2020/21 Summer Research Scholarship Program

Research Projects offered by Faculty of Science Schools

School of Agriculture and Food Sciences ................................................................. 2
School of Biological Sciences ................................................................................ 17
School of Chemistry and Molecular Biosciences ............................................... 30
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School of Mathematics and Physics .................................................................. 50
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How to apply

The UQ Summer Research Program is offered by a number of schools in the Faculty of Science during the summer vacation period (mid-November to mid-February). This document provides you with a list of available projects.

1) Browse the projects. You may select a school from the table of contents above to be taken directly to their listed research projects.

2) Contact a potential supervisor in the area of your interest, or the contact person listed, to discuss your interest to undertake their research project. Gain the research project supervisor’s tentative approval, and include this with your full UQ Summer Research Scholarship application.

3) Submit your application via StudentHub.
Functional characterisation of novel components involved in the development and control of legume nodules

Nitrogen fertiliser use in agriculture is inefficient, costly and can be environmentally damaging. Legume crops represent an economically and environmentally sound alternative, as their symbiotic relationship with nitrogen-fixing soil bacteria enables them to thrive in the absence of nitrogen fertiliser. The bacteria (commonly referred to as rhizobia) are housed in specialised root organs, called nodules. Identifying critical components of legume nodulation is now needed to optimise the process and improve agriculture sustainability.

This project aims to discover and functionally characterise novel molecular factors that act in the development and control of legume nodules. Findings will considerably enhance the current nodulation model and could help underpin strategies to reduce the reliance on nitrogen fertiliser use in agriculture.

Number of student places available: 3

Expected outcomes: Findings are anticipated to advance our understanding of how various genes and signals function in the development and regulation of legume nodules. Successful outcomes could also help to generate future publications.

Techniques will include growing and maintaining soybean plants and compatible Bradyrhizobium bacteria, and will incorporate additional methods that may include generating transgenic soybean ‘hairy roots’ using Agrobacterium rhizogenes, fixing and treating roots to detect GUS activity, bioinformatic analyses, primer design and quantitative RT-PCR to confirm the regulation of candidate genes, etc.

Suitable for: Students interested in any of biotechnology, molecular biology, genetics and/or plant science.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Edward Narayan</th>
<th>Duration: 8 weeks</th>
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</thead>
<tbody>
<tr>
<td>Contact Details:</td>
<td>Email: <a href="mailto:e.narayan@uq.edu.au">e.narayan@uq.edu.au</a></td>
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**Hormone monitoring in animals using enzyme-immunoassays**

This project aims to introduce participants with current techniques of non-invasive hormone monitoring using enzyme-immunoassays. The work will be based in the laboratory and involve processing of biological samples (wildlife fur samples) for hormonal assays.

**Number of student places available:** 2

**Delivery:** This is lab based work so on-site Gatton lab.

**Expected outcomes:** Students will gain technical competency in sample preparation, quality control, assay precision and accuracy checks, analysis and interpretation of hormonal data. Acknowledgement in research outputs and certificate of completion for use in CV.

**Suitable for:** Animal Science students, Biomedical Science, Veterinary Science, Wildlife/Equine/Production Animals/Agriculture

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
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<th>Duration: 8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
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<td></td>
<td>Office – Building 83, room N309</td>
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**Analysis of bile acids in serum to determine an association with Alzheimer's**

Samples of serum need to be analysed in UPLC for the presence of primary and secondary bile acids.

**Number of student places available:** 1

**Delivery:** Onsite attendance is required

**Expected outcomes:** Nutrition awareness, analytical chemistry, ability to handle samples and ability to analyse datasets to draw conclusions

**Suitable for:** Applicants must have completed at least 2 units of chemistry, and have some understanding of chromatography.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Supervisor
Dr Christopher Proud and Dr Jaquie Mitchell

### Duration: 8 weeks

### Contact Details:
- Email – c.proud@uq.edu.au; Jaquie.mitchell@uq.edu.au
- Office – Hartley Teakle Building (83), Room 406, St Lucia campus

### Aerobic rice - traits of value for high-yielding, non-flooded rice production.

There are a number of opportunities to conduct short (or long) term experiment in relation to aerobic adaption in the field (Gatton) or glasshouse experiments (St Lucia or Gatton).

Aerobic rice is a new system in the southern Australia production, and as such little research has been conducted the underlying physiological mechanisms contributing to high-yielding aerobic rice, nor the appropriate donors for the traits. In this study, we'll develop screening methods to identify donor varieties and evaluate genetic variation in key traits (eg root morphology, transpiration) that contribute to aerobic adaptation.

Short vegetative experiments (6 weeks) or longer term (4 to 5 months; plants grown to maturity) can be conducted to fit into course plans.

### Number of student places available: 2

### Delivery:

### Expected outcomes: An understanding of the effect of abiotic stress on plant growth and development; experimentation and research strategies for glasshouse or field conditions

### Suitable for: Suitable for students studying or interested in plant biology, agricultural science (crop physiology, agronomy or quantitative genetics). If you are interested in this or similar projects contact us to explore where your skills and interests can be applied. All projects will be tailored to suit the successful candidate.

### Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
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<tr>
<td>Contact Details</td>
<td>Email – <a href="mailto:c.proud@uq.edu.au">c.proud@uq.edu.au</a>; <a href="mailto:Jaquie.mitchell@uq.edu.au">Jaquie.mitchell@uq.edu.au</a></td>
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<td></td>
<td>Office – Hartley Teakle Building (83), Room 406, St Lucia campus</td>
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### Abiotic (cold) stress tolerance of rice

There are a number of opportunities to conduct short- or long-term experiments in aspects of cold tolerance in rice. Our Agrifutures-funded project aims to evaluate variation and elucidate the underlying mechanisms in key physiological traits and molecular quantitative trait loci that may contribute to cold tolerance, a major limitation to production for the Australian rice industry. You can conduct short vegetative experiments (6 weeks) or longer term (4 to 5 months; plants grown to maturity) to fit into course plans.

#### Number of student places available: 2

#### Delivery:

- **Expected outcomes**: an understanding of the effect of abiotic stress on plant growth and development; experimentation and research strategies for glasshouse conditions

- **Suitable for**: Suitable for students studying or interested in plant biology, agricultural science (crop physiology, agronomy or quantitative genetics). If you are interested in this or similar projects contact us to explore where your skills and interests can be applied. All projects will be tailored to suit the successful candidate.

- **Other important details**: Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
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<tr>
<th>Supervisor</th>
<th>Prof Elizabeth Aitken</th>
<th>Duration: 8 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:e.aitken@uq.edu.au">e.aitken@uq.edu.au</a></td>
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<td>Office – John Hines Building, room 519A, St Lucia campus</td>
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**Assessing pathogenicity of isolates of the fungal species *Fusarium oxysporum* obtained from non-crop plants**

*Fusarium oxysporum* is a ubiquitous fungus that exists in endophytic, saprophytic and pathogenic forms. In banana we can occasionally detect endophytic forms high in the canopy but in other plant species we generally only see the endophytic forms in the roots. We would like to examine a range of plant species to determine the extent of recovery of *F. oxysporum* in their tissues. The project will involve some limited field work, techniques in fungal isolation and culturing, DNA extraction, PCR and sequence analysis.

**Number of student places available:** 1

**Delivery:** On site attendance required with research undertaken in the laboratory and glasshouse

**Expected outcomes:** The project will involve some limited field work, techniques in fungal isolation and culturing, DNA extraction, PCR and sequence analysis.

**Suitable for:** Suitable for students studying Plant Sciences or Fungal Biology

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please contact Liz Aitken directly if interested.
Assessing banana seedlings for early interactions with the fungal pathogen *Fusarium oxysporum*

Cultivated banana plants are parthenocarpic, meaning that they produce fruit without seed. However, wild banana plants are mostly diploid and fertile and do produce seeds. In banana breeding programs, seeds are often hard to obtain and as a consequence they usually are put through a process of embryo culture where the embryo is removed from the seed and transferred into tissue culture media using aseptic techniques. We are working with a highly fertile diploid line that produces seed readily. We are curious to see if we can germinate the seed directly and subject the seedlings to an early screening process with the fungal pathogen *Fusarium oxysporum*. The aim is to distinguish between resistant and susceptible accessions at an early stage in the process and so hasten the breeding effort. Normally it takes up to 6 months to screen the plants for resistance/susceptibility. This project will involve research in the glasshouse, laboratory and tissue culture facility. Techniques involved will including culturing both plants and fungi, pathogenicity assays and microscopy techniques including confocal microscopy.

Number of student places available: 1

Delivery: On site attendance required with research undertaken in the laboratory and glasshouse

Expected outcomes: Techniques involved will including culturing both plants and fungi, pathogenicity assays and microscopy techniques including confocal microscopy.

Suitable for: Suitable for students studying Plant Sciences or Fungal Biology

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please contact Liz Aitken directly if interested.
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**Chemical profile of water soluble extracts of several samples of bushfoods and native plants.**
Samples will be analysed by high resolution chromatography platforms for full chemical profiling.

**Number of student places available: 1**

**Delivery:** Onsite attendance is required

**Expected outcomes:** Nutrition awareness, analytical chemistry, ability to handle samples and ability to analyse datasets to draw conclusions

**Suitable for:** Applicants must have completed at least 2 units of chemistry, and have some understanding of chromatography.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
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**Analysis of shelf-life and composition of butter flavoured with bushfoods oils.**

Samples will be analysed for shelflife using gas chromatography and for sensory quality. Butters will be made and stored.

**Number of student places available: 1**

**Delivery:** Onsite attendance is required

**Expected outcomes:** Nutrition awareness, analytical chemistry, ability to handle samples and ability to analyse datasets to draw conclusions

**Suitable for:** Applicants must have completed at least 2 units of chemistry, and have some understanding of chromatography.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
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**Complete analysis of Kurrajong seeds for both macronutrients and phytochemicals.**

Samples of Kurrajong seeds will be analysed to obtain a nutrition information panel and by high resolution chromatography platforms for full chemical profiling.

<p>| <strong>Number of student places available:</strong> | 1 |
| <strong>Delivery:</strong>                          | Onsite attendance is required |
| <strong>Expected outcomes:</strong>                  | Nutrition awareness, analytical chemistry, ability to handle samples and ability to analyse datasets to draw conclusions |
| <strong>Suitable for:</strong>                       | Applicants must have completed at least 2 units of chemistry, and have some understanding of chromatography |
| <strong>Other important details:</strong>            | Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process. |</p>
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<tr>
<td><strong>Development of edible and oxygen proof films for hard candies.</strong></td>
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<td>To develop a film that can be sprayed onto portions of hard candies to prevent moisture entry and loss of lolly quality</td>
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<tr>
<td><strong>Number of student places available:</strong></td>
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<tr>
<td><strong>Delivery:</strong></td>
<td>Onsite attendance is required</td>
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<tr>
<td><strong>Expected outcomes:</strong></td>
<td>Sustainable packaging awareness, ability to handle samples, and knowledge of clean labelling, ability to analyse datasets to draw conclusions</td>
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<tr>
<td><strong>Suitable for:</strong></td>
<td>Applicants must have completed at least 2 units of sensory science and desirable have done food chemistry, principles of food preservation or food product development.</td>
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<td><strong>Other important details:</strong></td>
<td>Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.</td>
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<tr>
<td>Supervisor</td>
<td>Prof Susanne Schmidt</td>
<td>Duration: 10 weeks</td>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:Susanne.schmidt@uq.edu.au">Susanne.schmidt@uq.edu.au</a></td>
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<tr>
<td><strong>Advancing the circular nutrient economy for sustainable food systems in a world without waste and pollution</strong></td>
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<tr>
<td>Empirical research will test crop performance with recycled nutrients retrieved from waste streams to advance next-generation fertilisers. Theory-based research analyses information from databases and other. Both sub-projects will contribute an overall project outcome.</td>
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<tr>
<td><strong>Number of student places available:</strong> 2-3</td>
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<tr>
<td><strong>Delivery:</strong> With ‘business as usual’, we offer empirical research activities. Under Covid-restrictions, we offer literature- and data-based projects as well.</td>
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<tr>
<td><strong>Expected outcomes:</strong> Performing original research in glasshouse and laboratory, searching databases, and potentially modelling using APSIM.</td>
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<tr>
<td>Gained employability skills include teamwork, planning, conducting, analysing and communicating original research to peers, practitioners and industry partners.</td>
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<td><strong>Suitable for:</strong> Students interested in plant and environmental sciences, but also students interested in economics, policy and legislation</td>
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<tr>
<td><strong>Other important details:</strong> Interested students <strong>must</strong> contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.</td>
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<tr>
<td>Supervisor</td>
<td>A/Prof Bhagirath Chauhan</td>
<td>Duration: 8 weeks</td>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:b.chauhan@uq.edu.au">b.chauhan@uq.edu.au</a></td>
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**Evaluation of herbicides for crop safety in vegetables**

Weeds reduce crop yield, increase the cost of growing vegetables, impair quality produce, and have an impact on farm management decisions, such as disease control, the timing of harvest, choice of herbicide options, and weed seed banks. Herbicide choices are very limited for weed control in vegetables. This research will evaluate the effect of herbicides on vegetable crops emergence and growth.

**Number of student places available: 2**

**Delivery:** On-site attendance is needed

**Expected outcomes:**
- Increase candidate’s understanding of the use of herbicides for weed control in vegetables
- Gain skills in vegetables growing and data collection.
- Learn to generate publications from their research.

**Suitable for:** Background in agriculture; suitable for BS and MS students

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Susanne Schmidt</th>
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<tr>
<td>Duration:</td>
<td>10 weeks</td>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:Susanne.schmidt@uq.edu.au">Susanne.schmidt@uq.edu.au</a></td>
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</table>

**Growing clean air**

We will test a prototype of plant-substrate for effectiveness in improving air quality.

Theory-based research analyses information from databases and other. Both sub-projects will contribute an overall project outcome.

**Number of student places available: 1-2**

**Delivery:** With ‘business as usual’, we offer empirical research activities. Under Covid-restrictions, we offer literature- and data-based projects as well.

**Expected outcomes:** Performing original research in glasshouse and laboratory, searching databases, and potentially modelling using APSIM.

Gained employability skills include teamwork, planning, conducting, analysing and communicating original research to peers, practitioners and industry partners.

**Suitable for:** Students interested in plant and environmental sciences, but also students interested in economics, policy and legislation

**Other important details:** Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Supervisor: Dr Nidhi Bansal

#### Duration: 8 weeks

#### Contact Details:
Email – n.bansal@uq.edu.au

### Evaluation of effect of addition of hydrocolloids on improving the properties of poor foaming milk

Milk tends to foam easily, but this tendency depends upon several factors including the composition of milk and the conditions during foaming. Foaming of milk is highly desirable for products such as Italian style coffee such as cappuccino. However, producing consistent foam quality is a major challenge in the dairy industry. This research project involves evaluating methods to improve foaming properties of milk that have natural tendency to foam less. Some of these approaches include addition of ingredients such as hydrocolloids and milk protein powders. This project work will include the measurement of physicochemical and foaming properties of the milk samples.

### Number of student places available: 3

### Delivery: On-site attendance is required

### Expected outcomes: Searching appropriate literature, developing a research plan, hands-on lab experience, data analysis and oral and written communication skills

### Suitable for: BSc Food science major or Master of Food Science and Technology

### Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Wildlife community trends in SE Asian forests

Students will use existing camera trap data on SE Asian wildlife to estimate trends in populations. There will be flexibility about which species and specific research questions. Students are encouraged to think broadly and creatively about new and interesting questions.

