Summer Research Program 2025

Research Projects offered by Schools in the Faculty of Science

Next Steps

Step 1: Browse the Projects

- You can browse by School by clicking on the table of contents above.

Step 2: Obtain Supervisor Approval

Email the listed project supervisor ensuring you:

- Introduce yourself to the supervisor and outline your suitability to a project highlighting any key skills and/or knowledge you have that relate to the project you are applying for;
- Outline your motivations for wanting to participate in the program;
- Detail what you hope to gain from the research experience; and
- Outline the knowledge and capabilities you can contribute to the project team.

If you receive supervisor approval, you will be required to upload evidence of this approval as part of your application via Student Hub.

You can use the statement you provided to the supervisor as your personal statement that you are also required to submit as part of your application in Student Hub.

Supervisor approval for application is tentative and not binding. It does not guarantee a place in the program, or in any specific project.

Step 3: Submit your application via StudentHub

School of Agriculture and Food Sustainability

Project title	**Sensor based detection of equine heat stress behaviours**
Project duration	6 weeks
Hours of engagement	20-35 hours per week
Location	Gatton campus
Project description	In this project we are looking to use sensor technologies to monitor equine behaviour and how this may be influenced by hot environmental conditions. Heat stress has been defined as a welfare challenge for horses. Although heat stress has been defined as a welfare challenge a clear definition of heat stress in horses does not exist. Traditionally heat stress is defined as the inability of the horse to maintain body temperature within a prescribed temperature range that is considered physiologically normal. However, in other species such as cattle and sheep behavioural changes are regarded as the primary response to hot climatic conditions. Altered behaviour patterns due to heat stress are yet to be defined in horses. As such the purpose of this project is to undertake a short research project in investigating behavioural changes in horses during hot climatic conditions. A component of this work is to utilise sensor technologies to define equine behaviours.
Expected outcomes and deliverables	Students can expect exposure to research in heat stress physiology. There will be some components of this project that are in-field monitoring animals as well as desktop related work. There is an opportunity here to learn and be involved in some data analytics and preparation of data for formal publication.
Suitable for	This project is suitable for students who have completed their second year of studies or those that have partially completed a coursework masters project
Supervisor	Dr Angela Lees (primary) Dr Kieren McCosker
Contact for further information	Dr Angela Lees: a.lees@uq.edu.au
Additional information	This project will involve some outdoor work on hot days during the summer.
School	School of Agriculture and Food Sustainability

Project title	**Defining heat tolerance in Droughtmaster cows using a modified iberia heat tolerance test**
Project duration	6 weeks
Hours of engagement	20 hours per week
Location	Gatton campus
Project description	Heat stress in particular is well defined to have negative impacts on intensively managed animals, especially dairy cattle and feedlot cattle. As such there has been a large amount of research data generated on these two animal systems. However to date the impact of heat stress and the implications for grazing beef cattle has received limited attention. In addition, traditionally it has been assumed that the tropically adapted cattle breeds (i.e. bos indicus) are not impacted by heat stress and/or hot climatic conditions and as such are described as being thermotolerant. New research findings (from 2021 onwards) are suggesting that grazing beef cattle, specifically the tropically adapted cattle breeds are no longer adequately coping with heat stress conditions. This is an important consideration for Australian producers, where a large proportion of the grazing beef industry, particularly in northern Australia, are centred around breeding programs using the tropically adapted breeds and are exposed to challenging environmental conditions. Overall highlighting that further research in this area, particularly in an Australian context is required. Heat tolerance is currently not well defined and there is evidence that Bos indicus cows are becoming more susceptible to heat stress. In this project we will be using the Iberian Heat Tolerance Test as a method to define heat tolerance in cattle.
Expected outcomes and deliverables	Students can expect exposure to research in heat stress physiology. There will be some components of this project that are in-field monitoring animals as well as desktop related work. There is an opportunity here to learn and be involved in some data analytics and preparation of data for formal publication.
Suitable for	This project is suitable for students who have completed their second year of studies or those that have partially completed a coursework masters project
Supervisor	Dr Angela Lees (primary) Dr Kieren McCosker
Contact for further information	Dr Angela Lees: a.lees@uq.edu.au
Additional information	This project will involve some outdoor work on hot days during the summer.
School	School of Agriculture and Food Sustainability

Project title	**Impact of climate change on Pakistan's citrus performance and export and industry responses and choices - foresights and scenarios in Pakistan context**
Project duration	6 weeks
Hours of engagement	25 hours per week
Location	Gatton campus
Project description	Citrus is Pakistan's leading fruit crop. Although production has increased at about 4% annually, productivity is below comparable countries, farmgate waste is high and value is stagnant. Despite low productivity, high waste and stagnant value, the industry's main product, Kinnow mandarin, has unexploited potential for marketing at higher levels of quality and value, especially in export markets. Kinnow is a well-coloured, rich-flavoured easy-peel mandarin hybrid with numerous seeds. Low-seeded variants have been introduced but do not yet comprise marketable consignments. Domestic marketing predominates, characterised by gluts in supply, low prices, lack of product differentiation and wastage. While the industry is being supported by various initiatives from the government and development partners promoting export, issues such as climate change and water inadequacy represent shared growing concerns among producers, processors, exporters, governments and development partners. In this backdrop this project aims to answer the following research questions: 1. What are prospective export market destinations for Pakistan's citrus - now and in near future? 2. How the climate change impacts the citrus industry performance and export? 3. What response strategies exist for farmers and other value chain actors? 4. How could government and development partners support the industry to tackle the problem/leverage the opportunities? The task involves producing a report based on review of existing literature and analysis of secondary data, including foresighting exercise to assess trends, develop forecasts and scenarios and draw response strategies to answer the above research questions.
Expected outcomes and deliverables	The task involves producing a substantive report, in which student is expected to employ their already developed analytical and literature review skills to understand the situation and impact of climate change on agrifood industry performance and export. Student can expect to learn foresighting technique and scenario building.
Suitable for	This project is open to applications from students with a background in agribusiness or agriculture or environmental economics, with data analysis and literature review skills and working knowledge of horticultural industry and environmental tools and framework.
Supervisor	Dr Rajendra Adhikari (primary)
Contact for further information	Dr Rajendra Adhikari: r.adhikari@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Genome editing approach for climate-smart Pigeonpea (Cajanus cajan)**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	Long Pocket
Project description	Genome editing is an emerging technology that provides novel opportunities to improve plant resilience and productivity. To successfully apply this cutting-edge technology in Pigeonpea, a multi-purpose legume, it is important to identify suitable materials for editing. This project aims to test different plant materials for enhanced gene editing efficiency in pigeonpea.
Expected outcomes and deliverables	Scholars will learn bioinformatic, molecular and tissue culture skills. They will be involved in sgRNA/CRISPR Cas9 constructs design, tissue culture, transformation, DNA extraction, PCR, gel electrophoresis, and analysis of sequencing results.
Suitable for	This project is open to applications from 3-4th year students who have completed some tissue culture and/or genetics, plant biotechnology courses.
Supervisor	Dr Linh Hoang (primary) Prof Sagadevan Mundree
Contact for further information	Dr Linh Hoang: l.hoang@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Effect of climate change on weed ecology**
Project duration	6 weeks
Hours of engagement	24 hours per week
Location	Gatton campus
Project description	This project investigates the impact of climate change on weed ecology, focusing on how shifting temperatures and precipitation patterns influence weed distribution, growth, and competition with crops. By examining the adaptive responses of weeds to these changing environmental conditions, the study aims to identify emerging threats to agricultural productivity. The project will also explore the potential for increased herbicide resistance and the need for innovative control measures in the face of a changing climate.
Expected outcomes and deliverables	Students may improve their skills in conducting lab/pots experiments and data recording.
Suitable for	This project is open to applications from students with a background in agriculture, agronomy, botany, biochemistry, chemistry, crop science, or 3rd and 4th year students only.
Supervisor	Prof Bhagirath Chauhan (primary)
Contact for further information	Prof Bhagirath Chauhan: b.chauhan@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Tracking interactions between secondary traits and final grain yield of wheat**
Project duration	6 weeks
Hours of engagement	Typically, 30 hours per week. Applicant will be required to be on-site for the project.
Location	St Lucia campus
Project description	This project aims to improve understanding about yield formation under the scope of a national project – AAGI, led by Prof Scott Chapman (UQ). More specifically, this project will use statistical/machine learning methods to investigate the interaction between secondary traits and final grain yield of wheat and how this interaction changes over time and/or by changing environments.
Expected outcomes and deliverables	• Develop an understanding about yield formation mechanism. • Develop skills for implementing statistical method to explore and present network relationship between secondary traits and final yield. • Develop skills in research design, implementation, and communication. • A report documenting the work done and the findings.
Suitable for	This project is suitable for students who are passionate about agriculture research and have a solid background in crop physiology, statistics, and programming. Currently, this project will highly depend on using a few R packages (e.g., netgwas, nutriNetwork) to explore the designated questions.
Supervisor	Dr Qiaomin Chen (primary) Dr Vivi Arief
Contact for further information	Dr Qiaomin Chen: qiaomin.chen@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Investigating the Valuation of Teaching Activities in Agriculture Education**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	Work at both Gatton and St Lucia campuses, and online
Project description	This project aims to explore the perceived value of various teaching activities (e.g., lectures, tutorials, practicals) among agriculture students and educators in higher education. The study will delve into the factors influencing these perceptions, including the nature of the subject matter, the characteristics of the student body, and the educators' own teaching styles and experiences. The research will employ a mixed-methods approach, combining quantitative and qualitative data collection techniques. A survey will be distributed to agriculture students and educators at various higher education institutions to gather quantitative data on their perceptions and experiences. The survey will include closed-ended questions and a section for open-ended responses to allow for more in-depth exploration of their perspectives. In addition to the survey, semi-structured interviews will be conducted with a select group of agriculture students and educators to gather qualitative data. The interviews will focus on exploring their personal experiences, challenges, and preferences related to different teaching activities.
Expected outcomes and deliverables	This project is expected to provide valuable insights into the perceived value of various teaching activities among agriculture students and educators. The findings will contribute to ongoing discussions about pedagogical approaches in higher education and inform the development of more effective teaching and learning strategies in agricultural education.
Suitable for	Any student interested in designing and conducting quantitative and qualitative research
Supervisor	Mr Suresh Krishnasamy (primary)
Contact for further information	Mr Suresh Krishnasamy: suresh.krishnasamy@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Investigating the Valuation of Teaching Awards and Teaching Excellence**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	Work at both Gatton and St Lucia campuses, and online
Project description	This project aims to explore the perceived value of teaching awards and recognition of teaching excellence among higher education educators. The study will delve into the factors that influence educators' perceptions of these awards and the impact they have on their professional development and satisfaction. The research will employ a mixed-methods approach, combining quantitative and qualitative data collection techniques. A survey will be distributed to higher education educators to gather quantitative data on their perceptions and experiences with teaching awards and recognition. The survey will include closed-ended questions and a section for open-ended responses to allow for more in-depth exploration of their perspectives. In addition to the survey, semi-structured interviews will be conducted with a select group of higher education educators to gather qualitative data. The interviews will focus on exploring their personal experiences with teaching awards, the impact they have had on their careers, and any challenges or limitations they have encountered.
Expected outcomes and deliverables	This project is expected to provide valuable insights into the perceived value of teaching awards and recognition of teaching excellence among higher education educators. The findings will contribute to ongoing discussions about the role of teaching awards in promoting and supporting effective teaching practices.
Suitable for	Any student who is interested in designing and conducting quantitative and qualitative research projects.
Supervisor	Mr Suresh Krishnasamy (primary)
Contact for further information	Mr Suresh Krishnasamy: suresh.krishnasamy@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Morphological traits of importance in lodging resistance in Australian rice**
Project duration	6 weeks
Hours of engagement	30 - 35 hours per week
Location	Gatton campus
Project description	There is an opportunity to conduct a short term experiment in relation to lodging resistance in the field (Gatton) experiments. Lodging is the stems bend or fall over which makes harvesting a challenge and inefficient, leading to significant yield losses. Our AgriFutures-funded project aims to address lodging by identifying rice varieties resistant to lodging and traits contributing to lodging resistance. In this study, we'll identify genotypic variation in lodging, plant height and culm morphological traits related to lodging resistance in Australian rice population.
Expected outcomes and deliverables	An understanding of lodging resistance in rice; experimentation and research strategies for 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.
Supervisor	A/Prof Jaquie Mitchell (primary) Dr Wenliu Gong
Contact for further information	A/Prof Jaquie Mitchell: jaquie.mitchell@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Effect of Nanobubble in Membrane Filtration Process**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	The project will investigate the impact of nanobubbles on mass transfer in the membrane filtration process. While cavitation and gas bubbles typically cause membrane blockages, reducing filtration efficiency, there is evidence that nanobubbles may actually enhance permeate flux. This improvement is attributed to the decreased viscosity of a nanobubble-liquid mixture compared to the liquid alone. The student will systematically explore the effects of nanobubbles on the physical properties of liquids and their behaviour during membrane filtration using experimental methods. Through this project, the student will gain hands-on experience in food processing techniques such as bubble generation and membrane filtration, as well as in physical analysis methods like viscosity and particle size measurement.
Expected outcomes and deliverables	The student will develop strong skills in food processing, including nanobubble generation and membrane filtration, as well as in the physical assessment of liquid foods, such as viscosity and particle size measurement.
Suitable for	This project is open to applications from students with a background in Food Science and Technology.
Supervisor	Dr Phuong Nguyen (primary)
Contact for further information	Dr Phuong Nguyen: p.nguyen2@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Spray drying of herbal extracts**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Herbal teas are commonly used for their benefits for the human health. However, the drying procedure can damage and hinder the properties of these substances. For example, polyphenols can be highly decreased in number once leaves are vacuum or freeze dried. As a consequence, an alternative procedure is creating extracts from leave and encapsulate them via spray drying. However, spraying conditions can lead to different encapsulation efficiencies and different powder properties. The aim of this project will be to optimize the spraying conditions in order to obtain the highest efficiency of encapsulated extract from different types of leave. The initial focus will be on mint and peppermint. The main outcome will be the optimized encapsulated extract. Therefore, the same procedure will be applicable to a broad range of extracts.
Expected outcomes and deliverables	The student is expected to gain knowledge in the spraying techniques and the techniques to characterize powders of different types.
Suitable for	Undergraduate or postgraduate students
Supervisor	Dr Alberto Baldelli (primary) Dr Buddhi Dayananda
Contact for further information	Dr Alberto Baldelli: a.baldelli@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Effect of drought stress on herbicide performance of button grass**
Project duration	6 weeks
Hours of engagement	20 hours per week (4 hours x 5 days per week)
Location	Gatton campus
Project description	The severity of drought is increasing in Australia in the wake of global climate change. Knowledge about the influence of drought on weeds and herbicide performance is necessary for optimising herbicide applications. This research will investigate the effect of drought stress, as one of the negative effects of global climate change on the performance of the commonly used herbicides in button grass.
Expected outcomes and deliverables	This study would help growers for informed decision-making to increase herbicide efficacy in dryland regions. Students may improve skills in conducting pots experiment and data recording.
Suitable for	This project is open to applications from students with a background in agriculture, agronomy, botany, biochemistry, chemistry, crop science, or 3rd and 4th year students only.
Supervisor	Prof Bhagirath Chauhan (primary)
Contact for further information	Prof Bhagirath Chauhan: b.chauhan@uq.edu.au
School	School of Agriculture and Food Sustainability

