Federation University

Institute of Innovation, Science and Sustainability

# Bachelor of Science Honours Projects (SZ8)

**&**

## SCCOR3001 - Research Projects

# 2025

## Contact our Supervisors:

Students are encouraged to contact our supervisors to discuss projects, arrange a time to visit their lab and view our facilities.

Simply email the supervisor to arrange a time…..

**Step 1:** ***Find a Project and Supervisor***

**Step 2:** ***Apply for Honours***

**Step 3:** ***Accept your offer***

**Information on how to enrol**

**Institute of Innovation, Science and Sustainability**

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# SCCOR3001 – Research Project Elective

In SCCOR3001, students will undertake a supervised research project involving research of a publishable standard which forms the basis of a final report presented at the end of the unit. A prerequisite for enrolment in this undergraduate unit is successful completion of two years full time equivalent of a Science-based degree.

SCCOR3001 is designed for students enrolled in Science Course to extend individual and independent learning skills. The course will explore current scientific problems in relevant fields of research. As part of the course, students are trained to develop a project with defined objectives, collate, evaluate, critically interpret experimental data using statistical analysis and communicate their results scientifically.

**This Information Booklet contains a listing of Research projects that are suitable for BSc Honours and may be adapted for SCCOR3001 Research Project students in 2025. Note that this is not a complete list of available projects for 2025, so students are encouraged to directly contact academic staff to discuss possible projects.**

Students interested in undertaking SCCOR3001 in Semester 1 or Semester 2 in 2025 should contact an academic supervisor (one of your lecturers or a contact listed in this booklet) who can provide guidance around a suitable project for you to undertake. More information is also available from the **SCCOR3001 Unit coordinator Dr Yutang Wang:** yutang.wang@federation.edu.au.

# Bachelor of Science Honours

Students who excel in their undergraduate degree are eligible to apply for entry into the Bachelor of Science Honours program. Honours is an intensive research-based program requiring an extra year of full-time study (or 18 months part-time study) on top of your undergraduate degree.

## What is Honours?

The Bachelor of Science Honours course (SZ8) is an additional fourth year of Undergraduate studies, completed over 9 months full-time (FT), or 18 months part-time (PT). The main objective of the program is to train students as professional research scientists.

Honours students engage in an individual research project under the close supervision of an academic staff member with relevant expertise in their chosen field. Students also complete theoretical coursework designed to complement their research and develop key skills in communication, critical analysis and project management, equipping them for independent research roles in the workplace or for entry into postgraduate research programs.

For more program information and link for application, please visit the Federation University Course Finder.

## Why complete an Honours year?

For some students completing honours is the first step towards building an academic research career and pursuing post graduate study. However, completing an Honours year also offers many benefits to those looking to boost their marketability in an increasingly competitive job market.

Honours gives you the opportunity to:

- Get experience in real scientific research
- Extend your knowledge in a specialist field of interest
- Contribute new knowledge to your field (with possibility of publication)
- Develop workplace skills attractive to employers
- Use advanced techniques and equipment and broaden your technical skill set

BSc Honours can be challenging, with a level of independence expected of students representing a significant change from previous undergraduate courses. However, most students find that their Honours year is an extremely rewarding experience.

**The BSc Honours Research projects are available in the following discipline areas:** Biomedical Science; Environmental Science; Environmental and Mathematical Sciences; Food Science; Information Technology; Science; Veterinary and Wildlife Science.

For further information on the **Bachelor of Science Honours Course**, feel free to contact the **SZ8 Science Honours coordinator** at your campus:

**Berwick Campus**
Dr Rob Bischof
r.bischof@federation.edu.au
(03) 4313 7930

**Gippsland Campus**
Dr David Smith
d.smith@federation.edu.au
(03) 5122 6023

**Mt Helen Campus**
Dr Nicholas Shultz
n.schultz@federation.edu.au
(03) 5327 9681

# How to apply for Honours

As a guide, qualification for the BSc Honours Course generally requires students to have a GPA > 6.0 (or equivalent) in a relevant undergraduate degree, and the support of an academic supervisor. Students with a GPA < 6.0 are nevertheless encouraged to discuss options with their proposed supervisor, who may endorse your application for entry into the BSc Honours Course.

Part of completing the Online Application for entry to the Bachelor of Science (Honours) SZ8 course will require students to provide an outline of their intended research project, which will need to be co-signed by their chosen supervisor(s).

## Step 1 Find a Project and Supervisor

A link to further information will be made available that provides an introduction to Bachelor of Science Honours within the Institute (IISS) and the scope of research available to students in 2025.

**You can also contact academic staff working in areas that interest you directly and ask them if they would consider supervising you.**

**This Information Booklet contains a listing of Research projects suitable for Honours students in 2025. Note that this is not a complete list of available projects for 2025, so students are encouraged to directly contact academic staff they are interested in working with to discuss possible Honours projects.**

It is a good idea to talk to a number of prospective supervisors to assess whether their research focus aligns with your interests and whether you feel you could work well with their research group. If possible, talk to other students in the group or past students who have worked with them as well.

Some questions to help you refine what you want to work on:

- What aspects of your undergraduate degree have you found most interesting?
- Which courses did you enjoy the most?
- What topics or issues did you wish you could have studied in more depth?
- Which academic staff had a teaching style that you liked in undergraduate courses?
- Which academic staff are working in areas that interest you?

## Step 2: Apply for Honours

**FedUni students can complete an Online Application for entry into the BSc Honours Course (SZ8). In addition, you will also need to complete and submit the online Honours Research Proposal Form.**

Students wanting to enrol in BSc Honours at FedUni, who completed their undergraduate degree elsewhere should contact the relevant **Science Honours Program Coordinator** to discuss eligibility requirements.

**Closing date for Applications for entry into BSc Honours for Semester 1 2025 is 18 November 2024.**

## Step 3: Accept your offer

If you are offered a place in the BSc Honours SZ8 course you will need to formally accept your offer in writing. You should also get in touch with your supervisor to begin discussing any additional requirements (eg ethics approvals, laboratory safety training) for your project prior to starting your research work.

Semester 1 intake typically starts at the beginning of February, Semester 2 intake starts at the beginning of August. Additional discipline-based information sessions may also be run, dates and details to be advised by email to eligible students.

## BSc Honours Scholarships

Several University scholarship opportunities may be available for BSc Hons candidates in 2025.

The Institute of Innovation, Science and Sustainability may also provide scholarship support for candidates for the BSc Hons program: details will be available prior to the deadline for Honours applications this year.

## Find a Supervisor

| Supervisor | Project title |
|---|---|
| Dr David Bean | Antibiotic resistance in bacteria from the environment<br>Characterisation of Staphylococci from Australian mammals<br>Elucidation of mechanisms of intrinsic polymyxin resistance in Gram-negative bacteria<br>Hydration of yeast in brewing: adding value or unnecessary risk?<br>Isolation and characterisation of yeasts from spontaneously fermented Victorian beer products<br>Making a truly Australian beer: searching for native yeasts<br>Micro v Macro: The role of macrophages in immunity to bacteria and evasion tactics used by Salmonella<br>Thermal stress resistance of Salmonella in chocolate |
| Prof Stuart Berzins | Age-related changes in immunity to vaccines<br>Unconventional T cell Function in Chronic disease |
| Dr Rob Bischof | Assessing the impact of nutrition, heat stress and grazing behaviour on the immune status of dairy cows<br>Functional and phenotypic characterisation of airway macrophages<br>Galectin 3 and 9 molecules from worms as new treatments for inflammatory diseases<br>Testing of novel therapeutics for the treatment of lung disease<br>Understanding the lung microbiome in health and disease |
| Dr Habtamu Derseh | Functional and phenotypic characterisation of airway macrophages<br>Microplastics in the environment<br>Testing of novel therapeutics for the treatment of lung disease |
| Dr Meagan Dewar | Development and evaluation of field-based detection devices of wildlife pathogens<br>Effect of age and gender on cognitive function in Columbian Ground Squirrels<br>Microcontaminant impact on the microbiome of Victorian penguin populations<br>Seabird and elasmobranch microbiomes |
| Prof Singarayer Florentine (Florry) | Habitat specificity and competitive traits of Australian acacias invaded to natural landscapes in Asia Pacific: a global review<br>Investigating Plant Traits in the Climate Future Vegetation Plots – Dandenong, Knox and Maroondah<br>Seed ecology and agronomy of a selected Murnong (Microseris) yam daisy species |