### Number of student places available: 1 or 2

### Delivery

### Expected outcomes: Contribution to a peer-reviewed publication

### Suitable for: Masters and 3rd year students in Biol or SEES

### Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Student must be confirmed by the supervisor before acceptance.
<table>
<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Karen Cheney</th>
<th><strong>Duration:</strong> 8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:k.cheney@uq.edu.au">k.cheney@uq.edu.au</a></td>
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<td>Office – Goddard Building, room 118</td>
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**Colour perception in coral reef fishes.**

Colour vision is essential for many animals to find food and mates, and avoid predation. However, the visual systems of most animals differ from that of humans. We therefore use visual modelling and behavioural experiments to understand how animals perceive objects in their environment. You will be trained in running behavioural experiments with coral reef fish to understand how fish perceive colour patterns.

**Number of student places available:** 2

**Delivery:** On-site attendance is required

**Expected outcomes:** Running animal behavioural experiments, experimental design, visual modelling, spectrophotometry and animal husbandry

**Suitable for:** All training will be provided. However, the students must be interested in neurobiology, marine science, visual ecology, animal behaviour and/or fish biology.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Paul Ebert</th>
<th>Duration: 8 weeks</th>
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<td>Contact Details:</td>
<td>Email – <a href="mailto:p.ebert@uq.edu.au">p.ebert@uq.edu.au</a></td>
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<td>Office – Goddard Building, room 374 (8-374)</td>
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**Stress survival behaviour**

Many animals enter a quiescent state as a means of surviving severe stress. The research model organism, C. elegans takes this one step further and actually has a distinct developmental program, called dauer diapause, that aids in stress survival. Dauer diapause is associated with a complete cessation of eating, which . This project will explore how perception of and response to environmental cues differs between dauer and non-dauer C. elegans.

**Number of student places available: 1 or 2**

**Delivery:** This project requires on-site attendance

**Expected outcomes:** C. elegans are ideal for behavioural studies due to their small size, genetic uniformity and stereotypic behaviour. This results in much more robust results than can be achieved in most organisms.
You will learn to design behavioural experiments, collect, analyse and interpret data. Your work will lead to genetic studies in future that will identify the genes responsible for the encoded behaviour that promotes stress survival. This will in turn lead to a better understanding of behaviour in higher animals in which genetic studies are much more difficult.

**Suitable for:** Suitable for students who have completed their second year of science. I will prefer students with an interest in genetics or animal/human behaviour.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
**Supervisor** | Prof John Pandolfi & Carolina Montenegro-Chong | **Duration:** 8 weeks
---|---|---
**Contact Details:** | Email – [c.chongmontenegro@uq.net.au](mailto:c.chongmontenegro@uq.net.au)  
Office – Gerhmann Building (60), Level 8

### Historical fisheries of our coastal seas

Fisheries have had a great impact in changing marine fish populations. Depletion of commercially important fish stocks and overexploitation of fish species are major concerns for managers and inhibit conservation efforts.

Using historical data (e.g. archaeological and palaeoecological records, historical fishing records, naturalist species lists, etc.) to reconstruct past fish population sizes has informed and improved current conservation targets and key stock assessments parameters by providing quantitative estimates of past abundances levels and community dynamics.

The aim of this project is to document changes in the blackspotted croaker and Queensland groper fisheries dynamics in Australia through time using historical data.

**Number of student places available:** 1

**Delivery:** The project can be completed under a remote working arrangement as it is entirely conducted through an online database - TROVE.

**Expected outcomes:**

- To document past changes in catch rates, abundances, and effort (CPUE) of the blackspotted croaker and Queensland groper through time.
- Inform predictions of future stock trajectories and improve knowledge for management and conservation purposes.
- The data collected from this project will also form part of a PhD research in historical fisheries.

**Suitable for:** Students interested in marine ecology, historical ecology, conservation biology, and fisheries biology.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Tatsuya Amano</th>
<th><strong>Duration:</strong> 8 weeks</th>
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The prevalence and drivers of including non-English-language studies in environmental evidence synthesis

Evidence synthesis, such as meta-analysis and systematic reviews, now plays an increasingly important role in biodiversity conservation. Although our recent study showed that over one third of conservation-related literature is published in languages other than English, those non-English-language studies are often simply ignored in environmental evidence synthesis. This project first investigates the prevalence of using non-English-language studies in environmental evidence synthesis, focusing on systematic reviews by the Collaboration for Environmental Evidence ([https://www.environmentalevidence.org/completed-reviews](https://www.environmentalevidence.org/completed-reviews)) and/or existing meta-analyses in ecology and conservation, and then (if time allows) explores what factors (e.g., the number of nationalities in the author team) determine the level of use of non-English-language studies. Findings from this project could have an important implication for making a better use of non-English-language studies in environmental sciences and achieving less biased evidence syntheses to tackle global environmental challenges like biodiversity loss.

**Number of student places available:** 2

**Delivery:** The project can be completed under a remote working arrangement.

**Expected outcomes:** The Scholars will gain (i) skills for efficiently conducting scientific literature reviews, which will be widely applicable to any disciplines, and (ii) knowledge on evidence syntheses—a scientific way of systematically collecting evidence from a range of sources, which has been playing an increasingly important role in informing decision-making on specific issues in e.g., healthcare, education, international development as well as biodiversity conservation.

**Suitable for:** Basic knowledge on ecology and conservation biology is preferable but not necessary.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Simon Hart</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:s.hart@uq.edu.au">s.hart@uq.edu.au</a></td>
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<tr>
<td></td>
<td>Office – Goddard Building (8) room 220, St Lucia Campus</td>
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**Ecological dynamics in deteriorating environments**

Ecosystems are increasingly subject to chronic environmental change. Understanding the consequences of chronic environmental change on the dynamics of ecological communities is critical for the conservation of species diversity, and the maintenance of ecosystem function. This project will combine theory with experimental data to understand the consequences of deteriorating environmental conditions on the dynamics of ecological communities. We will focus on freshwater habitats, because globally, these ecosystems are particularly vulnerable to chronic environmental change, and to the loss of species diversity.

**Number of student places available:** 2

**Delivery:** On-site attendance is required

**Expected outcomes:** freshwater ecology, experimental design, mathematical modelling (optional), statistical analyses.

**Suitable for:** Any interested students

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Interested students should not be in any way intimidated by the theoretical or statistical components of this project.
**Supervisor**: Dr Simon Hart  
**Duration**: 8 weeks

**Contact Details:**  
Email – s.hart@uq.edu.au  
Office – Goddard Building (8) room 220, St Lucia Campus

### Dramatic ecology: understanding population outbreaks and population crashes in nature.

Ecological systems are generally well regulated. But when regulation breaks down, the consequences are dramatic. Epidemics, outbreaks, irruptions, plagues, blooms and population crashes all occur when population regulation breaks down. And when these events happen, the large negative consequences ripple through ecosystems, and the societies that rely on them. The aim of this project is to produce a global analysis and synthesis of the breakdown of ecological regulation. Understanding when and why ecological breakdown occurs, will improve our ability to anticipate, prevent, and adapt to these dramatic ecological events.

**Number of student places available:** 1

**Delivery:** Can be done off-site (i.e. remote working agreement)

**Expected outcomes:** Ecological theory, meta-analyses, statistical analyses, scientific writing for publication

**Suitable for:** Any interested students

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Interested students should not be in any way intimidated by the theoretical or statistical components of this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Simon Hart and Dr Masato Yamamichi</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:s.hart@uq.edu.au">s.hart@uq.edu.au</a></td>
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<td></td>
<td>Office – Goddard Building (8) room 220, St Lucia Campus</td>
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**Community dynamics among bloom-forming cyanobacteria**

Cyanobacterial (algal) blooms have serious negative consequences for ecosystems, and for the provision of safe drinking water. It is critically important, therefore, to understand when and why cyanobacterial blooms occur. This project will combine ecological theory and experiments to understand how species interactions amplify or dampen cyanobacterial (algal) blooms. Increasing our understanding of bloom forming dynamics will improve our ability to anticipate, prevent, and adapt to these dramatic ecological events.

**Number of student places available:** 2

**Delivery:** On-site attendance is required

**Expected outcomes:** freshwater ecology, microbiology, experimental design, mathematical modelling (optional), statistical analyses.

**Suitable for:** Any interested students

**Other important details:** Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Interested students should not be in any way intimidated by the theoretical or statistical components of this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Andrew Letten</th>
<th>Duration: 6-8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:a.letten@uq.edu.au">a.letten@uq.edu.au</a></td>
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</table>

**The effect of antibiotic resistance on competitive ability and niche overlap in microbial systems**

There is a growing awareness that tackling antibiotic resistance necessitates a deeper understanding of how resource competition, within and between species, modulates the fitness of resistant microbes. Recent advances in ecological theory offer a powerful framework to probe the mechanisms regulating intra- and inter-specific competition, but the significance of this body of theory to the problem of antibiotic resistance has been largely overlooked.

This experimental project will use microbial competition assays to investigate the effect of resistance mutations on competitive ability and niche overlap between resistant strains and other bacteria.

**Number of student places available:** 1

**Delivery:** On-site attendance is required

**Expected outcomes:** Develop expertise in bacterial culture, competition assays, optical density measurements etc. Also potential for more emphasis on modelling or analysis depending on student interests.

**Suitable for:** Students with some exposure to bacterial culture and wet lab techniques or eagerness to learn! R or python skills also helpful but not required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Andrew Letten</th>
<th>Duration: 6-8 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:a.letten@uq.edu.au">a.letten@uq.edu.au</a></td>
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</table>

**Microbial competition and costs of antibiotic resistance in fluctuating environments**

Microbial communities occupy dynamic environments, where fluctuations in environmental factors (e.g. pH, temperature, antimicrobials) and nutrients can drive oscillations in population abundances through time. The pulsed nature of most antibiotic dosing regimes likely acts as a particularly potent driver of variability. Nevertheless, the implications of different temporal patterns of antibiotic delivery on the interaction between within-host competition and the evolution of antibiotic resistance have thus far been largely ignored.

This experimental evolution project will explore how the timing of antibiotic and nutrient pulses affects the evolution of resistance. The summer research student will conduct multi-day competition experiments to investigate the influence of synchronous and asynchronous antibiotic and resources pulses on the evolution of resistance.

**Number of student places available: 1**

**Delivery:** On-site attendance is required

**Expected outcomes:** Develop expertise in bacterial culture, competition assays, optical density measurements etc. Also potential for more emphasis on modelling or analysis depending on student interests.

**Suitable for:** Students with some exposure to bacterial culture and wet lab techniques or eagerness to learn! R or python skills also helpful but not required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
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<tr>
<th>Supervisor</th>
<th>Dr Milos Tanurdzic</th>
<th>Duration: 6-10 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:m.tanurdzic@uq.edu.au">m.tanurdzic@uq.edu.au</a></td>
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**Gene regulatory networks controlling plant architecture: genetic targets of the transcription factor BRANCHED1**

Control of plant architecture is dominated by processes that regulate the development and growth of axillary buds. Students on this project will utilize molecular cloning, functional genomics and computational biology to discover genetic interactions between a key transcription factor BRANCHED1 and its genetic targets in annual species like Arabidopsis as well as perennial tree crops like mango, macadamia and avocado and compare BRC1 gene regulatory networks across these species.

**Number of student places available:** 2

**Delivery:** These projects will have a wet lab and computational analyses parts, which can be adjusted to be mostly computational since some raw experimental data already exists

**Expected outcomes:** Experience in experimental and analytical methods in plant molecular genetics and genomics, bioinformatics analyses of gene expression data, and gene regulatory network inference analyses

**Suitable for:** 2nd or 3rd year students in biology, plant sciences, genetics, biotechnology

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Relationship between abundance and habitat quality for the threatened Brush Tail Rock Wallaby in the Little Liverpool Range

This project will combine existing habitat mapping, habitat quality assessments and 5 years of QTFN brush-tail rock wallaby (BTRW) camera trapping data to assess variance in foraging behaviour and abundance, and potential habitat drivers for this variance. The species is exposed to a number of threatening processes in this part of its northern range margin, including loss of over 60% of its core range area due to the 2020 bushfires. Anecdotal evidence and literature from the Main Range suggests that physical (e.g. rock architecture) and biological (e.g. forage quality, weed incursion, invasive predator activity) both play a role in population success for the species. The Little Liverpool Range (LLR) remains an unburnt stronghold for the species connected to the Main Range, but knowledge of populations in the area is limited. The majority of high-quality geology for habitat exists in the LLR on private land, where conservation partnerships are essential for guaranteeing BTRW population persistence. By helping QTFN understand variation in BTRW populations across their 9 known home sites, and how this relates to variance in habitat quality, you will help the organisation design management plans that better BTRW habitat throughout this essential part of their range.

**Number of student places available:** 1

**Delivery:** Onsite

**Expected outcomes:** For the research team:

1. Habitat quality assessments for 9 confirmed BTRW home sites on QTFN Aroona Station
2. Estimate relative abundance for colonies using camera trap footage and Camelot
3. Estimate foraging range for all colonies using camera trap arrays and scat surveys
4. Produce a report and mapping products summarising key findings for QTFN to help them manage the threatened species on their property and throughout the LLR

For your skill base:

1. Experience using camera traps to survey endangered and elusive species
2. Basic vegetation field survey methods
3. Basic indirect threatened species survey methods
4. Basic ESRI-product mapping techniques
5. Scientific writing and communication

**Suitable for:** Final year undergraduate

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

High level of fitness is required for field work. Willingness to stay remotely at QTFN Aroona Station essential, for field trips of up to 1 week. Access to a computer and internet

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**Faculty of Science, Summer Research Scholarship, Project List 2020/2021**

*Last updated 18 September 2020*

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connection is needed or can be provided by QTFN for camera trap data analysis. Manual license preferred and 4WD experience preferred but not essential.

Great potential to extend this project beyond QTFN Aroona as a HRD project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Craig Williams</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email - <a href="mailto:c.williams3@uq.edu.au">c.williams3@uq.edu.au</a></td>
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**Natural Product Isolation – Desert Plants**

The student will perform plant metabolite extraction, purification, isolation and structure elucidation.

**Number of student places available:** 1

**Delivery:** On-site attendance required.

**Expected outcomes:** Scholars will gain skills in chromatography and new molecule elucidation and characterisation, which may provide an opportunity to generate publications from their research. Students will be asked to produce a report at the end of their project.

**Suitable for:** Those students that have successfully completed CHEM3004 and/or CHEM3001.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Craig Williams</th>
<th>Duration: 8 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email - <a href="mailto:c.williams3@uq.edu.au">c.williams3@uq.edu.au</a></td>
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**Advanced Organic Synthesis**

The student will perform a range of advanced synthetic organic chemistry techniques to gain experience in constructing bioactive molecules.

**Number of student places available:** 1

**Delivery:** On-site attendance required.

**Expected outcomes:** Scholars will gain skills in synthetic organic chemistry and molecule characterisation, which may provide an opportunity to generate publications from their research. Students will be asked to produce a report at the end of their project.

**Suitable for:** Those students that have successfully completed CHEM3001.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Cheong Xin Chan</th>
<th>Duration: 10 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email - <a href="mailto:c.chan1@uq.edu.au">c.chan1@uq.edu.au</a></td>
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**Comparative genomics of coral reef symbionts and related species**

Symbiodiniaceae are a specialised group of dinoflagellate algae that grow symbiotically with diverse coral reef animals including corals and sponges. Environmental stress (e.g. episodic increase in ocean water temperature) can break down the coral-dinoflagellate symbiotic association, causing coral bleaching; unless this symbiosis is soon re-established, corals are at risk for starvation, disease, and death. Our team is interested in the genome evolution of Symbiodiniaceae algae and their related species, specifically in their evolutionary transition from free-living to symbiotic lifestyles, and its functional implications for the coral host and the health of coral reefs in light of global climate change.

