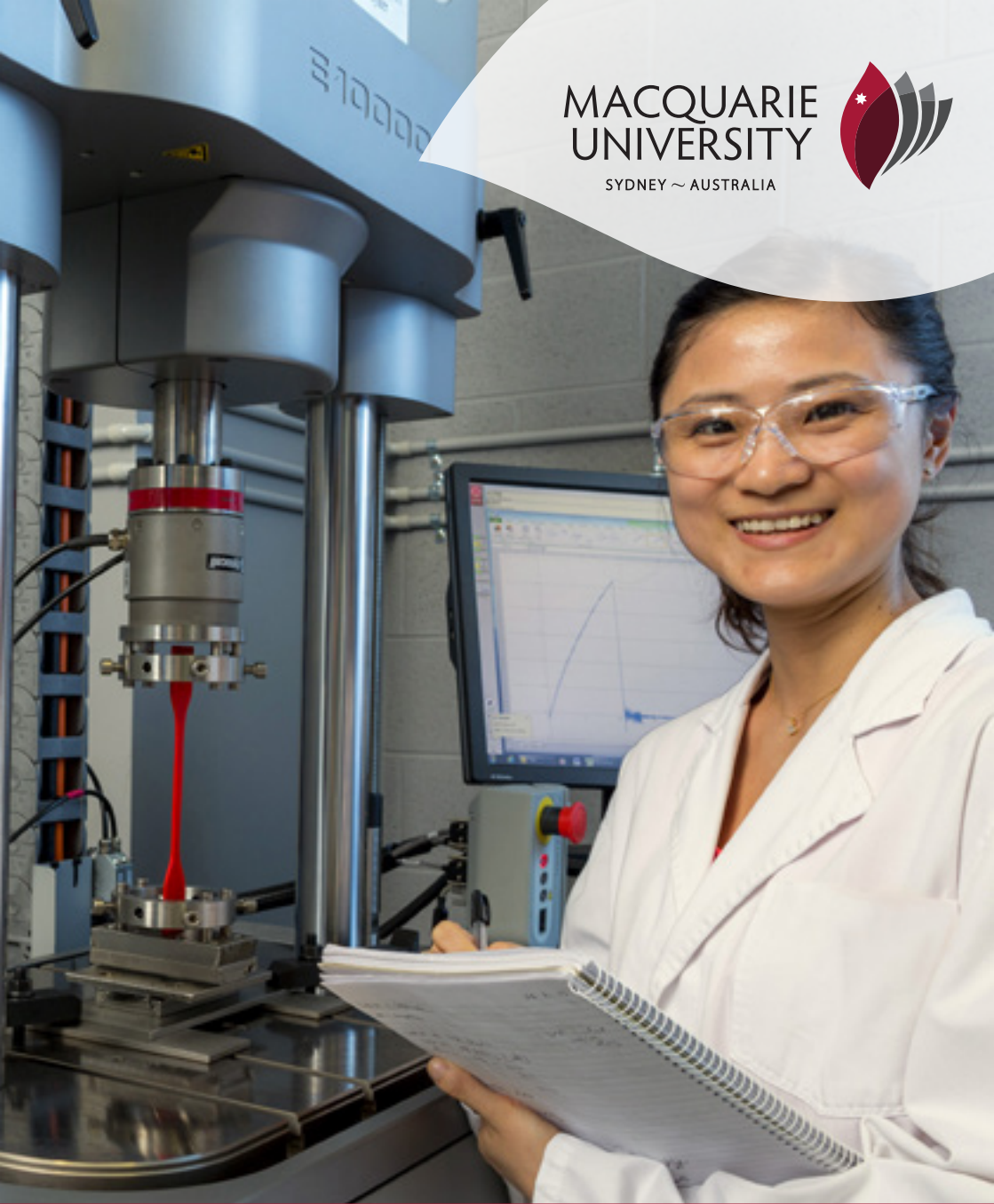


MACQUARIE
UNIVERSITY
SYDNEY ~ AUSTRALIA



World-leading research
at Macquarie University

From the Deputy Vice-Chancellor – Research



PHOTO LEFT: ALEXANDER PHOTO WHITE

Although relatively young – 50 years since foundation – Macquarie University has already established an enviable reputation for research excellence.

Macquarie's aim to rank amongst the world's top research-intensive universities is supported by a comprehensive research and research training strategy for achieving and maintaining a pervasive research culture across the whole institution, concentration in selected areas of research excellence, a high-quality research training (master and PhD) program, effective knowledge transfer to research end-user communities, and strong international research collaborations and partnerships.

In 2014, Macquarie will celebrate its 50th anniversary. This momentous occasion is an opportunity to reflect on our past successes and look forward to the future. As we reflect on our history as one of Australia's leading research institutions, we pay homage to many of the people who contributed to our positive growth and high standard. One of those people is former Deputy Vice-Chancellor – Research Professor Jim Piper. Professor Piper's contagious enthusiasm for research and research excellence is a key contributor to our standing as one of Australia's leading research-intensive universities – as noted in Macquarie University's standing in international rankings.

The University benchmarks its research quality against a number of leading international university research rankings, most importantly the Academic Ranking of World Universities (ARWU) and the Leiden Rankings. In the case of the ARWU rankings, Macquarie has progressed from rank 300 up to 260 over the past five years and in 2012, for the first time, entered the top 200 universities in natural science and mathematics.

