

**BIOPLATFOMS
AUSTRALIA**

2023

ANNUAL REPORT



PARTNERS



LEADERSHIP

Bioplatforms Australia is committed to maintaining a high standard of governance and leadership. Strategic direction and operational oversight are provided by an independent Board of Directors and supported by an Executive Management Committee who advise on platform technologies and organisational initiatives.

Board Members and Responsibilities

Bioplatforms Australia's Directors offer a wealth of experience across scientific, business and government domains. Each Director has responsibility for particular aspects of organisational strategy in addition to their fiduciary duties.

Dr Leslie Trudzik – Chair

Prof Sue Meek – Director

Dr Katherine Woodthorpe – Director

Prof Peter Gray – Director

Executive Management Committee

The Executive Management Committee manages and advises on platform issues and operations. It is also responsible for implementing strategic initiatives, including Commonwealth funding agreements established with network partners. The committee is comprised of the Chief Executive and scientific leaders from across the Bioplatforms network.

Contents

- 2** Chairman's Report
- 3** Highlights
- 4** Network Access
- 6** Bioplatforms Australia
- 7** Strategy
- 8** Synthetic Biology program
- 10** Feature stories
- 12** Research programs
- 14** National initiatives
- 16** Collaborations and Partnerships
- 18** Industry engagement
- 20** Capabilities network
- 24** BioCommons



Chairman's Report



Dr Les Trudzik
Chair

2022/23 was a year of significant progress for Bioplatforms Australia, and indeed the broader NCRIS network, with the provision of longer-term operational security through the Commonwealth Government approval of the NCRIS 2022 Guidelines.

I commend the Department of Education Research Infrastructure team on the development and implementation of the 2021 National Research Infrastructure Roadmap. This not only provided long term certainty for Bioplatforms operations, it also provided the opportunity to extend and grow the national research infrastructure network with a call for "Step Change" investments, including in Synthetic Biology, and in which Bioplatforms had already developed the early stages of a national capability with joined investments at the Australian Genome Foundry and IDEA Bio. The Roadmap process encouraged new thinking on future needs, signalled further interoperation of existing capabilities in the pursuit of seamless offerings for the research community, and reinforced the value of national research infrastructure delivering impact and commercialisation through partnership with Australian industry.

The establishment of the National Research Infrastructure Advisory Committee, under the stewardship of Chair Professor Liz Sonnenberg, will be a tremendous asset in leading the delivery of research infrastructure and building future capability from the existing mature and collaborative NCRIS network.

New Infrastructure Investment

The longer term certainty has enabled Bioplatforms to focus more strategically to refresh the technology base of our network across genomics, proteomics, metabolomics and bioinformatics facilities. To ensure Australia retains a globally competitive position in Life Science, Bioplatforms made over \$15 million investment in new technology, including

- Upgrades to the national fleet of genome sequencing with the installation of three Illumina NovaSeq X systems, that will meet capacity constraints and drive down access price for researchers.
- A collaborative development of spatial transcriptomics capability was supported at ANU, AGRF and SAGC, representing cutting edge genomic resolution to enable single cell analysis.

- Upgrades across all Proteomics and Metabolomics facilities with high resolution mass spectrometry installations ensures currency of capability. The investment at Monash in Single Cell Proteomics complements the genomics investments and provides for integrated analysis of biological systems.
- A contribution to the Australian BioCommons to develop Australia's first Gen3 Human Genomics instance and collaborate with Chief Investigators on an MRFF Cardiovascular Disease Data Commons award builds upon the very successful Bioplatforms Framework Initiative focused on the MRFF Cardiovascular Mission.
- A significant translational partnership with Omico that aims to provide genomic assessment for all adult cancer sufferers with a poor prognosis. This national scale clinical trial, supported by the Department of Industry Science and Resources together with critical contributions from private industry, philanthropy and our NCRIS peers at NCI, will see Bioplatforms partner and build clinical genomics capability with leading pathology organisations across jurisdictions.

Bioplatforms Facility Contribution

Bioplatforms has been able to maintain and strengthen its commitment to supporting the Australian life sciences community through a diverse access program, provision of targeted infrastructure requirements, and making integrated capability available to initiatives that are of significant breadth, scale and complexity, in a way that is not readily achievable through other mechanisms. In 2022/23 the Bioplatforms network undertook 15,931 contracts for 3,406 discrete collaborators, from which 17% of activity was focused on industrial and commercial research communities.

Bioplatforms investments in 'Omics and Synthetic Biology research infrastructure provide avenues for broad impact in areas of significance to Australia, indicated by our access breakdown with 59% from the biomedical sector, 23% focused on food and agricultural research with the final significant focus being biodiversity and environmental research. The publications supported now exceed 821, indicative of the systematic value the Bioplatforms network brings the Australian research system.

Strategic Research Partnership

Bioplatforms purposefully seeks to support the discovery-to-impact cycle within the innovation system through advanced partnership strategies that require contributions from multiple scientific disciplines. Towards this end, Bioplatforms has partnered extensively to drive convergence with other researchers, scientific capabilities, partnering and businesses, and financial investors, thereby providing a vibrant ecosystem for innovation and application.

An example of our partnership approach included the formation and early deployment of an integrated NCRIS Health Group comprising leadership from Population Health Research Network, Phenomics Australia, National Imaging Facility, Therapeutic Innovation Australia and Bioplatforms Australia. The purpose of

the cluster is to support significant Australian research agendas deliberately and seamlessly with harmonious access to the cross section of health directed NCRIS capabilities. The collective approach is now providing collaborative support to a growing number of NHMRC and MRFF initiatives.

The ongoing collaborative work of the Bioplatforms framework data strategy has also continued to deliver new initiatives in areas such as Australia's unique biodiversity. A comprehensive genomic reference library is now nearing completion for Australia's vertebrate fauna, with significant activities in flowering plants, grasses and fungi on going. Bioplatforms is partnered with our NCRIS peers the Atlas of Living Australia and Australian Research Data Commons to expose this data through the Australian Reference Genome Archive.

The framework initiatives are increasingly aimed at generating multi-faceted benefits from their broad collaborations. As an example, the aforementioned native fungi survey – Australia's Functional Fungi – has assisted taxonomists classify an abundant and diverse family, working with the food industry to characterise mushrooms as a safe protein source and supporting biotech with discovery of new classes of potentially life changing drugs called psilocibins.

A highly effective team

The achievements of 2022/23 year as outlined above have been made possible only through the efforts and commitment of many hundreds of people in the Bioplatforms network. I would like to thank all involved, and particularly acknowledge the contributions of the network Convenors, Professor Malcolm McConville, Professor Andrew Lonie and Professor Marc Wilkins whom retired from his Bioplatforms duties to take up Associate Dean Research at UNSW. Collectively, and individually, our Convenors have played a significant role in engaging broad research communities, providing advice to the Board, supporting our Executive and acting as the wider face of Bioplatforms throughout a national network comprising Universities, Medical Research Institutes, Publicly Funded Research Agencies, Industry bodies, and State and Territory government funded research initiatives.

I am also indebted to my fellow Directors, Dr Sue Meek, Dr Katherine Woodthorpe and Professor Peter Gray for their energy, insights and thoughtful guidance throughout such a critical time. Their blend of experience and expertise has been instrumental in all our decision making.

The contribution of the Company Executive, Andrew Gilbert and his small yet high achieving team – Mabel Lum, Sophie Mazard, Sarah Richmond, Victoria Snelson and Kelly Scarlett – has been central to our accomplishments throughout the year, and to the aspirational plans that these now permit.

I finish this by noting this will be my last letter as Chair of Bioplatforms. It has been a privilege to play a part in the Bioplatforms journey, from its establishment in 2007 as a foundational Director under the wonderful chairship of John Grant, through periods of relative uncertainty and funding challenges, to now see the leading role that Bioplatforms plays across so many critical functions within Australian research and innovation. It has been a terrific experience that has allowed me to work with many great people and develop cherished friendships.