This project aims to discover genome features, genes, and functions in diverse Symbiodiniaceae that are specific and/or relevant to environmental adaptation using a comparative genomic approach, using newly sequenced and existing data.

**Number of student places available:** 1

**Delivery:** The project will be delivered under a remote working arrangement. On-site attendance is not required, but in-person training/meeting will be arranged as necessary to ensure timely completion of the project.

**Expected outcomes:** This project is strictly computational based, with no wet-lab component. The researcher will acquire skills in de novo genomics and genome-scale bioinformatics, specifically in the analysis of high-throughput sequencing data, comparative analysis of large-genome-scale data, functional annotation of genome sequences, and/or the development of scalable phylogenomic approaches.

The researcher will work as part of a team and is expected to produce a report or oral presentation at the end of their project. Research outcomes may be included in a scholarly publication.

**Suitable for:** Advanced undergraduate students (year 3+) or Masters students with a strong background in life sciences (i.e. biology and related subject areas), mathematics, and/or computer sciences. A background in genomics and/or bioinformatics is desirable but not essential. This project will require scripting (e.g. Python, PERL), high-performance computing in the UNIX environment, and/or R.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Elizabeth Gillam</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:e.gillam@uq.edu.au">e.gillam@uq.edu.au</a></td>
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**Is the bloom in Koala CYP2C P450 enzymes responsible for their unique ability to subsist on eucalyptus leaves?**

**Background:** The diet of koalas is unique in comprising effectively 100% eucalyptus leaves, which contain a variety of potentially toxic terpenes. Cytochrome P450 enzymes are regarded as responsible for the metabolism of dietary and other environmental xenobiotics. Compared to other marsupials and mammals more generally, koalas show a dramatic expansion in the CYP2C subfamily of P450s so we hypothesise that the CYP2C forms in koalas have expanded to deal with the terpenes present in their diet and can oxidise these chemicals to facilitate their clearance from the koala’s circulation.

**Approach and methods:** We will test this hypothesis by synthesising and subcloning the CYP2C enzymes from koalas then expressing them in E. coli in mono- and bicistronic format with the extant reductase accessory enzyme. The recombinant enzymes will be characterised for P450 yield then enzyme activity towards cineole and other terpenes as well as more typical CYP2C marker substrates will be assessed to explore their substrate specificity. If the hypothesis is proven to be correct (i.e. the extant koala CYP2C forms metabolise terpenes), selected ancestors of these CYP2C enzymes will be inferred, reconstructed and expressed to allow comparison with the extant forms to determine when the ability to metabolise eucalyptus terpenes evolved.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** Students will acquire skills in molecular cloning, bacterial expression and characterisation of enzymes using specialised spectrophotometric methods, and high-performance liquid chromatography. They will also acquire skills in bioinformatics, especially analysing evolutionary relationships between proteins and in sequence curation, alignment and interpretation.

**Suitable for:** This project would suit students with strong results in biochemistry, chemistry and bioinformatics and an interest in enzymes and their evolution.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please send your cv and a brief email to Prof Gillam at e.gillam@uq.edu.au before lodging an application.
**Supervisor**  |  Prof Elizabeth Gillam  |  **Duration:** 8 weeks
---|---|---
**Contact Details:**  |  Email – e.gillam@uq.edu.au  |  |

**What is the ancestral function of drug-metabolising enzymes?**

*Background:*

Cytochrome P450 enzymes are of key importance to human biology since, amongst other roles, they catalyse the breakdown of drugs and other environmental chemicals (xenobiotics). For this reason they are of great importance to drug companies as they are critical to the safe use of drugs. P450s evolved from a common ancestor present in the last universal common ancestor of bacteria, archaea and eukarya and are responsible for many different metabolic reactions in other animals, plants, and microbes, such as chemical signalling, use of carbon sources and synthesis of defensive compounds such as antibiotics. However it is unclear what role P450s performed in ancient organisms. Some possibilities are the breakdown of endogenous lipophilic molecules such as fatty acids and steroids. Indeed they are thought to have evolved in parallel with, and enabled, the development of steroid hormone signalling in mammals and other vertebrates.

We want to address the question: were xenobiotic-metabolising enzymes in animals always responsible for chemical defense or did they originate as enzymes with defined physiological roles in e.g. lipid metabolism? Our lab has been reconstructing and characterizing the ancestors of P450 enzymes from the other major xenobiotic-metabolising P450 clades in animals: CYP1, CYP2, CYP3, CYP4 and the mitochondrial clade. Now we hope to characterise the activity of these enzymes to explore the functional evolution of these enzymes.

*Approach:*

We will use ancestral sequence reconstruction to infer and characterise key ancestors of xenobiotic metabolising P450s. P450 sequences from extant organisms will be collected from available databases, compared, and curated to remove artefacts present in the genome databases. The curated sequence collection will be aligned and used to generate an evolutionary tree from which the ancestors at key evolutionary nodes will be inferred. Sequences for the ancestral P450s will be synthesised then expressed in bacteria and characterised for the ability to metabolise xenobiotics, steroids and other possible substrates.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** Students will acquire skills in molecular cloning, bacterial expression and characterisation of enzymes using specialised spectrophotometric methods, and high-performance liquid chromatography. They will also acquire skills in bioinformatics, especially analysing evolutionary relationships between proteins and in sequence curation, alignment and interpretation.

**Suitable for:** This project would suit students with strong results in biochemistry, chemistry and bioinformatics and an interest in enzymes and their evolution.

Depending on the interests of individual students, this project could involve more ‘wet’ biochemistry or more bioinformatics.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
Please send your cv and a brief email to Prof Gillam at e.gillam@uq.edu.au before lodging an application.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Shih Chun Lo (Lawrence)</th>
<th>Duration: 8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:s.lo@uq.edu.au">s.lo@uq.edu.au</a></td>
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### Highly luminescent organic materials for Augmented Realities

The project aims to develop highly luminescent organic chromophores that can be used for organic electronic devices such as organic light-emitting diodes (OLEDs for next-generation displays and lightings or augmented realities), and organic lasers. Compared to inorganic semiconductor counterparts, organic semiconductor materials offer many key advantages such as more light-weight, highly tunable, relatively cheaper and easier in materials synthesis and fabrication. The interests and demands on highly luminescent organic chromophores have been increasing in particular for bio-applications (such as bio-imaging, sensing) or organic electronics. It is challenging to generate organic chromophores with strongly luminescent in both solution and solid state, and simultaneously exhibit appropriate energy levels for charges injection in devices. The project will develop new organic semiconductor chromophores and study their properties for the potential in next-generation organic electronics including augmented realities or organic laser.

**Number of student places available:** 1

**Delivery:** On-site attendance required

**Expected outcomes:** Students are expected to learn how to design, synthesis, purify and characterise organic materials, as well as the working principles and usage in organic electronic devices. Students will also have opportunities to learn advanced photophysics and device physics through working closely with physics collaborators at QU’s School of Mathematics and Physics.

**Suitable for:** Students have strong interest in organic material development and synthesis as well as learning how organic electronics work and play roles in our next-generation laser and augmented realities technologies.

**Other important details:** Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
Supervisor | A/Prof Mikael Boden & Ariane Mora | Duration: 10 weeks
---|---|---
Contact Details: | Email – m.boden@uq.edu.au | |
Bioinformatics: Mining cancer data to identify rules governing dynamic DNA changes

This project involves data analysis and scientific problem solving. It uses and develops your computational skills.

Understanding the reversible processes that dynamically alter gene expression, such as DNA methylation, is an important step in designing drugs to treat diseases such as cancer. Despite the importance of DNA methylation there is little consistency in the field with how DNA methylation events are assigned to genes.

The current consensus regarding the effect of DNA methylation is that if observed in the promoter it is considered to act to repress gene expression and if found on the gene body, it may enhance gene expression. However, this is not the case in many situations. This project seeks to explore if any general rules can be disentangled by mining the data available in large data repositories that house thousands of patient samples with paired RNAseq and DNA methylation data.

If no rules can be determined, can we define a level of confidence to a particular change by incorporating prior knowledge to the decision-making process?

The student will be encouraged to approach the problem in a creative manner however they will have guidance regarding approach, downloading and analysing the data etc. Recommended to be solved using either Python or Java however open to other languages.

Number of student places available: 1

Delivery: A minimum of 10 hours on-site attendance is required per week.

Expected outcomes: As the scholar can have a flexible approach to solving the problem, the skills gained will depend on their interests and current skill level. However, they will have the opportunity to gain skills in data mining, machine learning, algorithm development, and server-side processing.

Suitable for: We welcome to anyone to apply, a background in science, engineering, math, or statistics is welcome – or any other field if you have a desire to learn. It will be easier if you already have good computational skills however, if you are looking to learn & willing to put in the time to develop strong computational skills then you are more than welcome to apply as well! Later students preferred (2-4th year).

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

To be considered for this project please contact either Mikael (m.boden@uq.edu.au) or Ariane (ariane.mora@uq.net.au) prior to applying so that we can discuss the project with you in more detail.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Mikael Boden &amp; Brad Balderson</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:m.boden@uq.edu.au">m.boden@uq.edu.au</a></td>
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**Bioinformatics: Defining the Limitations of DNA Binding Capture Technologies**

This project involves data analysis and scientific problem solving. It uses and develops your computational skills.

Chromatin-Immunoprecipitation (ChIP) is a technique to isolate DNA bound by some factor - such as histones with a particular modification, or transcription factors. This is extremely useful to know since histone modifications largely determine chromatin state (i.e. the ‘epigenome’), and transcription factor binding largely determines what genes are expressed, which then - through higher levels of regulation - determine the state of the cell.

ChIP-nexus is a relatively new kind of assay to measure such DNA binding. Based on a custom program written for calling - based on ChIP-nexus data - where a binding factor is bound, it appears that much fewer binding sites are identified compared with other binding assays. It was then noticed that all means of evaluating ChIP-nexus data in the original paper were comparing to other assays within binding sites, and so did not compare the number of binding sites between assays.

There are technical reasons to suspect ChIP-nexus does not effectively capture where protein-DNA binding occurs in a broad sense. Therefore the key aim of this project is to determine whether the problem lies with the calling method, or with limitations of the ChIP-nexus assay itself.

**Number of student places available:** 1

**Delivery:** A minimum of 10 hours on-site attendance is required per week.

**Expected outcomes:** In terms of value created by the project for the broader scientific community:

It’s hoped this project will better clarify the limitations of ChIP-nexus data in terms of the kind of binding it is able to capture (just strong binding?). It’s also hoped this could lead to a simpler binding-site caller which can take as input a more compact file type to simplify downloading and re-use of ChIP-nexus data.

**In terms of value created for the student by performing the project:**

It’s hoped the student will gain an understanding of genomics file-types for sharing assay measurements, experience in evaluating and moulding a methodology to the nature of the problem, and experience in reading, writing, evaluating and critiquing python code.

**Suitable for:** 2nd to late year students. Should have some prior experience with python programming, and a general interest in genomics.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please email m.boden@uq.edu.au or brad.balderson@uqconnect.edu.au for further details.
Supervisor | Prof Avril Robertson and Dr Kylie Agnew Francis | Duration: 8 weeks

Contact Details: Email – a.robertson3@uq.edu.au

**Antifungals targeting Cryptococcus Neoformans**

Infections caused by yeasts (*Candida* and *Cryptococcus*) and moulds (*Aspergillus*) are an increasing problem in healthcare with a global mortality rate of around 1.4 million, similar to tuberculosis and exceeding breast cancer or malaria. One of the most alarming and immediate threats is from the recently identified superbug, *Candida Auris*. Invasive *C. auris* causes blood-stream and wound infections with mortality rate of > 30%. *C. auris* is commonly mis-identified and frequently resistant to all major classes of antifungal drug.

We have developed novel molecules with activity against deadly pathogenic fungi. We now have a unique opportunity to further our discovery through fully elucidating the mode(s) of action and developing an understanding of the antifungal structure-activity and structure-toxicity relationships of the series.

Given the paucity of current antifungal drugs, and the severity of mycotic infections, new treatments are desperately needed.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** The applicant will learn solution and solid phase synthesis techniques, purification and characterisation methods. If synthesis is successfully completed the molecules will be tested for antifungal activity.

**Suitable for:** This project is open to applications from UQ enrolled students only with a background and interest in drug discovery. Synthetic organic chemistry skills are required the applicant must have completed CHEM2054 as a minimum.

Previous research experience, e.g., SCIE3260, is considered an advantage.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
**Supervisor**
Prof Avril Robertson and Dr Kylie Agnew Francis  
**Duration:** 8 weeks

<table>
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<tr>
<th>Contact Details:</th>
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<tbody>
<tr>
<td>Email – <a href="mailto:a.robertson3@uq.edu.au">a.robertson3@uq.edu.au</a></td>
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</table>

**Novel Anti-inflammatory compounds targeting the innate immune system**

Inflammasomes are part of the innate immune system responsible for processing and subsequent release of the potent pyrogenic cytokines, interleukin 1β and interleukin 18. Inhibiting inflammasomes (such as NLRP3, AIM2, NLRC4) using small molecules is an exciting strategy for future treatment of inflammatory diseases including asthma, type 2 diabetes and also disorders of the brain such as Parkinson’s and Alzheimer’s diseases. In the Robertson group, there is more than one compound series and innate immune target under investigation in this area.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** The student will learn and develop synthetic, purification and analytical skills contributing to our series for future patent and/or publication.

**Suitable for:** This project is open to applications from UQ enrolled students only with a background and interest in drug discovery/organic chemistry. Must have completed CHEM2054 as a minimum. Previous research experience, e.g., SCIE3260, an advantage.

**Other important details:** Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is **required** to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Elizabeth Krenske</th>
<th>Duration: 6-8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:e.krenske@uq.edu.au">e.krenske@uq.edu.au</a></td>
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**Computer simulations of bioactive molecules**

This project will use sophisticated computer simulations to study how drug candidates interact with biological molecules. The aim of the project is to understand what controls how a drug molecule binds to its intended target in the body, and how to tailor the properties of bioactive molecules. These insights will help in the design of new anti-cancer drug leads.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** Scholars will gain skills in computer-based molecular modelling. They will use software to perform simulations and will learn how these types of simulations can be applied to drug design as well as many other areas of chemistry. Students may be asked to produce a short written report at the end of their project.

**Suitable for:** This project is open to applications from UQ enrolled students majoring in Chemistry who have studied organic chemistry at 2nd and/or 3rd year level and have an interest in biological, organic, and/or theoretical chemistry.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Joe Rothnagel</th>
<th>Duration: 8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:j.rothnagel@uq.edu.au">j.rothnagel@uq.edu.au</a></td>
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**Characterisation of peptides encoded by short open reading frames**

Short peptides (sPEPs) that are encoded by short Open Reading Frames (sORFs) are surprisingly common in eukaryote genomes. Significantly, a mutation in a sPEP has been associated with a human genetic disorder. Recent bioinformatic and ribosomal footprinting studies have helped identify several thousand sORFs with coding potential and several sPEPs have also been identified by mass spectrometry. However, their role in cellular functions remains to be determined. You will identify and characterize sPEPs using bioinformatic tools, proteomics (mass spec) and cell biology. You will help to determine the contribution of sPEPs to the human proteome, and provide insights into their roles. This project will involve analysing raw proteomic (mass spec) data. Relevant background information can be seen here:

[https://www.nature.com/articles/nrg3520](https://www.nature.com/articles/nrg3520)

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** You will gain skills in proteomics; specifically in sample preparation for mass spec, mass spec data analysis, and bioinformatics.