The Leiden Rankings, which are based solely on analysis of research publication citation rates, currently rank Macquarie at 227 in the world for the percentage of research papers in the top 10 per cent of their field, with Macquarie's published research in natural sciences and engineering in the top 100 in the world for percentage of papers in the top 10 per cent, and mathematics, computer science, life and Earth sciences in the top 150. Both of these ranking scales place Macquarie in the top 10 of Australian universities.

These international quality rankings are augmented by the Excellence in Research for Australia (ERA) evaluations of research quality conducted for the second time by the Australian Government in 2012. Assessed in 20 research disciplines, Macquarie achieved the highest possible rating of 5 'outstanding performance well above world standard' in the key disciplines of Earth sciences; environmental sciences; and physical sciences; with biological sciences; history and archaeology; language, communication and culture; law and legal studies; and philosophy and religious studies rated 4, 'above world standard'. Taken together, the disciplines rated 5 or 4 represent 40 per cent of Macquarie's research, with 17 of the total 20 disciplines rated at world standard or above.

In this booklet we introduce the leading research areas at the University, the key researchers involved in those areas, and the associated national or University research centres. I encourage readers to use the web links provided to get more detail about the research topics and activities Macquarie is pursuing. Please contact us to explore opportunities to join the Macquarie research community or to develop new research collaborations and partnerships.

Professor Sakkie Pretorius
Deputy Vice-Chancellor – Research

What is ERA?

ERA (Excellence in Research for Australia) is a research quality evaluation program for Australian universities, introduced by the Australian Government through the Australian Research Council. The results of the second ERA evaluation were announced in December 2012.

ERA 2012 evaluated research quality as represented by research outputs from all disciplines and from all Australian universities, over the period 2005–2010. Twenty-two discipline areas were grouped into eight clusters which undertook evaluation of research outputs using either bibliometrics (for the experimental sciences) or peer review (covering humanities and creative arts; and social, behavioural and economic sciences). For a given discipline, for example biological sciences, publication quality in individual sub-discipline areas, for example plant biology, was also evaluated.

The quality of publications for each discipline and sub-discipline, and for each university undertaking research in those areas, was evaluated on a 5-point scale:

- 5 – outstanding performance well above world standard
- 4 – performance above world standard
- 3 – average performance at world standard
- 2 – performance below world standard
- 1 – performance well below world standard

At the national level, 13 per cent of research units evaluated at the discipline level, and 18 per cent of research units evaluated at sub-discipline level, were rated 5. Overall, 78 per cent of research units evaluated were rated at world standard or above.

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Earth sciences

In ERA 2012, research in Earth sciences received a rating of 5 out of 5 – ‘outstanding performance well above world standard’ – for the discipline overall and was 5-rated for the sub-discipline research areas of geochemistry, geology, geophysics, and physical geography and environmental geoscience.

Earth sciences at Macquarie has two linked but distinctive research clusters: Earth and planetary sciences (EPS) and environmental science (ES).

Macquarie’s EPS research is based predominantly within the ARC Centre of Excellence for Core to Crust Fluid Systems. The Centre’s interdisciplinary approach to studying the solid Earth integrates geochemistry, geodynamics, geophysics and petrology, and has launched Macquarie as a world leader in research on the evolution of the lithosphere, the timing of Earth events, the nature of the deep Earth and its geodynamics.

Led by Professor Sue O’Reilly, the Centre is delivering a new framework for mineral exploration, linking ore deposits to tectonics, mantle structure and the transport of material and energy. It also integrates previously disparate fields – geochemistry, geophysics, petrophysics, and numerical and thermodynamical modelling – to reach a new level of understanding of Earth’s dynamics and the fluid cycle(s) through time.

EPS hosts Professor William Griffin, who is the most cited Australian geoscientist and is ranked 25 in the world, and O’Reilly, who is the second most cited Australian geoscientist and is ranked 75 in the world.

Macquarie’s ES research focuses on climate science, coastal dynamics, environmental

impacts of resource production and use, fluvial systems, organic and inorganic contaminant geochemistry, and palaeoenvironmental reconstructions with studies of early Earth evolution. ES researchers play a major role in the National Climate Change Adaptation Research Facility, which is leading the research community in a national interdisciplinary effort to generate information for decision makers in government and in vulnerable sectors and communities to manage the risks of climate change impacts.

This area also incorporates Risk Frontiers, which is a world leader in natural hazards risk assessment and provides insurers with sophisticated research-based solutions. Applications, which are used globally, include emergency management, flood plain management and land-use planning.

Additionally, Earth sciences is home to Future Fellows, a Fellow of the American Geophysical Union, a Fellow of the Mineralogical Society of Great Britain and Ireland, a Young Scientist of the Year and Young Tall Poppy science award winners. Five of our researchers are ranked in the top one per cent of researchers in the world.

National research centre

ARC Centre of Excellence for Core to Crust Fluid Systems

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Macquarie University research centre

Risk Frontiers

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PHOTO: DWANE HAWACHER

Environmental sciences

In ERA 2012, research in environmental sciences received a rating of 5 out of 5 – ‘outstanding performance well above world standard’ – for the discipline overall and was 5-rated for the sub-discipline research areas of ecological applications, and environmental science and management.

Macquarie’s environmental sciences research operates at the interdisciplinary interface between biological, Earth and environmental sciences, and social and policy implications. Research focuses on five key, interrelated areas:

- Earth surface process dynamics (hydrology, oceanography, geochemistry, aeolian)
- Geomorphology and landscape evolution (river, coastal, desert and polar environments)
- Human impacts on the environment and rehabilitation/management responses
- Marine biology, specifically cetacean, chondrichthyes, Antarctic and marine park research
- Quaternary environmental change

The University’s strengths in environmental sciences are concentrated in Genes to Geoscience, Risk Frontiers, the ARC Centre of Excellence for Core to Crust Fluid Systems, and the National Climate Change Adaptation Research Facility.