Most of all, I am leaving with pride and confidence knowing that Bioplatforms will be under great care with the current team, Board members and the incoming Chair, Professor Peter Gray.

Capability



18

world-class facilities, including 2 biofoundries



\$37m

invested in best of breed technology and leading expertise



380

funded staff (325 full time employees)

Digital Infrastructure (BioCommons)



13

Bioinformatics training sessions (BioCommons, face-to-face and webinar)



2,248

training attendees
20% live,
80% recorded)



Galaxy Australia activities
- **1,293** active users per quarter (average)
- **2,989** analytical tools available

Initiatives and Collaborations



18

active National initiatives



1,194

registered users (209 new) to the Bioplatforms Data Portal across 13 initiatives datasets

Scientific outcomes of technology platform nodes



821

research papers published in peer-reviewed journals



>251

ARC and NHMRC grants Chief Investigator, partner investigator/organisation

Network Access

Effective results driven research requires a critical mass of expertise and state-of-the-art infrastructure for the Australian life sciences sector. Through Bioplatforms' infrastructure and personnel investment, we ensure highly skilled researchers have access to world-class technology platforms in Genomics, Proteomics and Metabolomics with integrated Bioinformatics capabilities.

The life sciences sector is transforming with increased focus on data-enabled approaches to modern day complex biological challenges. To ensure an ongoing state-of-the-art capability across the research sector, Bioplatforms has consolidated our diverse platforms and technology capabilities into 'critical mass' Centres, each with specialised functions. The demand in our 'omics capabilities continues to grow. The completed contracts have led to impacts across all four capabilities (Genomics, Proteomics, Metabolomics, Bioinformatics).

We support the breadth of the Australian research community through our diverse client base. Research contracts completed were distributed proportionally across clients and sectors, with repeat business averaging 7 contracts per client over the year, indicative of the value of Bioplatforms facilities to researchers. This year has seen an increase in industry clients as well as a stronger focus in Agri-food related works.

ENABLING LABORATORY ACCESS

Clients

-  **59%** University
-  **21%** Medical research institutes & PFRA
-  **18%** Government and industry

Research focus

-  **59%** Biomedical and diagnostics
-  **23%** Agri-food
-  **10%** Environmental

SYNTHETIC BIOLOGY

Biofoundries

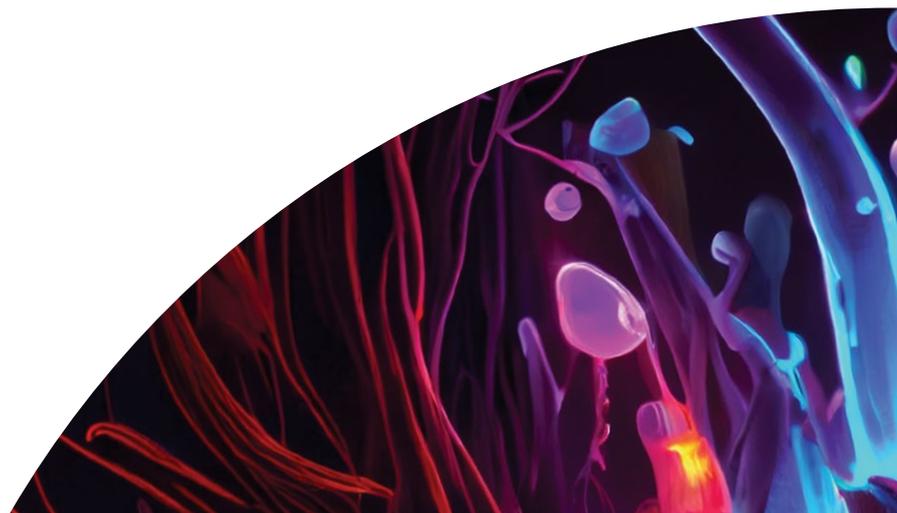
-  **\$8.3m** towards a national synthetic biology infrastructure capability

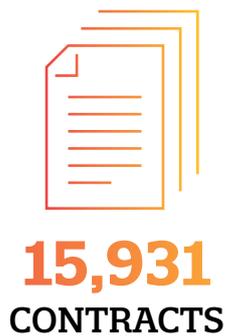
ARC Centre of Excellence

-  **\$35m** ARC investment
-  **32** partner organisations

Spin-off and start-ups

-  HydGene Renewables
-  Number 8 Bio





BIO INFORMATICS

Galaxy Australia

 **2,989** tools available
(637 added in 2022-23)

 **1,293** active users per
yearly quarter (average)

Biocommons

 **13** training events held

 **2,248** attendees

NATIONAL FRAMEWORK INITIATIVES

 **18** active National
initiatives

 **196Tb** omics datasets
(additional 49Tb in
2022-23)

 **>100** reference
genomes of native
Australian species

 **>10,000** environmental
samples with microbial
genomic resource

 **60** population
genomics studies
conducted in support
of conservation efforts

PARTNERSHIP DEVELOPMENT

 **2** Cooperative Research
Centres

 **2** National Environmental
Science Program hubs

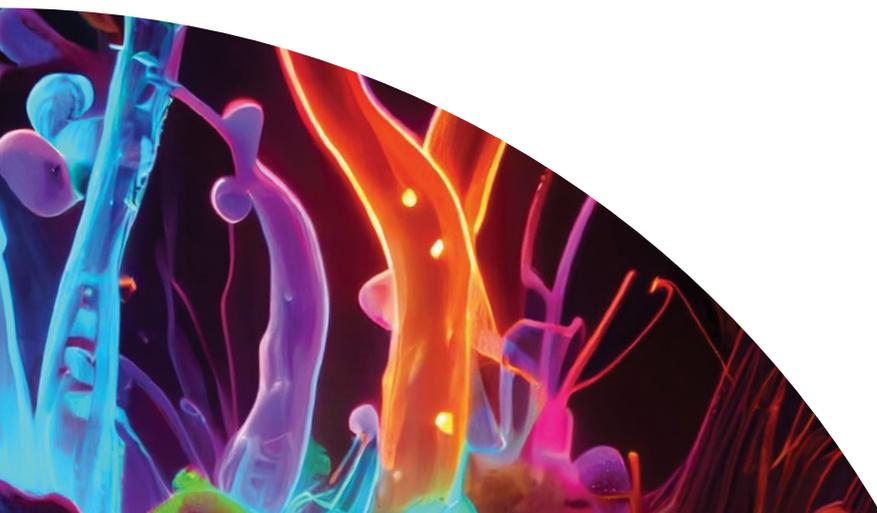
 **7** ARC Centres of
Excellence – active

 **7** Industry transformation
research hubs and
training centres – active

 **88** ARC projects

 **163** NHMRC projects

 **74** Commercially-linked
activities (patents, clinical
trials, start-ups)



Bioplatforms Australia

Australia's capacity to maintain world-class research outputs essential for innovation largely depends upon the availability of a highly skilled workforce and access to cutting-edge research infrastructure platforms. Future research success and application will increasingly be complex and multidisciplinary, beyond the singular involvement of any one party and deliberate partnership strategies will be required.

Demand

The Life Sciences sector, incorporating Technology, Biological Sciences; Agri-food and Veterinary Sciences; Biotechnology and Medical and Health sciences collectively, represent approximately 34% of the national research output with approximately 88% rated at or above world standard (>3; ERA 2018/19). In support of this evidence, 3 of 10 ARC Centres of Excellence awarded in 2020 included Bioplatforms as a partner organisation. Furthermore, approximately 30% of ARC Discovery projects awarded in 2020 were in support of research requiring 'omics capability.

Deployment

Bioplatforms has a successful history of prioritising key national research agendas and deploying the national asset of genomics, proteomics and metabolomics through deep collaboration to energise research, build re-usable data resources and enable open science of scale and diversity. Combined with support of peak peer reviewed research collaborations through the ARC Centre of Excellence program and MRFF Missions, Bioplatforms has proactively deployed NCRIS capability and fostered persevering collaborations across biomedicine, agriculture and environmental research communities.