| | |
|---|---|
| Dr Rebecca Gehling | Authenticating the source of honey and kombucha using rare earth element profiles<br>Bioaccumulation and effect of emerging contaminants in the environment<br>Chemical compounds present in designer drugs previously known as 'legal highs'<br>Chemical profiles of non-alcoholic fermented kombucha beverages<br>Microplastics in the environment<br>Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse |
| Dr Bill Grant | Effects of composting on organic carbon fractions |
| Dr Alison Green | Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse |
| A/Prof Andrew Greenhill | Antibiotic resistance in bacteria from the environment<br>Development and evaluation of field-based detection devices of wildlife pathogens<br>Evaluating the properties of mead produced from Eucalyptus honeys<br>Hydration of yeast in brewing: adding value or unnecessary risk?<br>Making a truly Australian beer: searching for native yeasts<br>Seabird and elasmobranch microbiomes |
| Dr Andrew Hood | Effects of oxidation conditions on humic and fulvic acids |
| Dr Apurv Kumar | Developing high-value renewable energy electrodes by upcycling waste carbon<br>Producing hydrogen from wastewater: Identifying organic compounds for value-added electrolysis |
| Dr Dylan Liu | Developing bio-degradable membranes to replace Nafion-based proton conduction membranes in hydrogen fuel cells |
| Dr Benjamin Long | Microcontaminant impact on the microbiome of Victorian penguin populations<br>Microplastics in the environment<br>Producing hydrogen from wastewater: Identifying organic compounds for value-added electrolysis<br>Self-assembling peptides as building blocks for 3D printable hydrogels<br>The Bush Medicine Project - Investigation of bioactive compounds in plants used in Indigenous Australian traditional medicine practices of south-eastern Australia |
| Dr Simone Louwhoff | Eucalyptus species as lichen host in lowland forest in Victoria<br>Garden pH indicators<br>Restoration projects and the return of lichens<br>The lichen flora of residential bush blocks |

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|---|---|
| Dr Ashley Olson | Development of a novel bio-acoustic monitoring system to determine habitat usage by the endangered Eastern Bristlebird<br>The influence of physiological performance on habitat selection by the banded velvet gecko, Oedura cincta, at Nanya Station |
| Prof David Piedrafita | Assessing the impact of nutrition, heat stress and grazing behaviour on the immune status of dairy cows<br>Commercial feasibility of molecular tests for accurate diagnosis of Haemonchus contortus nematode infections in livestock<br>Functional and phenotypic characterisation of airway macrophages<br>Targeting saliva antibodies as a diagnostic test to detect encysted stages of small strongyle (cyathostomin) infection in horses<br>Testing of novel therapeutics for the treatment of lung disease<br>Understanding the lung microbiome in health and disease |
| Dr Sarah Preston | Commercial feasibility of molecular tests for accurate diagnosis of Haemonchus contortus nematode infections in livestock<br>Galectin 3 and 9 molecules from worms as new treatments for inflammatory diseases<br>Post release tracking of Echidnas, Koalas and Birds of Prey Released from Ballarat Wildlife Hospital<br>Targeting saliva antibodies as a diagnostic test to detect encysted stages of small strongyle (cyathostomin) infection in horses<br>Understanding the lung microbiome in health and disease |
| Dr Jess Reeves | Ecology and Water Chemistry of the Morwell Wetlands<br>Living Bung Yarnda (Lake Tyers) environmental stewardship plan<br>Social Capital for Sustainable Farming |
| Dr Alicia Reynolds | Authenticating the source of honey and kombucha using rare earth element profiles<br>Bioaccumulation and effect of emerging contaminants in the environment<br>Chemical compounds present in designer drugs previously known as ‘legal highs’<br>Chemical profiles of non-alcoholic fermented kombucha beverages<br>Developing bio-degradable membranes to replace Nafion-based proton conduction membranes in hydrogen fuel cells<br>Developing high-value renewable energy electrodes by upcycling waste carbon<br>Developing nano-structured carbons for CO2 gas adsorption properties<br>Effects of composting on organic carbon fractions<br>Effects of oxidation conditions on humic and fulvic acids<br>Evaluating the properties of mead produced from Eucalyptus honeys<br>Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse<br>Producing hydrogen from wastewater: Identifying organic compounds for value-added electrolysis<br>Synthesis and catalytic properties of metal nanoparticles supported on processed lignite and other upcycled carbon supports |

| | |
|---|---|
| Dr Nick Schultz | Bioaccumulation and effect of emerging contaminants in the environment<br>Development of a novel bio-acoustic monitoring system to determine habitat usage by the endangered Eastern Bristlebird<br>Eucalyptus species as lichen host in lowland forest in Victoria<br>Making a truly Australian beer: searching for native yeasts<br>Restoration projects and the return of lichens<br>Seed ecology and agronomy of a selected Murnong (Microseris) yam daisy species<br>The lichen flora of residential bush blocks |
| A/Prof Surbhi Sharma | Developing bio-degradable membranes to replace Nafion-based proton conduction membranes in hydrogen fuel cells<br>Developing high-value renewable energy electrodes by upcycling waste carbon<br>Developing nano-structured carbons for $CO_2$ gas adsorption properties<br>Producing hydrogen from wastewater: Identifying organic compounds for value-added electrolysis<br>Synthesis and catalytic properties of metal nanoparticles supported on processed lignite and other upcycled carbon supports |
| Dr David Smith | Authenticating the source of honey and kombucha using rare earth element profiles<br>Colorimetric sensing arrays for food and beverages<br>Evaluating the properties of mead produced from Eucalyptus honeys<br>Garden pH indicators |
| Dr Kushan Tennakoon | Application of novel UV-C radiation technology to minimize aquatic weeds and algae impacts in waterways<br>Habitat specificity and competitive traits of Australian acacias invaded to natural landscapes in Asia Pacific: a global review<br>Investigating Plant Traits in the Climate Future Vegetation Plots – Dandenong, Knox and Maroondah<br>Seed ecology and agronomy of a selected Murnong (Microseris) yam daisy species |
| Prof Peter Vamplew | Utility-based reinforcement learning |
| Dr Morgan Wallace | Age-related changes in immunity to vaccines<br>Micro v Macro: The role of macrophages in immunity to bacteria and evasion tactics used by Salmonella<br>Unconventional T cell Function in Chronic disease |
| Dr Yutang Wang | Sympathetic nerve activity and abdominal aortic aneurysm (AAA) |

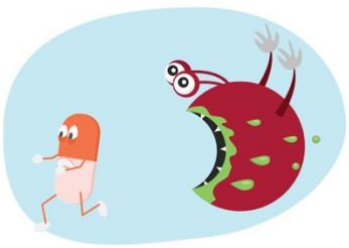
# List of Projects

## *Antibiotic resistance in bacteria from the environment*

**Location:** Mt Helen/Gippsland Campus
**Project Leaders:** Dr David Bean, Dr Andrew Greenhill
**Email:** d.bean@federation.edu.au; andrew.greenhill@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Antibiotic resistance is one of the greatest threats facing human medicine. Only one-third of antibiotics purchased in Australia are used in human medicine, the remainder being for mostly for veterinary and food production purposes. This gives the potential for antibiotic resistance to develop in the environment and eventually be transmitted to humans. This project aims to investigate the burden of antibiotic resistance in the environment and better understand the potential threat to human medicine. Bacteria will be recovered from diverse environment origins: wildlife, veterinary, food production animals and the environment itself, and be tested for the presence of antibiotic resistance. The project will provide important data on antimicrobial resistance in non-medical niches and potentially identify hotspots for the development of resistance in Australia.