Macquarie’s climate risk researchers enjoy partnerships with researchers in social inclusion, exploring the interface between the social and biophysical dimensions of climate variability and risk.

A major emphasis of research in the area of ecological applications is engagement with government, industry and community, resulting

in important applications in policy input and development. Macquarie has built on its long-established base of research on climate change and its social and environmental impacts, to significantly expand climate-related research through a strategic alliance with biologists, social scientists, economists and others through the Climate Futures Research Centre.

This multidisciplinary research centre aims to bridge the divide between climate and adaptation research, policy and practice needs, by serving as a hub for interactions between leading researchers, governmental decision makers, NGOs, businesses and vulnerable communities.

Macquarie environmental scientists lead the Australian Animal Tagging and Monitoring System, which provides data to support research on many of the critical marine issues facing Australia.

Macquarie is also a partner in the Environmental Biotechnology Cooperative Research Centre, which seeks to improve efficiency and reduce or utilise waste to benefit a wide range of industries and the environment; and has hosted three ARC Research Networks – Earth System Science, Fluorescence Applications in Biotechnology and Life Sciences, and Vegetation Function.

Macquarie award winners include Professor Peter Nelson, who was awarded a Humboldt Fellowship in 2006, and Associate Professor Paul Beggs, who received a Eureka Prize in 2010.

Additionally, our environmental science researchers serve on high profile national and international bodies including the Intergovernmental Panel on Climate Change, UN Millenium Ecosystem Assessment; UN Convention on Biological Diversity, IUCN World Commission on Protected Areas, IUCN Commission on Education and Communication, and UN Environment Programme.



National research centres

ARC Centre of Excellence for Core to Crust Fluid Systems

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Environmental Biotechnology Cooperative Research Centre environmentdirectory.com.au/ companies/ebcrs.htm

National Climate Change Adaptation Research Facility

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Macquarie University research centres

Climate Futures

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Genes to Geoscience

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Physical sciences

In ERA 2012, research in physical sciences received a rating of 5 out of 5 – ‘outstanding performance well above world standard’ – for the discipline overall and was 5-rated for the sub-discipline research areas of astronomical and space sciences, and quantum physics, and 4-rated – ‘performance above world standard’ – in the sub-discipline research area of optical physics.

Based predominantly within the Department of Physics and Astronomy, research in physical sciences at Macquarie has a strong focus on experimental and applied physics, while also concentrating on more fundamental and theoretical studies of astrophysics, and atomic, optical and quantum physics.

Macquarie hosts the OptoFab node of the Australian National Fabrication Facility, and enjoys a strategic alliance with the Anglo-Australian Observatory.

Macquarie is also a major node in the Centre for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS), and Macquarie’s Research Centre in Quantum Science and Technology is a major node of the new ARC Centre of Excellence for Engineered Quantum Systems (EQuS).

Additionally, our Optical Characterisation Facility provides state-of-the-art facilities for microspectroscopy and diagnostics, including AFM and two-photon scanning confocal microscopy.

Macquarie’s BioFocus Research Centre, founded in 2010, facilitates interdisciplinary research between biology, engineering, medicine and quantitative

sciences, and creates a critical mass of researchers to pursue fundamental problems in biomedical research.

Another new centre at Macquarie – the Research Centre in Astronomy, Astrophysics and Astrophotonics – is undertaking research in the areas of astrophotonics, binary stars, planetary nebulae, proto-planetary disks and star formation.

Award winners in the field include Professor Brian Orr (Optical Society of America William F Meggers Award) and Deputy Vice-Chancellor – Research Professor Jim Piper (WH (Beattie) Steel Medal and Carnegie Centenary Professorship). Orr, Piper and Professor Ewa Goldys have been elected Fellows of the Optical Society of America.

National research centres

ARC Centre of Excellence for Engineered Quantum Systems

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ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems

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OptoFab node of the Australian National Fabrication Facility

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Macquarie University research centres

BioFocus Research Centre

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Photonics Research Centre

web.science.mq.edu.au/
groups/mqphotonics/

Research Centre in Astronomy, Astrophysics and Astrophotonics

Professor Quentin Parker
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Research Centre in Quantum Science and Technology (QSciTech)