Digitisation of Discipline

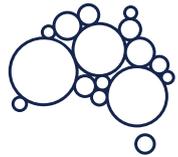
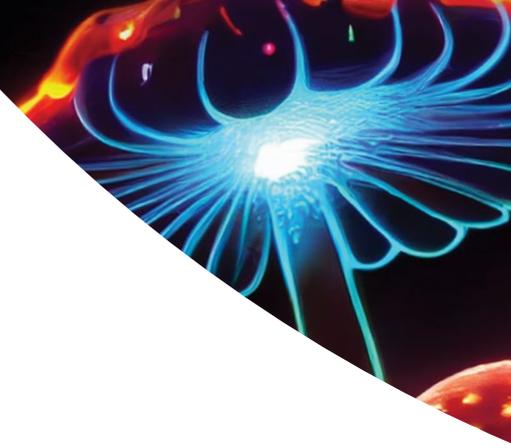
The 'omics have become data -centric digital sciences demanding of investment in computing power, data storage and management, software development and deployment and a differential expertise not traditionally identified with the biological sciences. The Australian BioCommons represents Bioplatforms response to this digital transition and addresses a number of pressing infrastructural needs, including supporting naïve adoption of bioinformatics through the Galaxy cloud offering; leading a national consortium in human genomics attempting to harmonise approaches and promote data sharing locally and globally, and the synthesis of that aggregate data for new science; and coordinating Australia's national digital providers (NCI, Pawsey, AaRNET, AAF, ARDC) in their support for increasingly complex Life Sciences requirements.

Evolving Strategy

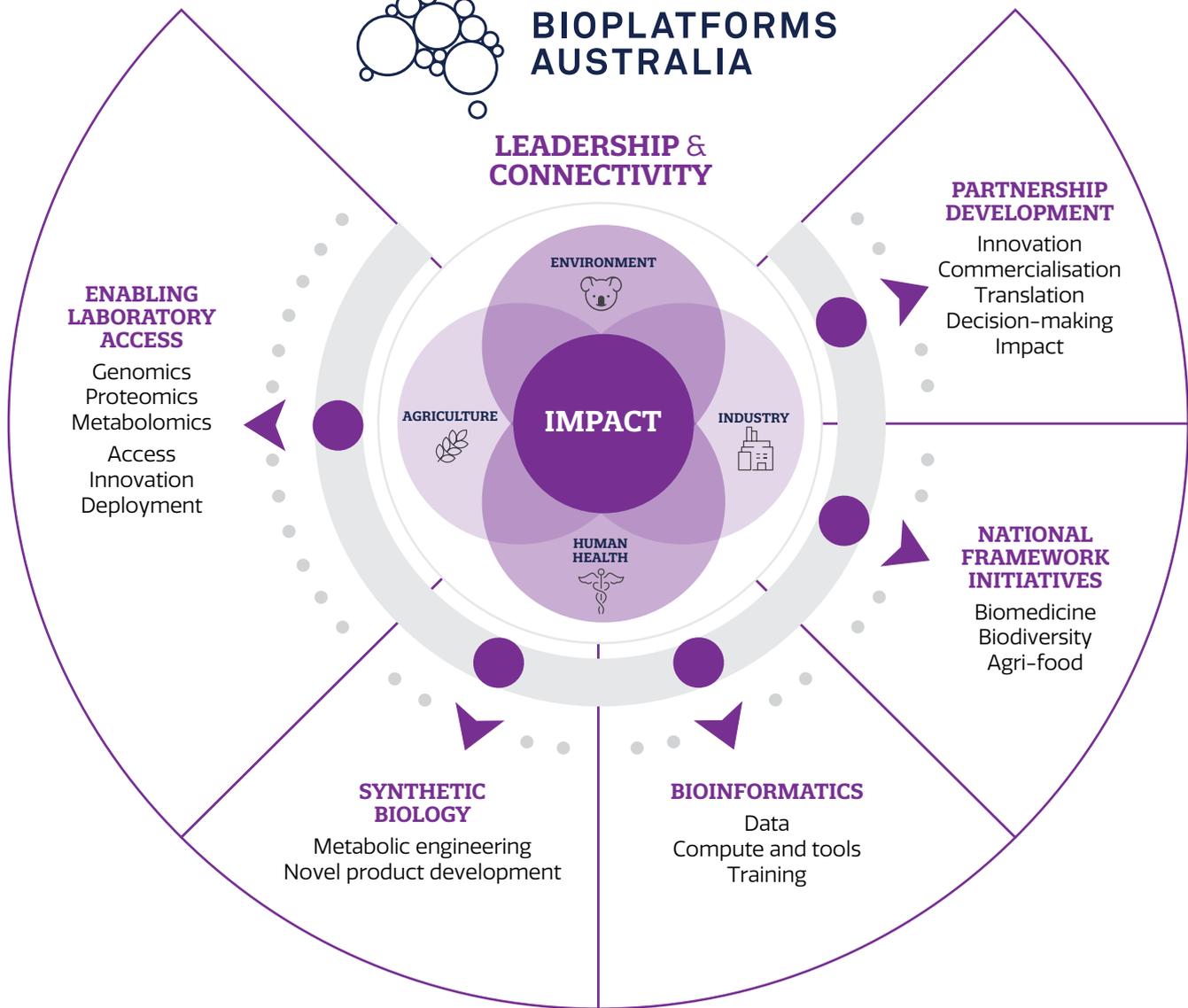
Bioplatforms is committed to supporting the Australian life sciences community through provision of targeted infrastructure requirements and making integrated capability available to initiatives of breadth, scale and complexity in a way that is not readily achievable through other mechanisms.

Bioplatforms supports the current research lifecycle through deep sector engagement with research communities, and is aligned with national strategic research initiatives such as future gene and cell therapies, precision medicine, food security and quality. Existing capabilities in data production, informatics, as well as human capital in the form of skills and training, and research communities, have ensured Bioplatforms can deeply support many touch points in a researcher's impact journey.

We deliberately seek to support the discovery to impact cycle within the innovation system through an advanced partnership strategy. The innovation cycle typically involves a myriad of inputs, including contributions by more than one scientific discipline. We recognise extensive partnership and convergence of capabilities with our NCRIS peers is critical to enabling a vibrant national innovation ecosystem.



BIOPLATFORMS AUSTRALIA



Synthetic Biology Program

Synthetic Biology combines engineering principles with biotechnology techniques providing scientists with the tools to redesign organisms to have new abilities. This fast-developing field is positioned to provide solutions to important societal challenges including environmental protection, climate change mitigation and adaptation, health innovation, agricultural productivity, and environmentally sustainable manufacturing.

Engineering biology to produce a high value industrial compound

IDEA Bio partners with Manildra Group to engineer a microbial strain to efficiently produce Propionic acid.

Manildra, a global leader in the starch and gluten industries, aimed to devise a more sustainable and economically viable method of producing propionic acid, an important compound used in food preservation, animal feed, and pharmaceutical industries.