**Suitable for:** This project is open to applications from students with a background in molecular cell biology and biochemistry. Knowledge of genomics and bioinformatics would also be an advantage.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
**Supervisor** | Prof Bostjan Kobe | **Duration:** 6-10 weeks
---|---|---
**Contact Details:** | Email – b.kobe@uq.edu.au |  
**Structural studies of proteins involved in infection and immunity**
The aim of this project is to use structural biology to understand the molecular basis of processes involved in infection and immunity. The work has implications for treating a range of infectious and inflammatory diseases and cancer, or for minimizing plant disease. We are focusing in particular on the proteins involved in cytoplasmic signalling by Toll-like receptors, bacterial pathogenesis, and effector-triggered immunity by plants. The main techniques will involve protein expression, purification, crystallization and structure determination, molecular interaction analyses and characterization of functional effects of site-directed mutants.

**Number of student places available:** Up to 3

**Delivery:** On-site attendance is required.

**Expected outcomes:** Scholars will gain skills in various lab techniques mentioned above and have an opportunity to contribute to publications based on their research. Students may also be asked to produce a report or oral presentation at the end of their project.

**Suitable for:** A background in biochemistry, biophysics and other relevant areas is an advantage. We are looking for motivated students with interest in research in the areas the lab works in.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please contact the supervisor before submitting an application at b.kobe@uq.edu.au.
Supervisor | A/Prof Nick West | Duration: 8 weeks
--- | --- | ---
Contact Details: | Email – n.west@uq.edu.au | |

**Characterisation of Antigen 85B from non-tuberculous mycobacteria**

NTM lung disease is a chronic debilitating and life-threatening respiratory disorder caused by bacteria commonly found in our environment, i.e. nontuberculous mycobacteria (NTM). NTM lung disease requires years of antibiotic treatment, and in many cases life-long, therapy to avoid respiratory failure. We need to develop a vaccine strategy to deal with for NTM lung disease to reduce treatment duration and improve longterm outcomes.

Our proposed study will focus on Antigen 85B (Ag85B), a well-described secreted protein of mycobacteria known to perform a number of important functions at the bacterial surface and beyond. Ag85B is an immunodominant antigen, first identified as a mycobacterial protein that binds to human fibronectin and is well known for its role in assembly of cell wall components essential to mycobacteria as a mycolyl transferase.

**Number of student places available:** 1

**Delivery:** On-site attendance is required.

**Expected outcomes:** The student will gain advanced skills and training in microbiology, genetics and advanced molecular techniques. Techniques learned also include protein expression, purification and analysis.

**Suitable for:** A student with a solid background/interest in biology, microbiology and bioinformatics and those with an interest in development of the next generation vaccines.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Social and cultural values of seagrass ecosystems in Northern Australia and the Pacific

Seagrass ecosystems provide critical Ecosystem Services (ES) that support human wellbeing, however the social, economic and cultural values associated with these habitats remain relatively poorly understood (Ruiz-Frau et al., 2017). More broadly, there is little information available globally on how people value coastal ecosystems, or how these values are distributed among different groups within coastal communities (Martin et al., 2016). As a result, management of the coastal zone tends to treat communities as homogenous entities sharing one set of values. However, small-scale studies have shown that people within coastal communities use and value coastal ecosystems in a range of ways that are shaped by demographic, social and economic characteristics, notably gender (de la Torre-Castro, 2017; Lau et al., 2019).

This project seeks to better understand the social and cultural values associated with seagrass ecosystems in northern Australia and the Pacific, and how these are differentiated by gender. Understanding these dimensions helps to build a more nuanced understanding of human interactions with coastal environments, and contributes to ensuring that management activities are better targeted and more equitable.

This is a review-based project drawing on peer-reviewed and ‘grey’ literature (e.g. reports).

#### Number of student places available: 1-2

#### Delivery: The project could be done remotely but ideally there would be some face-to-face involvement if the COVID situation permits

#### Expected outcomes: The Summer Research Scholar will gain interdisciplinary skills in systematic literature reviews and critical analysis, and will engage with a key issue in marine and coastal management.

#### Suitable for: This project is open to applications from motivated 3rd or 4th year undergraduate students or Masters students with an interest in marine and coastal management and social science. Applicants should be open to working in interdisciplinary environments, including between academia and practice.

#### Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please contact Dr Claudia Benham by email to discuss this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr William Defliese</th>
<th>Duration: 8 weeks</th>
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<td><strong>Contact Details:</strong></td>
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<td>Email – <a href="mailto:w.defliese@uq.edu.au">w.defliese@uq.edu.au</a></td>
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**Sea temperature reconstruction through the Middle Miocene Climatic Optimum and Transition, central Campbell Plateau ODP Site 1120**

This project aims to produce a high-resolution temperature record through the Middle Miocene Climatic Optimum (MMCO) and Middle Miocene Climate Transition (MMCT) at Ocean Drilling Program (ODP) Site 1120, central Campbell Plateau, southeast of New Zealand. The MMCO is a global warming event linked to high atmospheric CO₂ and provides a potential analogue of future global warming. The primary objective is to determine the degree of warming associated with this event in this understudied region.

We also aim to determine the magnitude of cooling following the MMCO at this site, which due to its location and shallow paleobathymetry should record the strengthening of the Antarctic Circumpolar Current (ACC) and associated changes in intermediate-water circulation and frontal systems during the MMCT.

Temperature records spanning the interval of 18-11 million years ago will be constructed from paired Mg/Ca ratios and δ¹⁸O analysis of fossil foraminiferal calcite recovered from the drill core. The student will assist with preparing samples for element ratio and stable isotopic analysis, and will be introduced to various data analysis methods and interpretation.

**Number of student places available:** 1

**Delivery:** The project cannot be undertaken remotely as students will be using facilities in the stable isotope and RIF labs. Students would likely be briefly meeting with the project lead (Dr Defliese) or one of the facility managers/technicians several times a week.

**Expected outcomes:** The student will learn basic laboratory skills, and learn methodology related to the topic of paleoclimatology/paleoceanography. The student will also contribute to data analysis, and be introduced to statistical analysis.

**Suitable for:** Any student with an interest in paleoclimatology/geology/geochemistry, a desire to get a hands-on research experience, and is interested in contributing to a research publication.

**Other important details:** Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

The student will have the opportunity to present their research as a poster at a research seminar/conference if they desire.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Renjie Zhou</th>
<th>Duration: 8 weeks</th>
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| **Contact Details:** | Email – [Renjie.zhou@uq.edu.au](mailto:Renjie.zhou@uq.edu.au)  
Office – Steele Building (3) Room 255B |
<p>| <strong>Mineralogical and geochemical investigation into ancient ocean basins</strong> | | |
| Minerals, including diamonds, in ophiolites (rocks of ancient ocean floors) provide important information regarding the operation of Plate Tectonics, the Earth’s unique and unifying theory. Students will work with state-of-the-art facilities at the School of Earth and Environmental Sciences and develop hands-on skills in mineralogy, geochemistry and geochronology. Facilities involved include laser ablation, scanning electron microscope, and inductively coupled plasma mass spectrometry. Samples studied are from various locations along tectonic plate boundaries of the Australian Plate. |
| <strong>Number of student places available:</strong> 1-2 (max) | | |
| <strong>Delivery:</strong> On-site attendance is required. This project will involve hands-on, face-to-face laboratory work. | | |
| <strong>Expected outcomes:</strong> Hands-on experience with geo-analytical facilities; data acquisition and interpretation of geological samples; presentation of findings. | | |
| <strong>Suitable for:</strong> Students who have completed ERTH1501 or ERTH1000 and have some chemistry background are encouraged to apply. Students who have completed ERTH2005 (Mineralogy) or ERTH2006 (Igneous &amp; Metamorphic Petrology) will be given priority. | | |
| <strong>Other important details:</strong> Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process. | | |</p>
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<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Sara Alidoust</th>
<th><strong>Duration:</strong> 8 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email –<a href="mailto:s.alidoust@uq.edu.au">s.alidoust@uq.edu.au</a></td>
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**Master Planned Community Development and Healthy Ageing**

The population of Australia is ageing, similar to many other counties all around the world. Recently, there has been an increasing amount of evidence on the impacts of the built environment, and in particular housing, on the health and wellbeing of older people. With an increasing tendency among older people to downsize and reside in master planned community developments, there is a question on the role of such communities in the health and wellbeing of the ageing residents.

This project involves a comprehensive systematic review of the literature through multiple databases and analysis of findings. The objective of the project is to compile evidence to describe documented associations between master planned community developments and the health of the ageing population.

| **Number of student places available:** | 1 |
| **Delivery:** | The project can be done remotely. |

**Expected outcomes:** The applicant has a great opportunity to develop knowledge of master planned community developments and planning age-friendly and healthy cities at an international level. The student will also develop highly transferable research skills, including how to use databases, read and interpret research papers, review literature and analyse data.

The findings of the literature review are expected to be documented at the end of the student project.

**Suitable for:** This project is open to applications from year 3-4 undergraduate and also postgraduate students. Prior experience in using NVivo for qualitative data analysis is appreciated, but not necessary. Library Training on Conducting a Systematic Review in the Social Sciences is required before the start of the project.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Interested applicants are welcome to contact Dr Sara Alidoust via email and discuss their application and/or ask any questions: s.alidoust@uq.edu.au
Community Wellbeing Frameworks in Local Government Planning: A policy review

Recently, there has been an increasing focus on community health and wellbeing at the local government level planning policies. Several local governments, in Australia and internationally, developed wellbeing frameworks and social sustainability frameworks to inform their planning policies aiming at improving the community wellbeing.

This research is aimed at undertaking a comprehensive review of healthy planning policies and local government frameworks on community wellbeing/social sustainability/liveability. The policy review can identify current gaps, inform local government plans and policies and help developing integrated and comprehensive frameworks aimed at improving community wellbeing.

Number of student places available: 1

Delivery: The project can be done remotely.

Expected outcomes: The applicant has a great opportunity to develop knowledge of local government policies and planning healthy cities at an international level. The student will also develop highly transferable research skills, including how to use databases, read and interpret policy documents, review literature and analyse data.

The findings of the policy review are expected to be documented at the end of the student project.

Suitable for: This project is open to applications from year 3-4 undergraduate and also postgraduate students. Prior experience in policy review and using NVivo for qualitative data analysis is appreciated, but not necessary. Library Training on Conducting a Systematic Review in the Social Sciences is required before the start of the project.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Interested applicants are welcome to contact Dr Sara Alidoust via email and discuss their application and/or ask any questions: s.alidoust@uq.edu.au
### School of Mathematics and Physics

<table>
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<tr>
<th>Supervisor</th>
<th>A/Prof Holger Baumgardt</th>
<th>Duration: 8 weeks</th>
</tr>
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</table>

**Contact Details:**
- Email – [h.baumgardt@uq.edu.au](mailto:h.baumgardt@uq.edu.au)
- Telephone – 07 3365 3430
- Office – Room 6-402

**Testing the nature of ultra-faint dwarf galaxies**

Ultra-faint dwarf galaxies are the tiniest known galaxies. They have sizes of only 100 pc or less and luminosities a million times smaller than that of the Milky Way. Ultra-faint dwarf galaxies have been discovered in large numbers in the halo of the Milky Way in recent years. They play a key role in testing our understanding of dark matter and small-scale structure formation. However, the nature of many ultra-faint dwarf galaxies is not yet firmly established. In this project, you will use the latest data from space-based satellites like Gaia and the HST to help better understand the nature of these enigmatic galaxies.

**Number of student places available:** 1

**Delivery:** no onsite attendance required

**Expected outcomes:** Ability to identify strengths, Develop confidence in communication, Better understanding of what a career in research entails

**Suitable for:** Year 3 students who have done PHYS3080 or who have comparable knowledge

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Warwick Bowen</th>
<th>Duration: 6 weeks</th>
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<tbody>
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<td>Contact Details:</td>
<td>Email – <a href="mailto:w.bowen@uq.edu.au">w.bowen@uq.edu.au</a></td>
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<tr>
<td><strong>Super-resolution quantum imaging using Bayesian inference</strong></td>
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<td>Super-resolution imaging is a critical tool for understanding living biology, since most of the molecules involved are far smaller than the wavelength of light and therefore cannot be resolved with conventional microscopes.</td>
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<td><strong>Number of student places available:</strong> 1</td>
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<td><strong>Delivery:</strong> can be remote if necessary</td>
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<td><strong>Expected outcomes:</strong> This project will analyse a new type of super-resolution imaging, that breaks the usually Rayleigh limit to resolving the separation of two emitters. It will first analyse the limits to the performance of this technique due to the quantisation of light, and then make explore how quantum correlations between photons can be used to improve performance.</td>
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<td><strong>Suitable for:</strong> A physics student with strong computational abilities and experience with Bayesian analysis</td>
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<tr>
<td><strong>Other important details:</strong> Please contact Prof Warwick Bowen by e-mail (<a href="mailto:w.bowen@uq.edu.au">w.bowen@uq.edu.au</a>) if you are interested prior to applying. Evidence of supervisor support is required to be uploaded as part of the application process.</td>
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<tr>
<td>Supervisor</td>
<td>Prof Tim McIntyre</td>
<td>Duration: 8 weeks</td>
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<tr>
<td>Contact Details</td>
<td>Email – <a href="mailto:t.mcintyre@uq.edu.au">t.mcintyre@uq.edu.au</a></td>
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**Schlieren imaging for supersonic and hypersonic flow fields**

Schlieren imaging relies on the fact that light follows a curved path when passing through a fluid with a density gradient. By using a combination of mirrors, lenses, and apertures, it is possible to design an optical system that visualises these flow gradients as changes in light intensity. This project involves developing and testing a schlieren system on a small flow facility with possible exploration of enhanced approaches such as colour schlieren or focussed schlieren techniques.

**Number of student places available:** 1

**Delivery:** The project will be conducted partially on-site. However, it can be adapted to any limitations on access to the campus.

**Expected outcomes:** The scholar will develop experience with an optical imaging system and its application to high speed flow facilities.

**Suitable for:** Any physics student with an interest in gaining experience in a research laboratory.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
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<tr>
<th>Supervisor</th>
<th>Prof Ben Powell</th>
<th>Duration: 6-10 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:powell@physics.uq.edu.au">powell@physics.uq.edu.au</a></td>
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**New particles in spin crossover materials**

I sometimes pity particle physicists, who are limited to studying a single vacuum and its excitations, the particles of the standard model. For condensed-matter physicists, every new phase of matter brings a new “vacuum.” Remarkably, the low-energy excitations of these new vacua can be very different from the individual electrons, protons, and neutrons that constitute the material. The materials multiverse contains universes where the particle-like excitations carry only a fraction of the elementary electronic charge, are magnetic monopoles, or are fermions that are their own antiparticles. None of these properties have ever been observed in the particles found in free space. Often, emergent gauge fields accompany these “fractionalized” particles, just as electromagnetic gauge fields accompany charged particles.

We have recently discovered a new phase of matter, spin-state ice, that is predicted to show both fractionalised quasiparticles and an emergent gauge field. Furthermore, the spin-state ice has a remarkably simple theoretical description. In this project you will study these materials theoretically and try to predict there properties. A range of methods from exact mathematical treatments through to models on supercomputers are possible, and can be selected to suit the interests and background of the student.

**Number of student places available:** 4

**Delivery:** This project can be carried out remotely

**Expected outcomes:** Advance theoretical/mathematical modelling, advanced numerical methods, experience of comparing theoretical predictions to experimental data

**Suitable for:** Should have completed at least the equivalent of 2-3 years of full time study in physics, maths and/or chemistry

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
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<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Peter Jacobson</th>
<th><strong>Duration:</strong> 8 weeks</th>
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<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:p.jacobson@uq.edu.au">p.jacobson@uq.edu.au</a></td>
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<td></td>
<td>Office – Physics Annexe room 436</td>
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**Improving the Fabrication of Superconducting Qubits**

High quality factor microwave resonators are critical components of quantum computer architectures. Aluminium resonators on silicon are now standard components in these architectures, but the measured quality factors in these resonators is lower than expected. Recent work suggests that the limiting factor for these devices are imperfections at the metal-substrate interface. This project focuses on preparing atomically precise interfaces for improved superconducting qubits. Using new equipment housed at SMP and CMM, the student will prepare clean substrates and develop procedures to grow high quality factor resonators.

