policy away from further intensification of rice production.

Contributions to the Indonesian national seismic hazard map

An earthquake hazard research project in Indonesia is supporting research and education in earthquakes and active tectonics and made important contributions to the 2017 update of the Indonesian national seismic hazard map. In Timor-Leste, an ANU collaboration with Geoscientists Without Borders is establishing earthquake monitoring with the Institute of Petroleum and Geology in Dili.

Shaping the global climate change research agenda

Research from the Fenner School of Environment and Society has established that urbanisation, together with air pollution, is the main contributor to the increased heavy rainfall and its spatial distribution at regional and subcontinental level in China, meaning the way we build our cities is contributing to and responsible for the increasing flooding in these cities. The outcomes of this research is shaping the global research agenda, including the scoping of the next round IPCC report, a highly influential assessment in shaping climate change policy internationally.

4D tectonic plate reconstruction

Computer software for 4D tectonic plate reconstruction has been developed allowing the systematic reconstruction of subducted lithospheric plates revealing jigsaw patterns of torn and disrupted tectonic plates. This gives an empirical ability to predict the location of the largest mineral deposits found to date in Indonesia and provides a new approach to aid in the process of targeting locations for mineral exploration.

Warramunga seismic and infrasound Earth monitoring arrays

Operational support for the Warramunga seismic and infrasound Earth monitoring arrays has provided structural information on the Australian continental lithosphere and characterisation of earthquakes on the Australian plate boundary relevant to quantifying earthquake and tsunami hazard in our region. This unique facility, in terms of its ability to accurately locate and monitor illicit global nuclear weapons testing, has obtained additional funding support from the United Nations Comprehensive Test Ban Treaty Organisation (CTBTO) for data recording and delivery into the International Monitoring System on behalf of the Australian Government.

Science for publics with disability

The Australian Centre for the Public Awareness of Science's (CPAS) 'Science for publics with disability' initiative uses science to engage students with intellectual disabilities, helping them observe what is happening around them, evaluate what it means, and then help them provide a reasoned response. The program is now being implemented across Africa with a specific focus on intellectual disability and trauma. Several countries in the southern part of Africa have used CPAS's model and are now looking to extend the program and make it sustainable at a local level. To date, over the past six months, they have trained 370 teacher/trainers who are currently impacting 3,500 intellectually disabled students in these countries.

Providing a regional, national and international public policy resource that addresses major issues confronting governments, industry and communities

- > James R Clapper in conversation with Kim Beazley
- > Inaugural Myanmar – Australia Strategic Dialogue
- > DFAT Foreign Policy White Paper
- > Consultation to Referendum Council regarding Indigenous peoples recognition in the Constitution





Asia and the Pacific's leading graduate public policy school

The ANU Crawford School of Public Policy continues to be Asia and the Pacific's leading graduate public policy school and is ranked fifth in the world, playing an essential role in shaping public policy through research, education and policy engagement. Crawford School is home to influential publications including the journal *Asia and the Pacific Policy Studies*, and publications such as *East Asia Forum*, *Dev Policy Blog*, *Policy Forum*, *Solutions and Advance*.

The 2017 ANU Crawford Leadership Forum, opened by the Foreign Minister, the Honourable Julie Bishop, was attended by influential leaders in business, politics, public service and academia from Australia and around the world. ANU also hosted the Honourable James R Clapper AO, former US Director of National Intelligence, and the Honourable Kim Beazley AC, former Ambassador to the United States, for a public lecture 'The future of Australia's American alliance'.

The Development Policy Centre (DevPol) hosted the fourth annual Australasian Aid Conference in partnership with The Asia Foundation, bringing together researchers from across Australia, the Pacific, Asia and beyond who are working on aid and international development policy to share insights, promote collaboration, and help develop the research community. The Conference attracted some 500 participants, policymakers, practitioners and academics to discuss and debate the latest development issues. DevPol has carved out the leading role in this country in terms of fostering and stimulating debate on development issues, continuing to impact stakeholders in Australia and Asia through research, events and their blog.