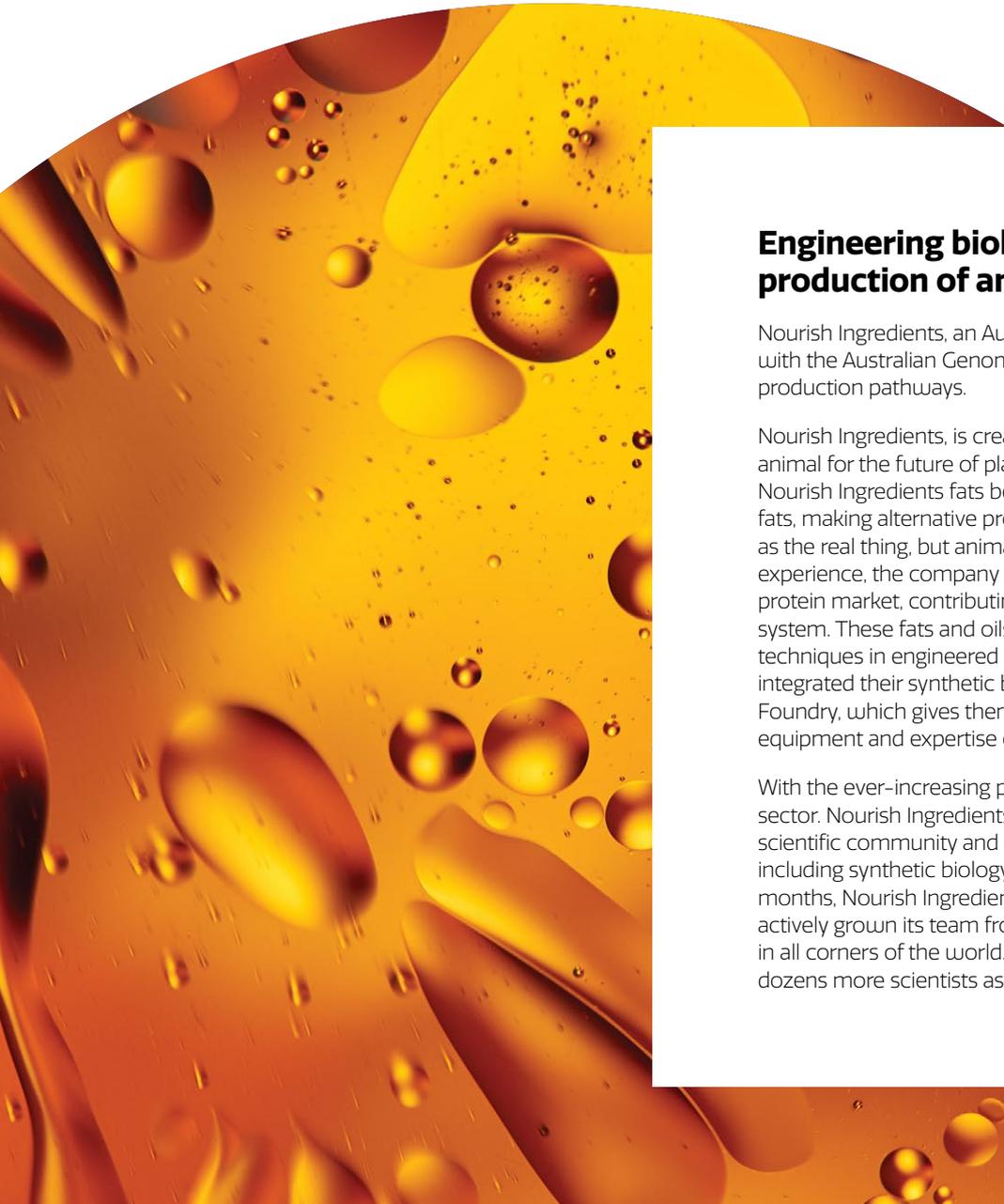
IDEA Bio's potential was harnessed to expedite the strain engineering process. Initially, the platform was utilised to map potential metabolic pathways within microbial strains that could be leveraged for the biosynthesis of propionic acid. By integrating large datasets of metabolic and genomic information, IDEA Bio's algorithms highlighted the most feasible pathways and proposed specific genetic modifications to redirect metabolic flux towards propionic acid production. An iterative learning process identified strains with improved production traits and suggested further modifications to enhance the strain's performance.



In 2020, the federal government, through NCRIS, committed a seed investment of \$8.3 million towards Synthetic Biology infrastructure. This initial investment supported a national Biofoundry capability with complementary nodes at Macquarie University and The University of Queensland. This now provides a high functioning and well accessed rapid-throughput and high-resolution capability with well-established links to other NCRIS facilities, Australian researchers, and industry. However, the Biofoundry is only the first step in developing Australia's infrastructure capacity to competitively capture expanding synthetic biology potential.

This year we have developed an investment strategy to enable a vibrant synthetic biology research and commercial ecosystem that will provide continued support and extension of the current Biofoundry, coupled with expansion to support a rapidly growing industry and research community, including:

- research capability across an array of biological organisms (bacteria, yeast, plants, mammalian cells and models specifically designed for medical products) that are aligned to Australian economic priorities and strengths (health, agriculture, industrial biotechnology);
- support that accelerates research discoveries and their translation into real-world impact through testing, scale-up, expertise and ecosystem considerations (legal, ethical, governance, social licence);
- a critical mass of skilled workers who can operate highly complex workflows and deliver process scale-up;
- a highly connected (both nationally and internationally), integrated, accessible (to industry and the research community) and virtually.



Engineering biology for animal free production of animal fats

Nourish Ingredients, an Australian deep-tech company, partners with the Australian Genome Foundry to develop innovative production pathways.

Nourish Ingredients, is creating authentic animal fats without the animal for the future of plant-based foods. Unlike plant-based fats, Nourish Ingredients fats behave in the exact same way as animal fats, making alternative proteins cook, smell, and taste as delicious as the real thing, but animal free. By providing a realistic taste experience, the company will increase uptake in the alternative protein market, contributing to a more sustainable future food system. These fats and oils are produced through Synthetic Biology techniques in engineered yeast strains. Nourish Ingredients has integrated their synthetic biology team in the Australian Genome Foundry, which gives them access to high throughput, cutting edge equipment and expertise of the AGF staff.

With the ever-increasing pace of the growing plant-based food sector, Nourish Ingredients hopes to contribute to the broader scientific community and create new capabilities in the workforce including synthetic biology-based food innovators. In the last 18 months, Nourish Ingredients has raised over USD\$25 million and actively grown its team from 10 to 50, with world-class scientists in all corners of the world. Nourish Ingredients hopes to add dozens more scientists as it scales its operations.

Feature Stories

A high technology genomic profiling program supported by the Australian Government will examine new treatments for advanced and incurable cancers.

Cancer drug development is undergoing fundamental change, driven by genomics and the advent of rational biomarker-directed drug development. More than 91% of drugs in development are now biomarker-directed, fuelling the new paradigm of precision oncology.

Precision Oncology Screening Platform Enabling Clinical Trials (PrOSPeCT) is a landmark program led by Omico, a network of leading cancer research institutions and hospitals. Omico is also known as the Australian Genomic Cancer Medicine Centre, which is a network of Australia's leading cancer research institutions and hospitals that grew out of the Molecular Screening & Therapeutics (MoST) Study at the Garvan Institute. PrOSPeCT will open up new treatment paths for people across Australia with difficult to treat cancers including ovarian, and pancreatic cancer, sarcomas and cancer metastasis.

PrOSPeCT aims to build a public-private partnership with industry to:

- enable 23,000 Australians patients with advanced and incurable cancers to access genomic screening. Patients will be recruited from across Australia, including rural, regional, and remote patients. Where possible, they will be matched to clinical trials for innovative biomarker-dependent cancer treatments and other therapy options.
- attract global investment in Australian clinical trials and build national trials capacity;
- create and commercialise a real-world digital asset of international significance.

The Australian Government has invested \$61.2 million through the Australian Government's Medical Products stream of the National Manufacturing Priority administered by the Department of Industry, Science and Resources. Other investors in the \$185 million program include NSW Health and key partners the National Computational Infrastructure at the Australian National University, Roche Australia, the Children's Cancer Institute Australia and Bioplatforms Australia.

This program will create up to 650 direct and indirect jobs, create a vibrant ecosystem for commercialisation of Australian medical research and grow smart businesses, and inject more than \$660M into the economy.

Bioplatforms is a core partner in the project, providing a large component of the gene sequencing through our network of enabling laboratories. This exciting project builds on our other cancer investments including the Melanoma Framework Initiative and Zero Childhood Cancer program.



The NCRIS Health Group – Working together to keep Australians healthy through research innovation.

Health and medical researchers investigate solutions to complex problems that are often not easily solved by a single discipline. A group of four National Collaborative Research Infrastructure Strategy (NCRIS) – enabled projects have come together with health and medical research partners to boost innovation in Australia's health and medical research translation.