**Number of student places available:** 1

**Delivery:** The project is experimental and includes hands on lab work, this will be carried out under UQ distancing policies.

**Expected outcomes:** The student will gain experience with vacuum equipment, device fabrication, cleanroom protocols, and material characterisation techniques.

**Suitable for:** This project is open to students with a background in physics, chemistry, or engineering. Enthusiasm for experimental work is a must.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.

Discussions with applicants are encouraged, please reach me at: [p.jacobson@uq.edu.au](mailto:p.jacobson@uq.edu.au)
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Itia Fabre-Bulle</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:i.fabrebulle@uq.edu.au">i.fabrebulle@uq.edu.au</a></td>
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**Virtual retinal display for zebrafish**

This project aims to scan the literature in search of the newest virtual retinal displays available. This project also aims to design an appropriate virtual retinal display for zebrafish and test it.

**Number of student places available:** 1

**Delivery:** The project can be completed under a remote working arrangement if necessary.

**Expected outcomes:** The Scholar will gain knowledge in optical physics in general, but more particularly in optical systems integration for animal research.

**Suitable for:** Optical physics background is preferable.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
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<tr>
<th>Supervisor</th>
<th>Prof Matthew Davis &amp; Dr Matt Reeves</th>
<th>Duration: 6-10 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:mmdavis@physics.uq.edu.au">mmdavis@physics.uq.edu.au</a></td>
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**Tunnelling of supercurrents in a Bose-Einstein condensate**

One of the features of superfluidity is that a flow in a ring below a critical velocity will never slow down like it would in a classical fluid with friction. This project will computationally study the coupling of two rings to understand the conditions for when a supercurrent can tunnel from one ring into another. It will begin with constructing a Hamiltonian matrix for the system, and diagonalizing it to look at the properties of the eigenstates. It will move on to simulating the interacting system with the Gross-Pitaevskii equation. If successful, it is hoped that these results will lead to experiments in the UQ Bose-Einstein condensation laboratory.

**Number of student places available:** Up to 2

**Delivery:** On campus preferred but can also be performed remotely. Student should attend research group meetings.

**Expected outcomes:** Students will learn how to solve the linear and nonlinear Schrödinger equation computationally. If successful, it is hoped that these results will lead to experiments in the UQ Bose-Einstein condensation laboratory.

**Suitable for:** Self-motivated second/third year physics students who are interested in pursuing research in theoretical and computational quantum physics.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.

Please get in touch with Professor Davis before applying for this project.
Model of an atomtronic transistor
The term “atomtronics” has been coined to describe the creation of electronic circuit-like experiments using ultracold quantum gases. This project will develop a simple model of an atomtronic transistor based on kinetic theory of gases and apply it to understand an experiment performed at the University of Colorado, Boulder. Students will use knowledge of statistical mechanics and thermodynamics to develop a model of particle and energy flow in a three-terminal trap.

Number of student places available: Up to 2

Delivery: On campus preferred but can also be performed remotely. Student should attend research group meetings.

Expected outcomes: The model will validate or falsify the understanding described in the experimental paper. A successful project will lead to publishing a paper describing the model and its results.

Suitable for: Self-motivated third year physics students who are interested in pursuing research in theoretical and computational quantum physics.

Other important details: Evidence of supervisor support is required to be uploaded as part of the application process.
Please get in touch with Professor Davis before applying for this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Matthew Davis &amp; Dr Matt Reeves</th>
<th>Duration: 6-10 weeks</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:mdavis@physics.uq.edu.au">mdavis@physics.uq.edu.au</a></td>
<td></td>
</tr>
<tr>
<td><strong>Nonequilibrium superfluid flows</strong></td>
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<tr>
<td>The aim of this project is to make a connection between classical mechanics and quantum mechanics - looking for the signatures of classical trajectories in the quantum wave functions. This is potentially interesting for superfluids, as to some extent they behave as classical fluids. This would require adding the effects of particle interactions - an additional nonlinear term in the Schrodinger equation.</td>
<td></td>
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</tr>
<tr>
<td><strong>Number of student places available:</strong></td>
<td>Up to 2</td>
<td></td>
</tr>
<tr>
<td><strong>Delivery:</strong></td>
<td>On campus preferred but can also be performed remotely. Student should attend research group meetings.</td>
<td></td>
</tr>
<tr>
<td><strong>Expected outcomes:</strong></td>
<td>Students will learn how to solve the linear and nonlinear Schrodinger equation computationally with sources and sinks. The results may influence the UQ experimental program on Bose-Einstein condensates.</td>
<td></td>
</tr>
<tr>
<td><strong>Suitable for:</strong></td>
<td>Self-motivated second/third year physics students who are interested in pursuing research in theoretical and computational quantum physics.</td>
<td></td>
</tr>
<tr>
<td><strong>Other important details:</strong></td>
<td>Evidence of supervisor support is required to be uploaded as part of the application process. Please get in touch with Professor Davis before applying for this project.</td>
<td></td>
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</tbody>
</table>
Superfluidity under a quench of interaction strength in a persistent current.

One of the key insights of Landau was to derive a phenomenological formula for the critical velocity in a superfluid. In a Bose gas this is related to the speed of sound, which is directly related to the strength of repulsive interaction between particles. By making use of something known as a “Feshbach resonance” in the scattering properties of two atoms, it is experimentally possible to tune the strength of interactions in a Bose gas. This project will look at a ring system in which there exists a persistent current that if left undisturbed will never decay. However, if the interaction strength is sufficiently reduced, the speed of sound will decrease below the speed of the current and the superflow will break down. This project will characterize the non-equilibrium dynamics as the flow breaks down and thermalizes. It should be able to be related to the well-known “Kibble-Zurek” mechanism for phase transitions.

Number of student places available: Up to 2

Delivery: On campus preferred but can also be performed remotely. Student should attend research group meetings.

Expected outcomes: The student will learn how to apply computational methods to solve the nonlinear Schrödinger equation. A complete set of results with appropriate interpretation could be turned into a publication.

Suitable for: Self-motivated second/third year physics students who are interested in pursuing research in theoretical and computational quantum physics.

Other important details: Evidence of supervisor support is required to be uploaded as part of the application process.

Please get in touch with Professor Davis before applying for this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Prof Matthew Davis &amp; Prof Margaret Mayfield</th>
<th>Duration: 6-10 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:mdavis@physics.uq.edu.au">mdavis@physics.uq.edu.au</a></td>
<td></td>
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</tbody>
</table>

### Statistical physics model of abundances and interactions in plant communities

This project aims to use the methods of statistical physics to help understand the equilibrium and dynamics and of interacting plant communities with Prof Margie Mayfield in the School of Biological Sciences. Prof Mayfield’s group has collected a significant amount of data on plant abundances, and shown that the data suggests that nonlinear interactions between the plants affect their seed production. We hope to gain a new understanding of this data using equilibrium models of statistical mechanics. See:

Higher-order interactions capture unexplained complexity in diverse communities
Margaret M. Mayfield & Daniel B. Stouffer
Nature Ecology & Evolution 1, Article number: 0062 (2017)
doi:10.1038/s41559-016-0062

### Number of student places available: 1

**Delivery:** On campus preferred but can also be performed remotely. Student should attend research group meetings.

**Expected outcomes:** Hopefully we will show that physics methods can be used to help understand the interactions between plants in a community.

**Suitable for:** Self-motivated science students with strong quantitative skills who are interested in pursuing an interdisciplinary project covering theoretical physics and biology. Knowledge of statistical mechanics is desirable.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.

Please get in touch with Professor Davis before applying for this project.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Cecilia Gonzalez Tokman</th>
<th>Duration: 10 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:cecilia.gt@uq.edu.au">cecilia.gt@uq.edu.au</a></td>
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</tbody>
</table>

**Stability in non-autonomous dynamical systems**

This project aims to investigate global stability aspects of non-autonomous dynamical systems, a class of models used to describe phenomena whose evolution rule changes over time, e.g. due to random and/or seasonal effects. It will involve the analysis of finite and/or infinite-dimensional models, relying on analytical and numerical tools from modern ergodic theory.

**Number of student places available:** 1

**Delivery:** The project can be completed under a remote working arrangement if required.

**Expected outcomes:** The student will develop knowledge and practice in analytical and numerical aspects of random dynamical systems, as well as written and oral communication skills. The project may lead to the development of random dynamical systems models amenable to rigorous analysis, and/or to novel stability results in the field.

**Suitable for:** Background/skills:
- A strong mathematical background is essential (e.g. two years in a mathematics/quantitative degree).
- Some experience in dynamical systems is highly desirable (e.g. SCIE3011).
- Experience with mathematical software (e.g. Matlab or Mathematica) is ideal but not required.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Travis Scrimshaw</th>
<th>Duration: 8 weeks</th>
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</thead>
<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:t.scrimshaw@uq.edu.au">t.scrimshaw@uq.edu.au</a></td>
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<td></td>
<td>Office – Building 69, room 709</td>
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</tbody>
</table>

**Super Box-Ball Systems**

The box-ball system is a dynamical system that is used to model water waves moving through a thin channel. The waves are encoded in objects called solitons, which we study using a simple discrete rule. The box-ball system can be generalised by converting ideas from representation theory into discrete objects called crystals. In this project, we are going to look at a generalisation due to Hikami and Inoue coming from the study of supersymmetry. The aim of this project is to combine their generalisation with another generalisation using recent results of Kwon and Okado on the corresponding crystals. We will be describing what a soliton is in this generalized framework. We will also explore what behaviours our new system can exhibit and contrasting them to the previous results.

**Number of student places available:** 2

**Delivery:** This project will entail regular meetings and requires the student to have access to a computer (a laptop is sufficient). Meetings can be done via Zoom if necessary.

**Expected outcomes:** Scholars will gain experience in using examples to develop theorems, performing experimental mathematics, and developing software (in Python) to better understand problems. Scholars will also work in the fields of combinatorics and mathematical physics, where they will also learn how to develop new definitions and write papers.

**Suitable for:** An interest in studying discrete systems and determining mathematical theorems from computations, examples, and computer experiments. Basic experience in programming using Python is desirable but not required.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
Supervisor: Dr Benjamin Roberts and Dr Jacinda Ginges  
Duration: 8 weeks

Contact Details:  
Email – b.roberts@uq.edu.au; g.ginges@uq.edu.au

High-accuracy atomic physics calculations for tests of fundamental physics and the standard model

High-precision atomic physics experiments play an important role in testing the Standard Model of particle physics at low energy. Highly accurate atomic structure calculations are required in order to interpret the experiments in terms of fundamental physics parameters.

Atomic physics calculations involve treating the many-electron atomic Hamiltonian approximately. In order to achieve high accuracy, a number of many-body effects need to be taken into account using perturbation theory. One such class of effects, known as "ladder diagrams", are missing from some calculations. Though small, these corrections seem to be important in some cases. The ladder-diagram method has been applied previously to energies with high success (see: Physical Review A, 78, 042502.) The plan here is to extend this method to include "ladder diagram" corrections directly into atomic wavefunctions. These wavefunctions can then be used to compute relevant atomic properties (for example, hyperfine splittings, transition rates, lifetimes etc.).

The project will involve aspects of quantum mechanics (elementary atomic theory) and numerical methods (application of existing code libraries to new problems in atomic physics). It will also involve some basic programming (in c++ and/or fortran), though no prior knowledge of programming is required.

Number of student places available: 1

Delivery: The project can be conducted remotely if need be

Expected outcomes: The project will involve aspects of quantum mechanics (elementary atomic theory) and numerical methods (application of existing code libraries to new problems in atomic physics).

Suitable for: Reasonable (undergraduate) level of quantum mechanics required. Some basic coding ability will be helpful, but is not required.

Other important details: Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Arkady Fedorov</th>
<th>Duration: 8 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:a.fedorov@uq.edu.au">a.fedorov@uq.edu.au</a></td>
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</table>

**Quantum control and measurement of superconducting quantum circuits.**

Superconducting quantum circuits are nanostructures fabricated on a chip, operated at milliKelvin temperatures and controlled by electrical signals. Due to unique physical properties of superconductors and Josephson junctions these systems have recently become one of the most promising platforms for building quantum computers and is an attractive testbed for fundamentals of quantum mechanics. The project is dedicated to learning, practicing as well as developing new techniques to control and measurement of superconducting circuits which may find use both in academia and in quantum industry.

**Number of student places available:** 1

**Delivery:** On-site attendance is recommended but not required. The project can be also performed in a remote mode.

**Expected outcomes:** The scholar will learn:

- Underlying physical principles of operation of superconducting quantum circuits including resonators and qubits.
- Basics of microwave measurements at cryogenic temperatures.
- Skills of numerical simulation of open quantum systems in application to superconducting devices

**Suitable for:** Physics, engineering students with interest in quantum physics, quantum information and experiment. Knowledge of basics of quantum mechanics is required. Experience with electronics, Python programming, data processing is a plus.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.

The project can be tailored to have components of measurements, design and simulation depending on candidate preferences and qualification.
<table>
<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Joel Corney</th>
<th><strong>Duration:</strong> 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:j.corney@uq.edu.au">j.corney@uq.edu.au</a></td>
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</table>

**Coupled modes in whispering-gallery resonators**

Optical resonators formed from microspheres or microdisks support high-quality "whispering gallery modes", in which the incoupled light circulates many times in a highly confined space. This provides a way of enhancing nonlinear optical effects, leading for example to novel quantum states of light.

In this theoretical project, you will calculate the nonlinear dynamics that ensues when the resonator can support multiple simultaneous modes. In particular you will explore the impact of various competing or enhancing effects on the threshold response of the device.

**Number of student places available:** 1

**Delivery:** Project can largely be completed off-site. Weekly on-site meeting preferred, but on-line alternative can be arranged.

**Expected outcomes:** You will develop skills in analytic and computational approaches in theoretical physics. You will be required to produce a short report and to give an informal talk at the end of the project.

**Suitable for:** Some knowledge of quantum physics is essential (equivalent to a second-year course on the topic). Familiarity with ordinary differential equations would be an advantage.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Tyler Neely</th>
<th>Duration: 10 weeks</th>
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<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:t.neely@uq.edu.au">t.neely@uq.edu.au</a></td>
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**Folded Smoke Rings in a 2D Bose-Einstein Condensate**

One of the hallmarks of superfluidity is the existence of quantised vortices. In a three-dimensional fluid, these can form a vortex ring – similar to a smoke ring familiar from classical physics. Like the classical ring, the vortex ring travels, carrying linear momentum through the fluid.

By taking a slice through the vortex ring, the equivalent structure in a 2D superfluid system is recognised, known as a vortex dipole. This object consists of a vortex and antivortex pair. Similar to the smoke ring, it moves as a fixed object through the fluid.

A recent numerical study has discovered higher-order fixed vortex structures – these would appear as folded rings in 3D and would be unstable but are stable in the 2D superfluid system. However, these have not yet been observed in experiments.

The aim of this project will be to numerically simulate the experimental system, using a software package known as XMDS2. The aim will be to determine an experimental sequence that can create the initial vortex structure.

Time allowing, opportunity to implement the sequence in the experimental system may arise.

**Number of student places available:** 1

**Delivery:** The project can be delivered flexibly, as it will in the first instance consist of numerical simulations (to potentially be implemented in the lab)

**Expected outcomes:** Experience with numerical simulations, understanding of superfluid physics, experience with parameter optimisation

**Suitable for:** Some basic coding experience is desirable, but not required. This project is more suitable to 2nd or 3rd year students.