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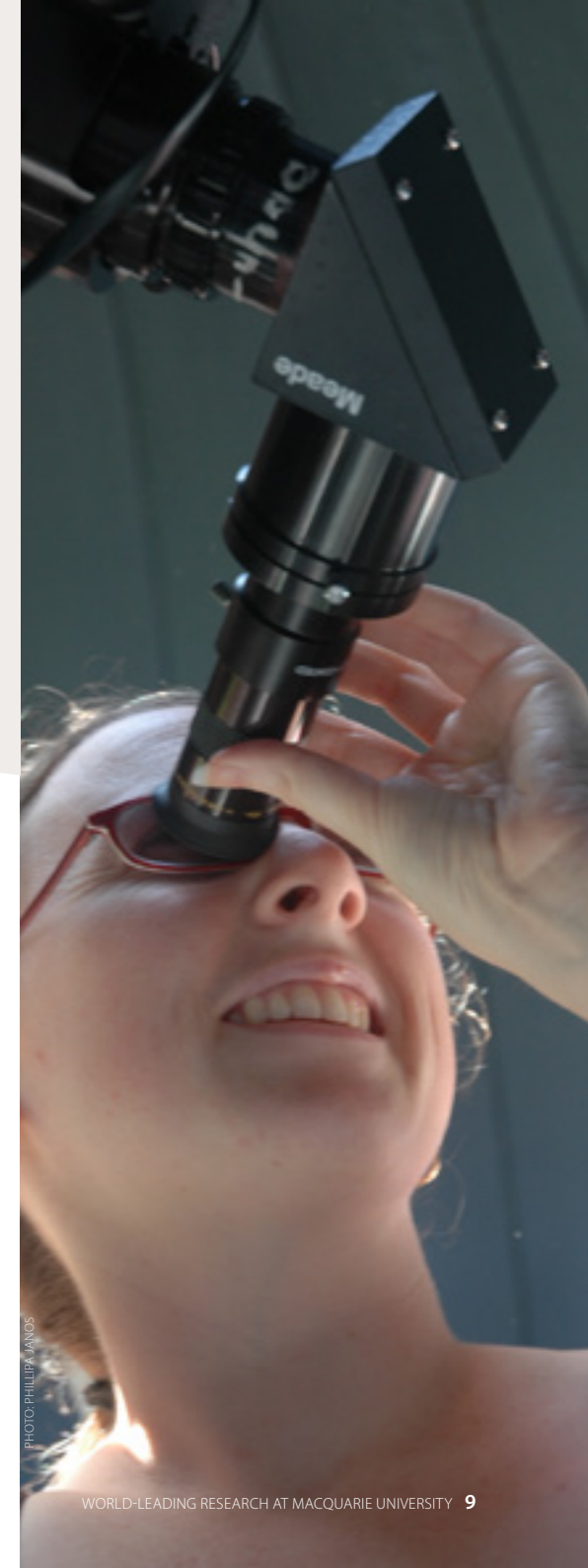


PHOTO: PHILLIPA JANOS

Biological sciences

In ERA 2012, research in biological sciences received a rating of 4 out of 5 'performance above world standard' for the discipline overall, and was 5-rated – 'performance well above world standard' – for the sub-discipline research area of evolutionary biology, and 4-rated for the sub-discipline research areas of ecology, microbiology, and plant biology.

Within biological sciences, Macquarie's research is chiefly focused around ecology and evolution, and biomolecular sciences.

Three of Macquarie's research centres – Biomolecular Frontiers, Climate Futures and Genes to Geoscience – contribute to these strengths.

The University's biomolecular sciences research has strengths in bioinformatics, biotechnology, genomics, glycomics, immunology and proteomics, and their application to health, environmental and industrial issues.

The Biomolecular Frontiers Research Centre integrates these disciplines, and encourages collaboration between researchers with complementary expertise.

Macquarie's ecology and evolution research has its focus in plant ecological strategies, biodiversity and conservation, climate change, coastal processes, conservation genetics, evolutionary animal behaviour, microbial genomics, and planning and risk analysis.

Much research within this area is underpinned by world-class infrastructure and technical support in the NCRIS Australian Proteomics Analysis Facility, which provides cutting-edge development in protein analysis technologies and attracts over 500 individual researchers to the facility each year.

The Climate Futures Research Centre conducts research in climatology, coastal processes, ecology, economics, geomorphology, law and governance, planning and risk analysis, social policy and water, but also encompasses Risk Frontiers, Macquarie's world-leading group which develops natural hazard risk models for the international re-insurance industry.

Macquarie is a founding partner in the National Climate Change Adaptation Research Facility and has a member – Professor Lesley Hughes – on the Australian Climate Change Commission.

Macquarie has hosted three ARC Research Networks – Earth System Science, Fluorescence Applications in Biotechnology and Life Sciences, and Vegetation Function, and is a partner in the Sydney Institute of Marine Science.

Biological sciences is home to 12 researchers ranked in the top one per cent of researchers in the world (ESI, 2013). Additionally, Professor Mark Westoby is Australia's third most cited Australian environment/ecology researcher and is ranked 20 in the world.

Award winners include Professor Ian Wright, who in 2008 won the Thomson Scientific Citation Award in ecology for the Australian with the highest citation rate per paper, 1997–2007; and Westoby, who was elected to the Australian Academy of Science in 2009 and was awarded an Australian Laureate Fellowship in 2010.

Additionally, highly competitive fellowships including Australian Postdoctoral Fellowships, Future Fellowships, a Rubicon Fellowship, an Australian Research Fellowship, a QE2 Fellowship, an NHMRC Wright Fellowship, a NSW OSMR BioFirst Fellowship, and a Marie-Curie Fellowship have been awarded to Macquarie researchers within the discipline.

National research centres

Australian Proteome Analysis Facility

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National Climate Change Adaptation Research Facility

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Macquarie University research centres

Biomolecular Frontiers

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Centre for the Integrative Study of Animal Behaviour

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Climate Futures

Professor Lesley Hughes
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Genes to Geoscience

Professor Mark Westoby
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PHOTO: BAUL WRIGHT

History and archaeology

In ERA 2012, research in history and archaeology received a rating of 4 out of 5 – ‘performance above world standard’ – as did the sub-discipline research area of historical studies.

The scope of research in historical studies and archaeology at Macquarie University is unique in Australia, and arguably in the world.

Research spans periods from Eurasian and Australian prehistory to the present, utilising modes of evidence from material archaeology to historiographic theory, adopting varied approaches from ‘Big History’ to micro studies, and including innovative reflection upon the nature of historical inquiry. Research is predominantly undertaken within the disciplines of ancient and modern history.