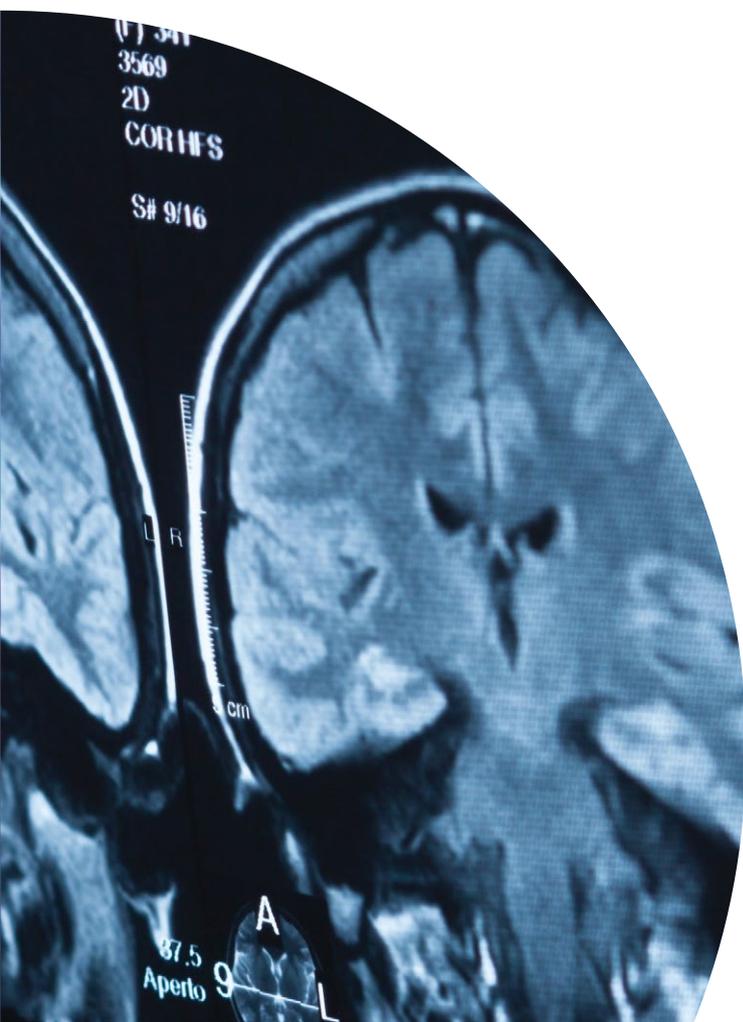
Bioplatforms Australia, National Imaging Facility, Phenomics Australia, Population Health Research Network and Therapeutic Innovation Australia will enhance collaborative opportunities between infrastructure capabilities and enable support across the whole research translation cycle.

Research to improve health outcomes is underpinned by research infrastructure encompassed by the NCRIS Health Group, including:

- National integration of large-scale health datasets to enable population health research
- Bespoke modelling to understand how diseases develop and test potential treatments
- Discovery and development research to identify drug targets
- Development of medical products including therapeutics and diagnostics such as nuclear medicine and radiopharmaceuticals
- Scale-up and manufacturing of medical products
- National facilities supporting clinical trials

Prior to the formation of the NCRIS Health Group, partners have undertaken cooperative activities, including shared staffing, partnership in government initiatives such as the Medical Research Future Fund and the Australian Research Council, as well as collaboration in other key health and medical research projects.

The President of the Australian Cardiovascular Alliance, Prof Gemma Figtree is collaborating with leading researchers and clinicians across biobanking, phenotypes, 'omics, preclinical modelling and clinical trial networks as part of a strategy for novel drug development. This internationally significant work is enabled by the NCRIS Health Group. Prof Figtree noted that supporting collaborative medical product research will improve health outcomes for Australians. This will allow development of novel medical products, platforms, technologies and practices, which have the potential to improve quality of life and decrease health-related costs.



Research Programs

Missions

Bioplatforms catalyses research collaborations to build new capabilities and critical data resources to support some of Australia's biggest scientific challenges. These challenges span agriculture, biomedicine and the environment, as well as extending to relevant international endeavours.



Active

Completed

The benefits of framework programs



Build large-scale data resources



Maximise impact of national research infrastructure



Build scientific capabilities



Catalyse scientific collaboration and international linkages



Research acceleration and translation into industry

HUMAN HEALTH,
BIODIVERSITY,
CONSERVATION,
AND PRIMARY INDUSTRY



Planned

FUNCTIONAL FUNGI



BIRDS



FISH



New

Overview

Bioplatforms' Initiatives are national collaborative projects that use integrated 'omics infrastructure to support research themes of national significance. The interdisciplinary and collaborative nature of these projects ensures the datasets are relevant to current scientific questions and immediately employed for high impact research.

Over the lifespan of the Program, 34 initiatives have received investment for research integrating genomics, proteomics and metabolomics. The 2022-23 year saw 3 new programs initiated: the Functional Fungi Initiative, Australian Avian Genomics initiative, Australian fish genomics initiative.

Additional programs are being scoped for future Framework Initiative investment, with continued focus on primary industry and innovation, as well as the completion of the establishment of genetic resources for all Australian flora, fauna taxonomic groups.

National Initiatives



The Australian Functional Fungi Initiative is collaborating with Australia's mycology research community and innovative industries to create genomic, metabolomic and proteomic data resources to advance the understanding and applications of Australian fungi.

The fungal kingdom is taxonomically separated from both plants and animals, and as such contains unique characteristics including structures, metabolites, nutritional properties and ecological functions. Globally, currently 148,000 species of fungi are recognised, however the vast majority of fungal species (estimate of over 90%) are currently unknown to science and the total number is somewhere between 2.2 and 3.8 million. The majority of western knowledge of fungal species in Australia stems from the history of use, and study of species thought to have originated, or be analogues of northern hemisphere fungal species. This has led to both incorrect identification and an underestimation about the true diversity, origin and potential of Australian fungi. This knowledge gap creates immense opportunity for exploration and innovative translation of 'omics data from Australian native fungi.

The generation of national data resources for Australian fungi will enable insight into their diversity and unique functions, while unearthing avenues for emerging industry applications. This initiative features exciting industries exploring origins and genetic improvement of Australian psychoactive and medicinal mushrooms, as well as projects uncovering novel diversity of entomopathogens (or zombie fungi) for biological controls, diagnostic development of opportunistic human fungal pathogens, exploring indigenous knowledge of fungi as native foods, biomaterial engineering, ecosystem management and conservation, and fungal adaptations in extreme Antarctic environments.

This initiative is the first of its kind for fungi in Australia, and in 2022 saw the participation of mycologist and fungal enthusiasts from 12 industry or start-up groups, 11 Universities and 7 organisations including Australia's leading fungal collections (Fungaria), CSIRO and state government departments.



Oz Barley - A genotype-to-phenotype data asset for Australian barley.





The Australian Avian Genomics Initiative aims to build a foundation of genomic data to advance our understanding and conservation of Australia's unique native birds.

As Bioplatforms advances through the Australian vertebrate Tree of Life with the previous national initiatives supported, the Avian Genomics Initiative will address gaps in genomic data resources to support investigation and management of unique and valuable Australian bird species.

Australia is considered the most important continent for the evolution of modern birds, with a majority of the world's species tracing their ancestry here. Australia is home to ~830 species of birds, of which 43% are endemics and only found here. However, central gaps remain in the reference data available for Australian bird species. Out of the 107 known families of birds that are found in Australia, 41 families of native or endemic birds have no Australian representative reference genome. Filling these gaps in referential data would have significant value in linking genomics, ecology and behaviour for species and functional traits that are uniquely Australian.