The East Asian Bureau of Economic Research (EABER) and the Australia-Japan Research Centre (AJRC) are both supported by the National Institutes Grant. EABER has a program of collaborative research and policy influential activities that encompass 46 of the top economic policy think tanks across Asia. It has recently been the base for the most far-reaching study of the Australia–China economic relationship with the engagement of both governments, for presentation to the Australian Prime Minister and the Chinese Premier. AJRC is supporting major higher educational reform in Japan involving participation of a succession of Japanese ministers and education.

Commencing in mid-2016, the Individual Deprivation Measure (IDM) is a new, gender-sensitive and multidimensional measure of poverty. The IDM Program is resulting in increased international collaboration with a number of Asian and African institutions, with the aim of having the IDM ready for global use as an individual measure of deprivation and a tool for tracking how development is changing the lives of the most deprived by 2020.

Inaugural Myanmar – Australia Strategic Dialogue

A team from the Coral Bell School of Asia Pacific Affairs was deployed to Myanmar to organise the inaugural Myanmar – Australia Strategic Dialogue, an event which included senior participants from the Australian and Myanmar governments. The Dialogue was the first event of its kind drawing in government representatives, military officers, business figures, think tank leaders, and academics from the two countries.

Bespoke policy work

There was a significant amount of bespoke policy work undertaken by staff of the University in 2017. For example:

- > Consultation was undertaken with the Referendum Council to plan out Indigenous language translations of a plain-language discussion paper on issues of recognising Aboriginal and Torres Strait Islander peoples in the Constitution.
- > Staff from the Coral Bell School of Asia Pacific Affairs participated in a meeting with DFAT officials to provide advice on DFAT's foreign policy white paper.
- > The *2017 East Asia Forum Quarterly on Japan* was distributed to over 8,500 print subscribers internationally and domestically and was received by all Australian parliamentarians with articles cross-posted online and in the *Australian Financial Review*.

- > New Mandala – the world’s pre-eminent website devoted to Southeast Asian Studies – provided cutting-edge commentary on major issues across the region.
- > Staff represented the Public Health Association of Australia at the DFAT Trade Division’s stakeholder meeting for peak bodies on international trade negotiations.
- > Advice was provided in best practice in regulatory design and enforcement with the US Government Accountability Office.
- > A keynote speech was delivered to the European Health Ministers Forum in Austria which facilitated the establishment of a framework for advising and developing European health policy.
- > Headed the 2017 review of the National Vocational Education and Training Act 2011.
- > Provided cross-college contribution to scoping opportunities for integration of gas and electricity networks in the ACT, developing frameworks of operational and market integration models to guide related policy.
- > Designed the Northern Territory Education Department Curriculum on Indigenous Language of 2017.
- > Undertook work for the Queensland Government that is credited with the re-establishment of a Queensland Drugs Court.
- > An academic staff member is currently appointed the Visiting Cabinet Historian of the National Archives of Australia, advising on the selection and presentation of the Cabinet records released by the Archives each year.
- > Led a number of major commissioned works by the Victorian Government to inform the Forest Industry Task Force.

Enhancing Australia’s prosperity through research in areas of national importance to Australia

- > ANU Grand Challenges Scheme
- > Understanding how the Southern Ocean responds to climate change
- > Sustainable Farming Initiative: to improve farm productivity and farmer wellbeing
- > Recovery and management of endangered and iconic Australian birds
- > Future Engineering Research Leaders



New discoveries in the dynamics of Southern Ocean circulation

The ANU Marine Science Initiative has produced a new understanding of how the Southern Ocean responds to climate change, specifically that the Southern Ocean can only be modelled correctly when turbulent eddies are resolved. This has created new discoveries in the dynamics of Southern Ocean circulation and feedback between the Southern Ocean and Antarctic coastal waters and has resulted in widespread adoption of high-resolution ocean models, including development of a fully coupled version of Australia's climate model. ANU is #1 in Australia for Earth and Marine Sciences and #13 in the world (*QS World University Rankings 2017/2018*).

