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Research School of Biology
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BIOLOGY Honours and Masters (Advanced) Programs
BIOL4001/BIOL8701

Biology Honours/Masters is an exciting, challenging and rewarding year. By working on an independent research project under the guidance of a supervisor, supported by training courses and workshops, you will develop valuable skills in designing and planning a research project, in laboratory, field, or computational techniques, data analysis, and interpreting, presenting and writing up scientific results. You will develop a specialist understanding of a particular field of biology and the process of scientific discovery. Many Honours/Masters students go on to publish their results as an article in a scientific journal.

Admission Requirements

- Satisfactory completion of an undergraduate degree with an average score of at least 70%, calculated across six 2000 and 3000 level courses relevant to the proposed field of research.
- The availability and agreement of an eligible staff member to supervise your project (usually a Lab Leader in RSB).

How to apply

For information on how to apply: Honours | ANU Research School of Biology.
As well as your academic transcripts you need to submit a Nomination of Supervisor form, signed by a prospective supervisor, in which you provide a brief (one paragraph) description of the proposed topic of research. You don't need a detailed project plan at the time of application. The application deadline is **15 December (late January start) or 31 May (July start).**

How do you find a project and supervisor?

Well before applications close, get in touch with potential supervisors to ask about projects and discuss your interests. Supervisors may offer an "off the shelf" project to choose from, or be willing to tailor a project to your interests. You might consider talking to past or current research students in RSB to get an idea of the research environments in different labs. Many RSB academics co-supervise projects with CSIRO, so a project based at CSIRO is also a possibility. Co-supervision across different ANU schools is also possible, but if you enrol in Biology Honours, one of your supervisors must be an eligible RSB staff member.

***What type of research is being done in RSB*?** Find out here: http://biology.anu.edu.au/research/divisions.
***What projects are available*?** See list below

Are there scholarships available?

Availability of scholarships changes from year to year, but there are often honours-level scholarships, or full or partial funding to support honours research project costs, being offered. Some of the scholarships currently available are:

Angus Nicholson Honours Scholarship in Science ($10,000)
Centre for Biodiversity Analysis Honours Awards ($10,000)
Anjeli Nathan Memorial Scholarship ($7000)
ARC Training Centre for Future Crops Development ($5000)

There may also be others - see the ANU scholarships page for further information.

External or Industry Scholarships: Your supervisor may know of other scholarships offered by industries, government agencies, Grains Research and Development Corporation (GRDC), CSIRO, or Australian Biological Resources Study (ABRS). Please discuss with your supervisor directly.

What does an Honours research year entail?

The Honours year is entirely based on independent research – you will be doing research supervised by a lab leader and will be a member of their research group for the year, together with other Honours/Masters and PhD students, postdoctoral researchers, research assistants or other staff.

- The year begins with a few weeks of **training courses and workshops** to equip you with important research skills such as lab and field safety, data analysis, and preparing a research seminar.
- Early in the year you will present a 10-minute **Introductory Seminar** to outline your project plans to RSB staff and students.
- A few weeks later you will submit a **Research Proposal** outlining the background, aims and methods for your project, and then meet with your *panel of examiners* to discuss your project plan. The Research proposal is worth 15% for Honours students. For Masters students it is compulsory, but does not contribute to your final score.
- Most of your year will be spent working on your **Research project**, under the guidance of your supervisor and often in collaboration with research staff or students in their group.
- You will meet with your *panel of examiners* again mid-way through the year to update them on your progress
- About a month before you submit your thesis, you will present your findings and conclusions in a 10-minute **Final Seminar**. Preparing the seminar is a good way to organize your thoughts, and presenting the seminar can be a great way to get feedback before writing your thesis.
- The major piece of assessment is your ~10,000 word **Thesis**. This is worth 85% of your final score for Honours students and 100% for Masters students. The thesis presents the background and literature review relevant to your project, your project aims, a description of the methods and results, a discussion of your findings and their implications, and your conclusions. Plenty of support and guidance is provided to help you prepare your thesis.
- After your thesis is submitted, you will meet with your examiners for the last time, for a discussion of your thesis and project.