**Other important details:** Evidence of supervisor support is required to be uploaded as part of the application process.
### Quantum integrable models of interferometry

Quantum integrable models are well-established in mathematical physics research. They contribute to the development of important mathematical frameworks, and to the understanding of physical systems. This project will investigate recent proposals to apply quantum integrable systems to studies in interferometry.

**Number of student places available:** 2

**Delivery:** The project can be completed on campus, or under remote working arrangements.

**Expected outcomes:** Scholars will have the opportunity to apply techniques of quantum integrability, and analyse their effectiveness in modelling interferometric protocols.

**Suitable for:** Students with a deep interest in mathematical physics.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>A/Prof Ebinazar Namdas</th>
<th>Duration: 8-10 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:e.namdas@uq.edu.au">e.namdas@uq.edu.au</a></td>
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</table>

**Organic Light emitting diodes (OLEDs)**

Organic Light Emitting Diodes (OLEDs) are a class of organic electronics, which is extensively being investigated because of its potential for flat-panel display and lighting. It’s an attractive area of research particularly because they are lightweight, flexible, have wider viewing angles and a faster response time. Currently, they are also used in displays of smart phones. The performance of an OLED depends on various parameters such as thickness of the light emitting layer (organic semiconductor), buffer layer between electrode and emitting layers etc.

**Number of student places available:** 2

**Delivery:** TBD

**Expected outcomes:** In this project, you will gain an in-depth knowledge about the working of mechanism of OLEDs, and measurement technique and/or device modelling and simulation.

**Suitable for:** 3rd year students

Requirement- Strong background in Matlab, etc (1 student)
Experimental Project requirement – Strong interest in applied physics, optics (1 student)

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Dietmar Oelz</th>
<th>Duration: 8 weeks</th>
</tr>
</thead>
</table>

**Contact Details:** Email – d.oelz@uq.edu.au

**Modelling and simulation in cell biology**
Typically projects are available in the mathematical/computational modelling and simulation of cell biology. Areas of particular interest are cellular morphogenesis, intra-cellular transport, (collective) cell migration and mechanical aspects of Neurobiology.

**Number of student places available:** 1

**Delivery:** Remote working arrangement is possible

**Expected outcomes:** Experience in mathematical modelling and simulation.

**Suitable for:** Students with interest in and intuition for applications, programming skills, curiosity and self-motivation.

Starting from year 3

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Dietmar Oelz</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:d.oelz@uq.edu.au">d.oelz@uq.edu.au</a></td>
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</table>

**Applied PDEs**
Typically projects are available in the context of mathematical models of phenomena related to cellular morphogenesis, intra-cellular transport, (collective) cell migration and mechanical aspects of Neurobiology.

**Number of student places available:** 1

**Delivery:** Remote working arrangement is possible

**Expected outcomes:** Experience in using PDEs as modelling tools and in manipulating PDEs both algebraically and numerically.

**Suitable for:** Talent and interest in Applied Mathematics and PDEs, curiosity and self-motivation.

Starting from year 3

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Alex Tam</th>
<th>Duration: 6-8 weeks</th>
</tr>
</thead>
</table>

**Contact Details:**
Email – [alex.tam@uq.edu.au](mailto:alex.tam@uq.edu.au)

**Mathematical modelling and simulation of contractile actomyosin rings**
Interactions between actin filaments and myosin motor proteins in the cell cortex generate forces that enable cells to move, change shape, and divide. Of particular interest is the ‘actomyosin’ ring, which contracts to split the cell in two during cell division. Since actin filaments and myosin motors are distributed at random in the cortex, it is not immediately clear why this ring contracts.

With Dr Dietmar Oelz, I have been working on a mathematical model based on filament bending to understand contraction in two-dimensional actomyosin networks, and have developed Julia code to simulate our model. However, several important questions remain unanswered, including:

- Does our model predict contraction in specific ring-like geometry?
- Can our model explain long-term patterns that arise in experiments?
- How does the application of external forces affect network contraction?

We will work towards answering these questions during this summer research project.

**Number of student places available:** 1

**Delivery:** This project can be delivered either in-person or under remote working arrangements

**Expected outcomes:** This project will enable a student to experience working as an applied mathematician in a relaxed environment. They will experience how the mathematics taught at UQ is being used in current research, and develop modelling and computational skills relevant to further Honours or postgraduate study in applied mathematics.

**Suitable for:** This project is suitable for any student with interest in applied mathematics, mathematical biology, and biophysics. A prospective student will ideally have some familiarity with scientific computing, for example in Matlab, Python, or Julia.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Please contact Alex Tam prior to submitting an application.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Anna Puskas</th>
<th>Duration: 8-10 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contact Details</td>
<td>Email – <a href="mailto:a.puskas@uq.edu.au">a.puskas@uq.edu.au</a></td>
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</tbody>
</table>

**Alcove walks and metaplectic polynomials**

The representation theory of algebraic groups and their metaplectic covers has led to interest in certain multivariate polynomials that satisfy functional equations governed by a Weyl group. These polynomials can be constructed in terms of combinatorial objects closely related to the representation theory of (finite dimensional) Lie algebras. This project focuses on understanding the connections between extant constructions, with a particular focus on the even orthogonal type.

**Number of student places available:** 1

**Delivery:** The project can be completed on campus, or under remote working arrangements.

**Expected outcomes:** The Scholar will gain experience with doing collaborative and independent research, and learn about models in algebraic combinatorics relevant in representation theory.

**Suitable for:** An undergraduate student interested in representation theory and algebraic combinatorics, with a working knowledge on the representation theory of finite dimensional Lie algebras.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.


<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Travis Scrimshaw</th>
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<tr>
<td>Duration:</td>
<td>8 weeks</td>
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<td>Contact</td>
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<tr>
<td>Details:</td>
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<tr>
<td>Email –</td>
<td><a href="mailto:t.scrimshaw@uq.edu.au">t.scrimshaw@uq.edu.au</a></td>
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</tbody>
</table>

**Limits of Kirillov-Reshetikhin Crystals**

Kirillov-Reshetikhin crystals are certain discrete structures that arose from the student of quantum systems in mathematical physics. They have been well-studied, but remain somewhat mysterious due to the lack of a uniform construction. There is a particular construction called the coherent limit that has been very useful, but is done in a case-by-case fashion. One aspect of this project is to give a uniform description of these limit crystals. There is another construction called the asymptotic limit of the corresponding algebraic structure. The other aim of this project is to develop the combinatorial interpretation of this limit, including a rigorous mathematical definition of this limit.

**Number of student places available: 2**

**Delivery:** This project will entail regular meetings and requires the student to have access to a computer (a laptop is sufficient). Meetings can be done via Zoom if necessary.

**Expected outcomes:** Scholars will gain experience in using examples to develop theorems, performing experimental mathematics, and developing software (in Python) to better understand problems. Scholars will work in the fields of combinatorics, mathematical physics, and representation theory, where they will also learn how to develop new definitions and write papers.

**Suitable for:** An interest in studying discrete structures and determining mathematical theorems from computations, examples, and computer experiments. Basic experience in programming using Python is desirable but not required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
**Supervisor**

Dr Travis Scrimshaw

**Contact Details:**

Email – t.scrimshaw@uq.edu.au

**Duration:** 8 weeks

---

### R-Matrices and Denominator Formulas for Kirillov-Reshetikhin Models

Kirillov-Reshetikhin modules are an important class of affine quantum group representation that appear in many areas of mathematical physics and geometry. While we understand many things about these modules, constructing explicit examples is difficult, but it can be done by using Dorey’s rule and a computer. An important component of this is computing the R-matrix, the morphism that interchanges the two factors, and a certain normalizing factor called the denominator formula. The goal of this project is to implement an algorithm for constructing the Kirillov-Reshetikhin modules and computing the denominator formulas using a computer. We will then use this code to compute important examples of the denominator formula where hand computations have currently failed.

**Number of student places available:** 2

**Delivery:** This project will entail regular meetings and requires the student to have access to a computer (a laptop is sufficient). Meetings can be done via Zoom if necessary.

**Expected outcomes:** Scholars will gain experience in performing experimental mathematics, developing software (in Python) to apply to mathematical problems, and conducting research in algebra. Specifically, scholars will work in the field of representation theory, where they will synthesize information, learn to write papers, and perform important computations.

**Suitable for:** An interest in studying algebra, and using computers to advance our knowledge in mathematics. The only requisite is an understanding of linear algebra; abstract algebra is desirable but not required. Experience in programming using Python is strongly desirable but not required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Terry Farrelly</th>
<th>Duration: 8-10 weeks</th>
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<td>Contact Details:</td>
<td>Email – <a href="mailto:t.farrelly@uq.edu.au">t.farrelly@uq.edu.au</a></td>
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</table>

**Some open problems in quantum fault tolerance**

Protecting quantum information from errors is crucial for emerging quantum technologies to function. To do this requires error correction and more general fault-tolerant strategies. In this project, scholars will learn about quantum error correction and fault tolerance. Then they will tackle one or a few of the 10 small open problems in quantum fault tolerance here [https://arxiv.org/abs/2008.05051](https://arxiv.org/abs/2008.05051).

The project may involve a numerical aspect or it can be purely theoretical.

**Number of student places available:** 1

**Delivery:** Working via zoom would be possible but not ideal

**Expected outcomes:** The scholars will learn about quantum error correction, fault tolerance, and possibly gain some experience with numerical simulations of quantum error correction. Other benefits include research and presentation experience.

**Suitable for:** Students interested in research with knowledge of quantum mechanics. Some basic knowledge of quantum information/computation would be useful but isn’t completely necessary.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>Dr Jacinda Ginges</th>
<th><strong>Duration:</strong> 8-10 weeks</th>
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<td><strong>Contact Details:</strong></td>
<td>Email – <a href="mailto:j.ginges@uq.edu.au">j.ginges@uq.edu.au</a></td>
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</table>

**Quantum electrodynamic contributions to the hyperfine structure in heavy atoms**

Hyperfine structure refers to the small energy-level splitting in atoms that arises due to the interaction of the nuclear magnetic moment with the magnetic field created by atomic electrons. It plays an important role in both atomic and nuclear physics, and it even defines the unit for time, the second (ground state hyperfine splitting in cesium). In this project, a semi-empirical approach for the inclusion of quantum electrodynamic (QED) radiative corrections to the hyperfine structure for heavy atoms will be developed. There is currently no accurate scheme to include such effects in atoms with many electrons. Quantifying these effects is important in precision tests of fundamental physics in heavy atoms.

**Number of student places available:** 1

**Delivery:** May be conducted remotely.

**Expected outcomes:** The student will use and develop both analytical and numerical skills and deepen their understanding of (relativistic) quantum mechanics. Successful completion of the project may lead to a refereed journal publication.

**Suitable for:** Students with a strong background in quantum mechanics and a demonstrated high level of performance in theoretical physics subjects. Students should have completed at least 3 years of undergraduate physics study.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
Supervisor | Dr Anna Puskas and Dr Travis Scrimshaw | Duration: 8 weeks
---|---|---
Contact Details: | Email – a.puskas@uq.edu.au; t.scrimshaw@uq.edu.au

Infinite Arrays of Crystals
Gelfand-Tsetlin patterns are classical objects in combinatorics consisting of triangular arrays of integers satisfying certain inequality conditions. They are related to symmetries of vector spaces invariant under permutations. These have a natural symmetry which allow them to be folded and related to vector spaces invariant under signed permutations. The primary goal of this project is to take a certain limit of Gelfand-Tsetlin patterns and relate this limit to another combinatorial object called zig-zag strip bundles.

Number of student places available: 1

Delivery: This project will entail regular meetings and requires the student to have access to a computer (a laptop is sufficient). Meetings can be done via Zoom if necessary.

Expected outcomes: Scholars will gain experience in performing experimental mathematics, developing software (in Python) to apply to mathematical problems, and conducting research in combinatorics with connection to representation theory. More specifically, scholars will learn to synthesize information, write mathematical papers, and utilizing computers to aid in constructing examples.

Suitable for: An interest in studying discrete structures and using computers to advance our knowledge in mathematics. Only basic knowledge of discrete mathematics is required. Experience in programming using Python is strongly desirable but not required.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Travis Scrimshaw</th>
<th>Duration: 8 weeks</th>
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<tbody>
<tr>
<td><strong>Contact Details:</strong></td>
<td>Email –<a href="mailto:t.scrimshaw@uq.edu.au">t.scrimshaw@uq.edu.au</a></td>
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**Decomposing Configurations of Lines**

An important object in algebraic geometry is the space of all the ways to build increasing dimensional vector spaces inside of n-dimensional space. This is called the flag variety. If we look at how a nilpotent matrix $M$ and consider the subset of the flag variety satisfying a certain properties coming from representation theory, a classical result describes the different pieces of this subset using combinatorial objects called standard Young tableaux. A recent variant of the flag variety was introduced by looking at the set of $k$ (1-dimensional) lines in $n$-dimensional space that also has important connections to representation theory. One aim of this project is to describe the equivalent decomposition of this new variety to see if the irreducible components are parameterized using a generalization of standard Young tableaux called standard set-valued tableaux.

**Number of student places available:** 2

**Delivery:** This project will entail regular meetings and requires the student to have access to a computer (a laptop is sufficient). Meetings can be done via Zoom if necessary.

**Expected outcomes:** Scholars will gain experience in performing experimental mathematics, developing software (in Python) to apply to mathematical problems, and conducting research in algebraic geometry. Specifically, scholars will learn to synthesize information, read and write mathematical papers, and perform important computations using a computer and by hand.

**Suitable for:** An interest in studying algebra and algebraic geometry and using computers to advance our knowledge in mathematics. The only requisite is an understanding of linear algebra; abstract algebra is desirable but not required. Experience in programming using Python is strongly desirable but not required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Fred Roosta</th>
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<tr>
<td><strong>Duration:</strong></td>
<td>8 weeks</td>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email <a href="mailto:fred.roosta@uq.edu.au">fred.roosta@uq.edu.au</a></td>
</tr>
<tr>
<td></td>
<td>Office – Building 67-447, St Lucia</td>
</tr>
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</table>

**Generalized Convexity and Natural Language Processing**

We will study generalized convexity and its implications for training of natural language processing systems.

**Number of student places available:** 1

**Delivery:** Remote (via Zoom)

**Expected outcomes:** The students will study new optimization algorithms and the underlying mathematical concepts, and in the process, the students will develop valuable programming skills.

**Suitable for:** Students with good background knowledge of linear algebra, optimization, and Python programming language.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Project Details

<table>
<thead>
<tr>
<th><strong>Supervisor</strong></th>
<th>A/Prof Bob Doneley</th>
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<tr>
<td><strong>Contact Details:</strong></td>
<td>Email - <a href="mailto:r.doneley@uq.edu.au">r.doneley@uq.edu.au</a></td>
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<tr>
<td><strong>Duration:</strong></td>
<td>6 weeks</td>
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<tr>
<td><strong>Retrospective review of reasons for presentation and outcomes for Tawny Frogmouths (Podargus strigoides) presented for veterinary care 2017-2020</strong></td>
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</table>
A review of the Veterinary Teaching Hospital’s database to determine the number of Tawny Frogmouths presented for veterinary care over a 3-year period, the reasons for presentation, and the outcomes.  
Ideally, this review would lead to the development of triage protocols based on prognostic indicators. |
| **Delivery:** | Access to the Veterinary Teaching Hospital’s database is needed, requiring the student’s presence on the Gatton Campus (Veterinary Teaching Hospital or the Clinical Hub). |
| **Number of student places available:** | 1-2 |
| **Expected outcomes:** | Data analysis and preparation of a paper suitable for publication |
| **Suitable for:** | Students with a working knowledge of Excel, and the use of statistics. |
| **Other important details:** | Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.  
This project would ideally suit veterinary, veterinary technology, or wildlife students |

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*Faculty of Science, Summer Research Scholarship, Project List 2020/2021  
Last updated 18 September 2020*
Parasitic zoonoses risk due to canine parasites among dogs and children in shared spaces of Southeast Queensland

Australia has one of the highest rates of pet ownership in the world, with 37% of Queensland households having dogs and this number is on the rise. As with other animal species, dogs are infected with various parasites, which not only affect their health and wellbeing but also some of these parasites are serious zoonoses for humans. Dog faeces could serve as a potent source of viable zoonotic pathogens, contaminating the surroundings and placing inhabitants at high risk.