The University’s ancient history research is concentrated in the Macquarie University Ancient Cultures Research Centre, and is distinguished by strengths in early Christianity, Egyptology, Late Antiquity, and Manichaean and Silk Road studies.

It is Australia’s most prominent centre of Egyptology, conducting archaeological work in Egypt which provides data for research on the early Dynastic to Coptic periods.

The Centre also provides world-class research infrastructure including digital and photographic archives of Egyptian wall art gathered on site, Greek and Coptic papyri, and specialist libraries for Egyptology, Manichaean studies and Graeco-Roman documentary research. The associated Gale Foundation-funded Australian Centre for Ancient Numismatic Studies houses a specialist library and over 3000 coins.

In modern history, Macquarie’s researchers with expertise in the history of culture, media and politics

collaborate across disciplines to explore issues around social, cultural and political change.

Macquarie is also recognised internationally as the progenitor of ‘Big History’, an original interdisciplinary approach to world history developed by Professor David Christian, which draws upon research in cognate fields and the sciences. ‘Big History’ has recently been taken up by the Gates Foundation as a model history curriculum to be developed for schools in the USA.

Macquarie’s Centre for Media History, the only one of its kind in the southern hemisphere, facilitates interdisciplinary research on the history of journalism, television and film. It has close links with industry and with international scholars; and its website, which hosts databases, bibliographies and the Media Archives Project, is the central portal for all researchers in Australian media history.

Collaborations involve joint authorship and funding, editorial work and research teambuilding, including significant collaborations at the international and national levels, as well as across disciplines at Macquarie. International collaborations include projects with the Universities of Cambridge, Göttingen and London, the British Museum, and the Quanzhou Maritime Museum. Collaboration and co-publication is also actively fostered with Egyptian colleagues and the Egyptian Supreme Council of Antiquities.

The quality of research in these clusters is illustrated by fellowships and prestigious awards.

Fellowships include a Columbia University Visiting Professorship, a Feodor Lynen Alexander von Humboldt Research Fellowship, a Leverhulme Visiting Fellow, a State Library of NSW Fellowship, and a NSW History Council Fellowship.



PHOTO: PAUL WRIGHT

Awards include an Australian Historical Association’s Mary Bennett Prize, a NSW Premier’s History Prize, a Prime Minister’s Australian History Prize, a NSW Premier’s Literary Prize, a Man Asia Literary Prize, a Miles Franklin Literary Prize, and a Magarey Medal for Biography.

Macquarie University research centre

Ancient Cultures Research Centre

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Language, communication and culture

In ERA 2012, research in language, communication and culture received a rating of 4 out of 5 – ‘performance above world standard’ – as did the sub-discipline research areas of communication and media studies, and linguistics.

Studies in language, communication and culture at Macquarie is largely interdisciplinary, addressing key elements of theoretical and applied linguistics, critical and literary theory, and media and communication studies.

Macquarie has a deep commitment to integrative and collaborative work with researchers in areas including computer science, education, historical studies, performance studies and creative writing, philosophy and psychology, as well as with researchers from the ARC Centre of Excellence in Cognition and its Disorders.

Linguistics research spans a range of topics from intercultural communication to language sciences including child language disorders. Macquarie is a world leader in language acquisition research, and sign language teaching and research, and is home to one of the world’s pre-eminent sign language researchers, as well as renowned researchers in applied linguistics, TESOL and professional communication.

Additionally, Macquarie is recognised as having one of the top 100 language departments in the world, excelling internationally in ancient and modern languages.

The nexus between language and culture informs research into historical and contemporary transnationalism as well as political and social developments in Europe, Asia and Latin America; migration and globalisation and their impact on

cultural, linguistic and literary productions; and language teaching and computer-mediated communication in second language acquisition, as well as language teaching methodology more generally.

The excellence of Macquarie’s research in language, communication and culture is evidenced by the establishment of a major laboratory for language acquisition. This lab incorporates the first child whole-head Magnetoencephalography (MEG) system in the world, which was funded by an ARC Linkage grant in partnership with the Kanazawa Institute of Technology and is used primarily to investigate the origins of language.

Macquarie’s Centre for Language Sciences, led by ARC Federation Fellow Professor Stephen Crain, is an interdisciplinary group involving researchers in linguistics and computing science.

The Centre for Media History also enhances capacity among Macquarie researchers in media and communication. The only one of its kind in the southern hemisphere, the centre has close links with industry and with international scholars; and its website, which hosts databases, bibliographies and the Media Archives Project, is the central portal for all researchers in Australian media history.

Macquarie’s high-profile researchers include an ARC Federation Fellow, a Fellow of the Academy of the Social Sciences in Australia, and two Fellows of the Australian Academy of Humanities.

International linkages include visiting professorships at Beijing Normal, Beijing Language and Culture, and Split Universities; and the Universities of Hamburg, Cardiff and Yale; and the Riken Institute.



National research centre

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Macquarie University research centre

Centre for Language Sciences
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Law and legal studies

In ERA 2012, research in law and legal studies received a rating of 4 out of 5 – ‘performance above world standard’ – as did the sub-discipline research area of law.

Research in law and legal studies at Macquarie involves multicontextual, cross-disciplinary, trans-jurisdictional and collaborative research approaches to law and its commercial, environmental and social dimensions in Australia and internationally.

These approaches are found in five primary areas of research concentration: commercial law, international and environmental law, legal governance, legal history and legal theory.

Two of Macquarie’s research centres – the Centre for International and Environmental Law and the Centre for Legal Governance – contribute to these research strengths.