As a member of a research group, you will be expected to participate in your group's regular activities such as lab meetings, and you are encouraged to actively participate in activities at the School or Division level, such as journal clubs, workshops, weekly seminars, and various social events.

What research projects are currently being offered?

Below are projects on offer for 2023/24. Please contact each lab leader directly to enquire about particular projects, or about the possibility of developing a new project to suit your interests.

Division of Ecology & Evolution

Lucy Aplin* - *Bird Behavior, Sociality and Cognition

- Animal culture and the spread of innovation in sulphur-crested cockatoos
- Urban foraging ecology of parrots
- Vocal dialects across urban landscapes in parrots
- Social cognition and social networks in sulphur-crested cockatoos

Damien Farine* – *Social Evolutionary Ecology

- Drivers and consequences of multilevel structure in animal societies
- Leadership and collective decision-making in animal groups
- Deep learning-based automated solutions for studies in ecology and evolution
- Dispersal ecology in social landscapes

Rob Magrath* – *Bird behaviour and acoustic communication

- Acoustic communication
- Learning to recognize alarm calls

Naomi Langmore* -*Avian evolutionary and behavioural ecology

- The evolution of song in female birds
- Coevolution between brood parasites and their hosts

Kara Youngentob* and *Karen Ford* – *Nutritional ecology

- How plant nutrients and toxins affect animals

***Megan Head* – Behavioural and evolutionary ecology**

- Thermal tolerance of invertebrates
- Insect behaviour
- Sexual selection in guppies

Paul Cooper* - *Invertebrate physiological ecology

- Effect of rehydration in a reclaimed agricultural catchment on aquatic invertebrates
- Interaction between grapevine cultivars and scale insects under climate change

Rod Peakall and Darren Wong* - *Molecular biology of novel flower colour evolution

- Molecular biology of novel flower colour evolution
- Computer modelling and simulation of semiochemical-based pollinator driven speciation
- The ecology. molecular biology and evolution of nectar production in sexually deceptive orchids

Daniel Noble* – *Climate change, development plasticity and Physiological Ecology

- How do early thermal environments impact thermal physiology and behaviour in ectotherms?
- How do antioxidants protect sperm function?
- How does climate impact parents to affect their offspring?
- How does environmental stress early in development affect population growth?

Sasha Mikheyev* – *Evolutionary genomics

- How animals adapt to rapid changes in their environments

Celeste Linde* – *Fungal-plant interactions

- Endophyte microbiomes associated with *Eucalyptus* dieback
- Can we use mycorrhizal fungi to help establish *E. viminalis* on the Monaro plains?
- Mycorrhizal turnover (arbuscular vs ectomycorrhizal fungi) in *Eucalyptus* associated with dieback.

Robert Lanfear* – *Molecular evolution and phylogenetics

- The causes and consequences of mutation in plant genomes
- New methods to build better phylogenies
- Predicting recombination from genome sequences
- Analysing millions of SARS-CoV-2 genomes in real time for public health
- Software engineering for phylogenetics
- Benchmarking phylogenetic tools and algorithms

Lindell Bromham* - *Molecular Evolution, Macroevolution, Language and Cultural Evolution

- Adapting to extremes: modelling evolution of tolerance to extreme conditions in Australian flora
- Rates of molecular evolution in eusocial species and their social parasites
- Patterns and processes of language evolution in Australia and New Guinea
- Evolutionary pressures shaping variation in mutation rates between species

Marcel Cardillo* – *Biodiversity, biogeography, macroevolution, macroecology, conservation biology

- Forecasting species extinctions under global environmental change
- Systematic conservation planning
- Phylogenetics, macroevolution, and conservation of the plant family Proteaceae
- Investigating the value of phylogenetic diversity for conservation

Craig Moritz* – *Understanding and protecting Australia's unique biodiversity

- Novel genomic methods for detecting chromosome change and effects on speciation
- Pheromone change and evolution in lizards
- Population genomic assessments of diversity and population history in small-range species
- Understanding divergence and genetic erosion in island mammals