Project title	**Encapsulation of vitamin b12 for milk fortification**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Vitamin b12 deficiency affects people with dietary restrictions, such as vegetarians. However, vegetarians do assume dairies. Therefore, including vitamin b12 in milk or dairy products could be a solution for this specific group of people. However, vitamin b12 tends to be yellow or red, making the milk less acceptable to the customers. Encapsulation could be used to mask the color. Spray drying is a scalable production technique usually used to encapsulate a variety of bioactive compounds. However, the optimization could be tedious. In this project, the summer student will spray 4 to 10 formulations containing vitamin b12, a masking sugar, and a masking polymer.
Expected outcomes and deliverables	The student is expected to learn the technique of spray drying, contribute to writing a manuscript, and approaching different types of characterization techniques.
Suitable for	Master's students with a background in Food Science.
Supervisor	Dr Alberto Baldelli (primary)
Contact for further information	Dr Alberto Baldelli: a.baldelli@uq.edu.au
School	School of Agriculture and Food Sustainability

School of Chemistry and Molecular Biosciences

Project title	**Advanced organic materials**
Project duration	6 weeks
Hours of engagement	36 hours per week in the lab
Location	St Lucia campus
Project description	The objective of this project is to create highly luminescent organic chromophores suitable for use in quantum-based optoelectronic devices, such as organic light-emitting diodes (OLEDs) intended for next-generation displays, lighting solutions, and augmented reality applications, as well as organic lasers. Organic semiconductor materials present several significant advantages over their inorganic counterparts, including light weight, high tunability, low costs, and simple synthesis and fabrication processes. There is a growing interest and demand for highly luminescent organic chromophores, particularly in the fields of lasers and bio-applications such as bio-imaging and sensing, as well as in quantum-based optoelectronics. However, it remains a challenge to produce organic semiconductors that demonstrate strong luminescence in both solution and solid states while also maintaining suitable energy levels for charge injection in devices. This project will focus on the development of novel organic semiconductors and the investigation of their properties to assess their potential for next-generation quantum-based optoelectronics.
Expected outcomes and deliverables	Students will acquire knowledge in the design, synthesis, purification, and characterisation of organic materials, along with an understanding of the operational principles and applications of quantum-based optoelectronic devices. Additionally, they will have the chance to delve into advanced photophysics and device physics through collaborative efforts with physics experts at QU's School of Mathematics and Physics.
Suitable for	Suitable for 3-year undergraduates who have completed CHEM3001 or displayed a high level of competency in CHEM2050 and CHEM2054. Students have a strong interest in organic material development and synthesis as well as learning how organic semiconductors work and play roles in our next-generation nano- and quantum technologies.
Supervisor	A/Prof Shih-Chun Lo (primary) A/Prof Ebinazar Namdas
Contact for further information	A/Prof Shih-Chun Lo: s.lo@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Recycling fluorine in fluorocarbons**
Project duration	6 weeks
Hours of engagement	25-35 hours per week
Location	St Lucia campus
Project description	Fluorocarbons are vitally important to an array of technologies including pharmaceuticals, agrochemicals, polymers, materials, lubricants and refrigerants. Some fluorocarbons that are generated on the kiloton scale are also of environmental concern. We are working to develop new ways to recycle and reuse fluorocarbons to reduce their environmental footprint and to reduce their cost of production. The current project will explore ways of recycling fluoride in the transformation of fluoride containing groups into new functional groups.
Expected outcomes and deliverables	The student will receive thorough training in inorganic and organic synthetic and analytical techniques. A taste for novel and ground breaking research will be provided to the student
Suitable for	This project is suitable for 2nd or 3rd year chemistry students looking to register some experience in a research laboratory
Supervisor	Dr Rowan Young (primary)
Contact for further information	Dr Rowan Young: rowan.young@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Prospecting in extreme microbial communities for novel microorganisms and enzymes**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Extreme environments, such as hot springs and mine sites, harbour many uncharacterised microorganisms with undocumented biochemical pathways that are likely involved in the metabolism that allow them to survive in these inhospitable habitats. In this project, the aim is to use bioinformatic techniques on microbial DNA sequence data from Northern Queensland (Innot, QLD) hot springs (~70°C) and/or acidic (~pH 3) mine sites (Herberton, QLD) to discover the diversity of microorganisms active in these environments and identify how their metabolism allows them to exist in these habitats. After identifying and characterising microbial species of interest, protein candidates from these microorganisms that allow them to interact with their surrounds will be identified and characterised using in silico techniques. It is likely these enzymes have increased stability/activity in high temperature or acidic environments compared to mesophilic or circa neutral equivalents, for these reasons proteins are of interest for applications in industrial processes. Key outcomes of this project are the identification and characterisation of the metabolism of microorganisms in these environments and identify potentially thermoactive or acid stable enzymes. The techniques used to generate these outcomes will allow the development a student's understanding in microbiology/genetics through using an integrated bioinformatic-based approach.
Expected outcomes and deliverables	• Learn how to use DNA sequence data analysis and visualisation tools. • Develop an understanding of structure and function of key enzymes/metabolic pathways. • Generate data that could be published in scientific literature.
Suitable for	Highly desirable skills and attributes for this position include: • A background in either biochemistry, microbiology or bioinformatics at a 3rd or 4th year level. • Familiarity with Linux operating systems and command-line tools. • Experience with R-studio for data analysis and reporting. • A strong ability to self-learn; has a good work ethic; is able to present and discuss data.
Supervisor	Dr Paul Evans (primary) Dr Kate Bowerman
Contact for further information	Dr Paul Evans: p.evans3@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Exploring students' understanding of vaporisation through mental images of molecules**
Project duration	6 weeks
Hours of engagement	22 hours per week (3 days per week)
Location	St Lucia campus
Project description	Learning chemistry requires engagement with multiple representations including molecule structures, experiments and simulations. Building on recent work in our research group, we are developing resources that support students reasoning through images. In this project, stimulus resource interviews will be used to capture student thinking as they develop an explanation of the process of vaporisation applying different levels of thinking. The project involves formal chemistry education research methods and develops qualitative research skills.
Expected outcomes and deliverables	Students who complete this project will gain qualitative research skills including interview skills, information and communication technology skills and instructional resource design involving multimodal and digital resources/tools.
Suitable for	This project is suitable for students who have completed CHEM1100, CHEM1200 and CHEM2060 to provide the foundation in concepts being explored. No education research experience is necessary but the successful candidate will need to feel comfortable in conducting interviews with students.
Supervisor	Prof Gwen Lawrie (primary) Dr Efpraxia Kartsonaki
Contact for further information	Prof Gwen Lawrie: g.lawrie@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Molecular machines: Benchmarking and comparing self-amplifying RNA vaccine platforms**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	The first self-amplifying mRNA vaccine for SARS-CoV-2 has been approved in Japan. The vaccine (ARCT-154) uses mRNA that codes for replicase proteins lifted from the Venezuelan equine encephalitis virus and encodes the Spike glycoprotein of SARS-CoV-2. In this project, you will generate and manipulate versions of the VEEV vaccine backbone construct in vitro to compare other self-replicating RNA vaccines, namely flavivirus self-amplifying platforms, to test the durability and expression of encoded proteins. In this project, you will clone and PCR-amplify constructs from the VEEV and Zika flavivirus replicons for in vitro and, ultimately, in vivo characterisations. Generate RNA using in vitro transcription, do transfections of mammalian cell lines and examine the expression of reporter (GFP and luciferase) encoded in the replicons.
Expected outcomes and deliverables	Scholars will gain skills in molecular biology, such as primer design, PCR, cloning and RNA production. Techniques such as cell culturing, RNA transfections, detection of protein expression, and ELISA will also be gained. The results will be described in publications along with other aspects of the work to which students can share authorship.
Suitable for	A general background in 3rd year genetics, microbiology, virology, immunology or molecular biology is recommended. One position is available.
Supervisor	Dr Rhys Parry (primary) Prof Alexander Khromykh
Contact for further information	Dr Rhys Parry: r.parry@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Development of a Kunjin virus replicon encoding antibody therapeutics for SARS-CoV-2**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	Kunjin virus is a non-pathogenic Australian flavivirus with a positive-strand RNA genome that replicates exclusively in the cell cytoplasm. Replicons are generated by deleting viral structural genes and replacing them with heterologous genes (HG), allowing for self-amplifying RNA (saRNA) delivery and expression of HG. In this project, you will generate Kunjin replicons expressing potent anti-SARS-CoV-2 Spike nanobodies and monoclonal antibodies. After generation and sequence confirmation of these constructs, you will verify their expression in mammalian cells transfected with the resulting saRNAs and verify antigen-binding properties of produced antibodies using ELISA with purified SARS-CoV-2 spike antigens from different variants. If the generation of these saRNAs is of sufficient quantity and quality, they will be tested in vivo in future protective animal studies.
Expected outcomes and deliverables	Scholars will gain skills in molecular biology such as primer design, PCR, cloning and RNA production. Techniques such as cell culturing, RNA transfections, detection of protein expression, and ELISA will also be gained. The results will be described in publications along with other aspects of the work to which students can share authorship.
Suitable for	A general background in 3rd year genetics, microbiology, virology, immunology or molecular biology is recommended. One position is available.
Supervisor	Dr Rhys Parry (primary) Prof Alexander Khromykh
Contact for further information	Dr Rhys Parry: r.parry@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Mosquitoes to mammals: verifying Kunjin virus mutations in the capsid protein identified by deep mutational scanning.**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	Kunjin virus is an Australian strain of West Nile virus (WNV) transmitted by mosquitoes and can cause encephalitis in horses. Previous work in the RNA Virology laboratory using deep mutational scanning (DMS) has identified mutations in the 5’ UTR, showing different tolerances to mutations in the 5’ end for mammalian or insect cells. This project aims to analyse the role of identified amino acids in the Kunjin virus capsid gene in modulating the insect-only and mammalian-only phenotype.
Expected outcomes and deliverables	Scholars will gain skills in molecular biology, such as primer design, PCR, cloning and mutagenesis. Techniques such as cell culturing and analysis of Sanger sequencing will also be gained. The virus isolates generated will be described in publications along with other aspects of the work to which students can share authorship.
Suitable for	The project is open to Science or Biotechnology students interested in virology. A general background in 3rd year genetics, microbiology, virology, immunology or molecular biology is recommended. One position is available.
Supervisor	Dr Rhys Parry (primary) Prof Alexander Khromykh
Contact for further information	Dr Rhys Parry: r.parry@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**The use of ancestral sequence reconstruction on dengue virus structural proteins**
Project duration	6 weeks
Hours of engagement	25 hours per week
Location	St Lucia campus
Project description	Dengue virus (DENV) is endemic in over 100 countries with 40% of the world's population at risk. A major obstacle to producing an effective DENV vaccine is generating a robust protective-antibody response against all DENV serotypes. A novel method to address this is to create new antigens using ancestral sequence reconstruction (ASR). ASR is a computational technique where extant sequences of proteins are analysed to infer putative ancestral sequences. This project aims to understand the potential for ASR across the main structural proteins of dengue virus - the pre-membrane and envelope protein.
Expected outcomes and deliverables	Student will gain skills in molecular biology such as primer design, PCR, protein analysis, virus purification, ELISA. Cell culture will also be a major component. There is potential for this work to be described in publications in which students can share authorship.
Suitable for	The project is open to Science or Biotechnology students interested in virology. Background in 3rd year microbiology, molecular biology, virology, structural biology or genetics is recommended. One position is available.
Supervisor	Dr Natalee Newton (primary)
Contact for further information	Dr Natalee Newton: natalee.newton@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Investigating the structural proteins of divergent dengue strains**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Dengue virus is endemic in over 100 countries worldwide with 40% of the world's population at risk of infection. Sylvatic dengue transmission is between viraemic non-human primates and mosquitoes in natural forest habitats. These strains of dengue are genetically distant from urban strains and continue to emerge. Previous work in my lab has identified mutations in the structural proteins of sylvatic dengue strains passaged in human cell lines. This project aims to analyse the role of these mutations in modulating antigenicity and host-interactions.
Expected outcomes and deliverables	Student will gain skills in molecular biology such as primer design, PCR, protein analysis, virus purification, ELISA. Cell culture will also be a major component. There is potential for this work to be described in publications in which the student can share authorship.
Suitable for	The project is open to Science or Biotechnology students interested in virology. Background in 3rd year microbiology, molecular biology, virology, structural biology or genetics is recommended. One position is available.
Supervisor	Dr Natalee Newton (primary)
Contact for further information	Dr Natalee Newton: natalee.newton@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**An Investigation of hetero Triplet-Triplet-Annihilation (TTA) using Time Resolved Spectroscopy**
Project duration	6 weeks
Hours of engagement	A minimum of three (3) days, up to a maximum of five (5) days per week, full time (20 - 36 hours per week)
Location	St Lucia campus
Project description	Photon upconversion based on Triplet-Triplet Annihilation is an attractive method for the generation of a single high energy photon from two lower energy photons. To date, most TTA studies rely on an initial triplet-triplet energy transfer (TTET) step between a sensitizer/annihilator pair, typically using a phosphorescent inorganic metal complex as the triplet donor and a highly fluorescent organic molecule as an acceptor. In that case, low energy photons can be used to efficiently excite the sample, and subsequent annihilation between two low energy triplet excited state organic molecules can result in the emission of a higher energy photon. Interestingly, a recent literature report (see J. Phys. Chem. Lett. 2013, 4, 2334) has suggested improvements in the overall upconversion efficiency can be achieved when two (or more) chemically different annihilator molecules are used, due to so called hetero-TTA (annihilation between chemically different organic molecules). This project seeks to initially confirm if the synergistic effects of a multi-acceptor approach in TTA are present, and if so, to understand the reasons behind the observed enhancement in upconversion using time resolved spectroscopic methods, namely time resolved photoluminescence and transient absorption spectroscopy.
Expected outcomes and deliverables	Students will gain a detailed understanding of basic photophysical processes, including energy transfer and photoluminescence, which occur after absorption of light. Further experience in the wet chemical methods (volumetric solution preparation) and their subsequent photophysical analysis will be obtained. Moreover, an introduction to time resolved (ultrafast) spectroscopic methods, including time resolved luminescence and transient absorption spectroscopy will be obtained, including kinetic analysis and modelling. As part of this project, students will be expected to collate all data and write a detailed experimental report. It is envisioned that, if the project is successful, this report will form the basis of a research publication.
Suitable for	This project is suitable for students with a strong background in inorganic and physical chemistry, and who have preferably completed (or are about to complete) their third year undergraduate studies (eg CHEM3010/ CHEM3011/CHEM3030). Excellent experimental/laboratory skills and attention to detail will be highly beneficial.
Supervisor	A/Prof Evan Moore (primary)
Contact for further information	A/Prof Evan Moore: egmoore@uq.edu.au
Additional information	This project involves the use of a high energy (Class IV) laser system. Students may be required to undertake an eye exam prior to commencement.
School	School of Chemistry and Molecular Biosciences