The Avian Genomic Initiative aims to:

- Build a foundation of genomic data to advance our understanding and conservation of Australia's unique bird species (including phylogenomics, reference genomes, population genetics)
- Accelerate fundamental research of bird genomics in areas that Australia is uniquely placed to make its mark on the world stage. This includes advancing our understanding of key species traits and how we may manage them, such as migration and nomadism and the spectrum in-between those extremes; nectarivory; drought tolerance or non-tolerance; co-operative breeding; genetic controls of plumage patterns and mimicry; vocal mimicry; construction of mud nests; adaptation to the arid zone; bill morphology; and detection of infrasound (how waterbirds locate water after rainfall events)
- Complement fundamental research with genomics to meet critical needs of our unique bird biodiversity, as identified by society, government and industry

Modern cereal breeding and crop improvement rely on the combination of genotypic and phenotypic data to identify important genetic regions that drive crop performance such as high yield, more tolerant to salinity, drought or heat. Despite this requirement, there are few public and trusted data assets available to Australian researchers and breeders.

The Australian Plant Phenomics Facility and Bioplatforms Australia collaborated with the ARDC and a range of stakeholders to develop OzBarley. The aim of the project is to develop a publicly available Genotype-to-Phenotype (G2P) data asset meeting FAIR principles that is specifically designed by and for Australian researchers and breeders focusing on barley as an economically important model crop.

While trusted repositories, like GenBank, exist for molecular sequence information, this is currently not the case for integrated genotypic and phenotypic data. This is still a young discipline, grappling with aspects of metadata standards, data annotation and sharing. The molecular and whole plant phenotypic data made available through OzBarley will implement standards currently being developed by the international phenotyping community, a process that will serve as template for adopting FAIR data standards for phenotypic data sets in future projects.

The OzBarley G2P data asset will provide the basis for in silico research and gene discovery. Since the large financial and time commitments from the generation and genotyping of a population will be already solved, OzBarley G2P will reduce the barrier to entry for future barley funding applications allowing scientists to focus on studying their traits of interest. Researchers, breeders, bioinformaticians and machine learning experts can now jointly work towards extracting maximum value from the data to support crop improvement.

The seeds will be available via the Australian Grains Genebank and all genotypic data (SNP and RNAseq) will be shared via a custom OzBarley GERMINATE instance.

Beneficiaries of the OzBarley project will be academics and breeders alike, thereby providing (i) a collaborative platform for public-private collaboration, (ii) a direct path to market and ultimately (iii) improved barley varieties for Australian growers.

Additional collaborating organisations include: Australian Grain Technologies, Intergrain, Secobr Researchers, University of Adelaide, CSIRO, SARDI, Federation University.

Collaboration and Partnerships

Elixir (Europe)
Joint Genome Institute (USA)
National Microbiome Data Collective (USA)
Kew Gardens (UK)
National History Museum (UK)
Earth BioGenome Project (Multinational)
Genomes on a Tree – GoAT (Multinational)
Pan-Cancer Analysis of Whole Genomes Consortium (Multinational)



International

HydGene Renewables
- Biological Hydrogen production
Coopers brewery
- biofouling and fermentation improvements
Number 8 Bio
Precision Oncology Screening Platform Enabling
Clinical Trials (ProSPeCT) – Omico



Commercial/ industry partners

Cardiovascular Health mission
Genomics Health Futures mission
Brain cancer biobank
Functional genomics Network
Indigenous genomics program



Medical Research Future Fund (MRFF)

Centre for Medicinal Agriculture
Research hub for Sustainable crop protection
Research Hub for Supercharging Tropical Aquaculture Through Genetic Solutions
Centre for Facilitated Advancement of Australia's Bioactives
Centre for Accelerated Future Crop Development
Centre for Next-Gen Technologies in Biomedical Analysis
Hub for Carbon Utilisation and Recycling – RECARB Hub
Centre in Plant Biosecurity – decision pending



ARC Industry Transformation Research Hub (ITRH) and Training Centre (ITTC)

Impact through collaboration

Bioplatforms has ongoing partnerships with Cooperative Research Centres, Australian Research Council (ARC) Centres of Excellence, and ARC Industry Transformation Research Hubs. We also collaborate closely on national programs and have strong links with international partners. These national and international partnerships are central to delivering on our core values and beliefs – building impact, quality, collaboration and trust.



Programs

Synthetic biology
Reef monitoring
Bioinformatics training
Australian Reference Genome Atlas (ARGA – ALA)
National Biodiversity DNA Library (NBDL – CSIRO)
Cross-NCRIS projects – OzBarley (ARDC, APPF); Ocean Data Nexus (ARDC, IMOS); Biomedical discovery asset (ARDC, Phenomics Australia)



ARC Centre of Excellence (CoE)

ARC CoE in Nanoscale BioPhotonics – completed
ARC CoE in Plant Cell Walls – completed
ARC CoE for Australian Biodiversity and Heritage
ARC CoE in Synthetic Biology
ARC CoE in Plant success in nature and agriculture
ARC CoE in Innovations in peptide and protein science
ARC CoE in Plants for Space
ARC CoE for the Mathematical Analysis of Cellular Systems
ARC CoE for Indigenous and Environmental Histories and Futures



Cooperative Research Centre (CRC)

CRC for Alertness, safety and productivity
CRC for Transformations in mining economics



National Environmental Science Program (NESP) 2 Hubs

Resilient Landscapes Hub
Marine and Coastal Hub

Commercialisation and Industry Engagement

Industry engagement continues to be a key component of the programs and initiatives that Bioplatforms supports. We work with our nodes to deliver targeted research services and ensure alignment with current national scientific and innovation priorities.

GenePath Labs

Bioplatforms offered support to GenePath Labs through early research on genomics screening, with seed funding provided in 2016. The voucher enabled them to develop the world's first genomic newborn screening assay. This screening assay is currently being used by Pathology Queensland and UNSW as part of a \$2.99 million MRRF Clinical Trials Grant. The project is led by Associate Professor Natalie Taylor with her team from the School of Public Health and Community Medicine, along with Adjunct Senior Lecturer Bennett Shum, founder of GenePath Labs. This CTA aims to transform newborn screening across Australia. The type II hybrid effectiveness-implementation trial is using targeted, adaptive genomics for ethical, evidence-based expansion of newborn screening.

To capitalise on the opportunities provided by our position at the intersection of academic and applied scientific research, we have increased our support for commercialisation. Now facilitated by a dedicated role, we have developed a commercialisation strategy based on 3 key pillars:

1. Identifying and triaging opportunities: We have established commercialisation training across our nodes, developed a program inviting commercialisation expressions of interest from researchers, and provide investment due diligence for high potential projects.
2. Enhancing translation capacity: In addition to providing infrastructure, expertise, and access to our extensive network, we are increasing our connection with relevant accelerators, commercialisation training providers, and investors.
3. Increasing access to early-stage investment: Independent of our NCRIS funding, we have established a pre-seed translation fund, allowing us to invest in early-stage high risk start-ups focussed on enabling them to reach the maturity to access further investment funding.

Number 8 Bio develops novel methane reduction technology for the beef and dairy industries

Number 8 Bio is an Australian start-up company. The company is creating a synthetic yeast strain for use in cattle feed aimed at decreasing methane emissions and feed costs for beef and dairy production. Methane is produced in the cow rumen. Rumen-dwelling microbes break down complex carbohydrates to produce carbon dioxide and hydrogen. Another set of microbes takes the gases and converts them into methane which is burped out by the cows. Methane is 28x worse for trapping heat in the atmosphere than carbon dioxide. Decreasing methane emissions means the resources that went into creating methane are now available to make more productive livestock. Number 8 Bio develop their technology using cutting edge, high throughput production and analytics equipment in the Australian Genome Foundry to build and test their new synthetic yeast strains.

Number 8 bio received early-stage support from Bioplatforms in addition to pre-seed funding and incubates with the NCRIS funded Australian Genome Foundry located at Macquarie University. The Start-up company successfully completed the UNSW SynBio 10X accelerator and has also received funding from Main Sequence, Possible Ventures and UNSW Founders. The company announced in the second quarter of 2023 that they had raised \$1.8M AUD in pre-seed funding prior to finalising their upcoming funding round, and currently employ six staff.