Gavin Huttley* - *Computational genomics, Bioinformatics

- Machine learning techniques for identifying the origin of genetic variants
- Non-stationary Markov processes and their application to understanding genetic divergence
- GPU programming for probabilistic molecular evolutionary models

Division of Plant Sciences

Kai Chan* – *Plant Organelle and Cellular Signaling

- Decrypting chloroplast signaling networks in C4 photosynthesis at cell type-resolution
- Agrochemical control of stress signaling pathways for enhanced stress tolerance
- Coordination of chloroplast signals with cellular secondary messengers during abiotic and biotic stresses
- Regulation of chloroplast function via alternative splicing in the nucleus

Danielle Way* - *Plant ecophysiology and global change biology

- How do models of C4 photosynthesis perform against experimental data?
- Impacts of elevated CO_2 on wheat yield and nutritional value

Simon Williams* – *Plant Structural Immunology

- How do effector proteins from necrotrophic fungi cause disease in wheat?
- The molecular basis for plant susceptibility and immunity to Fusarium wilt disease
- Understanding the molecular basis of fungal rust diseases in plants

Spencer Whitney* - *Synthetic Photosynthesis - bioengineering enzymes to adjust carbon fixation

- Engineering CO_2-fixing nanocages towards supercharging plant photosynthesis and growth
- Designing synthetic protein sponges for removing hazardous metal ion contaminants from the environment

Peter Solomon* - *Plant-pathogen interactions

- Protein interaction studies to understand how pathogen proteins cause disease
- Confocal analysis to study the interaction and localisation of plan-pathogen protein interactions
- Gene expression analysis in model plants upon treatment of a novel resistance chemical
- CRISPR analysis of pathogen genes to understand gene expression and protein folding

John Rathjen* – *Plant immunity and pathogen genomics

- How do parasitic fungi attack other fungi? (genomics/transcriptomics)
- Sweet immunity - sugar metabolism as the primary battleground of plant-pathogen interactions (molecular biology/biochemistry)
- Directed evolution of plant disease resistance proteins (synthetic biology)

Barry Pogson* - *Intracellular communication in plant stress tolerance

- Linking intracellular communication to molecular mechanisms that promote plant stress tolerance.
- Synthetic biology and cellular signaling.
- Energy use efficiency in wheat.

Adrienne Nicotra* – *Plant physiological ecology, evolutionary biology

- Thermal tolerance and response to climate change in plants and soil invertebrates from extreme environments (desert/mountain)
- Field studies of response to simulated climate change in the high country
- Understanding drivers of tree dieback in the high country
- Characterising the diversity, species richness, and functional groups of soil invertebrates in changing alpine ecosystems using environmental DNA and morphology

Anthony Millar* – *Plant RNA biology

- Using plant miRNAs to trigger disease resistance in plants

Ulrike Mathesius* - *Root-microbe interactions – symbionts to parasites

- Improving nitrogen-fixing symbioses by modification of plant signals
- Investigating trade-offs between symbiosis and parasitism in legumes
- Improving translation of nitrogen fixation to yield

Graham Farquhar

- Mapping isolated pools of liquid water within the leaf using stable isotope techniques
- Identifying sources of evaporated water through the leaf surfaces using the isotopic signatures carried by water vapors
- Development of an infra-red spectroscopy technique to measure live water content variations of a leaf subjected to vapor pressure deficit

Michael Djordjevic, Michael Taleski and Sara Shafik** – **Plant Molecular and Developmental Biology; Transporter Function, Peptide Hormone Function

- New Strategies to Improve Nitrogen Fixation in Legumes
- Engineering Plants with Fit-For-Purpose Root Systems
- Characterising Transporters Crucial for Establishing the Symbiotic Handshake

***Manny Delhaize** and Richard Poire*

- Characterising root mutants of wheat for improved water use efficiency
- Understanding the gravity-defying roots of the *Twisted Sister* mutants of wheat

Florence Danila** - **Plant Cell Biology and Intercellular Communication

- Understanding plasmodesmatal formation, function and regulation in C3 and C4 plants
- Investigating the role of plasmodesmata in plant-pathogen interactions

Benjamin Schwessinger** – **Plants fungi, evolution

- Enhancing agricultural and environmental biosecurity using cutting edge genomics & bioinformatics.