**Key words:** *antibiotic-resistance, E. coli, Salmonella, wildlife*



## *Characterisation of Staphylococci from Australian mammals*

**Location:** Mt Helen Campus
**Project Leader:** Dr David Bean
**Email:** d.bean@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** *Staphylococcus* species are frequently colonizers of the skin and upper respiratory tracts of mammals and birds. There are over forty species of staphylococci described, and some species specificity has been observed in host range: that is the *Staphylococcus* species observed on some animals appear more rarely on more distantly related host species. For example, our research group recently showed a difference in the Staphylococcal species carriage between companion dogs (generally *S. pseudintermedius*) and captive dingoes (generally *S. equorum*). This project aims to isolate and characterise staphylococci from other Australian mammals.

## *Elucidation of mechanisms of intrinsic polymyxin resistance in Gram-negative bacteria*

**Location:** Mt Helen Campus
**Project Leader:** Dr David Bean
**Email:** d.bean@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** The rise of antibiotic resistance in pathogenic bacteria is a medical catastrophe – and it's only set to get worse. Bacteria that do not respond to any antibiotics are causing infections with increasing frequency, leaving clinicians few treatment options. One approach has been to re-introduce old, retired antibiotics, such as the polymyxins. The polymyxin drug, colistin, became the last resort drug for treating resistant Gram-negative infections. The use of polymyxin drugs has led to an increase in resistance to these drugs. This project aims to elucidate the molecular mechanisms of intrinsic polymyxin resistance in four organisms: *Hafnia paralvei*, *Aeromonas hydrophila*, *Myroides odoratus*, and *Alcaligenes faecalis*.

## *Hydration of yeast in brewing: adding value or unnecessary risk?*

**Location:** Mt Helen/Gippsland Campus
**Project Leaders:** Dr David Bean, A/Prof Andrew Greenhill
**Email:** d.bean@federation.edu.au; andrew.greenhill@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** There has been great advancements in dry yeasts for the brewing industry in the past 10 – 15 years. Until recently there were relatively few brewing yeast strains available as dry yeast; though now there is a greater range and an increasing acceptance of dried yeast. However, there are still some reservations in some sectors of brewing fraternity, perhaps in part because large breweries have their own yeasts strains thus do not depend on dried yeast. However, amongst many in the craft brewing industry dried yeasts have gained acceptance. Dried yeast has many advantages over liquid yeast, not the least the storage life of dried yeast. Craft brewing is a key potential market for dried yeast producers.
Beyond acceptability of dried yeast, there remains debate over the need to rehydrate dried yeast prior to pitching. Some manufacturers suggest pitching yeast directly, others recommend rehydrating the yeast first. To add to the confusion, texts and brewing websites (many targeting home-brewers) provide opinions, often conflicting. Currently, decisions are being made on whether to rehydrate yeast before pitching based on opinions rather than data. Moreover, many of the opinions are influenced by dried yeast characteristics of >10 years ago, not on the current product.
The value of rehydrating dried yeast is an important research question. Dried yeast is a highly convenient product; however, the need to rehydrate does detract from that convenience. Moreover, there may be quality risks associated with rehydration, not the least the risk of contamination. This study seeks to determine the value of re-hydrating various strains of brewer's yeast.

### *Isolation and characterisation of yeasts from spontaneously fermented Victorian beer products*

**Location:** Mt Helen Campus
**Project Leader:** Dr David Bean
**Email:** d.bean@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Production of barrel-aged beers is currently a growth sector in Victorian breweries. Many of these rely on spontaneous fermentation: a reliance of native organisms in the environment to inoculate and ferment these products. This project will work with local Victorian breweries to look at the microorganisms present in these products, particularly the yeasts. This will involve isolation of the yeasts and subsequent phenotypic and genotypic characterisation. Population dynamics in active beer ferments may also be explored.

### *Making a truly Australian beer: searching for native yeasts*

**Location:** Mt Helen/Gippsland Campus
**Project Leaders:** Dr David Bean, A/Prof Andrew Greenhill, Dr Nick Schultz
**Email:** d.bean@federation.edu.au; andrew.greenhill@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** While many beers are marketed in a way to embodied the "spirit" of Australia, they all lack one truly native ingredient: an Australian yeast. Like hidden treasure, this yeast remains to be found, somewhere in the Australian bushland. This project seeks to find this hidden gem and includes field work, microbiology, molecular biology and brewing. The research involves going in to the field to sample trees for yeast. *Nothofagus* seems to be the most desirable tree genus for yeast recovery. Yeasts would then be isolated from this environmental material and characterised by DNA sequencing (and maybe running gels). Lastly the usefulness of the recovered yeasts for brewing would be investigated (in small scale and potentially large scale too).

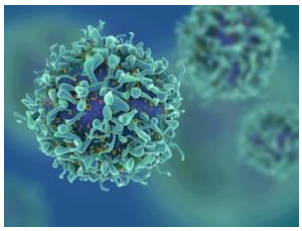
### *Thermal stress resistance of Salmonella in chocolate*

**Location:** Mt Helen Campus
**Project Leader:** Dr David Bean
**Email:** d.bean@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** *Salmonella* is a leading cause of gastroenteritis. Typically, the organism is inactivated by cooking, but in some low water activity foods (chocolate in particular) the thermal resistance of *Salmonella* is enhanced, making it difficult to irradicate the organism. This project aims to elucidate the mechanism behind this increase resistance to heat, and in particular understand the difference heat resistance observed between different *Salmonella* serotypes.

### *Unconventional T cell Function in Chronic disease*

**Location:** Mt Helen Campus
**Project Leaders:** Prof Stuart Berzins, Dr Morgan Wallace
**Email:** m.wallace@federation.edu.au, s.berzins@federation.edu.au
**Project Level:** Honours; SCCOR3001



**Project description:** There is growing interest in the function of the immune system and its role in diseases such as COVID-19, cancer and allergies. In many instances, a subset of immune cells called unconventional T cells are abnormal in these patients, but it is unclear whether this is a cause or an effect of the disease development. Unconventional T cells play important immunoregulatory roles by releasing large amounts of cytokines, and thus make attractive therapeutic targets. The function of these cells can be studied through *in vitro* culturing of cells isolated from human blood samples. The cultures can be manipulated to assess the role of immune stimulation and cytokine signals to study their functions following activation. This project will involve tissue culture techniques and flow cytometry to analyse unconventional T cell functions with a goal of identifying new ways to target these cells to treat chronic diseases, such as cancer and autoimmunity.

**Key words:** *Immunology, T cells, immune responses, cancer, viruses*

### *Assessing the impact of nutrition, heat stress and grazing behaviour on the immune status of dairy cows*

**Location:** Berwick/Gippsland Campus
**Project Leaders:** Dr Rob Bischof, Prof David Piedrafita
**Email:** r.bischof@federation.edu.au; david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

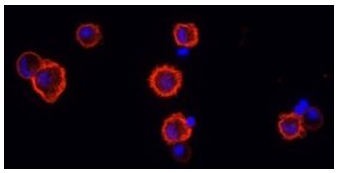
**Project description:** In the dairy industry, knowledge of ruminant nutrition and its impact on herd health and productivity assists farmers to make decisions about feeding levels of supplements (grains, proteins, oils) to optimise rumen fermentation as well as milk production and composition. This project will be carried out in collaboration with Ellinbank Research Institute to assess the impact of grazing behaviour, heat stress and milk quality on the immune status of dairy cows. Methods will include immunology, biochemistry and cell-based studies.