The Centre for International and Environmental Law has affiliations and cooperative research arrangements with several overseas universities. It is a member of the International Union for Conservation of Nature (IUCN), the premier non-governmental organisation addressing environmental matters. Macquarie researchers are members of different IUCN specialist groups and have undertaken important consultancy work under its auspices.

The Centre for Legal Governance draws together historians (legal history), political scientists (secession and international law), philosophers and medical researchers (bioethics, health governance, legal theory and social ontology), and with environmental studies experts (environmental law and climate change).

It provides a platform for research into legal governance and regulatory problems facing governments, businesses and communities and contributes to the development of ethically informed legal and social policy. Its strengths include international and comparative law, environmental law, human rights law, health law and information and privacy law.

Macquarie researchers have made major contributions to prestigious international handbooks of criminal law, environmental law, international law, international trade law, law and religion, and public law. In the field of international criminal justice these include significant commentaries on war crimes, torture and other breaches of human rights.

Macquarie researchers also undertake applied legal research reporting directly to end-users through pro bono and commissioned research across a range of government, community and industry sectors. This activity includes consultancies with AusAid and the United Nations Development Programme, and submissions to government bodies such as the Senate Legal and Constitutional Committee.

The high quality of research in law and legal studies at Macquarie is indicated by a number of esteem factors. Professor Brian Opeskin is a Fellow of the Australian Academy of Law and a former Commissioner and Deputy President of the Australian Law Reform Commission.

Emeritus Professor Bruce Kercher is President of the NSW Bar Association’s Francis Forbes Society for Australian Legal History.

Dr Alexander Zahar has served on the United Nations at the International Criminal Tribunal for the Former Yugoslavia and is an expert

reviewer of greenhouse gas inventories submitted by states pursuant to the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

Additionally, Macquarie law researchers have held numerous honorary or visiting appointments at institutions such as Yale Law School, and the Universities of Cambridge, Cape Town and Windsor.

Macquarie University research centres

Centre for International and Environmental Law

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Centre for Legal Governance

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Philosophy and religious studies

In ERA 2012, research in philosophy and religious studies received a rating of 4 out of 5 – ‘performance above world standard’ – as did the sub-discipline research area of philosophy.

The philosophy program at Macquarie has long-standing research strengths in ethics, European philosophy, metaphysics, philosophical psychology, philosophy of mind, and social philosophy, and more recently has also developed specialisations in applied ethics, bioethics, medical ethics and moral cognition.

A distinctive strength of philosophy research at Macquarie is a focus on human agency, mind and self. Philosophers are at the forefront of research in these fields, with expertise in philosophy of agency, moral responsibility and moral cognition, memory, and extended cognition. These are areas in which, increasingly, philosophical research proceeds in partnership with the psychological and cognitive sciences.

A further distinguishing feature of Macquarie’s philosophy research is its commitment to engaging with major contemporary issues, drawing on a plurality of philosophical traditions – analytic and European – as well as the scientific literature. Recent examples include the development of conceptual frameworks for understanding problems of work, addiction, parenting, gender and health inequality.

Much of this research is conducted within the Macquarie University Research Centre for Agency, Values and Ethics (CAVE), an interdisciplinary centre involving researchers from cognitive science, law, medicine, philosophy, psychology and social inclusion, with strong links to national and international partners.

Macquarie’s philosophy researchers are involved in significant international collaborations with researchers at universities in the UK, US, Canada, Netherlands, France and Germany, including Universities of Aberdeen, Birmingham, Cambridge, Glasgow, Hertfordshire and Oxford; Bristol University; Queen’s University Belfast; California Institute of Technology; McGill University; Utrecht and Delft Universities; University of Amsterdam; Institut Jean Nicod; Ecole Normale Supérieure; Conservatoire national des arts et metiers; Goethe University and Institut für Sozialforschung.

Philosophy researchers have received prestigious awards and fellowships including an Australian Museum Eureka Prize for Research in Ethics, an Elected Fellow of the Australian Academy of the Humanities, a Fellowship at the Helsinki Collegium for Advanced Studies, and a Mercator Gastprofessur.

Additionally, researchers sit on editorial or advisory boards of leading journals including *Australasian Journal of Philosophy*, *Bioethics*, *BMC Medical Ethics*, *Critical Horizons*, *European Journal of Philosophy*, *Health Expectations*, *Memory Studies*, *Neuroethics*, *Philosophical Explorations*, and *Philosophical Psychology*, and have served on national research councils in Australia, Canada, Europe, New Zealand, UK, and USA.

Macquarie University research centre

Centre for Agency, Values and Ethics
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PHOTO: CAVE

Chemical sciences

In ERA 2012, research in chemical sciences received a rating of 'performance at world standard' and was 4-rated – 'performance above world standard' – in the sub-discipline research area of analytical chemistry.

A range of departments at Macquarie contribute to research which falls within the analytical chemistry sub-discipline. These include, in addition to chemistry and biomolecular sciences, biological sciences, Earth and planetary sciences, electronic engineering, environment and geography, and physics and astronomy.

This results in diverse research in which Macquarie researchers use fundamental analytical chemistry in conjunction with other techniques to investigate, and to make major contributions to, biomass and bioenergy; biopolymers; biosensors and bioelectronics; environmental monitoring, toxicology and assessment; electrochemistry; food and agricultural chemistry;

nanotechnology; organic and inorganic geochemistry; and proteomics.