World-leading research capability on management of agro-ecological landscapes for human wellbeing and environment outcomes

The Sustainable Farming Initiative is a unique environmental economic and mental health initiative that has major national rural and regional implications for the agricultural sector and is partnering with key philanthropic foundations as well as important industry bodies such as Meat and Livestock Australia. The long-term objective is to catalyse major changes in farming practices and management behaviour that leads to agricultural production that is ecologically sustainable and at the same time leads to better farm productivity and profitability as well as significantly improved farmer wellbeing.

Recovery and management of endangered and iconic Australian birds

In 2017 research on recovery and management of endangered and iconic Australian birds identified the characteristics of ideal Superb Parrot nest hollows, nest tree fidelity, competition with other species and mapping of foraging areas in urban Canberra. On-ground interventions to save the world's most endangered bird species, the Orange-Bellied Parrot, from extinction have been undertaken. Results from the Superb Parrot research have been incorporated into decisions by the ACT Government, and a specialist ANU-based group Difficult Bird Research Group has been formed to research recovery actions on highly challenging critically endangered species. As a result of the Superb Parrot research, the NSW Government has now funded long-distance GPS trackers that will, for the first time, allow us to establish where Superb Parrots migrate to in the winter. The Difficult Bird Research Group has become the 'go-to' group for difficult critically endangered bird species.

Australasian Pollen and Spore Atlas

The Australasian Pollen and Spore Atlas is a unique national project. Following on from the 2016 National Institutes Grant Report, ANU researchers are now part of the AusPollen Network that is providing data to government departments to assist in developing a forecasting and warning system for future severe weather events. Further, in collaboration with the University of Tasmania a new respiratory health app, AirRater.org has been rolled out and trialled in the ACT and Tasmania, with the intention of making it available across the country.

Doubling the efficiency of solar cells

The computer-aided chemical design group in the Research School of Chemistry uses state-of-the-art quantum chemistry calculations to identify and explain the mechanism, kinetics and thermodynamics of complicated multistep chemical processes. The group have been using modelling and simulations done on the National Computational Infrastructure's Raijin to develop a method for doubling the efficiency of solar cells. The team modelled the performance of different molecules' interaction with the dye in dye-sensitised solar cells, and developed several compounds with potential to improve the efficiency of these solar cells. A solar cell was manufactured using one of the new compounds, resulting in the efficiency of the solar cell doubling.

New discoveries in biodiversity change and responses to management interventions

Researchers from the Fenner School of Environment and Society (FSES) are monitoring and understanding environmental change in Australia, with many key new discoveries about biodiversity change and responses to management interventions made in 2017, for example weed control and revegetation. Empirical analyses from the long-term datasets associated with this research produced several ecological and management surprises in 2017. One of many was the discovery that replanted vegetation acts as a drought refuge for many species during extreme temperatures and extreme rainfall depression. FSES produces an annual Australia's Environment Report, which is widely referred to and used, particularly by local governments and bodies.

Future Engineering Research Leaders

The Future Engineering Research Leader (FERL) PhD Scheme was launched in 2017. This scheme will provide up to ten 50 per cent scholarships for jointly awarded PhDs with other Go8 Universities and top international universities. The FERL PhD Scheme can also be used by researchers to attract PhD candidates from top institutions who would normally not come to Australia to do their PhD. The FERL PhD Scheme is raising the profile of Australian research training and enhancing sector collaboration.

Research outcomes in physics and engineering

Benefits from a number of long-term initiatives in physics and engineering, supported by the National Institutes Grant, were realised in 2017, including:

- > New miniature sensors developed at ANU could be the key to future safer medical imaging and security scans. The team developed a detector for terahertz radiation made from nanowires one hundredth the diameter of a human hair, a million times smaller than the current technology. The devices have great potential for compact imaging and spectroscopy systems because of their nanoscale resolution and broad detection bandwidth. It is the first time that nanowires have been used for terahertz time-domain spectroscopy.
- > Quantum internet is a step closer after ANU scientists have found a new way to store quantum data long enough to share the information around a next-generation internet. The improved storage is an important part of a viable quantum internet, allowing a global network to be built to connect quantum computers. The team used a rare earth element, called erbium, in a crystal to increase the storage time of telecom-compatible quantum memory by 10,000 times compared to previous efforts.
- > Research has discovered the most efficient packing of objects such as grains and pharmaceutical drugs. The knowledge could be vital for building skyscrapers on sand, understanding how grains were stored in silos, or how drugs were packed and delivered to specific targets in the body. The team used high-resolution CT scans to reveal how spherical particles in a disordered arrangement settle and compact themselves into ordered patterns. The team used the relatively new field of mathematics known as homology to interpret 3D X-ray microscope images and large-scale computer simulations.
- > A team of physicists at ANU have used a technique known as 'ghost imaging' to create an image of an object from atoms that never interact with it. This is the first time that ghost imaging has been achieved using atoms, leading to applications being developed for imaging and remote sensing through turbulent environments and may lead to a new method for quality control of nanoscale manufacturing, including atomic scale 3D printing.
- > A suitable material to allow brain cells to grow and form predictable circuits has been developed as part of a multidisciplinary collaboration at ANU, which could lead to the development of prosthetics for the brain. The study is the first to show the neuronal circuits grown on the nanowire scaffolds were functional and highly interconnected, opening the potential to apply their scaffold design for neuro-prosthetics.

Case Study

ANU Grand Challenges Scheme

In 2017 the ANU Grand Challenges Scheme, fully funded by the National Institutes Grant, was established to fund transformative research with the potential to radically change our understanding of, and responses to, the world's most intractable problems. The Grand Challenges Scheme addresses objectives of the ANU Strategic Plan 2017–2021 to ensure the University delivers on its unique national responsibilities and to conduct research with global relevance and impact.

Five Grand Challenges will be identified between 2017 and 2021, with the expectation that one Grand Challenge will be announced each year. Following an extensive assessment and selection process culminating in a public pitch by the three Grand Challenge finalists on 31 October 2017, the first ANU Grand Challenge has been awarded.

Your Health in Your Hands: Future Personalised Medical Technologies for a Sustainable and Effective Healthcare aims to revolutionise personalised medicine through wearable sensor technologies with genomics, tailored to individual need, irrespective of geographical location or social circumstances, to ensure that healthcare can be provided equally and effectively.

The unprecedented technological and medical achievements of the 20th century have significantly contributed to improving quality of life, yet inequality in healthcare is one of the major challenges for our time. In many cases, the current standard of care is a 'one size fits all' model, but this personalised medicine model promises to revolutionise our understanding of health.

It will enable people to get a holistic picture of their health, prevent the development of disease, or monitor and better manage an existing condition. This multi-stage approach includes developing wearable technologies to monitor the onset of disease, identifying key mechanisms of the disease through genome sequencing, and analysing big data sets through machine learning to detect disease early and provide new insights into their mechanisms. The project aims to enable patients to treat and manage disease through personalised treatment programs.

What is truly remarkable about this project is its capacity to assist people living in vulnerable communities, in rural and remote locations who often have the highest rates of disease. Through wearable sensors monitoring, for example, breath and sweat, ANU researchers will be able to tackle these diseases head on before they become expensive to treat – thereby improving the lives of many.

The project team will start by focusing on two global health priorities – diabetes and multiple sclerosis. Ultimately, this research could be applied to other critical diseases like asthma and cancer.

Enhancing distinctive concentration of excellence in research

- > Enhancing critical mass in seismology and mathematical geophysics
- > Australian Dictionary of Biography
- > Establishment of the Digital Humanities Lab
- > Launch of the Target and Drug Discovery Platform
- > Ongoing investment in the Southern hemisphere's most powerful supercomputer
- > Leading the Consortium for Ocean-Sea Ice Modelling in Australia



ANU is home to world-class, unique infrastructure and facilities and runs distinctive national programs. A number of facilities maintained by the University through the support of the National Institutes Grant are national facilities, available for the benefit of the entire nation. This section of the National Institutes Grant Report provides an overview of the distinctive infrastructure, facilities and programs of the University and the benefits arising from them.