Division of Biomedical Science and Biochemistry

Giel van Dooren** - **Cell biology and metabolism of apicomplexan parasites

- Uncovering connections between nutrient uptake and mitochondrial metabolism in Toxoplasma parasites

Christina Spry** - **Drug design, infectious diseases, biochemistry and biophysics

- Investigating how aspartate decarboxylase mutations confer resistance to the tuberculosis drug pyrazinamide
- Elucidating the role of a unique and essential fusion protein in the tuberculosis-causing bacterium

Alex Maier** – **Malaria/Parasitology

- Incommunicado - Impact of cellular signalling on the survival and development of the malaria parasite
- Fighting malaria with fat – analysis of the lipid metabolism of the malaria parasite
- Power unseen – in-situ visualisation of parasites of medical and veterinary importance
- Public Perception of Parasitology

Adele Lehane** – **Antimalarial drug action and resistance

- The role of the malaria parasite's SulP transporter in ion regulation
- Transporters associated with resistance to antimalarial clinical candidates – investigating their natural functions and roles in resistance

Ben Corry** - **Membrane channels, transporters and computational biophysics

- Designing new sodium channel inhibitors for treating chronic pain
- Understanding the Piezo channel proteins responsible for our sense of touch
- New methods for water filtration using biologically inspired membranes and temperature gradients
- Simulating the structure and function of malaria parasite membrane transporters
- Computationally predicting the danger of new SARS-Cov-2 variants and circulating animal coronaviruses

Caitlin Byrt** – **Engineering plant membrane proteins and solute transport to increase yield security

- Applying synthetic biology approaches to building novel membrane proteins for food and water security applications
- Characterising key metabolite transporters in the C_4 photosynthetic pathway
- Deciphering the role of aquaporins in C_4 photosynthesis
- Deciphering functional roles of aquaporins in salt-secreting mangroves
- Elucidating determinants for hydrogen peroxide and water permeation through target aquaporins

Joseph Brock** – **Membrane structural biology, biochemistry and biophysics

- Biosensors for the diagnosis of endometriosis and reproductive disorders.
- Engineering the secretory pathway of Yeast for producing plastic degrading enzyme (Samsara Eco / Jackson group collab).
- Structural basis of multi-drug transport in human fungal pathogens by cryo-EM.
- Establishing a yeast surface display nanobody platform.

Aude Fahrer** - **Immunology

- Cancer immunotherapy

Research School of Chemistry

Colin Jackson* – *Synthetic Biology and Protein Engineering

- Engineering enzymes to transform down chitin waste into valuable products
- Engineering new biosensors for synthetic biology
- Understanding protein evolution and engineering at the molecular level through ancestral sequence reconstruction

CSIRO

Dr Lydia Guja* - *Seed biology, seed ecology, and plant conservation

- Understanding germination drivers for seeds of endangered communities such as grasslands and alpine peatlands, and the impacts of changed climate or stress
- Laboratory investigations of the responses of native seeds to fire cues
- Drivers of seed longevity in conservation storage
- How seed functional traits affect early life history processes and community composition

Christine Cargill – Bryophyte Systematics

- Systematics of Australian liverworts and hornworts
- Soil crusts

Francisco Encinas-Viso - *Pollination ecology and population genetics*

- The role of flower scents in alpine plant-pollinator interaction networks.
- Population genetics of the alpine reed bee (Exoneura sp.).
- Modelling climate change effects in Australian alpine plant-pollinator communities.

Alexander Schmidt-Lebuhn – *Plant Systematics and Biogeography*

- Phylogenomics, taxonomy and biogeography, especially of the daisy family Asteraceae
- Machine learning in species identification and collection science
- Polyploidy and genome size

Heidi Zimmer – *Plant Conservation*

- Threatened flora conservation
- Orchids

Questions or further information?

If you have any questions or would like any further information about the Biology Honours/Masters program, please contact RSB Student Admin (rsb.studentadmin@anu.edu.au), or the mid-year program convenor (marcel.cardillo@anu.edu.au)