Project title	**Synthetic organic electrochemistry under mass transfer control**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Synthetic organic electrochemistry is gaining importance as a safe and sustainable technology to prepare organic molecules. Electro-organic reactions use electrical current instead of chemical reagents to promote chemical change, thus reducing the cost and generation of waste during the manufacturing of pharmaceuticals. This project will study how the reactivity of organic molecules in an electrochemical cell can be modulated by tuning the mass transfer properties of the setup.
Expected outcomes and deliverables	The student will learn how to carry out synthetic electrochemical reactions and as well as general synthetic organic chemistry, including monitoring of reaction mixtures and purification and characterisation of organic molecules.
Suitable for	This project is open to motivated students with a strong background in chemistry.
Supervisor	Dr David Cantillo (primary)
Contact for further information	Dr David Cantillo: d.cantillo@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Novel Chemistry Using Stable Cytochrome P450 Enzymes**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Enzymes can catalyse many desirable functionalization reactions with a high degree of selectivity and under milder conditions than often required for chemocatalysis. The exquisitely chiral three dimensional shape of the active site of an enzyme serves to constrain the chemistry in ways not possible with small molecule catalysts. A case in point are the cytochrome P450 enzymes, such as the highly substrate-promiscuous forms involved in human drug metabolism. Using a reducing cofactor (NADPH), molecular oxygen, and a haem prosthetic group, these enzymes can perform more than 60 different chemical reactions on often very chemically complex molecules of diverse structure and functionality. While most reactions can be described overall as monooxygenations, this basic chemistry achieves many different outcomes including aromatic and aliphatic hydroxylations, epoxide formation, heteroatom oxidation, C-C bond formation and ring formation, expansion, contraction and cleavage. However P450s are not only limited to oxidative chemistry. Building on earlier studies using porphyro-mimetic models and exotic P450 reactions, the ground-breaking work of 2018 Nobel prizewinner, Frances Arnold, has greatly extended the working range of P450s. Her group has demonstrated that P450s can also be engineered to catalyse non-natural chemistry including, carbene and nitrene transfer reactions, fluoroalkylation, nitration, C-C bond formation, cyclopropanation, aziridination, intra- and intermolecular C-H amidation, aminohydroxylation of styrenyl olefins, anti-Markovnikov alkene oxidation sulfimidation, insertion of B or Si at carbon centres, and formation of highly strained cyclobutene rings. Importantly, as genetically encoded protein catalysts, the efficiency of these engineered P450s towards desired reactions can be improved by directed evolution approaches. In spite of this demonstrated catalytic versatility, P450s are yet to be widely exploited for industrial biocatalysis, due to the instability of most natural enzymes under process conditions, and their typically poor turnover rates. Instability also limits the engineering and directed evolution of P450s for novel chemistry. Since engineering usually destabilizes the protein to some degree, a higher degree of inherent stability is beneficial. CYP102A1 (P450BM3), the model enzyme for most of this work, is only marginally stable, leading the Arnold group to explore alternative non-P450 haemoproteins such as cytochrome c and globins from thermophiles. Moreover none of these proteins is naturally equipped to bind complex drug-like molecules; CYP102A1 is a fatty acid hydroxylase whereas the other haemoproteins are not natively enzymes. However, in prior work supported in large part by AstraZeneca, we have produced highly stable versions of the promiscuous drug-metabolizing P450s and their redox partners and shown they can withstand extended incubations under elevated temperatures. The overall aim of this proposal is to explore the use of thermostable P450 enzymes for the chemo-, regio- and stereoselective derivatization of complex

	molecules for metabolite generation and late-stage functionalization. In particular, we will explore the novel chemistry made feasible by the work of Frances Arnold on enzymes that have evolved to bind complex natural products. The. The P450 and 'P411' mutant enzymes previously constructed in the lab will be tested against substrates of interest to AstraZeneca. This work will leverage the AstraZeneca chemical collections to extend and catalogue the capabilities of the collection of over 38 thermostable P450s from the CYP1, CYP2, CYP3 and CYP4 families developed at UQ over the last few years.
Expected outcomes and deliverables	Students will acquire skills in molecular cloning, bacterial expression and characterisation of enzymes using specialised spectrophotometric methods, high-performance liquid chromatography and gas chromatography. They will also acquire skills in bioinformatics, especially analysing evolutionary relationships between proteins and in sequence curation, alignment and interpretation.
Suitable for	Postgraduate students with a strong chemistry background
Supervisor	Prof Elizabeth Gillam (primary)
Contact for further information	Prof Elizabeth Gillam: e.gillam@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Computer Modelling of Chemistry**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	This project will use computer simulations to study how molecules react. It will explore hidden factors that control chemical behaviour, visualising molecules and their reactions in atomic-level detail. A wide range of project topics are available, studying different areas of chemistry: e.g. catalysts that degrade plastics, or drug candidates that bind to biological molecules, or reactions used for the synthesis of valuable organic molecules.
Expected outcomes and deliverables	Scholars will gain skills in molecular modelling and in understanding reaction mechanisms. Scholars may learn about the activities of the broader research group (e.g. by participating in group meetings and activities) and will be asked to produce a short written and/or oral report at the end of their project.
Suitable for	This project is open to applications from UQ enrolled students majoring in Chemistry who have taken at least one of CHEM2050/2901, CHEM2060/2902, and/or CHEM3011 (or equivalent).
Supervisor	Prof Elizabeth Krenske (primary)
Contact for further information	Prof Elizabeth Krenske: e.krenske@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Supercharged Vaccines: Building the Ultimate Nano-Warriors!**
Project duration	6 weeks
Hours of engagement	Monday - Friday, 30 - 36 hours per week
Location	St Lucia campus
Project description	Project Overview: Imagine being part of the next big thing in vaccines! Vaccination has been a superhero in public health, saving lives worldwide. But now, we are levelling up with next-generation vaccines that use tiny pieces of pathogens, called peptides, instead of the whole thing. This gives us super precision in designing vaccines that are both powerful and safe. This Summer: Dive into the exciting world of vaccine development and help us synthesise a new multi-tool for fighting against group A Streptococcus infection. We are crafting a cutting-edge nanoparticle system that is not just a vaccine - it is the whole package, with both the fighter (antigen) and the booster (adjuvant) in one awesome molecular structure! Project Mission: Gear up to chemically synthesise a superhero-level peptide vaccine that carries the battle-ready group A Streptococcus antigen. Your creation has been designed to outsmart and outfight the toughest pathogens out there!
Expected outcomes and deliverables	What You will gain: Dive into the fascinating world of peptide chemistry! You will gain skills in peptide synthesis, purification, and characterisation. But that's not all - your work on this project could lead to contributions in future publications, making a real impact on the scientific community! Translational Skills: Beyond the lab, you will sharpen skills like oral and written communication, time management, and organisation. These are the tools that will not only boost your academic journey but also prepare you for a successful career ahead!
Suitable for	This project is ideal for students with a foundation in chemistry, particularly those in their 3rd or 4th year who are excited about the possibility of continuing into postgraduate studies.
Supervisor	Dr Rachel Stephenson (primary)
Contact for further information	Dr Rachel Stephenson: r.stephenson@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**The aggregation properties of the antifungal drug Amphotericin B (dry lab, computational chemistry project)**
Project duration	6 weeks
Hours of engagement	Approx. 30 hours per week (4 days per week)
Location	St Lucia campus
Project description	Background: Invasive fungal infections are difficult to treat, and many current drugs are toxic to human cells. This project studies the aggregation properties of Amphotericin B (AmB), a potent but toxic antifungal drug, and new variant of AmB to understand how aggregation relates to the drug's mechanism of action. Aim: To analyse existing computer simulations to compare aggregation properties of conventional AmB and AmB variants. Approach: In our lab, we use molecular dynamics simulations, a computational approach to studying chemical and biological systems. see https://vimeo.com/588776538 on a quick explanation on what molecular dynamics simulations are.
Expected outcomes and deliverables	In this project you will: • Learn the basic principle of molecular dynamics simulations. • Develop or improve your computational and programming skills. • Learn how to keep lab notes and design, carry-out and analyse your own experiments to a standard required for scientific publications. • Work in a research group and contribute to active research projects. • Gain knowledge in biophysical chemistry and rational drug design.
Suitable for	Suitable for undergraduates in their 3rd or 4th year or Masters students, with an interest in computational chemistry, biophysics or physical chemistry. Background in chemistry or biophysics is preferred. Basic background in scripting is preferred. Students need to be curious, highly motivated and interested in learning something new.
Supervisor	Dr Evelyne Deplazes (primary)
Contact for further information	Dr Evelyne Deplazes: e.deplazes@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**How do antimicrobial peptides cause membrane leakage?**
Project duration	6 weeks
Hours of engagement	Approx. 30 hours per week (4 days per week)
Location	St Lucia campus
Project description	Background: Antimicrobial peptides (AMPs) can kill bacterial and fungal cells through a complex, membrane-mediate mechanism that is less susceptible to resistance than conventional antimicrobial drugs. Unfortunately, AMPs also damage red blood cells (haemolysis), which makes them not suitable to treat systemic infections. This project uses lipid extracts from cells to develop membrane models that more accurately mimic the haemolytic activity of AMPs and help identify what properties give a peptide potent antibiotic activity yet would be safe to use in humans. Aim: To use biophysical chemistry experiments to compare the properties of lipid vesicles made from synthetic lipids to vesicles made from fungal, bacterial or red blood cell extracts. Approach: In our lab, we use a range of biophysical techniques such as UV-vis and fluorescence spectroscopy, dynamic light scattering or zeta potential measurements to characterise properties of biological membranes and their interactions with peptides and small molecules.
Expected outcomes and deliverables	In this project you will: • Learn biophysical techniques that are usually not taught in undergraduate sciences degrees. • Learn how to keep lab notes and design, carry-out and analyse your own experiments to a standard required for scientific publications. • Work in a research group and carry out experiments that form part of a larger project. • Gain knowledge in membrane biophysics, structural biology, and peptide-based drug design.
Suitable for	Suitable for undergraduates in their 3rd or 4th year or Masters students, with an interest in biophysical chemistry, peptides and structural biology. Background in chemistry or biochemistry is preferred. Students need to be curious, highly motivated and interested in learning something new.
Supervisor	Dr Evelyne Deplazes (primary)
Contact for further information	Dr Evelyne Deplazes: e.deplazes@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Structural studies of proteins involved in infection and immunity**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	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, 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.
Expected outcomes and deliverables	Scholars will gain skills in various lab techniques mentioned above and have an opportunity to contribute to publications from their research. Students may also be asked to produce a report or oral presentation at the end of their project.
Suitable for	Students with background in biochemistry, biophysics and other relevant areas are most suitable. We are looking for motivated students with interest in research in the areas the lab works in.
Supervisor	Prof Bostjan Kobe (primary)
Contact for further information	Prof Bostjan Kobe: b.kobe@uq.edu.au
Additional information	Please contact the supervisor before submitting an application at b.kobe@uq.edu.au.
School	School of Chemistry and Molecular Biosciences

Project title	**Genetic and epigenetic mechanisms controlling plant growth and development**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Student(s) will learn and use lab-based molecular biology and plant genetics techniques to explore genetic and epigenetic mechanisms of gene regulation in the model plant Arabidopsis thaliana or some of the tropical tree crops (mango, avocado).
Expected outcomes and deliverables	Molecular genetics and functional genomics lab research experience, bioinformatics analyses of sequencing data experience
Suitable for	Second, third or fourth year students in the Genetics, Molecular Biology, Plant Biology or Bioinformatics majors
Supervisor	Dr Miloš Tanurdžić (primary)
Contact for further information	Dr Miloš Tanurdžić: m.tanurdzic@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Simulation of systems out of equilibrium**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	St Lucia campus
Project description	When a system changes with time or if there is a flux (heat flux, momentum flux or mass flux) the system will be out of equilibrium. This is important in many systems such as one where there is fluid flow, mixing or current flow in a battery. We are interested in simulating these systems computationally and developing theories to explain their behaviour. In this project the student will simulate a system and have the opportunity to develop computer code to interpret the results.
Expected outcomes and deliverables	This project is open to motivated students with a strong background in physics or chemistry and mathematics or computing, and an interest in computational science and research.
Suitable for	The applicant will learn about modelling nonequilibrium systems at the molecular level. They will use computer programs to simulate trajectories and develop code to analyse their results. At the end of the project the student will summarise their findings in a report and present the results to our group.
Supervisor	Prof Debra Bernhardt (primary) Ms Tanika Duivenvoorden
Contact for further information	Prof Debra Bernhardt: d.bernhardt@uq.edu.au
School	School of Chemistry and Molecular Biosciences

Project title	**Molecular structure with flow – a computer study**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	St Lucia campus
Project description	When molecules flow, they can change their conformation and their relative orientation. This can result in different reactivity, assembly and other behaviour. In this project computer simulations will be carried out to visualise molecules under flow.
Expected outcomes and deliverables	The applicant will learn about modelling systems at the molecular level, and how flow can affect physical and chemical properties. They will collect, analyse and visualise their data. They will have the opportunity to propose ways of improving physical or chemical reactions. At the end of the project the student will summarise their findings in a report and present the results to our group.
Suitable for	This project is open to motivated students with a strong background in chemistry, physics or maths and an interest in computational science.
Supervisor	Prof Debra Bernhardt (primary) Dr Stephen Sanderson
Contact for further information	Prof Debra Bernhardt: d.bernhardt@uq.edu.au
School	School of Chemistry and Molecular Biosciences

School of the Environment

Project title	**Understanding the persistence of antibiotic resistance bacteria in microbial communities**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Our ability to tackle antibiotic resistance is limited by an imprecise understanding of the fitness costs of resistance mutations. The widespread coexistence of resistant and sensitive bacteria in the absence of antibiotics, in spite of fitness costs, presents a frustrating paradox. The goal of this project is to investigate fitness costs associated with antibiotic resistance under different patterns of resource availability (e.g. feast vs famine) and to potentially test hypotheses via competition experiments in the wet lab.
Expected outcomes and deliverables	Students will gain experience in a range of microbiological techniques as well as broad insight into novel applications of ecological and evolutionary theory in microbial systems. The data derived from the project will contribute to an ongoing PhD project in the group.
Suitable for	This project is suitable for students with a background in microbiology, genetics or ecology looking for a project with a wet lab focus. Basic wet lab skills (pouring plates, colony counting, DNA extraction, growth assays etc.) are advantageous but can also be picked up very quickly by motivated students. Some knowledge or willingness to learn R also helpful.
Supervisor	Dr Andrew Letten (primary)
Contact for further information	Dr Andrew Letten: a.letten@uq.edu.au
School	School of the Environment