Number 8 Bio intends to raise further funding to undertake animal trials with its first product, a synthetic yeast strain for use in cattle feed aimed at decreasing methane emissions and feed costs for beef and dairy production.

Capabilities Network

Scientific research changes lives through innovation.

Bioplatforms Australia encourages innovation by investing in scientific infrastructure and biomolecular research capabilities through our Capabilities Network. This Network spans 18 leading universities and research facilities across Australia, employs 380 staff annually.

Our capabilities network is organised into five technology platforms



Genomics

Gene Discovery and Genome Function

- Australian Genome Research Facility
- The Ramaciotti Centre for Genomics, UNSW, NSW
- Biomolecular Resource Facility, ANU, ACT
- Garvan-Weizmann Centre for Cellular Genomics, NSW
- Genomics Western Australia, WA
- South Australian Genomics Centre, SA



Proteomics

Protein Structure and Function

- Australian Proteome Analysis Facility, NSW
- Monash Proteomics & Metabolomics Facility and Monash Antibody Technologies Facility, VIC
- University of South Australia, SA
- Proteomics International and UWA, WA



Bioinformatics

Data acquisition, integration, analysis and modelling

- Australian BioCommons led out of the University of Melbourne
- The Queensland Cyber Infrastructure Foundation (QCIF)



Metabolomics

Small Molecule Analysis

- Bio21 Institute, University of Melbourne, VIC
- Australian Wine Research Institute, SA
- Centre of Metabolomics, UWA, WA
- Australian Institute of Bioengineering and Nanotechnology, UQ, QLD

Synthetic Biology

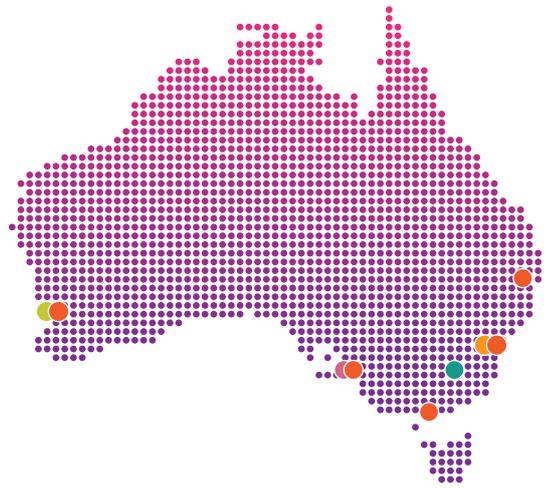


Design-Build-Test-Learn

- Australian Genome Foundry - Macquarie University, NSW
- IDEA Bio - University of Queensland, QLD

Genomics

- Australian Genome Research Facility
- Ramaciotti Centre for Genomics
- Biomolecular Resource Facility
- Genomics Western Australia
- South Australian Genomics Centre



The genomics platform is important to every field of life science research and provides cutting-edge genome research services via our state-of-the-art infrastructure and world class specialists with expertise in high throughput genomics, transcriptomics, epigenomics and bioinformatics

Enhancing athletic performance and sports injury recovery

Australian Football League (AFL) has a significant cultural and economic impact in Australia. Players need to minimise injury to perform optimally and to maximise the chances of team success.

This study aimed to identify genetic differences that may be associated with the occurrence of injuries in elite male Australian football players.

Understanding genetic relationships associated with risk of injury can better guide training and health support to manage the longevity of players at high risk of injury, as well inform rehabilitation strategy to accelerate recovery.

Biplatforms facilities

Australian Genome Research Facility (AGRF)

Partners: Edith Cowan University, University of Notre Dame Australia, Curtin University, Flinders University, Queensland University of Technology.

Outcome: The researchers found associations with certain types of injuries and specific genes such as the NOGGIN (muscle), COL5A1 (muscle, contact bone), IGF2 (contact bone, contact tendon), and COL1A1 (ligament, non-contact ligament).

Impact: AFL players and potentially other elite athletes may benefit by knowing their personalised susceptibility to injury to inform training strategies that strengthen vulnerable players and reduce their risk of injury.

Genomics research to advance medicine for Aboriginal and Torres Strait Islander patients

Genomics can enable personalised, more targeted approaches to the prevention and treatment of a range of health conditions including cancer, diabetes and heart disease, as well as rare diseases among indigenous children.

Professor Alex Brown, Head of Indigenous Genomics at Telethon Kids Institute, Australian National University, SAHMRI and the SAGC will lead a five-year project, worth almost \$5 million, funded under the 2021 Genomics Health Future Mission. This program will rapidly progress the development of genomic research and resources that will better inform the prevention and management of health and disease in Indigenous Australians.

Biplatforms facilities

Biplatforms Australia – South Australian Genomics Centre (SAGC)

Partners: Telethon Kids Institute, Australian National University, SAHMRI, SAGC, Walter and Eliza Hall Institute for Medical Research, Garvan Institute, Charles Perkins Centre and University of Sydney, Victor Chang Cardiac Research Institute, University of NSW, QIMR Berghofer Medical Research Institute, Queensland University of Technology, CSIRO Health and Biosecurity Flagship, Queensland Health, Griffith University, Deakin University, University of Adelaide, University of South Australia, WA Department of Health

Outcome: This collaborative national network between researchers, genetic health services, Indigenous community-controlled health organisations and industry partner, will advance the benefits of Genomic Medicine for Aboriginal and Torres Strait Islander patients, who have to date been excluded from national genomics efforts

Impact: The network will support and empower Indigenous leadership in Genomic Medicine for the future.

Proteomics

- Australian Proteome Analysis Facility
- Monash University – Monash Proteomics & Metabolomics Platform, Monash Antibody Discovery Platform
- Mass Spectrometry and Proteomics
- Proteomics International



Proteomics is the large-scale study of protein structure and function. Bioplatforms' supported facilities offer a broad range of services including high throughput protein characterisation, protein biochemistry, monoclonal antibody production, along with drug discovery and screening.

Managing contamination of fire retardant in our environment

Poly- and perfluoroalkyl substances (PFAS), also known as the "forever chemicals" have been used in the production of semiconductors, firefighting foams, automotive parts, medical utensils and many other items due to its high resistance to heat, grease and non-reactivity. PFAS persist in the environment because of these features and contamination has been observed throughout the human and natural environment. Hundreds of PFAS exist however, only a handful dominate samples analysed by researchers and how they are metabolised and excreted by living organisms is still largely unknown.

Bioplatforms facilities

Mass Spectrometry and Proteomics (University of South Australia)

Partners: South Australian Health and Medical Research Institute (SAHMRI), Future Industries Institute at UniSA

Outcome: Methods for the quantification of common and less abundant PFAS in rat blood and soil by liquid chromatography-tandem mass spectrometry has been developed to help understand the distribution of PFAS in the environment and their pharmacokinetic properties. We are also working to develop a method for the analysis of urine to identify if compounds are readily excreted or not and potentially accumulating in tissue.

Impact: The development of these methods will assist researchers and the Australian government to implement legislation for the regulation of production, use and disposal of PFAS in the future. Better management of the PFAS in the environment will reduce exposure and persistence of environmental contaminants that may be impacting the health of our native animals and ecosystems.

Developing renewable energy sources

There is an increasing demand on energy around the world, with traditional sources struggling with both global provision and aligning with environmental requirements. Renewable energy sources that can be sustainable and scaled up efficiently are in high demand.

Researchers have discovered an enzyme that can "quite literally covert air into energy". These enzymes from a specialised superfamily of hydrogenase (NiFe) can overcome two extraordinary catalytic challenges:

- oxidising extremely low levels of hydrogen amid ambient levels of the catalytic poison oxygen
- the transfer of derived electrons are to the respiratory chain.

Bioplatforms facilities

Monash Proteomics & Metabolomics Platform (MPMP)

Partners: Greening Lab (www.greeninglab.com) including various collaborators

Outcome: This discovery may provide opportunity to find novel ways to produce clean energy and sources that generate green electricity – in this case using hydrogen from ambient air.