Access to state-of-the-art analytical equipment is a very high priority for success in this area, and the Australian Proteome Analysis Facility, the ARC Centre of Excellence for Core to Crust Fluid Systems and the Department of Chemistry and Biomolecular Sciences have all formed strong and strategic alliances with major manufacturers of analytical equipment.

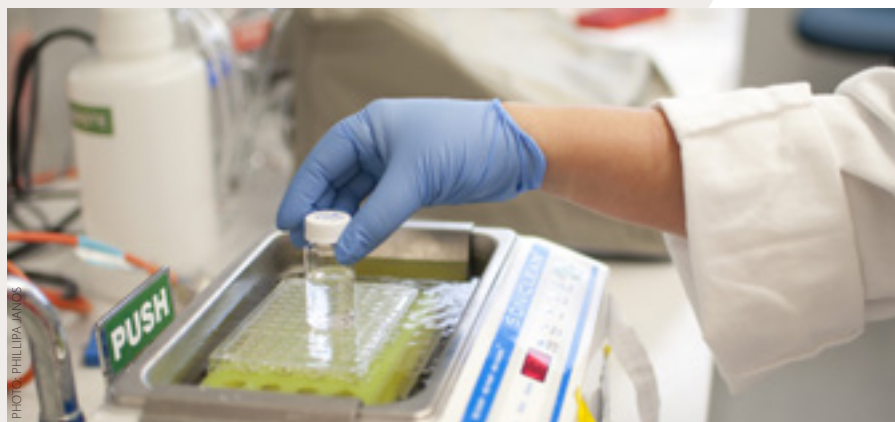
National research centres

ARC Centre of Excellence for Core to Crust Fluid Systems

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Australian Proteome Analysis Facility

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Education

In ERA 2012, research in education received a rating of 'performance at world standard' and was 4-rated – 'performance above world standard' – in the sub-discipline research area of specialist studies in education.

Research in education at Macquarie is targeted towards three key areas that are significant in the development of education opportunities for children in the future. Information and communications technology (ICT) is transforming the nature of education in Australia and across the globe, and Macquarie is home to outstanding researchers in the field, as well as the unique ICT Innovation Centre, which is jointly supported by Macquarie University and the New South Wales Department of Education. One of the outcomes of this unique environment has been the Learning Activity Management System (LAMS), a royalty-free online tool available to assist teachers build collaborative learning environments.

Macquarie's leadership in special education draws from its unique position as the only university in Australia with its own school for children with disabilities – Macquarie University Special Education Centre (MUSEC). As both a school and

a research environment, researchers in cognitive science, early childhood, education, linguistics and psychology can rapidly translate their initiatives into practice and yield research outcomes that exceed world standard.

An important emerging strength at Macquarie which contributed to the above world standard ranking is the focus on Indigenous education, building particularly on Macquarie's strengths in ICT and its excellence in education in science and mathematics.

National research centre

ARC Centre of Excellence in Cognition and its Disorders

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Macquarie University research centre

Macquarie University Special Education Centre (MUSEC)

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Information and computing sciences

In ERA 2012, research in information and computing sciences received a rating of 'performance at world standard' and was 4-rated – 'performance above world standard' – in the sub-discipline research area of computation theory and mathematics.

Macquarie was one of only two universities to be ranked above world standard in this field. Research in this area is predominately contributed to by the Department of Computing, with minor contributions by the Departments of Mathematics and Statistics.

The focus is research into algorithms, complexity and cryptography applied to advanced computing systems, with the aim of developing algorithms and cryptographic methods and protocols.

This group includes prominent researchers in theory and cryptography including Professor Igor Shparlinski, a Fellow of the Australian Academy of Science; Professor Vijay Varadharajan, the Microsoft Chair Professor in Innovation in Computing; and Professor Josef Pieprzyk, Director of the Centre for Advanced Computing – Algorithms and Cryptography (ACAC).



PHOTO: PAUL WRIGHT



PHOTO: BRETT CORNISH

ARC Centres of Excellence

ARC Centre of Excellence in Cognition and its Disorders

Macquarie is the lead institution of the ARC Centre of Excellence in Cognition and its Disorders (CCD), which offers opportunities for interdisciplinary and international collaborative research in the study of cognition, its disorders and their treatment.

Led by Professor Stephen Crain, the Centre is undertaking research to help improve the diagnosis and treatment of a range of cognitive disorders including autism, dementia, dyslexia, specific language impairment and schizophrenia.

Interdisciplinary teams conduct research in five areas of cognition: belief formation, language, memory, person perception and reading. They implement intervention programs based on their findings to inform educational policy and clinical practice, with considerable potential impact for the health and social wellbeing of Australia.

The Centre is administered by Macquarie, but collaborates with a host of leading national and international research universities including the Universities of New South Wales, Western Australia, New England, Sydney, Cambridge, Oxford, London, Auckland and Hong Kong.

ccd.edu.au

ARC Centre of Excellence for Core to Crust Fluid Systems

Macquarie is the lead institution of the ARC Centre of Excellence for Core to Crust Fluid Systems (CCFS) which is driving interdisciplinary research toward a new understanding of Earth's evolution, fluid budgets and origins.

Water is essential for human existence. The exchange of water and other fluids between the surface and the deep interior plays a crucial role in most Earth systems, including the evolution of the surface and the hydrosphere/atmosphere/biosphere.

The Centre, led by Professor Sue O'Reilly, integrates previously disparate fields – geochemistry, geophysics, petrophysics, and numerical and thermodynamical modelling – to reach a new level of understanding of Earth's dynamics and the fluid cycle(s) through time.