Project title	**AI-Enhanced Circular Bioeconomy: Optimizing Resource Use and Waste Management**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	The increasing global emphasis on sustainability and climate action necessitates innovative approaches to resource management and waste reduction. The bioeconomy, which involves the use of renewable biological resources to produce energy, food, and other materials, plays a crucial role in achieving a circular economy. The integration of AI in bioeconomy practices can significantly enhance the efficiency of resource use and waste management, contributing to both economic growth and environmental sustainability. This project is motivated by the strategic priorities outlined in Queensland's Biofutures Roadmap and Action Plan and Germany's National Bioeconomy Strategy, which emphasize the need for advanced technologies and innovative solutions to foster a sustainable bioeconomy. Dr. Anthony Halog's expertise in life cycle assessment, sustainable systems engineering, and circular economy provides a strong foundation for this project. <u>Objectives</u>: 1. To explore the application of AI technologies in optimizing resource use and minimizing waste in the bioeconomy sector. 2. To assess the potential environmental and economic impacts of AI-enhanced bioeconomy practices. 3. To develop a conceptual framework for integrating AI into bioeconomy supply chains for improved sustainability. <u>Research Questions</u>: 1. How can AI be applied to optimize resource use in bioeconomy processes? 2. What are the potential benefits and challenges of implementing AI in bioeconomic practices for waste management? 3. How can AI-driven solutions contribute to achieving the goals of a circular economy in the context of the bioeconomy? <u>Methodology</u>: 1. Literature Review: Conduct a comprehensive review of existing literature on AI applications in bioeconomy and circular economy. This will include analysing case studies, research papers, and industry reports to identify best practices and technological innovations. 2. Data Analysis: Utilize available datasets on bioeconomic activities, waste management, and AI applications to model scenarios of resource optimization. Data from Queensland's biofutures initiatives and Germany's

	bioeconomy strategy will be particularly relevant (biofutures-roadmap-and-…) (31617_Nationale_Biooeko…). 3. Stakeholder Interviews: Engage with industry experts, policymakers, and academic researchers to gather insights into current challenges and opportunities in integrating AI into bioeconomy practices. 4. Framework Development: Based on the insights gained from the literature review, data analysis, and interviews, develop a conceptual framework for implementing AI-enhanced bioeconomy processes. Timeline: Week 1: Project kick-off, literature review initiation, and initial data collection. Week 2: Continuation of literature review and stakeholder identification for interviews. Week 3: Conduct interviews and gather qualitative data. Week 4: Analyse quantitative data and begin drafting the conceptual framework. Week 5: Develop the AI-enhanced bioeconomy framework and validate it with stakeholders. Week 6: Finalize the project report, prepare a presentation, and outline future research directions. Expected Outcomes: 1. A comprehensive report detailing the role of AI in optimizing resource use and waste management within the bioeconomy. 2. A conceptual framework for integrating AI into bioeconomic supply chains to promote circular economy practices. 3. Recommendations for policymakers and industry stakeholders on implementing AI-driven solutions for a sustainable bioeconomy.
Expected outcomes and deliverables	Overall, students will gain: 1. Technical skills in AI and data analysis. 2. Research skills in sustainability and the circular bioeconomy. 3. Soft skills in communication, teamwork, and project management. 4. Insights into sustainable development, preparing them for future careers in academia, industry, or public policy related to sustainability, bioeconomy, and environmental management.
Suitable for	To successfully complete this research project, students should possess the following qualities, knowledge, and experience: 1. Background in Relevant Fields: • Chemistry, Chemical Engineering, or Environmental Science: Understanding of bioeconomy processes, chemical reactions, and environmental impact assessment will be beneficial. • Computer Science, Data Science, or Engineering: Knowledge of AI technologies, data analysis, and programming skills (e.g., Python, R) are crucial for developing AI models and analysing data.

	• Sustainability Studies or Industrial Ecology: Familiarity with concepts of sustainability, circular economy, and life cycle assessment will help contextualize the project's goals. 2. Academic Level: • The project is ideally suited for 3rd or 4th-year undergraduate students or graduate students (master's level) who have completed foundational courses in their respective disciplines and have some experience in conducting research. 3. Technical Skills: • Data Analysis and Modelling: Proficiency in using data analysis tools and statistical software to interpret complex datasets. Experience with machine learning or AI frameworks (such as TensorFlow, Keras, or Scikit-Learn) is a plus. • Research and Literature Review: Ability to conduct comprehensive literature reviews, synthesize information from various sources, and identify gaps in existing research. • Programming Skills: Familiarity with coding languages commonly used in AI and data science (e.g., Python, R, MATLAB) is necessary for developing and testing AI models. 4. Soft Skills: • Critical Thinking and Problem-Solving: Capability to think analytically and creatively to propose innovative solutions for optimizing resource use and waste management. • Communication Skills: Proficiency in written and verbal communication to effectively present research findings and collaborate with interdisciplinary teams. • Teamwork and Collaboration: Willingness to work in a team setting, engaging with stakeholders, researchers, and industry experts. 5. Motivation and Interest: • Passion for Sustainability: A genuine interest in promoting sustainability, environmental conservation, and the circular economy. • Enthusiasm for AI and Technological Innovation: Curiosity and eagerness to explore how emerging technologies like AI can drive sustainable practices.
Supervisor	Dr Anthony Halog (primary)
Contact for further information	Dr Anthony Halog: a.halog@uq.edu.au
School	School of the Environment

Project title	**Global plagioclase geochemistry to assess fertility of porphyry copper deposits vs explosive volcanism**
Project duration	6 weeks
Hours of engagement	Approx. 35 hours per week (7 hours per day, 5 days per week). Schedule is flexible and will be discussed with supervisor and team.
Location	St Lucia campus
Project description	This project will produce a compilation of geochemical analyses on plagioclase by combining and curating data from global databases and the literature. Together with A/Prof Teresa Ubide and her team, the student will then assess global trends in volcanic vs plutonic plagioclase, as well as in plagioclase from explosive vs effusive volcanism, and plagioclase from mineralised and barren intrusions. The work will make it possible to explore magmatic processes leading to volcanism and mineralisation in critical metals in arc systems, in perfect alignment with Ubide's ARC Future Fellowship program of research.
Expected outcomes and deliverables	Critical thinking, organisational skills, coding in R/Python, data treatment and interpretation in the context of arc volcanism, volcanic eruptions and critical metals for the energy transition (porphyry copper mineralisation)
Suitable for	This project is open to applications from students with a background in Earth Science, including mineralogy, petrology and geochemistry. 3rd and 4th year students only.
Supervisor	A/Prof Teresa Ubide (primary)
Contact for further information	A/Prof Teresa Ubide: t.ubide@uq.edu.au
School	School of the Environment

Project title	**Digitalisation-Enabled Circular Bioeconomy for Global Transformation**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	This 6-week project, titled "Digitalisation-Enabled Circular Bioeconomy for Global Transformation," is designed to explore the intersection of advanced digital technologies and circular bioeconomy principles, particularly within agricultural value chains. The project aims to develop a comprehensive framework that integrates digital tools like AI, IoT, and blockchain to enhance sustainability, optimize resource use, and reduce waste in bioeconomic practices. Program Background: The project is set against the backdrop of global efforts to transition to a more sustainable, circular bioeconomy. With a particular focus on the agricultural sector, the research seeks to address pressing environmental challenges by leveraging digital innovations. Aim: The primary aim is to create a digitalisation framework that can be applied to circular bioeconomy practices, with the goal of improving environmental sustainability and resource efficiency in agricultural systems. Hypothesis/Approach: The hypothesis driving this research is that the integration of digital technologies into bioeconomic practices will lead to more sustainable and efficient agricultural value chains. The approach includes conducting case studies, engaging stakeholders, and developing policy recommendations that support the adoption of these technologies. Throughout the 6 weeks, participants will engage in a detailed literature review, develop a conceptual framework, conduct case studies, and draft policy briefs, culminating in a comprehensive understanding of the potential for digital technologies to transform the bioeconomy
Expected outcomes and deliverables	Learning Outcomes: 1. Integration of Digital Technologies in Circular Bioeconomy: Students will learn about how advanced digital technologies like AI, IoT, and blockchain can be applied to enhance sustainability in agricultural value chains. They will explore the theoretical and practical implications of integrating these technologies into circular bioeconomic practices, providing them with a strong understanding of the intersection between digitalisation and sustainability. 2. Environmental Valuation and Public Acceptance: Through case studies, students will gain experience in valuing the environmental benefits of circular bioeconomy practices and understanding the factors that influence public acceptance of innovative technologies. This will include engaging with stakeholders to assess perceptions and identify barriers to adoption, which is crucial for promoting sustainable practices in real-world contexts. 3. Governance and Policy Development: Students will evaluate existing governance models and develop policy recommendations to support the

	digitalisation of circular bioeconomy initiatives. They will focus on creating regulatory frameworks that encourage innovation while ensuring environmental and social sustainability. Project Deliverables (Expected Outcomes): 1. Systematic Review: Students will be tasked with conducting a systematic review of the literature on the integration of digital technologies into the circular bioeconomy. This review will form the basis of a conceptual framework that will guide the rest of the project. 2. Policy Brief and Recommendations: Students will prepare a policy brief that outlines recommendations for promoting digitalisation in the circular bioeconomy. This will involve evaluating current governance models and proposing regulatory frameworks to support sustainable practices. By the end of the 6-week project, students will have developed a comprehensive understanding of how digital technologies can be leveraged to promote sustainability in agricultural value chains and will have contributed to meaningful policy recommendations that could influence future practices in the circular bioeconomy
Suitable for	Educational Background: 1. The project is open to students who are in their 3rd or 4th year of undergraduate studies or are enrolled in a master's program. 2. Applicants should have completed courses related to sustainable development, environmental science, circular economy, or sustainable business practices. A solid foundation in these areas is essential for understanding the project's scope and contributing effectively. Knowledge in Circular Economy and Sustainable Practices: 1. Students must have a good understanding of circular economy principles, particularly as they apply to agriculture and bioeconomy. This includes familiarity with concepts like resource efficiency, waste reduction, and sustainable agricultural practices. 2. Knowledge of life cycle analysis (LCA) and systems thinking is crucial, as the project will involve assessing the environmental impacts of agricultural practices and proposing sustainable strategies. Research Skills: 1. Applicants should have experience in conducting literature reviews and systematic reviews. This will be important for the initial phases of the project where students will synthesize existing knowledge and identify research gaps. 2. Strong analytical skills are required to develop environmental indicators and to integrate environmental considerations into policy recommendations. Policy Analysis and Development: Experience or coursework in public policy, environmental policy, or related fields will be beneficial. The project involves the development of policy briefs and recommendations, so students should be comfortable with policy analysis and drafting documents that can influence decision-makers.

	Desirable Qualities: 1. Interest in Sustainability and Environmental Governance: 2. A demonstrated passion for sustainability, environmental conservation, and governance is highly desirable. This interest will drive the student's engagement and contribution to the project. Problem-Solving and Critical Thinking: Students who can think critically and approach problems from multiple angles will excel in this project. The ability to develop innovative solutions for sustainable resource management is key. Adaptability and Initiative: 1. Given the interdisciplinary nature of the project, students should be adaptable and open to learning new concepts and methodologies. Taking initiative in exploring new areas of research or proposing novel ideas will be valued. 2. This project is designed for students who are eager to apply their knowledge of sustainable practices and policy analysis to real-world challenges in the agricultural sector. 3. Those with a strong foundation in relevant coursework and a keen interest in circular economy and bioeconomy will find this project particularly rewarding
Supervisor	Dr Anthony Halog (primary)
Contact for further information	Dr Anthony Halog: a.halog@uq.edu.au
School	School of the Environment

Project title	**Circular Economy and Resource Governance: Transition to Circular Agriculture and Bioeconomy in Australia**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	The imperative for transitioning to circular agriculture and bioeconomy has never been more pressing, given the challenges posed by climate change, resource scarcity, and environmental degradation. Australia, with its extensive agricultural sector and significant reliance on phosphate imports for fertilizer production, stands at a crucial juncture where the principles of a circular economy can significantly mitigate environmental impacts while enhancing economic sustainability. The proposed research project is strategically aligned with Australia's national priorities, particularly in sustainable agricultural practices, environmental conservation, and resource management. This research project proposes to explore the transition towards circular agriculture and bioeconomy, specifically focusing on the sustainable utilization of phosphate for fertilizer production in Australia. By employing transdisciplinary, life cycle, and systems engineering approaches, the project aims to develop innovative strategies to optimize resource management, mitigate environmental impacts, and promote sustainable development within the Australian context. The research will contribute to addressing global challenges related to circular economy, climate change, waste treatment, and the rational use of technology and industry, with a specific focus on Australia's unique agricultural and environmental landscape. Key objectives include developing management systems for effluents and resources, creating environmental indicators for the fertilizer industry, managing industrial waste, integrating environmental considerations into decision-making processes, establishing life cycle analysis expertise, and contributing to standardized methods for sustainable development goals tailored to Australia. The project will also focus on enhancing Australia's capacity to innovate in circular agriculture and bioeconomy, ensuring long-term sustainability and resilience in the face of global environmental challenges.
Expected outcomes and deliverables	Learning Outcomes: 1. Understanding Circular Economy in Agriculture: Students will learn about the importance of transitioning to a circular agriculture model, especially in the context of Australia's reliance on phosphate imports for fertilizer production. They will explore how circular economy practices can enhance environmental sustainability and economic resilience in agricultural sectors. 2. Interdisciplinary Approach to Sustainability: The project will expose students to transdisciplinary methods, combining life cycle assessment, systems science, and resource management to address environmental impacts and optimize resource use. This will provide them with practical

	skills in applying these approaches to real-world agricultural and environmental challenges. 3. Policy and Management Strategies: Students will delve into the development of management systems for effluents and resources, creating environmental indicators, and managing industrial waste. They will also learn how to integrate environmental considerations into policy and decision-making processes, focusing on the fertilizer industry and broader agricultural practices. 4. Contribution to Global and National Priorities: By participating in this project, students will contribute to ongoing efforts to address global challenges such as climate change and resource scarcity. They will also help tailor sustainable development goals to the unique needs of Australia's agricultural sector. Project Deliverables (Expected Outcomes): 1. Systematic Review: Students will be expected to conduct a systematic review of existing literature and case studies on circular agriculture and bioeconomy, with a focus on sustainable phosphate utilization in Australia. This review will synthesize current knowledge and identify gaps or opportunities for further research. 2. Policy Brief: Participants will prepare a policy brief that outlines key strategies and recommendations for transitioning to circular agriculture in Australia. This brief will be informed by the systematic review and will aim to influence policy-makers and stakeholders involved in agricultural and environmental governance. 3. Development of Environmental Indicators: Students will work on creating environmental indicators for the fertilizer industry, which can be used to measure and improve sustainability practices within the sector. 4. Integration of Life Cycle Analysis: Throughout the project, students will apply life cycle analysis techniques to assess the environmental impacts of different agricultural practices and propose optimized resource management strategies. By the end of the 6-week project, students will have not only gained theoretical knowledge but also practical skills in research, policy analysis, and sustainable development strategies relevant to circular agriculture and bioeconomy in Australia.
Suitable for	Academic Background: The project is suitable for students who have taken advanced courses in sustainable development, circular economy, or sustainable business practices. This includes 3rd and 4th-year undergraduate students as well as master's students. Transdisciplinary Knowledge: Students should have an understanding of life cycle assessment (LCA), systems thinking, and resource management as these are central to the project's methodology. Experience in integrating environmental indicators into decision-making processes would also be beneficial. Environmental and Agricultural Focus:

	Given the focus on circular agriculture and the bioeconomy in Australia, students with a background in agricultural sciences or environmental conservation will be particularly well-prepared to contribute to this project. Research and Analytical Skills: The project involves developing management systems and establishing standardized methods for sustainable development goals, so students should have research skills and be capable of engaging with complex, multi-faceted problems. Analytical skills to manage and interpret data related to industrial waste management and effluent control are also crucial. Innovation and Problem-Solving Abilities: The project aims to enhance Australia's capacity to innovate in circular agriculture. Therefore, students who demonstrate a capacity for creative problem-solving and innovation in the context of sustainable technologies and waste treatment will be highly valuable. Commitment to Sustainability: Applicants should show a strong commitment to sustainable development and be motivated to contribute to the long-term sustainability and resilience of Australia's agricultural and environmental sectors. This project is open to students who have a robust foundation in the principles of sustainability, circular economy, and environmental governance, and who are ready to apply their knowledge to real-world challenges in Australia's agricultural sector
Supervisor	Dr Anthony Halog (primary)
Contact for further information	Dr Anthony Halog: a.halog@uq.edu.au
School	School of the Environment

Project title	**Advanced methods in determining the age of Earth materials**
Project duration	6 weeks
Hours of engagement	Approx. 30 hours per week
Location	St Lucia campus
Project description	Geochronology, the science of determining the age of minerals or rocks, is at the core of geoscience. Students will work with the state-of-the-art facilities and their data at the School of the Environment, including but not limited to laser ablation, scanning electron microscope, and inductively coupled plasma mass spectrometry. Students will apply data analysis to develop interpretations related to the development of critical minerals systems, plate tectonics, and other topics in geoscience. Please get in touch with the supervisor to learn more about these opportunities.
Expected outcomes and deliverables	Hands-on experience with geo-analytical facilities; data acquisition and interpretation of geological samples; presentation of findings
Suitable for	Undergraduate students who are interested in general topics in Earth, environmental, and marine sciences are encouraged to apply. Candidates who have completed ERTH1000, ERTH1501, GEOS1100, or one or more second-year or third-year ERTH courses would be given priority.
Supervisor	Dr Renjie Zhou (primary)
Contact for further information	Dr Renjie Zhou: renjie.zhou@uq.edu.au
School	School of the Environment

Project title	**Genetics of depression, anxiety or anorexia in worms**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	The project will test hypotheses related to either depression, anxiety or anorexia in the model genetic organism, Caenorhabditis elegans. The project will involve behavioural assay development, genetic testing and neuropharmacology.
Expected outcomes and deliverables	It is notoriously difficult to identify genes that predispose individuals to mental health disorders. Through this project, you will have the opportunity to facilitate the discovery of mental health genes. You will use the simple genetic model organism, C. elegans, to develop improved behavioural assays. These assays will be used to screen mutant worms for mental health conditions which will then be treated using therapeutic drugs developed for humans. How cool is that?
Suitable for	This project is open to students with prior research experience with C. elegans. Students who have completed either BIOL3380 or BIOL3222 will also be considered.
Supervisor	A/Prof Paul Ebert (primary) Dr Emma Barriere
Contact for further information	A/Prof Paul Ebert: p.ebert@uq.edu.au
School	School of the Environment

Project title	**Associative learning in a specialist parasitoid**
Project duration	6 weeks
Hours of engagement	20-30 hours per week
Location	St Lucia campus
Project description	The project will investigate associative learning by *Diadegma semiclausum*, a specialist parasitoid of the diamondback moth (*Plutella xylostella*). It will involve a series of laboratory studies in which naïve parasitoids will be exposed to the volatile compounds produced by different host plants of *P. xylostella*. The behaviour modifying effects of these volatile compounds on *D. semiclausum* behaviour will be evaluated in olfactometer bioassays.
Expected outcomes and deliverables	This research will determine if the model organism (*D. semiclausum*) utilises volatile chemical information produced by the host plants of its host insect (diamondback moth) to improve its foraging. This has implications for our understanding of the chemical ecology of parasitoids and how we might be able to manipulate them in biological control/ integrated pest management programmes.
Suitable for	Final year Ecology and Conservation student
Supervisor	Prof Michael Furlong (primary)
Contact for further information	Prof Michael Furlong: m.furlong@uq.edu.au
School	School of the Environment

School of Mathematics and Physics

Project title	**Equilibrium and non-equilibrium physics of spin-1 Bose systems**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Spin-1 Bose systems consist of bosons with internal spin degrees of freedom. The internal degrees of freedom give rise to a rich variety of different spin phases the system may be in. This project will explore equilibrium and/or non-equilibrium properties of this system using numeric and analytic methods. The student will also have the opportunity to engage with the wider quantum many-body group in journal clubs and weekly seminars.
Expected outcomes and deliverables	Learn numerical and analytic methods for studying many-body quantum problems. Learn about theories on how many-body systems equilibrate. Complete a written report summarising results at the end of the project.
Suitable for	3rd or 4th year students only
Supervisor	Dr Lewis Williamson (primary)
Contact for further information	Dr Lewis Williamson: lewis.williamson@uq.edu.au
School	School of Mathematics and Physics

Project title	**Heuristics for designing sculpted laser beams and light fields**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	You will develop heuristics - rule-of-thumb design methods - for the design of a range of sculpted light fields and laser beams. You will use computational simulation of laser beams to evaluate the performance of the heuristics.
Expected outcomes and deliverables	Students will gain experience in optics and computational physics. You will develop heuristics for sculpted light fields, and evaluate their performance.
Suitable for	Students should have some background in introductory physics and computation, Existing software will be used, but some coding in Matlab will be required.
Supervisor	Dr Timo Nieminen (primary) Dr Alex Stilgoe
Contact for further information	Dr Timo Nieminen: timo@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Probe microscopy for surface characterisation with optical tweezers**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	Optical tweezers-based probe microscopy of surfaces has an already-long history. One aspect that has been little-explored is to measure the change in the trap potential occupied by the particle, including the effect of the surface being probed. In this way, Brownian motion becomes a source of information, rather than a source of uncertainty. This can allow weaker traps to be used, enabling the characterisation of softer surfaces without damage. Deformable surfaces can also be studied. You will: Use computational modelling for a feasibility study of surface characterisation based on measuring the potential confining an optically-trapped particle, as modified by the surface. Model the measurement of deformable surfaces and structures, with free particles and with attached particles Compare the use of 2D-only position measurements of the probe particle vs 3D measurements.
Expected outcomes and deliverables	You will gain experience in computational physics, and concepts and systems such as Brownian motion and optical tweezers. You will use computational simulation to evaluate the use of measurement of optical potential for probe microscopy for surface characterisation, comparing it with other methods.
Suitable for	Students interested in physics and/or biophysics, with experience in computation and coding. Existing software will be used, but some coding in Matlab will be required.
Supervisor	Dr Timo Nieminen (primary)
Contact for further information	Dr Timo Nieminen: timo@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Energy considerations in bacterial locomotion**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	General principles of motion, such as driving and resistive forces, and energy requirements, can be used study the scaling of the motion of organisms with size, fluid properties, etc. Such models can apply across many orders of magnitude of size, etc., from bacteria to macroscopic animals. You will: • Review existing models, including those developed bacterial for motion, and other organisms • Use suitable methods, modified as appropriate, to study the effect of interactions with surfaces (and other bacteria?) on the motion of bacteria such as E. coli
Expected outcomes and deliverables	You will gain experience in multi-disciplinary mathematical modelling and computation, and the application of general principles of scaling. You will suggest models and scaling laws related to energy in bacterial motion. This can include comparing this microscopic case to macroscopic systems such as cargo transport by ships, etc.
Suitable for	Suitable for students with some experience with mathematical modelling, numerical methods, and basic physics
Supervisor	Dr Timo Nieminen (primary)
Contact for further information	Dr Timo Nieminen: timo@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Listening to the quantum world**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Quantum mechanics can be challenging to demonstrate, but with advancements in single photon detection, it is now possible to create accessible and engaging demonstrations. In this project, you will develop ideas for showcasing quantum effects using single photons, single photon detectors, and a speaker. Your goal will be to build a demonstration device using an Arduino and affordable components, and package it using 3D printing for a robust, transportable public display. You will develop and prototype a quantum demonstration device, learn Arduino programming and 3D printing, and gain skills in hardware-software interfacing, and public engagement.
Expected outcomes and deliverables	Students will acquire foundational skills in optics and quantum mechanics through this project, gaining a unique opportunity to develop highly transferable skills applicable across a wide range of fields in both academia and industry. At the end of the project, you will have a portable demonstration that can be used for outreach that focus on quantum physics.
Suitable for	No prior knowledge of Arduino, 3D printing, or optics is needed, as these skills will be learned during the project. General coding knowledge (such as using for loops, if statements, and functions) is required. Beginner-level Python knowledge will be helpful but is not necessary if you have general coding experience.
Supervisor	A/Prof Jacqui Romero (primary) Mr Daniel Dahl
Contact for further information	A/Prof Jacqui Romero: m.romero@uq.edu.au
School	School of Mathematics and Physics

Project title	**Single Shot Quantum Spatial State Tomography**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	This project offers an opportunity to explore quantum mechanics through hands-on work with entangled photons. One of the most common techniques for generating entangled quantum states of photons is Spontaneous Parametric Down Conversion (SPDC), a non-linear process in which a high-power laser is directed onto a special non-linear crystal, causing the laser light to occasionally split into two entangled photons across various optical properties. In this project, you will develop a novel method using a multi-plane light converter to measure the spatial properties (the shape) of single photons produced by SPDC.
Expected outcomes and deliverables	Students will acquire foundational skills in optics and quantum mechanics through this project, gaining a unique opportunity to develop highly transferable skills applicable across a wide range of fields in both academia and industry.
Suitable for	Prior experience with optics or entangled systems is required. General coding knowledge (such as using for loops, if statements, and functions) is required. Beginner-level Python knowledge will be helpful but isn't necessary if you have general coding experience.
Supervisor	Mr Daniel Dahl (primary) Dr Jacqui Romero
Contact for further information	Mr Daniel Dahl: d.king1@uq.edu.au
School	School of Mathematics and Physics

Project title	**Out-of-the-lab deployment of precision on-chip optical sensors,**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Precision Si-chip optical sensors such as acoustic, inertial, and magnetic sensors. These sensors have a host of applications from defence to geological surveying to navigation. However, translating the developments from in-lab proof-of-principle experiments to a deployment environment has proved to be a technical hurdle. Such deployment environments may include underwater, down boreholes or affixed to autonomous aerial vehicles all of which present challenges for sensor compatibility. This project will be working directly with a team of post doctorate and postgraduate researchers on state-of-the-art nanofabricated optomechanical sensors and investigating their performance. Further it will involve all elements of deployment technologies such as designing small footprint vacuum compatible housing and packaging hardware, support electronics miniaturization, and environmental/vehicular noise characterization and mitigation strategies.
Expected outcomes and deliverables	This project will provide students with hands on experience in precision sensing and translational research. It will cover a background on photonic characterization, electronics and hardware design for various applications. Upon successful completion the student shall have the ability to produce a roadmap for full-scale field research.
Suitable for	This project is open to applications from students with a good understanding in physics. Knowledge of optical technology, electronics, CAD design, and/or hardware-based programming will be beneficial. 3rd or 4th year students preferred.
Supervisor	Dr Benjamin Carey (primary) Prof Warwick Bowen
Contact for further information	Dr Benjamin Carey: benjamin.carey@uq.edu.au
School	School of Mathematics and Physics

Project title	**Uncertainty quantification in feature extraction for COVID-19**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	St Lucia campus
Project description	This project will look at methods to identify important variables (features) in a COVID-19 dataset. In particular, we will investigate how practitioner knowledge can be successfully embedded in the analysis and how sure we are that the identified features are important.
Expected outcomes and deliverables	The student will gain understanding of different methods for feature selection and Monte Carlo sampling, write code and potential coauthorship on a research article.
Suitable for	Competency in coding, experience with Bayesian statistics or Monte Carlo methods is desirable but not required.
Supervisor	Dr Matthew Sutton (primary) Dr Meagan Carney
Contact for further information	Dr Matthew Sutton: m.sutton2@uq.edu.au
School	School of Mathematics and Physics

Project title	Quantum optics bootcamp
Project duration	6 weeks
Hours of engagement	20–36 hours per week
Location	St Lucia campus
Project description	This project is to co-develop a set of experiments that students new to quantum optics will undertake to develop conceptual knowledge and lab skills. The project involves designing, building, and documenting the experiments to produce a permanent Introductory Lab Manual for quantum optics labs at UQ.
Expected outcomes and deliverables	Students will gain experience over a range of basic and advanced optical lab skills, scientific writing skills, and an introduction to STEM pedagogy.
Suitable for	Second or third year student. If they have prior experience from a Capstone course or similar that would be helpful, but not strictly necessary.
Supervisor	Prof Andrew White (primary) Dr Markus Rambach
Contact for further information	Prof Andrew White: andrew.white@uq.edu.au
School	School of Mathematics and Physics

Project title	**Optimisation methods for calibrating crop growth model parameters**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Predictive analysis through crop growth models is essential for informed decision-making in agriculture and breeding. These simulations require first performing computationally intensive calibration of crop model parameters, related with environmental uncertainty and genotypic variations, based on observed data. This project aims to compare various optimization methods for solving this challenging optimization problem. If time permits, the successful applicant will also have the opportunity to develop novel optimization algorithms.
Expected outcomes and deliverables	• Develop an understanding of crop growth models. • Develop skills for implementing optimization algorithms for model fitting. • Develop skills in research design, implementation, experimentation, and communication. • A report documenting the work done and the findings.
Suitable for	Essential: knowledge on machine learning, statistics and numerical optimization. Applicants must clearly demonstrate that they have strong background in these subjects. Desirable: knowledge in crop growth models.
Supervisor	Dr Nan Ye (primary) Dr Bangyou Zheng Dr Yayong Li
Contact for further information	Dr Nan Ye: nan.ye@uq.edu.au
School	School of Mathematics and Physics

Project title	**Nonequilibrium superfluid flows**
Project duration	6 weeks
Hours of engagement	35 hours per week
Location	St Lucia campus
Project description	Superfluidity arises when an atomic gas is cooled using laser cooling and evaporative cooling to nanokelvin temperatures. Below a critical velocity they flow without viscosity. The UQ Bose-Einstein condensation laboratory works with these superfluids, and are interested how their nonequilibrium dynamics lead to persistent currents that never decay. 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. A brief introduction to the field can be found here: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5468603/
Expected outcomes and deliverables	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. A successful project will lead to publishing a paper describing the model and its results.
Suitable for	Self-motivated students interested in physics and/or mathematics who are interested in gaining experience in research in theoretical and computational quantum physics.
Supervisor	Prof Matthew Davis (primary) Dr Angela White
Contact for further information	Prof Matthew Davis: mdavis@uq.edu.au
School	School of Mathematics and Physics