**Key words:** *immune status, ruminant nutrition, heat stress, grazing behaviour, milk composition, feed quality*

## *Functional and phenotypic characterisation of airway macrophages*

**Location:** Berwick/Gippsland Campus
**Project Leaders:** Dr Rob Bischof, Prof David Piedrafita, Dr Habtamu Derseh
**Email:** r.bischof@federation.edu.au; david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Airway macrophages are prominent immune cells that are known to play an important role in healthy and diseased lungs. Macrophage M1/M2 polarisation and functional differentiation is affected by a range of stimuli, but we know very little about the 'altered' state of macrophages in the context of airway disease. The aim of these studies is to examine and better understand the characteristics of airway macrophages in healthy and inflamed lung tissues. This project will include immunohistology, microscopy, immunology and cell biology techniques.



**Key words:** *airway macrophages, inflammation*

## *Testing of novel therapeutics for the treatment of lung disease*

**Location:** Berwick/Gippsland/Mt Helen Campus
**Project Leaders:** Dr Rob Bischof, Prof David Piedrafita, Dr Habtamu Derseh
**Email:** r.bischof@federation.edu.au david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Inhaled drug delivery for administration of medications, especially for treating lung-related conditions, is gaining considerable global interest. The inhaled delivery of approved drugs at lower doses and formulated in a different way to those currently being delivered systemically (eg oral) is proposed to be an efficient way to maximise therapeutic drug concentration in the lungs and reduce side effects. This project will use sheep models developed in our laboratory to evaluate the efficacy and therapeutic benefits of drug delivery to the lungs. Several project options will be available, and methods will involve physiology, immunology, and *in vivo* and *in vitro* techniques. Research here will facilitate the development and clinical transition of more effective inhalable therapeutics.

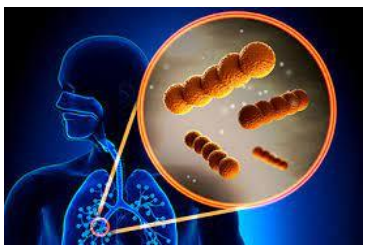
**Key words:** *lung disease, translational model, sheep*

## *Understanding the lung microbiome in health and disease*

**Location:** Berwick/Mt Helen/Gippsland Campus
**Project Leaders:** Dr Rob Bischof, Dr Sarah Preston, Prof David Piedrafita, A/Prof Andrew Greenhill
**Email:** r.bischof@federation.edu.au; sj.preston@federation.edu.au; david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** It is widely accepted that the lungs contain a small but dynamic endogenous microbial population that plays an important role in normal lung physiology and function. Significant changes in the lung microbiome in response to inflammation and disease is also well recognised, although gaps remain in our understanding of how the lung microbiome, with or without a link to the gut, contributes to lung immunity and health. This project will examine the lung microbiome in healthy and inflamed/diseased lungs using genomics, bioinformatics, and *in vivo* and *in vitro* techniques, with a view to identify novel therapeutic targets for the treatment of lung disease.

**Key words:** *lung microbiome, airway disease, inflammation*



## *Development and evaluation of field-based detection devices of wildlife pathogens*

**Location:** Gippsland/Berwick Campus
**Project Leaders:** Dr Meagan Dewar, A/Prof Andrew Greenhill
**Email:** m.dewar@federation.edu.au
**Phone:** (03) 5122 8918
**Project Level:** Honours (S2 start)

**Project description:** This project will involve developing protocols and evaluating the ability of two nucleic acid amplification methods for the field-based detection of pathogens in wildlife species. Following optimisation and the development of protocols, the student will conduct a study in a field setting where samples will be collected, and field based genomic devices applied to detect and genetically characterise pathogens. This will pave the way for future field-based disease surveillance.

**Key words:** *disease surveillance, pathogen detection, genomic sequencing*

### *Effect of age and gender on cognitive function in Columbian Ground Squirrels*

**Location:** Berwick Campus
**Project Leaders:** Dr Meagan Dewar (Fed Uni), Anais Beauvieux (Fed Uni), Vincent Viblanc (CNRS France)
**Email:** m.dewar@federation.edu.au
**Project Level:** Honours (S1 start)

**Project description:** This project is part of a larger project examining the effects of the gut microbiome on cognition in mammals. The effects of age and gender on the cognitive ability of Columbian ground squirrels will be measured using a field-based spatial memory task and problem-solving task. The candidate will assist with setting up and running field-based activities and evaluating the cognitive abilities of individuals by analysing cognitive test videos and assessing how these abilities relate to factors such as individual age, sex, condition, and ultimately whether variations in cognitive performances can be related to fitness (reproductive success). Metrics such as latency to exit, the number of errors (blind alley entries), and the total distance travelled within the maze can thus be calculated. The problem-solving task involved puzzle boxes that required innovative behaviours to access a food reward, also recorded, with measures including persistence, motor diversity, and neophobia that can be calculated.
This project will require the student to assist with fieldwork in Alberta Canada (April – June). Expenses for the fieldwork will be covered for the student, but the candidate will require a valid passport.

**Key words:** *cognition, squirrels, animal behaviour*

### *Seabird and elasmobranch microbiomes*

**Location:** Berwick Campus
**Project Leaders:** Dr Meagan Dewar, A/Prof Andrew Greenhill
**Email:** m.dewar@federation.edu.au
**Project Level:** Honours (S2 start)

**Project description:** A number of projects are available to examine the microbial composition of sharks (great white, tigers and bull) and Temperate (little) and Antarctic penguins (Adelie, Emperor). These projects focus on characterising the microbial community that lives inside these host species using genomic sequencing and bioinformatics analysis. The aim of these projects is to further our knowledge into the microbes colonising these species and our understanding of the role that the microbiome plays in host health, nutrition and metabolism.

**Key words:** *microbiome, genome, microbial ecology, bacteria, seabirds, sharks*

### *Chemical compounds present in designer drugs previously known as 'legal highs'*

**Location:** Berwick/Gippsland/Mt Helen Campus
**Project Leaders:** Dr Rebecca Gehling, Dr Alicia Reynolds
**Email:** r.gehling@federation.edu.au
**Project Level:** Honours

**Project description:** New psychoactive substances (NPS), previously known as 'legal highs', are any synthetic designer drug that mimics the physical and psychological effects of illicit substances such as MDMA, methamphetamine, LSD and cannabis. Whilst governments continue to add emerging NPS to the list of scheduled compounds, new compounds quickly appear on the market often with very similar chemical structures to those that have already been banned. As new 'legal highs' emerge, it is critical that the active ingredients within these products are identified to ensure they are complying with the law but also to identify any potential psychoactive substances that could cause harm to an individual when consumed. This project aims to identify the active constituents present in a range of readily available 'legal highs' and to determine if these compounds are structurally like their illicit counterparts via Gas Chromatography (GC) and/or High-Performance Liquid Chromatography (HPLC) coupled with Mass Spectrometry (MS).

**Key words:** *chemistry, forensic science, legal highs, drugs, GC-MS, HPLC-MS*

### *Chemical profiles of non-alcoholic fermented kombucha beverages*

**Location:** Berwick/Gippsland Campus
**Project Leaders:** Dr Rebecca Gehling, Dr Alicia Reynolds
**Email:** r.gehling@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Kombucha is a popular non-alcoholic fermented beverage which has rapidly grown in popularity over the past 30 years. This sweet, fermented drink is believed to have a range of health benefits however there are still questions surrounding these purported health benefits and not enough is currently known about its chemical profile. This project aims to identify and quantify some of the key compounds produced during the fermentation of sweetened tea through the action of a symbiotic culture of bacteria and yeast (SCOBY). This is to provide a greater understanding of the chemical profiles of fermented Kombucha beverages and the differences between commercial and non-commercial fermentation.