Enhancing critical mass

In 2017 ANU enhanced critical mass and distinctive concentration of excellence in research in seismology and mathematical geophysics. The aim was to expand capacity in solid-Earth geophysics research unique within Australia, enhancing the national capacity to image deep crust and mantle of the Australian continent and surrounding regions as a basis to understanding earthquake and tsunami risk, contribute to the growing need to explore under sedimentary cover to discover hidden mineral wealth, and to gain an understanding of Earth's deep interior, together with an ability to participate in and influence leading international research programs and address gender balance in an under-represented STEM area. The School of Demography is also building research strength and depth in the areas of mortality, longevity and ageing; and the John Curtin School of Medical Research is expanding the use of clinical suites to include obstetric research and neurological research.

Australian Dictionary of Biography

The Australian Dictionary of Biography (ADB) is the largest and longest running social science research project in Australia. The ADB, Australia's pre-eminent dictionary of national biography is a national, cooperative enterprise, founded and maintained by ANU. It contains concise, informative and fascinating descriptions of the lives of



significant and representative persons in Australian history. The ADB has drawn on an extensive national network of researchers (over 4500 authors) and editorial and advisory boards (nearly 500 members) to produce the most authoritative reference source in Australian history and biography. In 2017 the ADB launched three new innovative research projects involving network analysis: Indigenous Australian Dictionary of Biography, First Three Fleets Project and Colonial Women in the ADB. Building on the established resources and networks of the ADB, these programs reflect a commitment to ensure relevance and national engagement.

The Indigenous Australian Dictionary of Biography Project will add 190 new Aboriginal and Torres Strait Islander biographies to the ADB which, although it has published nearly 13,000 biographies since its first volume in 1966, has tended to under-recognise the contribution of Indigenous people to the Australian story. A special stand-alone Indigenous ADB will be published at the end of the project.

The First Three Fleets Project is examining how those, who survived the journey from England to New South Wales in 1787–91 'remade' their lives in the infant colony, and how their children and grandchildren fared. It is anticipated that about 100,000 new records will be added to Obituaries Australia and People Australia as a result of this project.

The Colonial Women in the ADB Project aims to improve the gender balance of women in the ADB. Previously, women accounted for only 4 per cent of people in the ADB who flourished during the colonial period. An additional 1,500 new entries are being added about women who flourished during that time.

Establishment of the Digital Humanities Lab

The Centre for Digital Humanities Research at ANU has established a Digital Humanities Lab for research collaboration, outreach and training in digital methods. The Digital Humanities Lab is the first of its kind in Australia, providing a first-class facility from which to conduct the next generation of object-based digital research. The Digital Humanities Lab also allows new opportunities for research collaboration and industry engagement with the national cultural and collecting institutions. For example, existing projects with the National Museum of Australia and internal collaborations within ANU, such as 'Skullbook', which will produce the first digital bone library in Australia. These digital 3D models will be disseminated globally as an Open Access resource hosted on a dedicated webpage.

ANU to host peak body for Humanities Centres and Institutes in Australia and New Zealand

From November 2017 the Humanities Research Centre at ANU will host and coordinate the Australasian Consortium of Humanities Research Centres – the peak body for Humanities Centres and Institutes in Australia and New Zealand and the Australian Chapter of the global Consortium of Humanities Centres and Institutes based in the USA.

Enhancing health and medical research infrastructure through the new Target and Drug Discovery Platform

The infrastructure to support the University's health and medical research is fundamental to the University's success in this field. Key infrastructure and facilities include the National Computational Infrastructure, The Australian Cancer Research Foundation Biomolecular Resource Facility, The Advanced Imaging Precinct, Australian Phenomics Facility, the National Centre for Indigenous Genomics and many others, such as the new Target and Drug Discovery Platform (TDDP). The TDDP is a new purpose built facility to discover new drugs and treat diseases which is also utilised by the University of Canberra, ACT Health, CSIRO and a number of local biotech companies. The facility is dedicated to enabling drug discovery research and development of new therapies to treat disease together with developing partnerships with pharmaceutical companies to follow up these discoveries, generating significant investment in Australian drug discovery research.