Project title	**Dark soliton formation in superfluids from the scattering of sound**
Project duration	6 weeks
Hours of engagement	35 hours per week
Location	St Lucia campus
Project description	One of the key insights of Landau was to derive a phenomenological formula for the critical velocity in a superfluid. In a Bose-Einstein condensate this is connected to the speed of sound. In a one-dimensional superfluid in a ring, an obstacle moving with a speed of less than the critical velocity can pass through the system without viscosity, i.e. it doesn't create any excitations. If this is accelerated above the critical velocity it will then create topological objects known as dark solitons. This project will study a superfluid ring in which there is an obstacle moving at a speed less than the critical velocity. We will simulate the launching of pulses of sound at the obstacle, and characterise how they scatter from the obstacle as a function of amplitude and obstacle velocity. There will be a transition point at which dark solitons will be formed in inelastic scattering events. The goal of the project is to explain this with reference to Landau's theory of superfluidity. This project can be extended to 2D systems where there will be vortex pair formation.
Expected outcomes and deliverables	The student will learn how to apply computational methods to solve the nonlinear Schrodinger equation. A complete set of results with appropriate interpretation could be turned into a publication.
Suitable for	Self-motivated students interested in physics and/or mathematics who are interested in gaining experience in research in theoretical and computational quantum physics.
Supervisor	Prof Matthew Davis (primary) Dr Andrew Groszek
Contact for further information	Prof Matthew Davis: mdavis@uq.edu.au
School	School of Mathematics and Physics

Project title	**Grain harvesting and blending optimisation**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	This project will explore methods to optimise within-field and across-region grain harvest and methods to optimise within-field and post-farm grain blending opportunities. The main tasks will be a survey of literature in these areas followed by prototype implementation of a selected optimisation method. This work supports the ongoing "Analytics for the Australian Grains Industry" (AAGI) project, funded by the Australian Grains Research & Development Corporation (GRDC).
Expected outcomes and deliverables	The project deliverables are a literature report and a prototype optimisation engine, implemented in Python. Students will develop skills in surveying and summarising literature and in implementing optimisation engines.
Suitable for	This project requires students with a strong background in mathematics who have completed MATH3202 or MATH7232. Preference will be given to students who have completed MATH3205, MATH4202 or MATH7202. Good writing and coding skills are also required.
Supervisor	Dr Michael Forbes (primary) Mr Lucas Sippel
Contact for further information	Dr Michael Forbes: m.forbes@uq.edu.au
School	School of Mathematics and Physics

Project title	**Red Pitaya FPGA programming for heterodyne detection data analysis**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	We are seeking students to join our team for a summer project that combines the worlds of FPGA programming and Quantum Computing. This project will involve programming a Red Pitaya board to perform real-time digital signal processing. You'll have the opportunity to work closely with experienced researchers and engineers who will guide you throughout the project. Once the system is verified, we will bench-test and implement it to measure and characterize transmon qubit processors, a critical component in quantum computing research.
Expected outcomes and deliverables	Verifying the standard data processing including ADC capture and storage, Triggered sample and repetition capture, DDC cosine/sine multiplication block, FIR filter block, Data averaging.
Suitable for	• experience with FPGA programming • basic understanding of digital signal processing • some understanding of quantum physics is desirable but not required
Supervisor	A/Prof Arkady Fedorov (primary) Dr Prasanna Pakkiam
Contact for further information	A/Prof Arkady Fedorov: a.fedorov@uq.edu.au
Additional information	Most of the blocks are already implemented. The averaging has to be implemented and the card has to be tested.
School	School of Mathematics and Physics

Project title	**Optical tweezers platform for the study of active matter**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Active matter are systems of particles or objects that extract energy from their environment. Active matter operates from the scale of molecules to entire organisms. At the microscale, lasers can be used to provide a source of both light and heat energy to activate matter. These systems are out-of-equilibrium and are not well understood. They can be studied using optical tweezers. This project will build a flexible optical trapping system to enable studies of active matter.
Expected outcomes and deliverables	The student will have the opportunity to learn about experimental physics and gain practical knowledge of optics and microscopy. At the end of the project the student will have contributed to production of an experimental apparatus that will be used for microscopy and the study of active matter. Their work may lead to publication, and they will be asked to present their work at a UQ optical micromanipulation group meeting.
Suitable for	Interest in physics and optics
Supervisor	Dr Alexander Stilgoe (primary) Prof Halina Rubinsztein-Dunlop
Contact for further information	Dr Alexander Stilgoe: stilgoe@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Lifecycle of emulsion droplets studied with optical tweezers**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Emulsions are an important part of everyday life. They are ubiquitous throughout nature and industry. This project will study the properties of oil-water emulsions from the time of their production to their eventual decomposition using optical tweezers. Optical tweezers provide 3D trapping and control of transparent microscopic objects that have been used throughout physics, chemistry, and biology. In this project, multiple optical traps will be used to control, manipulate, deform, and measure oil micro-emulsions. The measurements will aid understanding of emulsions throughout their lifecycle and give insight into stabilizing processes that have important applications for health, food, and medicine.
Expected outcomes and deliverables	The scholar should gain skills in laboratory work concerning optics and understanding of laser micromanipulation process. The results of the work could lead to publication, giving the scholar opportunity to start a research portfolio. The scholar will be invited to present their work to the other members of the UQ optical micromanipulation group.
Suitable for	Interest in physics, some knowledge of chemistry would be good.
Supervisor	Prof Halina Rubinsztein-Dunlop (primary) Dr Alexander Stilgoe
Contact for further information	Prof Halina Rubinsztein-Dunlop: halina@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Atomistic modelling of novel superconducting materials**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	St Lucia campus; hybrid or remote working is also possible
Project description	The development of new materials for quantum technologies is at the forefront of current research. Density functional theory (DFT) uses quantum mechanics to simulate materials and molecules at the atomic scale 'from first principles', i.e., without relying on empirical data. This project uses DFT, combined with molecular dynamics and machine learning, to investigate the microscopic properties of tantalum-germanium alloy superconductors. The aim is to combine our results with X-ray absorption experiments from SMP collaborators, which will allow us to fully characterise and understand the atomic-scale behaviour of these novel materials, advancing their potential use in quantum technologies.
Expected outcomes and deliverables	The student will gain experience with high-performance computing and widely used materials modelling software and methods, including first-principles methods and machine-learned potentials.
Suitable for	This project is open to students with a background in physics, chemistry or materials engineering. Some knowledge of condensed matter physics and programming is a plus. A keen interest in computational materials physics is essential.
Supervisor	Dr Carla Verdi (primary)
Contact for further information	Dr Carla Verdi: c.verdi@uq.edu.au
Additional information	Interested students are encouraged to contact c.verdi@uq.edu.au for any inquiry or to discuss the project in more detail.
School	School of Mathematics and Physics

Project title	**Supersymmetry breaking in three space-time dimensions**
Project duration	6 weeks
Hours of engagement	25 - 36 hours per week
Location	St Lucia campus
Project description	During the last four decades, supersymmetry has been at the forefront of research in theoretical and mathematical physics of fundamental interactions. It played a crucial role in constructing models aimed at the unification of all forces, including quantum gravity, namely string theory. As such, an active area of research is attempting to reconcile string theory with observed cosmology. Supersymmetry has also led to several new developments in mathematical physics. Supergravity, the supersymmetric extension of Einstein's general relativity, arises as the low-energy limit of string theory. Supersymmetry is expected to be spontaneously broken in nature at a scale not visible to present-day experiments. Despite its importance, supersymmetry breaking in field theory and supergravity still leaves several open questions. This project aims to study toy models for supersymmetry breaking in three space-time dimensions. This will be a pedagogical, though novel, project playing with simpler toy models compared to the four-dimensional case to decipher general supersymmetry breaking mechanisms.
Expected outcomes and deliverables	Students will learn advanced topics in field theory and general relativity. Specifically, they will acquire first-hand knowledge of supersymmetry and supergravity and the use of superspace techniques in their studies. The students will also have opportunities to interact with PhD students and a postdoc who work under the supervision of Dr Gabriele Tartaglino Mazzucchelli. As part of weekly activities in this group and of the mathematical physics group, the students will discuss and present their research with peers, in particular with an end-of-project presentation.
Suitable for	This project is suitable for 3rd or 4th-year students in physics and/or mathematics who have attended the courses at UQ on general relativity and field theory.
Supervisor	Dr Gabriele Tartaglino Mazzucchelli (primary)
Contact for further information	Dr Gabriele Tartaglino Mazzucchelli: g.tartaglino-mazzucchelli@uq.edu.au
School	School of Mathematics and Physics

Project title	**High-resolution imaging of turbulent films**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	The UQ Bose-Einstein lab produces films of superfluid Bose-Einstein condensates where we study superfluid quantum turbulence and its analogy with classical fluid turbulence. The aim of this project is different – to produce classical 2D films (soap films) so that we can easily demonstrate 2D turbulent phenomena in the lab, while also developing an experimental setup suitable for prototyping turbulent behaviour in diverse 2D geometries. The project will involve setting up the soap film apparatus similar to the one found in https://doi.org/10.1016/S0378-4371(98)00008-9 consisting of a vertically propagating 2D film and high-speed laser imaging. For imaging the soap film, we will set up a novel optical system known as Schlieren imaging: https://en.wikipedia.org/wiki/Schlieren_photography. This involves laser illumination and producing video footage of the soap film turbulence.
Expected outcomes and deliverables	Students will gain experimental knowledge and skills, and will gain practical optics lab experience along with some theory fundamentals.
Suitable for	This project is open to physics majors at any level, including first year physics students. The project does not require specialised knowledge but will be best suited to a student inclined towards experimental physics and keen for hands on laboratory experience.
Supervisor	Dr Tyler Neely (primary)
Contact for further information	Dr Tyler Neely: t.neely@uq.edu.au
Additional information	The project will require that laser safety training and other laboratory training is completed prior to commencing the project.
School	School of Mathematics and Physics

Project title	**Design of room temperature single molecule switches**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Switches are the basis of all modern digital electronics. Binary logic is based on turning switches on (1) and off (0). So miniaturising memories and logic circuits requires miniaturising switches. Societies program of miniaturising switches is so advanced that the next frontier is reaching the molecular scale. This requires a detailed understanding of the quantum physics and chemistry of the molecules at play. Traditional quantum chemical approaches are limited to absolute zero. So they do not describe switching at room temperature, where we would like use our switches. This project will apply state-of-the-art quantum theory to model switching in a class of materials known as Prussian blue analogues.
Expected outcomes and deliverables	You will learn advanced quantum mechanics and gain experience of applying quantum field theory and both analytically and computationally to a problem with real world applications.
Suitable for	This would suit a physics student with a strong understanding of quantum mechanics (no previous knowledge of chemistry is required, although chemistry majors are welcome to apply). It will involve learning and apply quantum field theory and both analytical and computational work. 3rd and 4th year students only.
Supervisor	Prof Ben Powell (primary)
Contact for further information	Prof Ben Powell: powell@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Can we design a room temperature, ambient pressure superconductor?**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	A room temperature, ambient pressure superconductor would change the world. We could plant "farms" of solar panels in the outback and losslessly transport the energy generated to capital cities and Asia, dramatically lowering the cost of power generation. But the world record for the highest temperature ambient pressure superconductor hasn't increased in decades. However, new types of materials have recently emerged that can be clicked together like lego. This offers us the chance to design new materials with tailored properties from the ground up. However, doing so is a formidable theoretical challenge that requires understanding the quantum mechanical behaviours of 10^23 electrons simultaneously? In this project you will develop and apply new theoretical techniques to attack this problem.
Expected outcomes and deliverables	You will learn advanced quantum mechanics and how to apply it analytically and computationally.
Suitable for	3rd and 4th year students with a strong background in quantum mechanics.
Supervisor	Prof Ben Powell (primary)
Contact for further information	Prof Ben Powell: powell@physics.uq.edu.au
School	School of Mathematics and Physics

Project title	**Imaging and Manipulating Molecular Nanostructures via Scanning Probe Microscopy**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	Scanning tunnelling microscopy and atomic force microscopy can be used to manipulate and build nanoscale structures atom by atom. In this project, students will use a new low-temperature STM/AFM installed in the SPMQT laboratory to image and manipulate single atoms and molecules. Potential targets include light-emitting molecules as single-photon emitters for quantum computation or improved OLEDs and magnetic materials for data storage. Don't hesitate to contact Peter to see the lab and get some background.
Expected outcomes and deliverables	The student will gain experience with ultrahigh vacuum equipment, scanning probe microscopy, material characterisation techniques, and data analysis.
Suitable for	This project is open to students with a background in physics, chemistry, or engineering. Familiarity with condensed matter physics is a plus. Enthusiasm for experimental work is a must.
Supervisor	Dr Peter Jacobson (primary)
Contact for further information	Dr Peter Jacobson: p.jacobson@uq.edu.au
Additional information	See the group website at: https://spmqt.org/
School	School of Mathematics and Physics

Project title	**A data driven neural network approach for investment strategies in retirement**
Project duration	6 weeks
Hours of engagement	35 hours per week
Location	St Lucia campus
Project description	In the face of economic uncertainty and rising inflation, managing retirement savings and wealth has become a critical challenge in the financial sector. This complexity is particularly evident with the global shift toward Defined Contribution (DC) superannuation plans, which are especially prevalent in Australia. Under DC plans, individuals bear the full investment risk throughout both the accumulation (pre-retirement) and decumulation (post-retirement) phases, encompassing a potential full-life cycle of over 50 years. Australia ranks as the world's fourth-largest holder of pension fund assets, with more than 87% of its $2.77 trillion in superannuation assets invested in DC plans. Consequently, a vast majority of Australian employees and retirees are exposed to considerable financial risks in retirement. The fear of outliving retirement savings often surpasses the fear of death among many pre-retirees. This project aims to develop a robust decumulation strategy for holders of DC pension plans using a novel approach that circumvents traditional dynamic programming. Building on existing research, this project will formulate the DC investment problem as a constrained stochastic optimal control problem. It will then develop and implement a data-driven neural network approach to solve this problem. The objective function of the optimal control problem will involve the weighted expected wealth withdrawn and the expected shortfall (Conditional Value-at-Risk) which targets left-tail risks. In addition, the project will explore the integration of a tontine overlay—an irrevocable investment in a pooled fund with a fixed timeframe. This approach mimics the structure of current lifelong pension products offered by Australian super funds. Tontines are often appreciated for their conceptual simplicity and transparency in the distribution of benefits among participants, as upon the death of an investor, their portfolio is distributed among the surviving members of the fund. If the investor survives, they will earn mortality credits from deceased members, in addition to returns from their own investment portfolio.
Expected outcomes and deliverables	Students participating in this project will: • Learn to develop and implement a novel data driven neural network method using Tensorflow/PyTorch for decumulation strategies. • Contribute to a research paper that will most likely be submitted for publication, gaining experience in academic writing and the publication process within the field of computational finance. • Develop and refine their presentation skills by sharing their research findings within SMP and to a relevant research group.