**Key words:** *chemistry, fermentation, kombucha*

## *Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse*

**Location:** Berwick/Gippsland/Mt Helen Campus
**Project Leaders:** Dr Rebecca Gehling, Dr Alison Green, Dr Alicia Reynolds
**Email:** r.gehling@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Since the early 1990's legal 'designer drugs', which mimic the physical and psychological effects of their illicit counterparts, have flooded the market and have rapidly gained in popularity. This rise in popularity can be attributed to the ease at which they can be obtained, but also due to public perception that they are a 'safer' option. One method to identify the prevalence of these new psychoactive substances within the community is to monitor wastewater for metabolised and un-metabolised drugs excreted in urine. This project aims to qualitatively identify the presence of designer drugs of abuse within wastewater in Victoria through Gas Chromatography (GC), High Performance Liquid Chromatography (HPLC) and Mass Spectrometry (MS).

**Key words:** *chemistry, drugs, forensic science, wastewater, GC, HPLC, MS*

## *Microplastics in the environment*

**Location:** Berwick/Gippsland/Mt Helen Campus
**Project Leaders:** Dr Rebecca Gehling, Dr Benjamin Long, Dr Habtamu Derseh
**Email:** r.gehling@federation.edu.au
**Project Level:** Honours; SCCOR3001

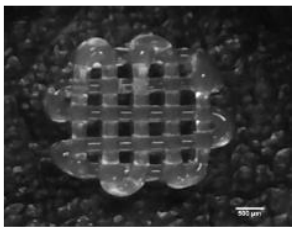
**Project description:** Microplastic analysis is crucial for understanding the widespread impact of plastic pollution on ecosystems and human health. Microplastics are tiny plastic particles less than 5 mm in size which can be found throughout the biosphere (soil, air, water, and animal tissues). These tiny particles originate from the breakdown of larger plastics or from products that contain "microbeads" like personal care products. Microplastics are readily transported throughout the environment and are a growing concern due their persistence, widespread distribution, and harmful impacts on wildlife and ecosystems.
This project is part of the broader $M^2$ Microplastics project which aims to explore and develop novel methods for the identification, classification, and quantification of microplastics present in environmental and/or biological samples using methods including density separation, organic and/or Soxhlet extraction, fluorescence microscopy, FTIR analysis and GC-pyrolysis.

**Key words:** *microplastics, Fluorescence, Emerging Contaminants, Detection, $M^2$ Project*

## *Self-assembling peptides as building blocks for 3D printable hydrogels*

**Location:** Mt Helen Campus
**Project Leader:** Dr Benjamin Long
**Email:** bm.long@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Short self-assembling peptides have been shown to be useful building blocks for self-assembled hydrogels. This project aims to make enzymatically and spontaneously cross-linkable peptides for 3D printing hydrogel implants that mimic the extracellular matrix. These hydrogels can be tuned for anticancer properties, stroke rehabilitation and neuron growth promotion. In this project you will become familiar with solid phase peptide synthesis, organic synthesis and a range of chemical characterisation techniques (IR, UV and NMR Spectroscopy; HPLC-MS; Small Angle X-ray Scattering).



**Key words:** *hydrogels, peptides*

## *Microcontaminant impact on the microbiome of Victorian penguin populations*

**Location:** Mt Helen/Berwick Campus
**Project Leaders:** Dr Benjamin Long, Dr Meagan Dewar
**Email:** bm.long@federation.edu.au
m.dewar@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Pharmaceuticals as organic microcontaminants are an emerging problem in the environment. While these pharmaceuticals are well known to disturb the gut microbiome there is also increasing evidence to show that pharmaceuticals in environmentally relevant concentrations can exert the correct selective pressures to change bacterial community makeup and for bacteria to develop antimicrobial resistance genes. It is currently unknown if this effect extends to the gut microbiome of protected fauna such as little penguins. In this project, you will examine if a relationship exists between the makeup of gut microbiome communities and the concentration of pharmaceuticals found in penguin guano. You will become familiar with field sampling techniques, and wet analytical chemistry techniques such as solid phase extraction (SPE, QuEChERS) and HPLC-MS/MS, bioinformatics, and sequencing.

**Key words:** *pharmaceuticals, microbiome*

## *Bioaccumulation and effect of emerging contaminants in the environment*

**Location:** Mt Helen/Berwick/Gippsland Campus
**Project Leaders:** Dr Benjamin Long, Dr Nick Schultz, Dr Rebecca Gehling, Dr Alicia Reynolds
**Email:** bm.long@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Emerging organic contaminants such as pharmaceuticals, pesticides and herbicides, PFAS and microplastics are known to be discharged to the environment. Little is known about the concentrations of these contaminants in the Australian environment and their penetration through the food web. In this project you will contribute to the characterisation of the problem and help measure the effects of these contaminants on the environment (through environmental sampling and or microcosm studies). You will become familiar with field sampling techniques, and wet analytical chemistry techniques such as sample preparation (SPE, QuEChERS, Density Separation and Digestion), chromatographic techniques (HPLC and GC), and sample detection (Mass Spectrometry, Fluorescence Microscopy, Infrared Spectroscopy).

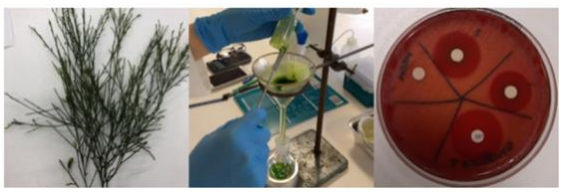
**Key words:** *pharmaceuticals, microplastics, emerging contaminants, detection*

## *The Bush Medicine Project - Investigation of bioactive compounds in plants used in Indigenous Australian traditional medicine practices of south-eastern Australia*

**Location:** Mt Helen/Gippsland/Berwick Campus
**Project Leader:** Dr Benjamin Long (+ additional campus specific supervisors)
**Email:** bm.long@federation.edu.au
**Project Level:** Honours

**Project description:** Indigenous Australian culture has at least 50,000 years of history and historical knowledge that has been preserved orally. Traditional medicine in indigenous Australian culture is holistic in nature and treats the person as a whole, rather than applying single curative measures. However, there were still many concoctions and herbal remedies in use. The Bush Medicine Project investigates the antimicrobial properties and toxicology of Australian native plants used in Indigenous Australian medicine practices (https://federation.edu.au/bush-medicine-project).
An honours level investigation in the Bush Medicine Project will further investigate “hits” from the undergraduate student program. Your project will be multidisciplinary and include aspects of chemistry, microbiology and cell biology tailored to your goals and expertise.

**Key words:** *pharmacognosy, antimicrobial, bush medicine*



## *Restoration projects and the return of lichens*

**Location:** Gippsland/Berwick Campus
**Project Leaders:** Dr Simone Louwhoff, Dr Nicholas Schultz
**Email:** s.louwhoff@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** In Victoria, as elsewhere, clearing of our native vegetation and associated loss of habitat and biodiversity has been extensive. In an effort to remediate this, revegetation and restoration programs aim to return fragmented landscapes to a more functional state. Lichens are sensitive to microclimatic conditions and have long been known as good indicators of habitat continuity but are rarely considered when measuring success of restoration projects.

The overall objective is to investigate the lichen flora of revegetated land and compare it to that of remnant patches in similar ecological vegetation classes (EVCs). This will require field and lab identification of lichens, including the use of microscopes and potentially chemical techniques.

**Key words:** *lichen, bio- indicators, revegetation, monitoring, restoration*

## *Eucalyptus species as lichen host in lowland forest in Victoria*

**Location:** Gippsland Campus
**Project Leaders:** Dr Simone Louwhoff, Dr Nicholas Schultz
**Email:** s.louwhoff@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Trees are host to an amazing diversity of dependent species, but have you ever thought about lichens? Whilst frequently overlooked, they play an important ecological role. Some Eucalypt species (particularly those with persistent bark) have been shown to make suitable hosts for several different lichens, however, only limited research into the lichen flora of Eucalypts has been conducted. The overall objective is to conduct a field survey of the lichen flora of eucalypts in lowland forest. This will require field and lab identification of lichens, including the use of microscopes and potentially chemical techniques.