Curtin University and the University of Western Australia, along with five overseas nodes in Canada, China, France, Germany and the USA contribute resources and provide access to a variety of expertise and instrumental capabilities.

ccfs.mq.edu.au



ARC Centre of Excellence for Engineered Quantum Systems

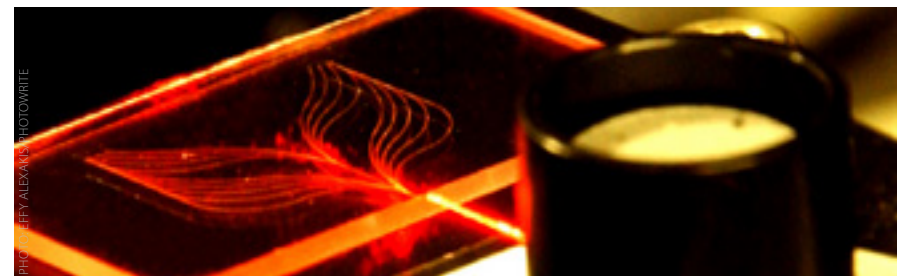
Macquarie hosts a major node of the ARC Centre of Excellence for Engineered Quantum Systems (EQUs), a multi-institution collaboration which seeks to engineer complex, multi-component quantum systems for science and new applications.

Other nodes are hosted at the Universities of Queensland, Sydney, Western Australia and New South Wales. This extensive team possesses experimental capabilities in all major quantum technologies including opto- and nano-mechanics, quantum photonics, spins in semiconductors, superconducting circuits and trapped atoms.

Research projects will see the Centre deliver new scientific insights and technical capabilities across a range of disciplines.

Outcomes of the Centre's work will improve the lives of Australians and people all over the world by producing breakthroughs in biology, chemistry, engineering, medicine and physics.

equs.org



ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems

Macquarie hosts a major node of the ARC Centre of Excellence for Ultrahigh Bandwidth Devices for Optical Systems (CUDOS).

With additional nodes at the University of Sydney; University of Technology, Sydney and Swinburne; and RMIT, Monash and Australian National Universities; it is the premier photonics research group in Australia and provides substantial opportunities for research collaboration, networking and future employment.

The Centre's mission is to demonstrate all-optical processing applications and devices for ultrahigh bandwidth optical telecommunications. It has a major research program in fundamental and applied photonics, developing next-generation devices for astrophotonics, biophotonic systems, optical communications and quantum optics.

Research interests in the Macquarie node are focused on micro-fabricating and characterising photonic devices. In particular, the group draws on over 10 years of expertise developed within the Centre for Lasers and Applications in miniaturisation engineering and laser physics.

web.science.mq.edu.au/groups/cudos

World leading research

Macquarie University's research areas assessed as at or above world standard

Biological and biotechnological sciences

- Biochemistry and cell biology
- Ecology
- Evolutionary biology
- Microbiology
- Plant biology
- Zoology

Economics and commerce

- Applied economics
- Banking, finance and investment
- Business and management

Education and human society

- Anthropology
- Education systems
- Human geography
- Political science
- Sociology
- Specialist studies in education

Engineering and environmental sciences

- Ecological applications
- Electrical and electronic engineering
- Environmental science and management

Humanities and creative arts

- Applied ethics
- Archaeology
- Communication and media studies

- Cultural studies
- Historical studies
- Language studies
- Law
- Linguistics
- Literary studies
- Performing arts and creative writing
- Philosophy
- Urban and regional planning

Mathematical, information and computing sciences

- Artificial intelligence and image processing
- Computation theory and mathematics
- Distributed computing
- Pure mathematics

Medical and health sciences

- Cardiovascular medicine and haematology
- Cognitive sciences
- Psychology

Physical, chemical and Earth sciences

- Analytical chemistry
- Astronomical and space sciences
- Atmospheric sciences
- Condensed matter physics
- Geochemistry
- Geology
- Geophysics
- Optical physics
- Physical chemistry
- Physical geography and environmental geoscience
- Quantum physics

Distinguished Professors

Macquarie University Distinguished Professors are eminent scholars of exceptional distinction who have made an outstanding contribution to their field or discipline, and to Macquarie University.



Professor Stephen Crain

Crain is a world leader in the study of human language and cognition, in particular the application of new magnetic imaging technologies.



Professor Murray Goot

Goot is a political scientist who is widely recognised as one of Australia's leading academic analysts of political parties, the media and public opinion.



Professor William Griffin

Griffin pioneered a world-leading interdisciplinary approach to mapping the inaccessible deep Earth with Professor Sue O'Reilly.



Professor Naguib Kanawati AM

Kanawati is one of the most distinguished Egyptologists of his generation and his work in archaeology and art history is internationally recognised.



Professor Samuel Lieu AM

Lieu is an internationally recognised researcher in the field of early Christianity and the relationships between the East and West in the ancient world.



Professor Sue O'Reilly

O'Reilly is a pioneer in mapping deep Earth, with results delivering widely adopted new tools to the mineral exploration industry.



Professor Ron Rapee

Rapee is internationally recognised for his contribution to research and practice in clinical psychology, in particular in the areas of anxiety and depression.



Professor Igor Shparlinski

Shparlinski has made important contributions to the mathematical foundations of computer science, computer security and cryptography.



Professor David Throsby

Throsby enjoys an outstanding international reputation as an economist with specialist interests in the economics of the arts and culture.



Professor Mark Westoby

Westoby's contributions to the field of evolutionary ecology have defined key dimensions of ecological strategy variation across plant species.



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