The Southern hemisphere's most powerful supercomputer

The ongoing investment in the National Computational Infrastructure (NCI) enables a collaborator's share of the resources provided by the NCI including approximately 15 per cent of the peak national research supercomputer, Raijin – the most powerful system in the Southern hemisphere, storage in the NCI filesystems, access to high-performance cloud computing infrastructure, access to national reference data collections and access to a data science platform providing software infrastructure for in-situ data analytics. A major impact of NCI is the manner in which it rapidly and easily facilitates collaboration between researchers from ANU and those from across Australia and the world. In the year to 30 September 2017, research projects undertaken on Raijin involved the participation of over 480 ANU researchers as well as over 137 of the research collaborators from Australia and overseas, including other Australian and international universities, government departments or agencies and Australian and international commercial organisations. In 2017 the NCI has also made an impact in public policy and the region, advising the Australian Government on the development of a design and transition plan for a National Research Data Cloud, providing briefings and tours of the NCI facility for Australian Government officers, representatives from Australian Research Council and Geoscience and further afield for delegations from Bavarian, Canadian and American universities and government representatives from Taiwan. In December 2017, the Government announced \$70 million to replace Raijin.

Further examples of the benefits of the NCI include:

- > The development of nanowires by the Research School of Physics and Engineering, which was supported by extensive modelling of potential designs using Raijin. Nanowires will be used in next generation optical and electrical devices.
- > Genome sequencing looking into the genetic causes of complex immune diseases, such as lupus, type 1 diabetes and rheumatoid arthritis by the team at the John Curtin School of Medical Research.
- > The Department of Genome Science is undertaking research to understand the functioning of the protein Rubisco, which is at the centre of photosynthesis in all plants and how they form sugars from carbon dioxide. The modelling is feeding directly into laboratory experiments and plant-growth trials, and the results have led to licensing agreements and the formation of a start-up company to commercialise and deliver improved crops to farmers over the next five to ten years.

Consortium for Ocean-Sea Ice Modelling in Australia

2017 was the first full year of the Consortium for Ocean-Sea Ice Modelling in Australia (COSIMA). This consortium is led through the Research School of Earth Sciences at ANU and includes partners in the Bureau of Meteorology (BoM), Australian Antarctic Division (AAD), CSIRO, University of New South Wales and University of Tasmania. COSIMA aims to develop a systematic framework for ocean-sea ice model configurations that is used nationwide. By pooling their resources, partners in COSIMA are able to push to higher resolution, more comprehensive models with greater confidence in the optimisation, fidelity and performance of the models. COSIMA has output a pre-release version of Australia's highest resolution, full global ocean-sea ice model. This model configuration will be adopted by BoM and CSIRO for their Bluelink forecasting and reanalysis operational product in their next upgrade, and is intended to provide AAD with the capacity to forecast sea ice conditions around Antarctica.

Conversation sanctuary upgraded as part of the Mulligans Flat-Goorooyarroo Experiment

The Mulligans Flat-Goorooyarroo Experiment is a long-term ecological research project of national and international significance. The project aims to understand ways of restoring the structure and function of temperate woodlands to increase biodiversity and involves collaboration of scientists from multiple institutions. The innovative partnership with the ACT Government and Woodland Wetlands Trust demonstrates a new model for conservation, research and science communications. In 2017 the conservation sanctuary was upgraded with a new predator-proof fence which enlarges the conservation sanctuary and enhances researchers' ability to conduct innovative biodiversity and conservation research.



Enhancing unique capabilities in optical astronomy

The NIG supports the ongoing operation of the Siding Spring Observatory, a unique capability providing the basic infrastructure for optical astronomy to the nation. The observatory's telescopes are open for access to all Australian astronomers. Observations with the University's telescopes at the Observatory included the SkyMapper's role in identifying and observing the afterglow of the first-ever binary neutron star merger detected as a gravitational wave event by LIGO. Another highlight in 2017 was the first data release from the SkyMapper survey of the southern sky.