**Key words:** *lichen, host specificity, eucalypt forest, bark type*

### *The lichen flora of residential bush blocks*

**Location:** Gippsland Campus
**Project Leaders:** Dr Simone Louwhoff, Dr Nicholas Schultz
**Email:** s.louwhoff@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Residential bush blocks provide great biodiversity potential, but are often modified as part of property maintenance, including for bush fire mitigation. A pilot study identified that degree of vegetation modification in the landscape as well as host type had an impact on lichen diversity. However, it did not allow a direct comparison between different sites due to unequal representation of host species sampled.
The overall objective is to fine-tune the sampling technique of the lichen flora and host selection to gain a better understanding of suitable host trees to retain or replant for biodiversity. This will require field and lab identification of host species and lichens, including the use of microscopes and potentially chemical techniques.

### *The influence of physiological performance on habitat selection by the banded velvet gecko, Oedura cincta, at Nanya Station*

**Location:** Gippsland/Berwick/Mt Helen Campus
**Project Leaders:** Dr Ashley Olson, Dr Sharon Reid
**Email:** a.olson@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** The banded velvet gecko is a relatively large and arboreal species of gecko found at Nanya station, NSW. This species generally occupies belah woodlands and is rarely found in vegetation communities dominated by mallee eucalypts at Nanya Station. This study will investigate the role that physiological performance of traits associated with foraging play in habitat selection by banded velvet geckos. The performance of ecologically important traits such sprint speed and grip strength will be tested on different surfaces, such as the rough-barked belah and smooth barked mallee, to determine if movement on certain tree species is associated with sub-optimal performance. This project would require a mid-year start and will involve a significant amount of fieldwork during spring and summer at Nanya Station in remote western NSW. As geckoes are nocturnal, most fieldwork will be undertaken in the evening between 6pm and midnight.

### *Development of a novel bio-acoustic monitoring system to determine habitat usage by the endangered Eastern Bristlebird*

**Location:** Gippsland/Berwick/Mt Helen Campus
**Project Leaders:** Dr Ashley Olson, Dr Nick Schultz
**Email:** a.olson@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** The Eastern Bristlebird currently occurs as a single, relatively small, and isolated population in Victoria within Croajingolong National Park. This makes the species highly vulnerable to extinction in the State of Victoria. A reintroduced population elsewhere in Victoria is essential insurance against the catastrophic or gradual loss of the Croajingolong population. In early 2023, Federation University partnered with DEECA to undertake a pilot study investigating the movement of reintroduced bristlebirds in Wilson's Promontory National Park (WPNP) using radiotelemetry. The first of the two projects available will investigate the behaviour and habitat use by Eastern Bristlebirds following their release at WPNP in 2024. The second project will project will investigate the effectiveness of acoustic localisation as an alternative to radiotelemetry for monitoring the Eastern Bristlebird population at WPNP. Acoustic localisation is an innovative technique that uses an array of acoustic monitoring stations to triangulate the position of an organism when it vocalises based on the arrival time of sound waves at each station. Acoustic localisation could provide a passive, non-invasive, way of determining the location and habitat use of bristlebirds and many other species.

### *Post release tracking of Echidnas, Koalas and Birds of Prey Released from Ballarat Wildlife Hospital*

**Location:** Mt Helen Campus
**Project Leaders:** Dr Sarah Preston, Dr Adrienne Lavinia, Nikki Shanahan
**Email:** sj.preston@federation.edu.au; adrienne@extantveterinary.com
**Project Level:** Honours; SCCOR3001

**Project description:** Wildlife rescue, rehabilitation and release is vital in animal conservation. Post-release monitoring of released animals provides pivotal information on the success of the animal rescue and rehabilitation process but is seldom undertaken primarily due to limited/finite resources. Developments in tracking technology, particularly GPS enabled, can provide this information to wildlife organisations. By tracking animals post-release, information can be gathered that demonstrate the animals' successful integration back into the wild. This includes but is not limited to the animal's ability to recognise, hunt or forage for food, join social groups, and defend/maintain territories. In working with the Ballarat Wildlife hospital (https://ballaratwildlifehospital.org.au/) students would help release and track wildlife post release to collect data on the animal's ability to re-integrate back into the wild. They would become familiar with radio and GPS tracking technologies and analysis and observe animal behaviour to provide information back to the hospital regarding the success of the animal's integration back into the wild. The student would also be involved in helping care for the wildlife rescued by the wildlife hospital.

### *Commercial feasibility of molecular tests for accurate diagnosis of Haemonchus contortus nematode infections in livestock*

**Location:** Mt Helen/Berwick/Gippsland Campus
**Project Leaders:** Dr Sarah Preston, Rebecca Farnell, Prof David Piedrafita
**Email:** sj.preston@federation.edu.au; rebeccafarnell@students.federation.edu.au; david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Gastrointestinal nematode (GIN) infections cause economic losses in livestock and remains a global challenge for farmers. Haemonchus contortus is one of the most pathogenic GIN of small ruminants, often leading to death. In Victoria (Australia), outbreaks of H. contortus infections have been sporadic and linked to years with high rainfall. However, changing climatic conditions suggest infections may become more endemic and rapid and specific diagnosis is critical for effective treatment. Currently, Faecal Egg Counts (FEC) and larval cultures are the gold standard commercial diagnostic method which are carried out largely in regional, low technology laboratories. FEC are rapid but are limited by confirming patent infections, not GIN species. Conversely, larval culture allow species identification but are slow taking 1-2 weeks. There are many molecular diagnostic techniques used routinely in research allowing specific and rapid identification of GIN species including polymerase chain reaction (PCR), Loop-mediated isothermal amplification (LAMP) and sequencing of the ITS-2 rDNA region (nemabiome). A student working on this project would acquire skills in collecting samples from saleyards, performing molecular test such as PCR, LAMP and ITS-2 sequencing.

### *Targeting saliva antibodies as a diagnostic test to detect encysted stages of small strongyle (cyathostomin) infection in horses*

**Location:** Mt Helen/Berwick/Gippsland Campus
**Project Leaders:** Dr Sarah Preston, Tanya King, Prof David Piedrafita
**Email:** sj.preston@federation.edu.au; tanyaking@students.federation.edu.au; david.piedrafita@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Small strongyles (cyathostomin) infection in equines can cause clinical symptoms such as lethargy, sudden weight loss, debilitation, and diarrhoea. The encysted stages of cyathostomin can enter a dormancy stage called hypobiosis, which are not detected with a standard faecal egg count (FEC). Although a commercialised IgG(T) sera test identifying encysted larvae is available in the United Kingdom, the requirement for blood samples impedes its wide scale adoption. The aim of the study is to investigate whether saliva can be used as an alternative to blood to detect antibodies against encysted larvae. This would improve the diagnostics test available for horse owners and vets to accurately control worm infections. A student working on this project would acquire skills in collecting saliva from horses, running ELISA tests to measure antibodies in the lab and becoming very familiar with the faecal egg count test.

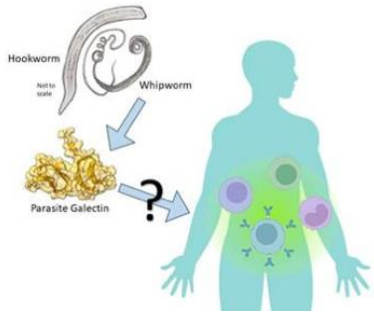
**Key words:** *parasites, immune system, worms, equine, saliva*

## *Galectin 3 and 9 molecules from worms as new treatments for inflammatory diseases*

**Location:** Mt Helen/Berwick/Gippsland Campus
**Project Leaders:** Dr Sarah Preston, Elizabeth Mullens, Dr Rob Bischof
**Email:** sj.preston@federation.edu.au; elizabethmullens@students.federation.edu.au; r.bischof@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** The search for novel treatments for chronic inflammatory conditions has led to an increased interest in gastrointestinal nematodes and the molecules they produce to evade the human immune system. Particularly, those that alter the immune response to a more anti-inflammatory profile and can establish chronic infections while the host is asymptomatic. One molecule family of interest are galectins. Carbohydrate-binding proteins that are potent, multifunctional signalling proteins for the immune system. They are also a large component of the excretory/secretory molecules nematodes produce during infection.
The aim of this research is to determine if two human infecting nematodes, *Necator americanus* (Hookworm) and *Trichuris trichiura* (Whipworm), produced functional galectin homologues of human galectin 3 and 9, and to determine if they displayed anti-inflammatory properties. A student working on this project would look at the effect of the parasite galectin on cultured human cells, and donor immune cells using immunohistochemistry, cytokine analysis and flow cytometry. It would also examine the functionality of the galectins using Western blot and sugar binding assays.