Suitable for	This project is suitable for Honours and Master-level students who possess a strong background in Python programming, particularly those who are familiar with Tensorflow/PyTorch for developing neural networks. Applicants should be capable of understanding and effectively extending the provided code library, which is complex. A solid foundation in finance is crucial, and familiarity with reading and interpreting research papers in computational finance is essential. This skill will form the basis for understanding and developing the methodologies employed in the project. Candidates should be highly analytical, detail-oriented, and motivated to engage in research that merges advanced computational techniques with practical financial modelling. This project offers an excellent opportunity for students to apply their theoretical knowledge in a meaningful, real-world context. Students enrolled in the Master of Financial Mathematics program are encouraged to apply.
Supervisor	Dr Duy-Minh Dang (primary)
Contact for further information	Dr Duy-Minh Dang: duyminh.dang@uq.edu.au
Additional information	Students must discuss their interest in the project and seek the supervisor's support before applying.
School	School of Mathematics and Physics

Project title	**Out-of-equilibrium dynamics of quantum fluids**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	The project aims to develop theoretical tools to model and understand out-of-equilibrium behaviour of quantum fluids. Such fluids are formed in interacting many-particle systems at ultra-low temperatures and understanding how these complex systems evolve dynamically when driven out of equilibrium remains a grand-challenge of modern quantum physics. The project intends to study the intriguing dynamical properties of quantum fluids formed by ultra-cold atomic gases, in particular, by atomic Bose and Fermi gases in one-dimensional (1D) waveguides. In such 1D waveguides, the effects of quantum and thermal fluctuations are enhanced, compared to their three-dimensional counterparts. As such, theoretical modelling of these systems confronts the challenges of quantum many-body physics heads on. In addition, ultracold atomic systems in 1D can often be described by integrable models of many-body theory, which aid the understanding of their behaviour in terms of exact many particle solutions. Systems of reduced dimensionality are expected to play an increasingly important role in future quantum technologies, with its ever-evolving trend in miniaturisation of electronic devices and precision measurement instruments. The expected outcomes of the project are the knowledge and theoretical tools required to underpin advances in quantum engineering applications, such as the design of quantum heat engines, the control of heat conduction in quantum nanowires, and the fabrication of new energy-efficient materials. Specific sub-projects include: • Development of new hydrodynamic theories of 1D quantum fluids at Euler and Navier-Stokes scales • Collective excitations of 1D Bose gases using the theory of Generalised Hydrodynamics (GHD) • Quantum transport in 1D quantum fluids • Theoretical design and modelling of quantum heat engines with ultra-cold atomic gases
Expected outcomes and deliverables	Apart from the addressing specific aims of the project (depending on the agreed subproject), the students will expand their background in physics, will learn about open research question at the frontier of quantum fluid dynamics, improve their coding skills, learn how to use supercomputing cluster facilities, which are all transferable skills for the modern quantum workforce.
Suitable for	This project is open to applications from students with a background in quantum mechanics, statistical mechanics, and computational physics.
Supervisor	Prof Karen Kheruntsyan (primary)
Contact for further information	Prof Karen Kheruntsyan: karen.kheruntsyan@uq.edu.au
School	School of Mathematics and Physics

Project title	**Vortex flow in bubble geometries**
Project duration	6 weeks
Hours of engagement	30- 36 hours per week
Location	St Lucia campus
Project description	The realisation of Bose-Einstein condensates created in the microgravity environment of the international space station has created an avenue to investigate the flow dynamics of superfluids on this topologically non-trivial geometry. Flow on superfluid shells promises interesting responses to rotation due to the additional restriction on the condensate phase imposed by the closed-curved geometry. This project will employ point vortex models to explore fundamental few-body vortex dynamics on bubble condensates and understand how curvature changes flow dynamics.
Expected outcomes and deliverables	During this research project students will develop their computational modelling and research skills and learn about quantum systems. They will develop an understanding of some new aspects of superfluid flow.
Suitable for	3rd or 4th year students who have taken an undergraduate course in quantum mechanics
Supervisor	Dr Angela White (primary)
Contact for further information	Dr Angela White: a.white5@uq.edu.au
School	School of Mathematics and Physics

Project title	**Superfluid flow through elliptical channels**
Project duration	6 weeks
Hours of engagement	30 - 36 hours per week
Location	St Lucia campus
Project description	Superfluid Bose-Einstein condensates have the ability to flow forever (for the lifetime of an experiment) which has been demonstrated for superfluid flow around a ring. This project will investigate what happens when spherical symmetry is broken and the superfluid flows along an elliptical path. Breaking spherical symmetry breaks the requirement of conservation of angular momentum and we may find regimes where the superflow or direction of vortex rotation may even reverse, as has been found for vortices in weakly interacting anisotropically trapped condensates or immiscible two component condensates flowing around an ellipse. The changing curvature along the elliptical path gives rise to an additional curvature induced potential, resulting in the atoms experiencing an effective double well potential along the ellipse. This project will explore the interplay between miscibility and flow dynamics around an elliptical path.
Expected outcomes and deliverables	During this research project the student will increase their understanding of superfluid systems and develop their computational modelling skills through modelling the flow of a two component condensate around an elliptical waveguide.
Suitable for	Student finishing 3rd or 4th year who has taken an undergraduate quantum mechanics course.
Supervisor	Dr Angela White (primary)
Contact for further information	Dr Angela White: a.white5@uq.edu.au
School	School of Mathematics and Physics

Project title	**Positive and negative pressure Casimir effect**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	This project is to explore modelling the Casimir effect using optical modes to address the open question as to when and if the Casimir effect can produce positive pressure. Plate geometries to be explored are flat, cylindrical, and spherical plates. The project will involve a literature review of previous approaches to this question, both physical and mathematical.
Expected outcomes and deliverables	Students will gain expertise in quantum field theory, modelling optical cavities, and the Casimir effect. For finite-element computation they will be able to take advantage of Bunya, UQ's supercomputer launched in December 2022.
Suitable for	Masters or 4th year students.
Supervisor	Prof Andrew White (primary) Dr Markus Rambach
Contact for further information	Prof Andrew White: andrew.white@uq.edu.au
School	School of Mathematics and Physics

Project title	**Inverse design for nanophotonics**
Project duration	6 weeks
Hours of engagement	20 – 36 hours per week
Location	St Lucia campus
Project description	Inverse-design is a promising technique to design high-efficiency, compact, and easy to fabricate, optical interconnects for neuromorphic computing and quantum photonics. This project will explore producing optical interconnects that efficiently disseminate light in a footprint 50,000 times smaller than current state-of-the-art photonic integrated circuits. It will take advantage of Bunya, UQ's supercomputer Bunya launched in December 2022, as well as the capabilities of CMM's Electron Beam Lithography Facility, the highest resolution, highest bandwidth EBL in Australia.
Expected outcomes and deliverables	Students will gain knowledge of design and production of photonic integrated circuits, as well as their application to fields ranging from neuromorphic computing through to quantum technology. As part of the project they will be expected to complete a circuit design, as well as lab tests of previously fabricated inverse-deign photonic elements. If time allows, they will fabricate and test their own elements and circuits.
Suitable for	Masters or 4th year students.
Supervisor	Prof Andrew White (primary) Dr Markus Rambach
Contact for further information	Prof Andrew White: andrew.white@uq.edu.au
School	School of Mathematics and Physics

Project title	**Empirical Analysis for Nonlinear Functional Data in Agriculture**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	This project will focus on the implementation and comparison of existing algorithms in the context of nonlinear functional data analysis, an essential area of machine learning. Functional data, which are records of observed quantities varying over time or across other coordinate systems, pose challenges that require advanced computational techniques. The project will specifically investigate kernel-based functional data learning methods and artificial neural networks. The goal is to assess the performance of these algorithms on functional data sets related to the grains industry, drawing inspiration from the ongoing "Analytics for the Australian Grains Industry" (AAGI) project, funded by the Australian Grains Research & Development Corporation (GRDC). This research will contribute to understanding how existing algorithms perform in practical applications, particularly in agriculture.
Expected outcomes and deliverables	Participants in this project will gain hands-on experience in implementing and comparing advanced machine learning algorithms for functional data analysis. By focusing on kernel-based methods and artificial neural networks, students will develop practical skills in algorithm implementation and performance evaluation. The expected deliverables include a comparative analysis of these algorithms, with insights into their strengths and limitations in processing functional data from the grains industry. The project will culminate in a final report detailing the findings and potential recommendations for future research.
Suitable for	This project is suitable for master's students with a strong background in machine learning, particularly those with experience in implementing algorithms. Familiarity with functional data analysis and a solid understanding of kernel methods and artificial neural networks are essential. Experience with programming in Python or R, as well as proficiency in handling large datasets, will be advantageous. This project is ideal for students interested in applying machine learning techniques to real-world agricultural data.
Supervisor	Dr Xin Guo (primary)
Contact for further information	Dr Xin Guo: xin.guo@uq.edu.au
School	School of Mathematics and Physics

Project title	**Geometric constraints on knots**
Project duration	6 weeks
Hours of engagement	25 hours per week
Location	St Lucia campus
Project description	Using combinatorial models for knots, we will analyse the effect that certain geometric constraints can have on topological quantities. In particular, we'll be interested in understanding how a discrete version of curvature affects the presence of pathways towards simpler knots. This project will require some degree of computational skills, but no prior topology knowledge is required.
Expected outcomes and deliverables	Expected outcomes include learning concepts from knot theory and low-dimensional topology, as well as from computational and applied topology. Depending on the student's interest, outcomes might include software implementation and/or relations to biology.
Suitable for	(MATH2400 or MATH2401) + (MATH1052 or MATH1072) recommended
Supervisor	Dr Agnese Barbensi (primary) Dr Daniele Celoria
Contact for further information	Dr Agnese Barbensi: a.barbensi@uq.edu.au
School	School of Mathematics and Physics

Project title	**Table and Chair Layout Optimisation**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus
Project description	The project will extend the Table and Chairs app which is used as a teaching example in MATH3202 and for mathematics outreach. The current version of the app can be found at: https://people.smp.uq.edu.au/MichaelBulmer/tablechairs.php Possible extensions include new layouts and allowing an option for two tables to be adjacent. The app, underlying mathematical model and experience with the app will be written up as a paper for INFORMS Transactions on Education.
Expected outcomes and deliverables	The scholar will gain skills in javascript app development, integer programming and paper writing. The deliverables will be an updated app and a paper. There may be an opportunity for a presentation at the end of the project.
Suitable for	This project is open to 3rd and 4th year students in Mathematics. Preferences will be given to those who have completed MATH3202, or are intending to enrol in MATH3202.
Supervisor	Dr Michael Forbes (primary) A/Prof Michael Bulmer
Contact for further information	Dr Michael Forbes: m.forbes@uq.edu.au A/Prof Michael Bulmer: m.bulmer@uq.edu.au
Additional information	Please email Michael Bulmer and Michael Forbes if you would like any further information.
School	School of Mathematics and Physics

Project title	**Mathematics and statistics to improve Koala management**
Project duration	6 weeks
Hours of engagement	20 - 36 hours per week
Location	St Lucia campus
Project description	Koalas are threatened in Queensland, and their status in northern New South Wales is uncertain. It is critical to identify population trends in order to save Koalas from threats. However this is challenging because several data sets on Koalas come from non-traditional sources such as scat (i.e. poop) detection, citizen science spottings, and drone surveys. Methods to combine and analyse this data and data from traditional ecological surveys to accurately estimate koala population trends and distributions need improvement. In this project you will build models and analyse data to aid Koala population management.
Expected outcomes and deliverables	Students will learn how to construct, analyse, and simulate mathematical and/or statistical models to inform population management.
Suitable for	Students should have completed STAT2003 (Mathematical Probability) or MATH3070 (Natural Resource Mathematics) and at least one other 2nd year or higher relevant Mathematics or Statistics course (e.g. from MATH3070, MATH3202, MATH3204, STAT2003, STAT2004/2904, STAT3001/3901, STAT3004, STAT3006, QBIO7002-7005). However, students with a quantitative ecology background, who may have less formal mathematics experience, will also be considered, provided their application details their quantitative skills. Applicants should be interested in ecology or environmental management, but no previous ecological expertise is required.
Supervisor	Dr Matthew Holden (primary)
Contact for further information	Dr Matthew Holden: m.holden1@uq.edu.au
School	School of Mathematics and Physics

Project title	**Elementary Methods in Additive Number Theory**
Project duration	6 weeks
Hours of engagement	24 hours per week
Location	St Lucia campus
Project description	Goldbach's conjecture is the assertion that every even integer greater than 2 can be written as the sum of two prime numbers. Despite enormous efforts, this has still not been proven and remains out of reach. There are plenty of problems of the above form that one can prove using a variety of techniques; some of these are simple yet powerful. In this project, the candidate will work on tangible problems in additive number theory using elementary techniques from analytic number theory.
Expected outcomes and deliverables	Students will learn about analytic number theory, a rich area of mathematics, along with the various theorems and techniques that have been developed over many centuries. They will gain key research skills that will stay with them as well as a suite of strategies for attacking novel problems. Importantly, they will work on an exciting problem within a supportive environment and they will get a taste for the life and work of a research mathematician. A final report will be submitted outlining the student's findings and proposing further work and ideas.
Suitable for	Students with a strong background in mathematics, particularly calculus and linear algebra.
Supervisor	Dr Adrian Dudek (primary)
Contact for further information	Dr Adrian Dudek: a.dudek@uq.edu.au
School	School of Mathematics and Physics

Project title	**Prime Numbers and the Riemann Zeta-function**
Project duration	6 weeks
Hours of engagement	24 hours per week
Location	St Lucia campus
Project description	The Riemann Hypothesis is possibly the most well known unsolved problem in all of mathematics. Incredibly, the more we know about the zeroes of the Riemann zeta-function, the more we know about the set of prime numbers. There are entire books full of unsolved problems on prime numbers; recent advances in studying zeta-function zeroes can be called upon to tackle these. One such problem involves proving the existence of a function h(x) such that the interval (x, x+h(x)) always contains at least one prime. The goal of this area of research is to find slow-growing functions that do the trick; this would ensure the existence of primes in quite small intervals. Much of this research is motivated by Legendre's conjecture: the unproved assertion that there is always a prime number between any two square numbers. In this summer project, the student will directly examine the interplay between the zeroes of the Riemann zeta-function and the occurrence of primes in short intervals. We will attempt to find some new relationships and see if there are any viable paths to improving on the present theorems.
Expected outcomes and deliverables	Students will learn about analytic number theory, a rich area of mathematics, along with the various theorems and techniques that have been developed over many centuries. They will gain key research skills that will stay with them as well as a suite of strategies for attacking novel problems. Importantly, they will work on an exciting problem within a supportive environment and they will get a taste for the life and work of a research mathematician. A final report will be submitted outlining the student's findings and proposing further work and ideas.
Suitable for	Students with a strong background in mathematics, particularly calculus. Experience in Fourier analysis and complex analysis would be useful.
Supervisor	Dr Adrian Dudek (primary)
Contact for further information	Dr Adrian Dudek: a.dudek@uq.edu.au
School	School of Mathematics and Physics