By providing the site and infrastructure for the observatory, ANU also supports the 4-metre Anglo-Australian Telescope (AAT), the largest optical telescope in Australia, which is currently operated as a national facility by the Australian Astronomical Observatory. In the 2017/2018 Budget the Australian Government committed close to \$120 million over a ten year period to the new European Southern Observatory strategic partnership and related rearrangement of the national astronomy capabilities formerly provided by the Australian Astronomical Observatory. ANU took a leading role in the consultations, and as part of this re-arrangement ANU will be operating the AAT as a national facility for all Australian astronomers (along with the other SSO telescopes) for the next seven years.

Portable geophysical Earth monitoring facility

2017 saw upgrades to portable geophysical Earth monitoring equipment including broadband seismometers and GPS instrumentation, for use on research projects through national sharing mechanisms by 11 research institutions comprising ANSIR membership. It is the only facility of its kind in the Southern hemisphere and is made available to the Australian geoscience community.

Upgrading the Heavy Ion Accelerator Facility

The Heavy Ion Accelerator Facility (HIAF) was upgraded in 2017 through the refurbishment of high voltage isolators and the development of a new ion source. The HIAF is used for creating extremely high energy beams of particles used for experiments ranging from studying the fundamental building blocks of atoms to radio isotope dating, supporting Australia's only experimental nuclear physics program. The HIAF accelerators provide important infrastructure for the Australian research community.

MakerSpace

An open-access digital design and fabrication space, MakerSpace, was launched in 2017. The space contains 3D printers, a laser cutter, mills and electronic benches. MakerSpace played a key role in designing and producing the new Australian of the Year trophies.

Independent science podcasting

The Centre for Public Awareness of Science launched a national platform for independent science podcasting to enable authentic, science-driven storytelling of high quality, producing additional audiences for science research.

Commencing the development of a National Argon Map

In conjunction with Geoscience Australia, the National Argon Map, an interactive map and archive of Argon geochronology dates of mineral and rocks spanning the entire continent has commenced development.

Continuing development of the Regional Photovoltaic Simulation System

2017 saw ongoing development of the Regional Photovoltaic Simulation System (RPSS) that will provide Australian electricity network service providers with real-time distributed solar photovoltaic simulations mapped to their electricity networks. Since the update provided in the 2016 Annual Report, more of Australia's Distribution Network Service Providers have signed on as partners on the project and a new version of the RPSS that can incorporate satellite data has been developed.

Further developing long-term strategic relationships with government, industry and the public, both nationally and internationally

- > Provision of China's first Stellarator device
- > Canada – Australia Roundtable on Indigenous Health and Wellness
- > Launch of the nation's first interdisciplinary Cyber Institute
- > Establishment of the 3A Institute (Autonomy, Agency, Assurance)
- > Australia – Iran Dialogue resumed
- > Enhancing ability of national parks policymakers and managers to adapt to climate change in Colombia



Provision of China's first Stellarator device

ANU is providing China with its first Stellarator device, which enables experimental research on magnetically confined plasma that is vital for developing fusion energy. ANU will work with the University of South China on fusion energy research, including providing it with the plasma Stellarator device and exchanging technical and academic personnel between the two institutions. Nuclear fusion powers our sun and all stars in the Universe and has the potential to provide sustainable, zero-emission and relatively cheap power to grids. The partnership is an important step towards developing a future energy source for the world.

The 25-year-old H1 Stellarator has been replaced with a high-power linear magnetised plasma machine called MAGPIE II, which supports research in advanced fusion materials, basic plasma physics and instrumentation development.

Australia's first interdisciplinary Cyber Institute

The University's new Cyber Institute combines expertise from across a range of disciplines to conduct leading research that will help shape the nation's future in the increasingly vital fields of cyber security and innovation, building on the Australian Government's 2016 Cyber Security Strategy and its International Cyber Engagement Strategy.

Expansion of engineering and computer science program

ANU has commenced a 10-year plan to drive the expansion of its program in engineering and computer science.

The expansion will transform the ANU College of Engineering and Computer Science and strengthen the capacity of ANU to respond to major challenges around the rising power of technology. By building on our capacity in engineering and computer science and attracting new talent, particularly women, ANU can drive and deliver Australia's response to our changing world.