**Key words:** *inflammation, nematodes, galectins*




## *Ecology and Water Chemistry of the Morwell Wetlands*

**Location:** Gippsland Campus
**Project Leader:** Dr Jess Reeves
**Email:** j.reeves@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** This project will look at the seasonal water quality variability and ecology of the Morwell Wetlands. Depending on your interest, the project can either focus on the flora (aquatic vegetation, algal communities) or the fauna (invertebrate assemblages) of the wetlands. Sampling will be undertaken in March-April and again in August-September and related to both climatic events and discharge regimes of the local industries. There is scope to improve the ecological values of Morwell Wetlands, so this project will provide a 'before' study, to determine the current condition and variability of the wetland system, prior to changes in the flow of the Morwell, in light of the mine site rehabilitation project.

**Key words:** *wetlands, ecology, climate change, rehabilitation, water chemistry*

## *Living Bung Yarnda (Lake Tyers) environmental stewardship plan*

**Location:** Gippsland Campus
**Project Leader:** Dr Jess Reeves
**Email:** j.reeves@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** This project involves both the development of an integrated citizen science environmental program and analysis of the community and project development itself. The environmental aspect will include a review of existing monitoring programs including water quality, waterbugs, fish, birds, vegetation and mammal scats and scratchings. A database will be developed, specific to Lake Tyers, but contributing to larger, extant monitoring programs. It will also involve recruitment and training of volunteer participants and analysis of the first 6 months of data collected, to be presented at a community forum. The social science aspect of the project will map the process of recruitment, engagement and community outreach of the program, beyond the participants. It will also map the environmental values of the various interest groups around Lake Tyers, to assist in development of the Environmental Stewardship program.

## *Social Capital for Sustainable Farming*

**Location:** Gippsland Campus
**Project Leader:** Dr Jess Reeves
**Email:** j.reeves@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** This project will look at the value of social capital in farming communities across Gippsland and the contribution this makes to community resilience. The project will involve both assessment of existing data and interviews with farmers from the Gippsland Agricultural Groups and the Bass Coast Landcare Network. This is a contribution to a funded project through the Soils CRC on the social and economic benefits of regenerative agriculture and will also make a contribution to the Gippsland Drought Adaptation Plan.

**Key words:** *social capital, agriculture, farming communities, resilience, regenerative agriculture.*

## *Effects of oxidation conditions on humic and fulvic acids*

**Location:** Gippsland Campus
**Project Leaders:** Dr Alicia Reynolds
**Email:** alicia.reynolds@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Humic and fulvic acids are important and complex fractions of soil organic carbon. Humic and fulvic acids are produced from Victorian brown coal and sold as high-value soil amendments and plant biostimulants. A recent PhD project used oxidation to produce new humic and fulvic acids from coal. This honours project uses new and established analytical techniques to find out more about the chemical structures of these new humic and fulvic acids. Focus areas could include organic acids (using ion chromatography and HPLC), other small organic compounds (using derivatisation, HPLC and GC/MS) or molecular weight (using dialysis and size exclusion HPLC). The effects of these products on seed germination could also be investigated.

**Key words:** *social license, renewable energy, just transition, community consultation.*

*Photo. Ion chromatograph for measuring organic acids in fulvic acids*

## *Effects of composting on organic carbon fractions*

**Location:** Gippsland Campus
**Project Leaders:** Dr Alicia Reynolds, Dr Bill Grant
**Email:** alicia.reynolds@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Composting is an important process for recycling organics, building soil organic carbon and improving soil productivity. Understanding the complex chemical and biological composting processes and how they are influenced by factors such as raw materials, microbial populations, heat transfer and mechanical processing are active areas of research. Mature products from well-managed thermophilic composting are typically rich in humic-like chemical structures that are resistant to further breakdown in soil.
This honours project investigates changes in the humic-like structures from compost and could focus on compost maturation or different compost sources (eg domestic and commercial). The project will use simple soil-organic-carbon separation methods as well as analytical chemistry techniques (eg infra-red spectroscopy, nuclear magnetic resonance, elemental ratios (CHNSO), titrations and GC-MS (gas chromatography with mass spectrometry)) to understand the transformation in a group of structures. Focus areas could include:

- Transformation of overall chemical structures of humin, humic and fulvic fractions
- Transformation of key macromolecules such as carbohydrates, lignins, carboxylic acids or phenols
- Changes in biological activity using biomarkers like sterols, fatty acids and terpenoids as indicators of bacterial, fungi and plants (vascular, non-vascular etc)
- Changes in carboxylic and phenolic structures that are associated with cation exchange capacity and plant-hormonal effects
- Production of chemical structures that are expected to be resilient soil carbon (e.g. condensed aromatics)
- Anthropogenic inputs such as plasticisers, herbicides and pesticides
- Evaluating tests or procedures that could be used to assess compost quality, in terms of compost maturity and agricultural value.

**Key words:** *social license, renewable energy, just transition, community consultation.*

*Photo. GCMS system used to characterise organic fractions during thermophilic composting*

### *Developing high-value renewable energy electrodes by upcycling waste carbon*

**Location:** Gippsland Campus
**Project Leaders:** A/Prof Surbhi Sharma, Dr Alicia Reynolds, Dr Apurv Kumar
**Email:** surbhi.sharma@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Solid organic wastes from agriculture, food processing and waste-water treatment facilities are expensive to manage and dispose in an environmentally friendly manner. Recycling and upcycling of these is a high priority for VIC govt as it essential for a sustainable circular economy.
This project will be focussed on upcycling waste carbon (sewage waste, biosolids, farm waste) and Lignite (low-value carbon, commonly available, in Victoria) into high-value electrode materials for applications in batteries, supercapacitors and fuel cells. Wet chemistry, hydrothermal processing, material characterisation studies (using techniques such as spectroscopy, microscopy and thermogravimetry) will be used to develop and study the materials. Electrochemistry studies may be involved.

### *Producing hydrogen from wastewater: Identifying organic compounds for value-added electrolysis*

**Location:** Gippsland Campus
**Project Leaders:** A/Prof Surbhi Sharma, Dr Apurv Kumar, Dr Alicia Reynolds, Dr Benjamin Long
**Email:** surbhi.sharma@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Producing hydrogen by electrolytically splitting water typically involves two reactions: reducing water to hydrogen and oxidising water to oxygen. Oxidising water to oxygen requires high potentials, limiting the energy efficiency of the system. Energy efficiency could be improved by oxidising small organic compounds (eg, aldehydes, alcohols and ammonia) instead of water. This approach also eliminates the need for valuable high-purity water, using waste- and process water instead.
This honours project could focus on a range of water sources (eg, brewery, domestic, dairy or other wastewaters and organic-rich hydrothermal carbonisation process water). Chemicals present in the water will be determined using infra-red spectroscopy, chromatography and mass spectroscopy. There may be an opportunity to study electrochemical splitting of the water.