The aim of this study is to a) quantify spatial variation in the prevalence of intestinal parasite infestation of pet dogs living in urban and suburban areas of Queensland and identify associated risk factors b) quantify spatial variation in the prevalence of hookworm egg contamination in dog parks in urban and suburban areas of Queensland and identify associated risk factors.

The proposed study will work around public parks and gardens in the urban and suburban areas of Brisbane. The project has two objectives: first, we will collect faecal samples from dogs that visit the parks and ask their owners to fill a questionnaire about their dog and their awareness about dog parasites. The second objective is to determine the level of contamination of dog parks by canine hookworms. All faecal and soil samples collected during this study will be brought to School of Veterinary Sciences, Gatton for analysis. The samples will be examined for various parasitic eggs and oocysts using the centrifugation with flotation methods. All the data will be statistically analysed for prevalence and possible interactions between parasite load and host, environment and management factors. Spatial epidemiology models will be used to produce distribution maps of various parasites.

Delivery: The study is field based and students will need to go to dog parks for sample collections.

Number of student places available: 2

Expected outcomes: This study will provide a deeper insight of the extent of parasitic infestation in dogs and potential zoonoses due to contamination of living spaces with canine hookworms in and around Brisbane.

This study will help the scholars learn the skills of public interaction; the students will also get opportunity to learn faecal and soil sample examination techniques, identification of various parasitic eggs and oocysts. They will also be exposed to statistical and spatial data analysis and interpretation.

Suitable for: The student should be enthusiastic and should be able to interact with people in public places. He or she should be familiar with basic microscopy.

Other important details: For any interest in the project, please write an email to me indicating why you are interested in the project and what are you expecting to gain from getting involved in this study.

Email: swaid.abdullah@uq.edu.au

Please contact me prior to submitting an application if you are interested in the project. Evidence of supervisor support is required to be uploaded as part of the application process.
Deep sequencing of β-tubulin genes to ascertain benzimidazole resistance mechanisms in canine hookworms in Australian dogs

Canine hookworms are some of the most pathogenic gastrointestinal parasites infecting companion animals. A principal class of drugs used for preventative treatment against canine hookworms are the benzimidazoles, which bind to β-tubulin to block microtubule polymerization. But, high selective pressure posed by continuous de-worming provides a competitive advantage for strains that are resistant to the drugs. Resistance to multiple drug classes has been confirmed in canine hookworms around the world, including Australia. While identifying molecular mechanisms is challenging, the β-tubulin isotype 1 gene is a useful monitoring target as a number of non-synonymous point mutations known to confer partial benzimidazole resistance have been discovered in several helminth species.

The identification of similar resistance-conferring mutations in different helminth species around the world suggests that monitoring allele frequencies in this gene is warranted for early detection of resistant strains. Our survey of domestic dog faecal samples in Southeast Queensland (SEQLD) has confirmed that hookworm infections are common. Further, we found that 5 hookworm-positive dogs (rescue and shelter) were treated with benzimidazoles less than a month prior to analysis, implying possible resistance. These results warrant a deeper investigation into the likelihood of anthelmintic resistance among canine hookworms.

This study will be the first molecular survey of canine hookworm β-tubulin profiles in Australia. This will be coupled with phenotypic profiling of hookworm isolates using an egg hatch assay (EHA). The two-pronged approach will allow not only quantification of resistance-conferring mutations in hookworm populations, but also permit correlation of these observations with phenotypic responses of hookworms to benzimidazoles.

Delivery: The study will be run in the Clinical Studies Centre Gatton Campus, UQ

Expected outcomes: This study will provide valuable data on field resistance status and enhance characterization of the clinical significance of any mutations identified.

Suitable for: The student should be enthusiastic and should be able to interact with people in public places. He or she should be familiar with basic microscopy.

Other important details: For any interest in the project, please write an email to me indicating why you are interested in the project and what are you expecting to gain from getting involved in this study

Email: swaid.abdullah@uq.edu.au

Please contact me prior to submitting an application if you are interested in the project. Evidence of supervisor support is required to be uploaded as part of the application process.
**R**oss River virus infection in horses.

Mosquito-borne viruses pose serious public health risks to both human and horses, especially in light of climate change leading to increased mosquito populations. Ross River virus (RRV) is associated with poor performance syndrome (PPS) in horses and in more serious cases horses present with fever, joint swelling and lameness (Barton & Bielefeldt-Ohmann, J Eq Vet Sci, 51:34-40, 2017), but the underlying mechanisms are not well understood. Nor do we have a complete understanding of the epidemiology of the infection in Southern Queensland. A sero-epidemiological study of race-horses in SEQ conducted during 2019-20 has indicated that 30-40% of horses under 4 years of age have antibodies to RRV. Studies of the Gatton Campus equine cohort has shown that foals are quickly exposed even in drought-years, and that most horses in that region has RRV-antibodies by 1 year of age. To get a better understanding of the epidemiology of RRV in a well-defined setting, foals born on the UQ Gatton Campus during Spring of 2020 will be followed from birth with regular blood samplings, to assess their levels of passive immunity, exposure and development of specific RRV immunity (both antibodies and cell-mediated responses). In addition, the project will study the potential cross-protection against other mosquito-borne alpha-viruses (Sindbis and Barmah Forest virus) and cross-reactivity to Getah virus. The latter virus does not occur in Australia, but a vaccine is available and could potentially be applied to horses here, if sufficiently potent cross-reactivity is found. The project will explore this issue.

**Delivery:** On-site attendance is preferable in order to maximize the learning experience by the student(s), but the project can be designed to involve data analysis only, which can then be done remotely.

**Number of student places available:** 1 (remote) or 2 (on site)

**Expected outcomes:** The scholar will gain skills in laboratory techniques in virology and immunology.serology as well as data analysis. The studies are likely to result in publishable data.

**Suitable for:** This project is open to applications from UQ enrolled students only. It would be an advantage, but not an absolute requirement, if the applicant has some basic laboratory skills (cell culture techniques, ELISA etc) and a basic understanding of immunology.

If project-participation has to be conducted remotely, then a pre-requirement for familiarity with statistical packages would be required.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
**Comparison of the Results of Severity Scoring Systems for Insect Bite Hypersensitivity (IBH) in Horses between students, veterinarians and specialists**

Insect Bite Hypersensitivity (IBH, Queensland Itch) is a common equine disease and can be a source of frustration for veterinarians and owners alike. The purpose of this project is to analyse 4 different scoring systems for inter-observer differences between junior and senior veterinary students, veterinarians and specialists. Powerpoint presentations of 100 horses with IBH will be scored using a purpose built online app. The student will enrol 20 junior and senior veterinary students to be trained by a webinar and then score the 100 horses. Statistical analysis will then be performed between the groups of scorers. This project should result in a peer reviewed manuscript for the student and could be combined with a subsequent VETS5015 research elective. The project will involve subject enrolment, training, data management and training in statistical analysis.

**Delivery:** Although Gatton campus attendance is preferred, this project can run entirely online if COVID-19 restrictions prevent student scholar access to campus.

**Number of student places available:** 2

**Expected outcomes:**

- The student will work under the direction of a General Practitioner, Veterinary Epidemiologist and an Equine Medicine/Critical Care Specialist.
- The applicant will gain skills in human ethics, subject enrolment, training, data management and statistical analysis.
- This project should result in a peer reviewed manuscript with co-authorship for the students and could be combined with a subsequent VETS5015 research elective.
- There is opportunity to gain research experience in other projects with the investigators over the summer break.

**Suitable for:** This project is open to 4th, 3rd or 2nd year onshore UQ veterinary science students. Priorities given to students with skills with good computer skills (excel), attention to detail, and an interest in epidemiology and equine medicine.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Short interviews are necessary prior to application submission. Please contact Abbey Cox on a.cox@uq.edu.au

<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Abbey Cox, John Al-Alawneh, Allison Stewart</th>
<th>Duration: 8-10 weeks</th>
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<tr>
<td>Contact Details</td>
<td>Email – <a href="mailto:a.cox@uq.edu.au">a.cox@uq.edu.au</a></td>
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</table>
**Supervisor** Dr Natalie Fraser, Allison Stewart  
**Duration:** 8-10 weeks

**Contact Details:** Email – [Natalie.fraser@uq.edu.au](mailto:Natalie.fraser@uq.edu.au)

**Hendra virus antibody titres in foals in response to vaccination**

Hendra virus infection remains a serious public health risk to horse owners and the veterinary profession. Recent studies predicted more frequent Hendra virus spillover events into novel areas in the future making Hendra virus vaccination even more crucial to prevent spread of disease. Current Hendra virus vaccination protocol recommendation for foal is based on studies of other diseases. Maternal antibodies interference and foal’s immune response to Hendra virus vaccination is unknown. This project aims to assess suitability of the current protocol and make recommendations if necessary.

**Delivery:** At least twice a week on-site (Gatton campus) attendance required.

**Expected outcomes:** Students will gain skills in animal handling, intravenous venepuncture for routine blood collection, intramuscular injection, and blood processing in the laboratory. There is potential for secondary projects with acknowledgements or co-authorship on abstracts or papers to be generated from extra data obtained during this project. There is opportunity to gain research experience in other projects with the investigators over the summer break.

**Suitable for:** This project is open to current 2nd and 3rd year onshore UQ veterinary science students. Students with an interest in veterinary public health and/or equine medicine are preferred.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Short interviews are necessary prior to application submission. Please contact the lead graduate student Nicholas ([k.yuen@uq.edu.au](mailto:k.yuen@uq.edu.au))
A comparison of the diversity of cases, financial outcomes and professional collaboration between a small animal hospital located in an urban and a rural location.

The Small Animal Veterinary Teaching Hospital of the University of Queensland (UQ-SAVTH) was once located in the middle of the city in St Lucia campus. The UQ SAVTH was moved to the rural campus of Gatton in 2012. The location of a practice determines to some degree the type of cases seen, the amount of money spent per cases and the number of general practitioners referring cases. The main purposes of this descriptive retrospective study are:

- to compare the variety of the cases presented to the UQ SAVTH at Gatton campus between 2014 and 2016 and at St Lucia campus between 2010 and 2012,
- to compare the average amount spent per consultation in the two UQ hospitals,
- to compare the number of referring veterinarians collaborating with the University development in both settings

This project has been designed with the following practical ideas in mind:

1) to ensure appropriate variety of cases and exposure of students, interns and residents graduating from UQ Gatton campus,

2) to understand better the socio-economics parameters of the area and be able to implement financial help and solutions for owners to afford care for their animals,

3) to know better the pool of referring veterinarians participating to the growth of the University and develop with them strategies to increase the referral pool of cases and future collaborations.

**Delivery:** The project will need to be on site about 50% of the time

**Number of student places available:** 1

**Expected outcomes:** The student can expect to:

- learn about clinic software from which the data will be extracted
- learn about the veterinary industry
- be involved and learn about study design
- be involved and learn about data analysis
- present the preliminary results of the study in a school, university and/or professional meeting
- participate in the writing of the manuscript for publication

**Suitable for:** Suitable for any student interested in animals as well as practice management. Therefore veterinary students or business school students are encouraged to apply but all students enrolled at UQ should feel free to apply. Data collection will be done at Gatton campus; however data analysis and writing up of the project can be done from St Lucia campus. Students usually located at St Lucia can use the free intercampus bus running daily between both campuses.

Mainly, this project requires an individual who is enthusiastic and proactive as well as reliable and hardworking. Having advanced knowledge and interest in business management in relation with the medical field as well as data collection and statistical...
analysis would be particularly valued but is not mandatory. Some specific knowledge about the veterinary industry would be an asset for this project but is not required to apply.

**Other important details:** Interested students *must* contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

This project has Ethics approval in place and some piloting has already been done by a veterinary student enrolled in the Winter break Research Scholarship.

If you would like to have more information, please contact Dr Erika Meler by email at e.meler@uq.edu.au. Ideally students should attempt to contact Dr Erika Meler prior to submitting an application but all applications will be considered.
Let’s not reinvent the Wheel! Reliability and Usefulness of the internet-based knowledge in Veterinary Medicine

As we all know internet is a great resource when it comes to finding fast information. But do all websites provide reliable and useful information when it comes to veterinary medical information. The goal of this project is to explore and review the content of a range of veterinary medicine related websites and to rank the information provided on its reliability and trustworthiness as well as its in-depth nature or usefulness.

The aim is double:
- to be able to direct petowners to reliable data sources when their animal is diagnosed with a condition and that they want to learn more about it,
- to create a registry of reliable websites for final year students to read from when they are in clinical rotations.

Delivery: The project can be done remotely.

Number of student places available: 1

Expected outcomes: The student can expect to:
- gain knowledge in veterinary medical science in general
- learn to critically analyse scientific content
- perform data collection
- be involved and learn about data analysis
- present the preliminary results of the study in a school, university and/or professional meeting
- participate in the writing of the manuscript for publication

Suitable for: Suitable for veterinary students in 3rd or 4th yr of the program. The study will involve some meetings at Gatton but can be mainly done remotely. This project requires an individual who is enthusiastic and proactive as well as reliable and hardworking. Having medical veterinary knowledge is required for this project.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

If you would like to have more information, please contact Dr Erika Meler by email at e.meler@uq.edu.au. Ideally students should attempt to contact Dr Erika Meler prior to submitting an application but all applications will be considered.
<table>
<thead>
<tr>
<th>Supervisor</th>
<th>Dr Erika Meler</th>
<th>Duration: 8 weeks</th>
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<tr>
<td>Contact Details:</td>
<td>Email – <a href="mailto:e.meler@uq.edu.au">e.meler@uq.edu.au</a></td>
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<td>Zoom meetings can be arranged upon request.</td>
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**Observation of workflow within the UQ small animal teaching hospital, identification of inefficiencies and bottlenecks, and suggestions for improvement.**

The Small Animal Veterinary Teaching Hospital of the University of Queensland (UQ-SAVTH) has a double mission of serving the community and providing outstanding animal care as well as teaching final year veterinary students. Clinical teaching occurs all throughout the process of patient management within the hospital and can slow down the workflow and make operations less streamlined. The main purposes of this observational study are:

- to analyse the timing and duration of clinical and teaching activities performed by clinical teachers throughout the day
- to identify causes of bottlenecks and inefficiencies
- to formulate a plan for a strategic improvement of the workflow

This project has been designed with the following practical ideas in mind:

1) to incorporate clinical teaching activities within hospital operation as best as possible to reduce bottlenecks,

2) to ensure efficient patient flow within the UQ-SAVTH, offer outstanding client service and also allow students and clinical teachers to finish their day on time,

3) to increase the number of cases per day that can be processed through the hospital for an increased case exposure for students and also an increase of revenue for the teaching hospital.