The expansion is being led by the Dean of the ANU College of Engineering and Computer Science, Professor Elanor Huntington. The College will create new disciplinary foci, led by outstanding new talent, delivering cutting-edge research and education, and establishing a new role for engineering and computing at the core of ANU interdisciplinary discovery and impact in the world.

Under the expansion, ANU will be seeking outstanding talent from around the world, with a focus on championing diversity and inclusion in engineering and computer science.

This will build on the high-profile appointment of Professor Genevieve Bell as the inaugural ANU Vice-Chancellor's Entrepreneurial Fellow. Professor Bell recently joined ANU from Intel and has also been appointed the inaugural Florence Violet McKenzie Chair at ANU, named in honour of Australia's first female electrical engineer. Under the expansion, Professor Bell will lead a new Autonomy, Agency and Assurance Institute, to be known as the 3A Institute, co-founded with CSIRO's Data61, Australia's largest data innovation network. The 3A Institute will bring together the best researchers from around the world and a range of disciplines to tackle complex problems around artificial intelligence, data and technology and manage their impact on humanity.

Resumption of the Australia – Iran Dialogue

The Australia – Iran Dialogue was held in September 2017, resumed after 12 years of a series of exchange meetings that began in 2005. Discussions focused on global, regional and bilateral relations between the Islamic Republic of Iran and Australia, with special reference to political, cultural and economic development. The delegation came away with a greater understanding of Iran's role as a pivotal actor in the highly complex regional and international settings. Both sides agreed to continue the Dialogue as a valuable means to foster a mutual understanding of each other's position on various issues, and to foster wider educational, cultural and social relations between the two sides.

Proving the existence of gravitational waves

Thirteen ANU Scientists were part of a global scientific collaboration that proved the existence of gravitational waves for the first time, 100 years after their existence was predicted by Albert Einstein in his Theory of General Relativity, leading to the 2017 Nobel Prize in Physics. When two black holes collided 1.3 billion years ago it was one of the most violent events in the Universe, yet completely invisible. The tiny ripples in spacetime from the collision reached Earth in 2015 and moved the twin gravitational wave detectors of the Laser Interferometer Gravitational-wave Observatory (LIGO) a fraction of the radius of a proton. ANU led the Australian Partnership in Advanced LIGO.

International research collaborations

A new research collaboration commenced in 2017 with PetroChina, China's giant state petroleum exploration company. The collaboration aims to explore for unusual hydrocarbon (oil/gas) sources that possess similar characteristics in Australia and China.

ANU continued its collaboration with 27 European research institutions and agencies, through COMPARE – tracking zoonotic diseases through Europe with Whole Genome Sequencing and epidemiology. ANU is the only non-EU partner in this project that will continue until 2020. The project has resulted in strategic linkages with other Australian institutions, and findings from the research have been incorporated into teaching modules for the new Master of Philosophy in Applied Epidemiology to assist with incorporation of whole genome sequencing information into public health surveillance.

Influencing enhancements in bushfire management

Since 2001 the Fenner School of Environment and Society has co-led an international group of landscape bushfire simulation modelers with US and Canadian involvement. The research achieved its objective of contrasting the relative importance of fuel treatment effort, ignition management effort and weather for simulated total area burned and area burned by moderate-to-high intensity fire, and to determine the level of consensus among independent simulation models. Research from this project continues to influence decision makers dealing with bushfire management. For example, the research has been recognised as a factor that the ACT Parks and Conservation Service can point to that contributed to positive outcomes during the 2012–13 bushfire season.

Supporting the Department of the Prime Minister and Cabinet

The Centre for Aboriginal Economic Policy Research (CAEPR) has a longstanding collaborative research partnership with the Department of the Prime Minister and Cabinet that is enabled by the National Institutes Grant. In 2017 the primary focus of that research was on a broad range of topics related to changes in the Indigenous population including the analysis of repeated cross-sectional data, longitudinal data, administrative and by-product data, labour market outcomes and transitions, school and post-school outcomes, welfare dependency and intergenerational transmission, incarceration and community violence and community functioning, presenting findings to the Department on six occasions and publishing two papers.