Impact: Like the development of most renewable energy resources, the success and implementation of this discovery is likely to seed both environmental and economic benefits into the future.

Metabolomics

- University of Western Australia
- Australian Wine Research Institute
- The University of Melbourne
- University of Queensland



Metabolomics involves large-scale analysis of cell metabolites. Metabolomics is integral to the suite of 'omics technologies required for systems analysis and is often described as the 'glue' that brings multiple 'omics efforts together. Through our network of metabolomics partner facilities, we provide state-of-the-art metabolomics capabilities and customised services, from specific detection and quantification services, through to complex investigations and systems wide analyses in biological systems.

Harnessing the power of microscopic organisms for sustainable production in industry

The University of Queensland and Macquarie University are partnering with Bondi Bio, a biotech start-up, to commercialise cyanobacteria as a platform technology for producing food and fragrances.

Cyanobacteria, often known as blue-green algae, are photosynthetic bacteria that can convert sunlight, carbon dioxide, and water into sugars and other organic compounds through photosynthesis. This makes them a potentially sustainable and efficient platform for producing a wide range of useful products. In the context of food production, cyanobacteria could be genetically engineered to produce proteins, vitamins, and other nutrients, contributing to the development of sustainable and nutritious food sources. In terms of fragrances, cyanobacteria could be utilised to generate a variety of aromatic compounds, reducing reliance on traditionally sourced ingredients, which can have significant environmental footprints.

Bioplatforms facilities

Queensland Metabolomics and Proteomics (QMAP)

Partners: Bondi Bio and Macquarie University

Outcome: Building molecular maps of the the metabolism of cyanobacteria will enable researchers to understand their entire metabolic pathway, underpinning the identification of key enzymes and reactions that can be targeted or optimised for various biotechnological applications.

Impact: Understanding and potentially manipulating metabolic pathways in cyanobacteria could potentially revolutionise sectors of the food and fragrance industries, making them more sustainable and environmentally friendly.

Non-invasive method to evaluate animal well-being

The pre-natal and early post-natal hormonal environment of lambs can influence an animal's well-being throughout its entire life, affecting metabolism, reproductive performance, cognitive functions and health and immune status. It is, therefore, of fundamental importance to understand the link between animal's well-being, in utero hormone exposure and individual animals displaying chronic stress symptoms.

Researchers at the University of Adelaide were seeking to identify a non-invasive method for assessing lamb hormone levels using lamb birth coat (wool).

The primary objectives of this project were to determine if hormones linked to foetal development can be detected in lamb wool and to evaluate differences in the hormone profile that could be used as markers of the animal health.

Bioplatforms facilities

Metabolomics Australia SA

Partners: University of Adelaide, School of Animal and Veterinary Sciences

Outcome: Steroid hormones were successfully quantified in lamb's wool, significant differences in the hormone profiles between breeds and litter sizes were observed and the differences in the hormone profiles were indicative of the animal's health status.

Impact: The determination of hormonal levels in lamb birth coat can be employed as a non-invasive metric to quantify animal well-being in large populations that can improve farming practices and animal well-being.

BioCommons

Australian BioCommons is building digital capability in Australian life sciences. BioCommons, continued to support a broad range of communities through collaboration with strategic partners during 2020–23.

The Australian BioCommons is coordinating activities with a wide range of partners, some of the 2022–23 activities of note have included:

- The renewal of ELIXIR, the European life science data infrastructure, collaboration strategy with Australian BioCommons. Both organisations work to further open access to resources to understand the molecular basis of life and have been collaborating for many years, leading to an original collaboration strategy in 2020.
- The establishment of infrastructure so that Australia can participate fully in the global ecosystem of responsible human genomics data analysis, and the enhancement of Australia's capability for secure and responsible sharing of human genome research data
- Building the Australian Cardiovascular disease Data Commons (ACDC)
- Bringing Nextflow Tower to Australian researchers
- ARGAs: Enabling discovery and use of genomic data from Australian native and agricultural species



Powering bioinformatics training with (free) computational infrastructure

When hosting a hands-on bioinformatics training or teaching event, the provision of access to a suitable computing set-up for all attendees is necessary so that they can undertake practical exercises. This has traditionally been challenging and time consuming for course organisers and trainers because they have needed to either find (a) a suitable computer training lab or (b) provision of virtual machines for each trainee, then ensuring these computers are set-up with the right operating system, appropriate software tools and data.

The new Training Infrastructure as a Service (TlaaS) from Galaxy Australia is web accessible, allowing trainees to use any web enabled device to access training. The infrastructure supports the experience of the various stakeholders throughout the training as well as the process:

- Trainees get access to the computational power they need and their jobs are optimised to ensure they run quickly. Each student's outputs from the course are accessible on Galaxy Australia after the workshop so new skills can be immediately put to use.
- Trainers use a customised dashboard to track their student's work which allows for real time control of the workshop progress. Galaxy Australia administrators monitor the training event behind the scenes and fine-tune any resourcing required for the best experience.
- Training materials can be selected from the library of over 200 tutorials developed and maintained by the worldwide community on the Galaxy Training Network (GTN), or trainers can bring their own curriculum.

As of 26 Jun 2023, 86 bioinformatics training events, attended by 7077 students, have used Galaxy Australia's TlaaS to provide the training environment. These have used 835 days of compute resources. All compute costs are fully subsidised by the operators of the Galaxy Australia service. The Galaxy TlaaS infrastructure has been developed by the global Galaxy developer community and then deployed by Galaxy Australia. TlaaS schedules jobs to the NCI Pulsar compute node. The training partners using TlaaS to date have included the UTS, La Trobe University, Griffith University, QUT, UNSW, University of Melbourne, UQ and QCIF.

Improving plant industry access to new genetics through faster and more accurate diagnostics of plant viruses and viroids

High-throughput sequencing of host plant small RNA (sRNA) is a popular approach for plant virus and viroid detection. However, a major bottleneck for implementing this approach in routine virus screening of plants in quarantine scenarios is a lack of computational expertise in using command-line environments by the front-line workers who need to apply these methods.

The Barrero group at QUT has chosen Galaxy Australia as a platform to circumvent these problems. They have developed two bioinformatics workflows inside Galaxy Australia (GA-VirReport and GA-VirReport-Stats) that are accessible through a web browser and can be used by quarantine workers who are not comfortable with using command line methods for detecting viruses and viroids from host plant sRNA extracts. In mid 2022, a group of fourteen staff from the Science and Surveillance Group from the Australian Government's Department of Agriculture, Water and the Environment were trained in the use of these Galaxy Australia pipelines during a three-day viral pathogen detection workshop. The Galaxy Australia's TlaaS (Training Infrastructure as a Service) was used to underpin the three-day viral pathogen detection workshop. The feedback received from the mostly beginner audience was that almost everyone left feeling 'very comfortable' using the tailored Galaxy Australia workflows for processing sRNA-Seq data and reporting positive detections.

These workflows will be of great benefit to quarantine and pest surveillance organisations and staff therein who are not comfortable with using complicated command line methods for bioinformatics analyses.

Galaxy Australia

The digital analysis service, Galaxy Australia, has grown to become a critical research infrastructure for the Australian life sciences community. Rapid development, including continual code base improvements and new hardware offer access to best practice pipelines and tools in genomics, proteomics and metabolomics.

Over the 2022–2023 period, Galaxy Australia has supported the training of 2,391 researchers including undergraduates and Masters students, as well as supported 63 publications.

Galaxy Australia annual growth at the end of 2022/2023:



27,314 USERS

GROWTH +40%



6,612,359 JOBS RUN

GROWTH +40%



BIOPLATFORMS
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Bioplatforms Australia is a non-profit organisation that supports Australian Life science research by investing in state-of-the-art infrastructure and expertise in genomics, proteomics, metabolomics and bioinformatics. Investment funding is provided by the Commonwealth Government National Collaborative Research Infrastructure Strategy.