**Delivery:** The project will need to be on site for at least 50 to 70% of the time

**Number of student places available:** 1

**Expected outcomes:** The student can expect to:

- learn about workflow in a veterinary hospital
- be involved and learn about study design
- perform data collection
- be involved and learn about data analysis
- present the preliminary results of the study in a school, university and/or professional meeting
- participate in the writing of the manuscript for publication

**Suitable for:** Suitable for any student interested in animals as well as practice management. Therefore veterinary students, medical or business school students are encouraged to apply but all students enrolled at UQ should feel free to apply. The study will be mostly based at Gatton campus however the student won’t be required to come every day to Gatton campus as writing and analysis of the data can be done from St Lucia. Students usually located at St Lucia can use the free intercampus bus running daily between both campuses.

Mainly, this project requires an individual who is enthusiastic and proactive as well as reliable and hardworking. Having advanced knowledge and interest in business management in relation with the medical field as well as data collection and statistical
analysis would be particularly valued but is not mandatory. Some specific knowledge about the veterinary industry would be an asset for this project but is not required to apply.

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<th>Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.</th>
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<tr>
<td>If you would like to have more information, please contact Dr Erika Meler by email at <a href="mailto:e.meler@uq.edu.au">e.meler@uq.edu.au</a>. Ideally students should attempt to contact Dr Erika Meler prior to submitting an application but all applications will be considered.</td>
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</table>
Women representation and gender equality in senior academic positions in veterinary science

Gender bias in academia, favouring men over women, penetrates virtually all domains of academic, including positions, promotions to higher positions, success in obtaining grants and many others.

More effort needs to be made globally to improve the representation of women in higher education to reflect the diversity of our society.

The study aims to evaluate the proportion of female academic staff in veterinary science schools/faculties in Australia, Europe and US in order to provide information that may help to understand why the biggest challenges for workplace gender equality in this discipline. This may also raise awareness of gender bias and unconscious discrimination, that may enable a fair evaluation, selection and support of outstanding individuals.

**Delivery:** The project can be completed under a remote working arrangement.

**Number of student places available:** 2

**Expected outcomes:** The student will gain skills in data mining, data cleaning, data interpretation and statistical analysis. An oral presentation will be delivered at the end of the program. One publication is expected to be generated from this study.

**Suitable for:** Students with a science background (any discipline), preference to 3rd or -4th year students.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
### Supervisor
A/Prof Chiara Palmieri, Dr Francois-Rene Bertin; Dr Allison Stewart  
**Duration:** 8 weeks

### Contact Details:
Email – c.palmieri@uq.edu.au; f.bertin@uq.edu.au; Allison.stewart@uq.edu.au

### Occurrence of the most common tumour diagnoses in horses and identification of individual risk factors for tumour development.

Information on tumour types and incidence in horses are very scarce and fragmentary and breed, age and sex predilections for many tumours are poorly described in the equine population.

**Aims:**
- Describe the most frequently diagnosed equine tumours from retrospective diagnostic records archived at the Veterinary Laboratory Service and the Equine Specialist Hospital of The University of Queensland
- Identify any risk factors associated with specific tumour types
- Identify any changes in the details of cases submitted and tumour diagnosed over time
- Identify any variation in the treatment outcome according to the tumour grading and its biological behaviour

More current data on the most frequently diagnosed equine tumour types should inform veterinary surgeons treating clinical cases, provide data for comparative research and identify research priorities.

**Delivery:** The project can be completed under a remote working arrangement.

**Number of student places available:** 1

**Expected outcomes:** The student will gain skills in the histological identification of different tumour types, data mining, data cleaning and statistical analysis. An oral presentation will be delivered at the end of the program. One publication is expected to be generated from this study.

**Suitable for:** Students with a background in veterinary science, preference to 3rd or -4th year BVSC(hons) students. This project could be continued as a 5017 research elective project.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
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<tr>
<th>Supervisor</th>
<th>Dr Allison Stewart, Dr Abbey Cox, Dr Fran Schapter, A/Prof Dan Schull</th>
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<tr>
<td>Duration:</td>
<td>8-10 weeks</td>
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<td>Contact</td>
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**Assessment of the utility of an online library and teaching module for equine auscultation of heart, lung and gastrointestinal sounds**

Using two prototype electronic stethoscopes which record sounds and phonographs, the student will record heart, lung and gastrointestinal sounds from horses to add to a library of sounds (if COVID restrictions, previous recordings can be utilised). Heart sounds will be recorded over the aortic, pulmonary, mitral and tricuspid valves in normal horses and those with murmurs. A teaching module will be created. After obtaining human ethics, 30 volunteer students will be enrolled to provide their opinions on the usefulness of the module. The final module will be used in VETS4022 and 5015 teaching and be linked to anatomic locations on the full sized Hub horse model “Phar Lap” as a learning resource.

**Delivery:** Although on-site (Gatton campus) attendance is preferred, this project can run entirely online if COVID-19 restrictions prevent student scholar access to campus.

**Number of student places available:** 2

**Expected outcomes:**

- the applicant will gain skills horse handling, auscultation, cardiology and in human ethics, subject enrolment, training, data management and statistical analysis.
- Instructions will be prepared and human ethics submitted for a project to test the usefulness of this learning tool in the education of veterinary and veterinary technology students
- There is the potential for the student to be involved in a veterinary education manuscript and present at educational meetings- ie VET Ed Down Under
- This project could result in a peer reviewed manuscript with co-authorship for the students and could be combined with a subsequent VETS5017 research elective.
- There is opportunity to gain research experience in other projects with the investigators over the summer break.

**Suitable for:** This project is open to 4th, 3rd or 2nd year onshore UQ veterinary science students.

Priorities given to students with attention to detail, teaching and an interest in cardiology and equine medicine.

A GPA > 5.8 is usually required to be successful at obtaining a scholarship. A total of 2 students can be involved in this project.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Short interviews are necessary prior to application submission. Please contact Allison Stewart on allison.stewart@uq.edu.au
<table>
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<tr>
<th>Supervisor</th>
<th>Dr Allison Stewart, Dr Abbey Cox, Dr Fran Schapter</th>
<th>Duration: 8-10 weeks</th>
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**Comparison of heart, lung and gastrointestinal sounds recorded from clipped and unclipped horses using two electronic stethoscopes**

Using two prototype electronic stethoscopes which record sounds and phonographs, the student will record heart, lung and gastrointestinal sounds from horses to add to a library of sounds (if COVID restrictions, previous recordings can be used). Heart sounds will be recorded over the aortic, pulmonary, mitral and tricuspid valves in normal horses and those with murmurs. After obtaining human ethics, 30 volunteer students will be enrolled to compare the quality of clipped verses unclipped sound files from each of the two electronic stethoscopes in a blinded manner. Statistically compare the results to determine if clipping increases the quality of recordings. Work will continue to create an online teaching resource or an app for listening to heart sounds on the full sized Hub horse model as a learning resource.

**Delivery:** Although on-site (Gatton campus) attendance is preferred, this project can run entirely online if COVID-19 restrictions prevent student scholar access to campus.

**Number of student places available:** 1

**Expected outcomes:**

- The student will work under the direction of a Equine Medicine/Critical Care Specialist, a General Practitioner and a Veterinary Epidemiologist.
- The applicant will gain skills horse handling, auscultation, cardiology and in human ethics, subject enrolment, training, data management and statistical analysis.
- This project should result in a peer reviewed manuscript with co-authorship for the students and could be combined with a subsequent VETSS017 research elective.
- There is opportunity to gain research experience in other projects with the investigators over the summer break.

**Suitable for:** This project is open to 4th, 3rd or 2nd year onshore UQ veterinary science students.

Priorities given to students with skills with good computer skills (excel), attention to detail, and an interest in cardiology and equine medicine.

A GPA > 5.8 is usually required to be successful at obtaining a scholarship. A total of 1 student can be involved in this project.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Short interviews are necessary prior to application submission. Please contact Allison Stewart on allergon.stewart@uq.edu.au
Seroprevalence and cross-neutralization of mosquito-borne flaviviruses in naturally exposed saltwater crocodiles

The risk of flaviviral infections among crocodilian species was unrecognized until West Nile virus (WNV) was introduced into the Americas, causing death and substantial economic losses in the alligator farming industry. Following outbreaks in the Americas, several other outbreaks have been reported in other parts of the world, including Australia. Considering that WNV share vectors with other flaviviruses, it is highly plausible that crocodilian species are exposed to various flaviviruses other than just WNV. This study will investigate the seroprevalence of Kunjin virus (WNVKUN), Murray Valley encephalitis virus (MVEV), Alfuy virus (ALFV), Kokobera virus (KOKV), Stratford virus (STRV), Fitzroy River virus (FRV), Bamaga virus (BgV) and Edge Hill virus (EHV). To better understand the epidemiology of these viruses in crocodiles, blood samples will be collected from farmed saltwater crocodiles at slaughter and screened by ELISA and virus microneutralizations. In addition to naturally exposed animals, crocodiles previously vaccinated against WNV will be tested for potential cross-neutralization (protection) as well as cross-reactivity to various flaviviruses. The study will allow us to investigate possible interference or antagonism of various flaviviruses (other than KUNV) to KUNV vaccine by comparing the response to vaccination between pre-exposed and non-exposed crocodiles. Furthermore, the project will allow us to explore the potential of using crocodiles as a sentinel species for the above-mentioned viruses. Thus, results from this project could be used to develop a surveillance tool to predict flaviviral outbreaks in humans and animals (e.g., horses) using a "One Health" approach taking into consideration the environment, human and animal health.

Delivery: This project will be based at the St. Lucia campus and requires on-site attendance.

Number of student places available: 1

Expected outcomes: The student will gain skills in various laboratory techniques such as cell culture, virology (virus culture and titration), serology and immunology (ELISA, western blot) and data analysis. This study is likely to result in publishable data.

Suitable for: This project is open to applications from UQ enrolled students only. It would be an advantage, but not an absolute requirement if the applicant has some basic laboratory skills (cell culture techniques, ELISA, etc.) and a basic understanding of immunology.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

The scholar will be working along with my PhD student who is studying WNV pathogenesis in crocodiles. Thus, in addition to the actual project, the scholar could also learn other diagnostic techniques such as immunohistochemistry and RT-qPCR used by the PhD student. Interested students must contact the supervisor before applying.
Supervisor: A/Prof Rowland Cobbold  
Duration: 8 weeks

Contact Details:  
Email – r.cobbold@uq.edu.au

Effectiveness of current cleaning and disinfection protocols for endoscopes and dental equipment in a veterinary hospital.

Use of endoscopes and dental equipment is common in veterinary hospitals for routine procedures, e.g. arthroscopy and dental surgery. Thorough cleaning and disinfection are crucial to prevent iatrogenic infection and minimise antimicrobial use. However, over time pathogens and biofilms may build up within the equipment as the inner layer wears after multiple cleaning cycles. This study will (1) assess the efficacy of the endoscopic and dental equipment cleaning and disinfection methods utilized at the UQ VETS Small Animal Hospital; and (2) benchmark UQ VETS decontamination protocol against other institutions.

Delivery: Regular on-site (Gatton campus) attendance required.

Number of student places available: 1-2

Expected outcomes: Scholar will gain skills in standard cleaning and disinfection protocols for veterinary equipment, techniques for sterile sample collection, performing bacterial enumeration, culture and susceptibility testing in the laboratory, and data analysis and interpretation. It is expected that a report/oral presentation will be produced by the scholar, which could lead to a scientific publication. This project has practical outcomes with respect to improving clinical procedures in veterinary practice.

Suitable for: This project is open to current 3rd or 4th year onshore UQ veterinary science students. Students with an interest in veterinary public health and microbiology are preferred. A GPA > 5.5 would increase success in obtaining a scholarship.

Other important details: Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process. Applicant is advised to contact supervisor before application submission.
## Screening of unowned cats for diseases of public health and cat health relevance.

Unowned cats are a problem with respect to animal welfare and wildlife predation. But it is suspected they also carry diseases that have human health significance, or pose a threat to the owned cat population. This project is collecting specimens from supplied cat cadavers and screening them for a range of infectious agents of relevance to cat and human transmission potential. A number of downstream project activities are possible based on this primary aim, including examining risk factors (eg age, diet) associated with carriage of diseases, spatial mapping of disease prevalence, or detailed characterisation of pathogens isolated.

### Delivery:
Regular on-site (Gatton campus) attendance required.

### Number of student places available:
1-2

### Expected outcomes:
Scholar will gain skills in cat necropsy and sample collection, biosecurity protocols, performing bacterial isolation, culture and susceptibility testing in the laboratory, serology, parasitological identification, and data analysis and interpretation. It is expected that a report/oral presentation will be produced by the scholar, which could lead to a scientific publication. This project has practical outcomes with respect to identifying further risks associated with the unowned cat population, with a view to enhancing control and prevention strategies.

### Suitable for:
This project is open to current onshore UQ students who have some background and experience in biology and/or infectious diseases. Students with an interest in pest animal management are also welcome. A GPA > 5.5 would increase success in obtaining a scholarship.

### Other important details:
Interested students **must** contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Applicant is advised to contact supervisor before application submission.
Supervisor | Dr Nicholas Clark | Duration: 8 weeks
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**Contact Details:** | Email – n.clark@uq.edu.au |

**Spatial modelling of wildlife hospital admissions**
Wildlife hospitals offer a tremendous service. One of the key benefits they provide is gathering information on spatial and temporal patterns in wildlife trauma incidents. Understanding which species are more susceptible to trauma, and uncovering particular areas or times of the year when incidents are more likely to occur, can provide leverage to local planners, conservation groups and policymakers. This project will develop and apply modelling tools to a large dataset of wildlife hospital clinical records to identify factors associated with increased incidence of trauma.

**Delivery:** The project involves desktop-based work and can be completed remotely. Some face to face meetings at Gatton or St Lucia would still be preferable

**Number of student places available:** 1

**Expected outcomes:** Outputs of these models will consist of high-resolution maps of trauma estimates and reports aimed at influencing planning decisions in efforts to reduce these occurrences. I envision a keen interest from end users (wildlife hospital clinicians) to translate these models into an automated pipeline that can provide enormous advantages for early detection of incidence clusters. Students will gain valuable experience in data analysis, script-based coding, data visualisation and spatiotemporal modelling.

**Suitable for:** Prospective students with interests in wildlife health, conservation and spatial data analysis will be very suitable to this work.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.
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<thead>
<tr>
<th>Supervisor</th>
<th>Dr Frances Shapter, Dr Justine Gibson, Dr Allison Stewart</th>
<th>Duration: 8-10 weeks</th>
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<tr>
<td>Contact Details:</td>
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**Use of a cumulative antibiogram in veterinary practice**

Cumulative antibiograms are commonly used in human medicine to guide empirical antimicrobial choices prior to return of culture and susceptibility results and are part of antimicrobial stewardship programs. There are no published veterinary antibiograms in the literature. An equine antibiogram has recently been generated for the UQVETS Equine Specialist Hospital. Through a comprehensive literature search, no reports of how the use of a cumulative antibiogram changes antimicrobial prescribing practice could be identified. This study will examine (1) changes in antimicrobial prescribing practice before and after cumulative antibiogram implementation; and (2) role of cumulative antibiogram in veterinary education of final year students.

**Delivery:** Some work can be done remotely. Intermittent on-site (Gatton campus) attendance required.

**Number of student places available:** 1

**Expected outcomes:** Students will gain skills in qualitative research, such as data collection and analysis from surveys and interviews. It is expected that a report/oral presentation will be produced by the scholar, which should lead to a scientific publication where the scholar may be acknowledged or co-authored depending on contribution to the project.

**Suitable for:** This project is open to current 3rd year onshore UQ veterinary science students. A GPA > 5.8 is usually required to be successful at obtaining a scholarship.

**Other important details:** Interested students must contact the supervisor/s, prior to submitting an application. Evidence of supervisor support is required to be uploaded as part of the application process.

Short interviews are necessary prior to application submission. Please contact the lead graduate student Nicholas k.yuen@uq.edu.au