School of Veterinary Science

Project title	**Deep sequencing of beta-tubulin genes to ascertain benzimidazole resistance mechanisms in canine hookworms in Australian dogs**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	Gatton campus, Clinical Studies Centre and adoption facilities
Project description	The project will involve: • Collection of faecal samples from dogs and examination of the faecal samples in the Parasitology Lab at Gatton campus. • Running lab-based drug efficacy tests. • Prepare worm samples for molecular testing. • Data collection and record keeping.
Expected outcomes and deliverables	Students will receive hands on experience in running faecal egg counts to estimate worm burdens in dogs and will learn to run various drug efficacy testing. Students will learn to use GraphPad statistical software.
Suitable for	The project is suitable for students doing BVSc(Hons), BVetTech, agriculture and Biology degrees. The students should be comfortable around dogs and working with faecal samples.
Supervisor	Dr Swaid Abdullah (primary)
Contact for further information	Dr Swaid Abdullah: swaid.abdullah@uq.edu.au
School	School of Veterinary Science

Project title	**Survey of Farmers' perceptions of gastrointestinal parasites and investigation of prevalence, impact, and control of these parasites on sub-tropical dairy cattle**
Project duration	6 weeks
Hours of engagement	30 hours per week
Location	Gatton campus
Project description	The project will involve: • Running a questionnaire survey among Dairy farmers of SouthEast QLD. • The project will involve collection of faecal samples from cattle and examination of the faecal samples in the Parasitology Lab at Gatton campus. • Data collection and record keeping.
Expected outcomes and deliverables	The scholars will gain skills in interacting with the dairy farmers (stakeholders), advertising the survey questionnaire and data collection. Students will receive hands on experience in running faecal egg counts to estimate worm burdens in cattle and will learn to run various drug efficacy testing. Students will learn to use GraphPad statistical software.
Suitable for	The project is suitable for students doing BVSc(Hons), BVetTech, agriculture and biology degrees. The students should be comfortable around cows and working with faecal samples.
Supervisor	Dr Swaid Abdullah (primary)
Contact for further information	Dr Swaid Abdullah: swaid.abdullah@uq.edu.au
School	School of Veterinary Science

Project title	**Developing a Knowledge Graph from Australian Sales, Environmental and Socio-economic Data**
Project duration	6 weeks
Hours of engagement	36 hours per week
Location	St Lucia campus, Gatton campus, and online
Project description	This project aims to collect and clean data from the Australian Pesticides and Veterinary Medicines Authority (APVMA) with environmental and socio-economic data from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES). And then develop a knowledge graph schema that represents the relationships among the entities in these datasets. The knowledge graph will serve as a valuable tool for visualizing relationships, identifying patterns, and supporting decision-making in agribusiness. 1. Collect sales data from APVMA, socio-economic data from ABARES. 2. Define entities (e.g., products, regions, environmental factors, relevant chemicals) and relationships (trends, patterns) for the knowledge graph. 3. Develop a schema that represents these entities and relationships. 4. Build a knowledge graph database and use tools such as Neo4j. 5. Generate the database with cleaned and processed data make and test with samples queries. 6. Visualise the Knowledge graph to explore key relationships and identify patterns. 7. Write the process and findings into a final report. 8. Present the outcome of the project.
Expected outcomes and deliverables	A functional knowledge graph integrating the specified datasets. Documentation of the data collection, pre-processing steps and knowledge graph design. A final report and presentation summarising the key findings.
Suitable for	Understanding of data pre-processing and data integration is required for this project. Familiarity with graph data or willingness to learn.
Supervisor	Dr Noorul Amin (primary)
Contact for further information	Dr Noorul Amin: noorul.amin@uq.edu.au
School	School of Veterinary Science

Project title	**Causes and outcomes of Wildlife admissions to Byron Bay Wildlife Hospital**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	Gatton campus
Project description	Program Background: The Byron Bay Wildlife Hospital is dedicated to the care and rehabilitation of native wildlife, providing essential medical treatment to injured and sick animals. Over the past three years, the hospital has amassed a significant amount of data on the wildlife species admitted, the causes of their admissions, and their treatment outcomes. This data represents a critical resource for understanding local wildlife health trends, the impact of human activity on wildlife, and the effectiveness of treatment protocols. Project Aim: The primary aim of this project is to conduct a comprehensive analysis of three years' worth of wildlife hospital admissions data from Byron Bay Wildlife Hospital. This analysis will focus on identifying the species most commonly admitted, the primary causes of their admissions, and the outcomes of these cases. Additionally, the project aims to uncover any trends over the three-year period, such as seasonal patterns in admissions or shifts in species prevalence.
Expected outcomes and deliverables	1. Data Analysis Skills: Gain hands-on experience with real-world wildlife hospital data, learning how to clean, organize, and analyse large datasets. Applicants will become proficient in using statistical software and tools to extract meaningful insights from complex data. 2. Species and Wildlife Health Knowledge: Deepen your understanding of local wildlife species, their health challenges, and the factors contributing to their injuries or illnesses. This knowledge is valuable for anyone interested in wildlife conservation, veterinary science, or environmental studies. 3. Trend Analysis and Visualization: Learn to identify and interpret trends in the data, such as seasonal patterns or shifts in species prevalence. You will also develop skills in data visualization, creating clear and informative graphs and charts to communicate findings effectively. 4. Research and Reporting: Gain experience in producing a comprehensive research report that summarizes the findings of your analysis. This report can serve as a valuable addition to your academic or professional portfolio. 5. Publication and Presentation Opportunities: Depending on the quality and significance of the findings, there may be opportunities to contribute to publications or present your work at conferences or seminars. This experience can be a significant boost to your academic and professional career.

Suitable for	Academic background • Applicants should have a background in biology, environmental science, veterinary science, wildlife conservation, or a related field. • This project is particularly well-suited for students in their 3rd or 4th year of undergraduate studies. Data analysis experience • Prior experience with data analysis is highly desirable, but not essential. This includes familiarity with statistical software such as R, or SPSS. • Applicants should have a basic understanding of statistical methods and be comfortable interpreting quantitative data. Attention to detail • Strong attention to detail is essential, especially when it comes to data cleaning and organizing. The ability to spot inconsistencies or errors in data is crucial for ensuring accurate analysis.
Supervisor	Dr Kate Dutton-Regester (primary)
Contact for further information	Dr Kate Dutton-Regester: k.duttonregester@uq.edu.au
School	School of Veterinary Science

Project title	**Development of artificial intelligence algorithms to explore veterinary and wildlife database records**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	Gatton campus
Project description	Patient records in veterinary clinics and wildlife hospitals comprise of detailed information on the demographics, medical history, diagnostic procedures, therapies and outcomes of treatment of the animals admitted. Summarizing this veterinary information is a critical task as it allows to condense complex patient information into coherent and concise summaries, providing an overview of the characteristics of condition on a population level and enabling clinicians to make more informed decisions about animal case based on coherent and contextually accurate medical record summaries. However, creating such summaries has traditionally been time-consuming. Artificial intelligence (AI) techniques provide the opportunity to automate the summarization and analysis of veterinary records, to search for patterns in veterinary datasets and thereby gain valuable insights from these large amounts of data. In this project, AI-powered database querying will be used on veterinary and wildlife records to extract key information and identify relevant diagnostic and therapeutic patterns. The student working on this project will develop AI-powered database querying algorithms to answers a range of clinical research questions relating to companion animal and wildlife health.
Expected outcomes and deliverables	The selected student will gain skills in applying AI technology to generate coherent and contextually accurate summaries of veterinary and medical records. The selected scholar will be working with academics and clinicians in this research project and will enhance his clinical research skills, which are directly applicable to the BVSc program. One or two publications will be generated from this research work and the student will be a co-author on these publications.
Suitable for	This project is open to a veterinary science student with experience in the use of artificial intelligence software, skills in web applications and in database management.
Supervisor	Prof Joerg Henning (primary)
Contact for further information	Prof Joerg Henning: j.henning@uq.edu.au
School	School of Veterinary Science

Project title	**Pathological characterisation and immunohistochemical evaluation of dermal changes in horses with insect bite hypersensitivity**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	Gatton campus
Project description	Insect bite hypersensitivity (IBH), also known as Queensland itch or equine summer eczema, is the most common pruritic disease affecting horses and is endemic to Queensland and the Northern territory. Approximately 30% of horses are affected. It is frequently triggered by a reaction to the saliva of Culicoides spp. of biting midges, but it can also result from hypersensitivity to other insect species including stable flies, mosquitos, black flies, horn flies and tabanids. Due to the severe itching and resulting self-inflicted injuries, IBH raises animal welfare concerns. A major objective of this project is to characterize the gross and histopathological changes in the skin of IBH affected horses. This project also aims to identify the difference in immune responses of IBH affected horses using immunohistochemistry (IHC). The student will be involved in sample collection from IBH-affected and controlled horses. The student will have an opportunity to learn animal restraining, biopsy collection, histopathology and IHC sample processing, troubleshooting, result interpretation and its correlation with the clinical manifestation of IBH. This project is part of a bigger project and the candidate will work alongside Dr Stewart's (equine medicine specialist) student who will be working on the clinical aspect of the project including IBH lesion scoring, CBCs and blood smear examination either at the UQVETs Equine Specialist Hospital or on farm visits.
Expected outcomes and deliverables	The successful student will gain skills in horse restraining, biopsy collection and preservation, tissue trimming, histological processing, tissue sectioning and staining. The student will get a hands-on experience with IHC, its troubleshooting and result interpretation. By the end of this project, the student will be able to identify, interpret and correlate the dermal histological and IHC changes with the clinical manifestation of the skin lesions. As the student will work alongside Dr Stewart's student, they will have the opportunity to learn some clinical skills including recruiting patients, client interviews, physical examination, photographing and scoring lesions and performing CBCs. The student will have primary author responsibilities on all presentations and publications, if the students make a significant contribution and continue to be involved, they can be included in the upcoming publications. The student can help prepare a poster and oral and written report on their findings.

Suitable for	Open to 2nd and 3rd-year veterinary students only. Previous horse-handling experience and basic histology knowledge are highly desirable. The use of Microsoft Word and Excel spreadsheet experience would be useful.
Supervisor	Dr Norman Naseem (primary)
Contact for further information	Dr Norman Naseem: m.naseem@uq.edu.au
School	School of Veterinary Science

Project title	**Assessing veterinary students' perceptions of Virtual Reality (VR) Technology employed in medical education.**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	Gatton campus
Project description	VR is a novel tech-based learning modality for medical education. Its uses extend from comprehension of anatomy and physiology to developing better clinical understanding through patient simulations. The Holohuman™ app provides a VR platform; it has been successfully implemented in the faculty of medicine, dentistry, and nursing at the University of Queensland (UQ). This study aims to evaluate the perceptions of UQ veterinary science students on the suitability and implementation of VR technology in the veterinary program. The research project will require the successful 2nd or 3rd year veterinary student to work with the research team to recruit other veterinary students to participate in the research trial. Students perceptions and skill levels will be scientifically tested before and after utilising the Holohuman™ app. Pre and Post surveys and quizzes will be utilised and statistical analysis designed to determine if a significant improvement was made. The surveys will be pilot tested on group of students over the summer research period, then incorporated into semester 1 2025 teaching for further evaluation. Human ethics has been submitted for approval. The summer student will assist a 2025 VETS5017 research elective student. The work will result in an abstract presentation at the AVA conference and a peer reviewed scientific paper. The research support team includes Drs Allison Stewart and Fran Schapter who have already mentored a previous summer student Alyse Wood who built a cardiology learning resource. Alyse used qualitative and quantitative analysis using pre-and post intervention surveys to statistically prove the usefulness of her cardiology resource with the results culminating in a 5017 research project, Bain Fallon Abstract presentation and a manuscript published in a Q1 journal. Drs. Stewart and Schapter also have a grant to build a VR platform with collaboration with Dr. Sobia Zafer from the UQ School of Dentistry who has published on the success of VR to improve student outcomes in the UQ School of Dentistry.
Expected outcomes and deliverables	Scholars may gain skills in Facebook adds to recruit students, anatomy skills from a VR perspective, data entry and statistics. Although a VETS 5017 student will have primary author responsibilities on all presentations and publications, if the students make a significant contribution and continue to be involved, they can be included on the publications. The student can prepare a poster and oral and written report on their findings.
Suitable for	Open to 2nd and 3rd year veterinary students only with an interest in scientific research, data collection and presentation, Excel spreadsheet and graphical skills and a knowledge of VR. Knowledge if the use of Google forms would be useful.
Supervisor	Dr Allison Stewart (primary)
Contact for further information	Dr Allison Stewart: allison.stewart@uq.edu.au
School	School of Veterinary Science

Project title	**Clinical scoring and dermal immunohistochemistry of horses with insect bite hypersensitivity**
Project duration	6 weeks
Hours of engagement	20-36 hours per week
Location	Gatton campus
Project description	The most common skin disorder in horses in Queensland is Insect Bite Hypersensitivity (IBH), and is caused by an allergic response to cullicoides bites resulting in extreme pruritic and secondary self trauma. The aim is to recruit and characterise the lesions in 30 horses with IBH using a validated scoring system. The student will assist with recruitment of cases, initial phone interviewing of clients, ensuring adequate Hendra vaccination, obtaining consent forms and scheduling consults either at the UQVETs Equine Specialist Hospital or arranging farm visits. The student(s) will assist Dr. Stewart with history, photo and videos of animals and scoring the severity of the various lesions. Students will learn techniques of venepuncture, surgical skin preparation and perform skin biopsies. CBCs with blood smears and freezing of serum will occur on samples at the Veterinary Laboratory Service on Gatton campus. The student will gain clinical pathology experience. Data will be entered into an excel spreadsheet. (Another student will assist with the clinical aspect of the project, but will primarily work with pathologist Noman Naseem to perform histopathology and immunohistochemistry on skin biopsy samples. Dr. Stewart's student will also assist Dr. Naseem's student in the lab). The selected horses will continue to be scored throughout the year by a graduate student and eventually be vaccinated with a new immunological vaccine. Summer students will have the opportunity to assist with further aspects of the project throughout the year if they wish.
Expected outcomes and deliverables	Scholars may gain skills in facebook adds to recruit patients, client interviews, physical examination, photographing and scoring lesions, venepuncture, surgical site preparation, performing skin biopsies, performing CBCs, collecting and processing serum, sample labelling, data collection and entry. The student will also be able to assist Dr Naseem's student with preparation of histopathology slides, describing and photographing lesions, and performing immunohistochemistry. Although a graduate student will have primary author responsibilities on all presentations and publications, if the students make a significant contribution and continue to be involved, they can be included on the publications. The student can help prepare a poster and oral and written report on their findings.
Suitable for	Open to 2nd and 3rd year veterinary students only. Previous horse handling experience is highly desirable. Use of google forms and excel spreadsheet experience would be useful.
Supervisor	Dr Allison Stewart (primary)
Contact for further information	Dr Allison Stewart: allison.stewart@uq.edu.au
School	School of Veterinary Science