### *Synthesis and catalytic properties of metal nanoparticles supported on processed lignite and other upcycled carbon supports*

**Location:** Gippsland Campus
**Project Leaders:** A/Prof Surbhi Sharma, Dr Alicia Reynolds
**Email:** surbhi.sharma@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Carbon supported metal nanoparticles are commonly used as catalysts in electrodes in electrochemical energy applications. Use of nanostructured electrocatalysts (often precious metals) helps minimise the costs whilst achieving desired catalytic performance. Supporting carbon nanomaterials anchor the nanoparticles while providing a conductive mesh for electron flow amongst other properties assisting the electrochemical behaviour.
This project will explore the deposition of selected metal nanoparticles on various upcycled carbons using microwave polyol processing technique. The nanoparticles' shape, size, morphology will be studied using electron microscopy. Role of the nanostructured carbon on the growth mechanisms of the nanoparticles will also be studied. Thermogravimetry will be used to identify metal loading. There may be opportunities to test the electrochemical properties and behaviour of the as-developed metal nanoparticle-carbon catalyst-support systems for specific applications.

### *Developing nano-structured carbons for $CO_2$ gas adsorption properties*

**Location:** Gippsland Campus
**Project Leaders:** A/Prof Surbhi Sharma, Dr Alicia Reynolds
**Email:** surbhi.sharma@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** A range of nano-structured carbon materials have been produced from lignite from the Gippsland coal mines. These materials have a range of potential applications, including battery electrodes, catalysts and gas adsorption. This honours project explores the $CO_2$ adsorption properties of these materials.
$CO_2$ is used in a variety of industries including food and beverages, promoting plant growth in greenhouses, fertilizer production. With the need to reduce anthropogenic $CO_2$ emissions, opportunities are being developed to use $CO_2$ in polymers, building materials and aviation fuels. These activities require $CO_2$ separation and purification technologies that are suitable for a variety of sources including cement kilns and hydrogen production.
The honours project uses thermogravimetric analysis to measure gas adsorption and desorption properties of a range of existing nano-structured carbon materials. This information will be used to assess the potential for lignite-derived materials to be used for $CO_2$ separation and purification applications. There may be opportunities to produce nano-structured carbon materials with improved $CO_2$ adsorption properties.

### *Developing bio-degradable membranes to replace Nafion-based proton conduction membranes in hydrogen fuel cells*

**Location:** Gippsland Campus
**Project Leaders:** A/Prof Surbhi Sharma, Dr Alicia Reynolds, Dr Dylan Liu
**Email:** surbhi.sharma@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Proton exchange membrane fuel cells widely use Nafion membranes. These membranes serve diverse purposes in the PEMFC systems which include conducting protons and acting as a separator between the anode and cathode. PEMs also need to have adequate mechanical performance, gas tightness, dimensional and chemical stability against strong acidic and oxidative conditions, in a compressed stack operating at temperatures between 60-100◦C under highly-variable humidity conditions. Nafion, currently the most commercially viable membrane, is perfluorosulfonic acid-based membrane consisting of a hydrophobic fluorocarbon backbone and hydrophilic sulfonic pendant side chains. These polymers are non-biodegradable and release toxic, fluorinated compounds upon degradation. Biodegradable alternatives for these membranes are therefore essential to explore to ensure sustainability of these "renewable energy" systems as we move towards global adoption of hydrogen fuel cells in our fight against climate crises.
This project will explore the development of nanocellulose based membranes from food waste to replace nafion-based membranes in direct methanol and PEM fuel cells. Water uptake, ion-exchange capacity and gas permeability tests and mechanical and thermal stability of the prepared membranes will be studied to determine their suitability for use in hydrogen and methanol fuel cells systems.

### *Authenticating the source of honey and kombucha using rare earth element profiles*

**Location:** Gippsland/Berwick Campus
**Project Leaders:** Dr David Smith, Dr Rebecca Gehling, Dr Alicia Reynolds
**Email:** d.smith@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Independently verifying the origin of foods including honey and kombucha is important for maintaining consumer confidence and identifying the foods region of origin. Rare earth element (REE) profiles have been used to identify geographic origins in some unprocessed foods like vegetables, meat, milk, cereals, honey, and tea. This project will investigate the REE profiles in honey, tea, kombucha, hops or malt from a range of geographic locations. Inductively coupled plasma with mass spectrometry (ICPMS) will be used to measure REE and simple statistical tools will be used to compare REE between samples.

**Key words:** *ICPMS, authentication, analytical chemistry*

### *Colorimetric sensing arrays for food and beverages*

**Location:** Gippsland Campus
**Project Leader:** Dr David Smith
**Email:** d.smith@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** Colorimetric sensing arrays aim to produce unique fingerprint-like patterns using a range of responsive chemical components in response to complex analyte systems. In this project we aim to use a range of commercially available pH-responsive dyes, metallo-complexes, redox-active, and solvatochromic dyes, to produce a sensing assemble that can be applied to distinguish and differentiate foods or beverages. Initially the project will focus on differentiating honey based on its botanical origin, but the intention is to expand the scope of the project to examine beer and raw materials used in the brewing process.

**Key words:** *chemistry, sensing, colorimetric, beer*

### *Garden pH indicators*

**Location:** Gippsland Campus
**Project Leaders:** Dr David Smith, Dr Simone Louwhoff
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**Project Level:** Honours; SCCOR3001

**Project description:** Numerous plants can be used as colour responsive pH indicators. The red cabbage indicator experiment where an extract from red cabbage changes colour in response to pH is commonly used with school students. This project aims to investigate and characterise other plants, fruits, and vegetables that share this ability. Some of these are informally and anecdotally recorded. We will aim to identify these and quantify and measure the response in terms of pH range and colour change. The eventual aim would be to incorporate these pH responsive dyes within the scope of other research projects (see "Colorimetric sensing arrays for food and beverages" Hons project). This initial garden pH indicator project would suit a candidate interested in chemistry, or a candidate interested in plants and flora. It would also be suitable for students with an interest in education.

**Key words:** *chemistry, pH, plants, education*

### *Evaluating the properties of mead produced from Eucalyptus honeys*

**Location:** Gippsland Campus
**Project Leaders:** Dr David Smith, A/Prof Andrew Greenhill, Dr Alicia Reynolds
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**Project Level:** Honours

**Project description:** Honey can be fermented to produce an alcoholic beverage known as mead. The flavour and aroma of the resulting mead is influenced by several factors, including the type and source of honey used. Little is known about how native Australian honeys impact these profiles. This project will examine the flavour and aroma compounds produced during the fermentation of eucalypt honeys. Analysis will include multiple techniques including gas chromatography mass spectrometry and sensory evaluation.

**Key words:** *chemistry, fermentation, aroma, GCMS*

## *Habitat specificity and competitive traits of Australian acacias invaded to natural landscapes in Asia Pacific: a global review*

**Location:** Berwick/Mt Helen Campus
**Project Leaders:** Dr Kushan Tennakoon, Prof S. K. Florentine (Florry)
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**Project Level:** Honours; SCCOR3001

**Project description:** The genus *Acacia* (Family: Fabaceae; subfamily: Mimosoideae) commonly known as Wattles are native to both Australia and Africa. The *Acacia* lineage native to Australia comprise over 900 species are found in different habitats: from coastal to subalpine regions, from high rainfall to arid areas, in tropical, sub-tropical and temperate regions. Approximately 300 *Acacia* spp. of Australian origin have been introduced around the world as timber and ornamental plants and approximately 23 of them have become highly invasive in many terrestrial ecosystems and causing significant impact on biodiversity. Ten *Acacia* spp. (with six species of Australian origin *viz*. *A. longifolia* subsp. *sophorae*, *A. mangium*, *A. mearnsii*, *A. melanoxylon*, *A. retinodes*. and *A. saligna*) are listed in the Global Invasive Species Database with one species (*A. mearnsii*) being in the 100 most invasive species list. It is vital to identify a discrete set of characteristics which facilitate successful invasion by exotic plants such as Acacia species in non-original regions. It has been claimed that invasive plants typically possess novel traits or exhibit more extreme trait values which confer on their competitive advantage over native flora such characteristics: (i) rapid growth, (ii) high N–fixing ability, (iii) heteroblasty and (iv) high flexibility in physiological performance found in Australian *Acacia* spp. However, no clear separation of particular trait sets has been reported for either highly invasive or less invasive different environmental conditions. We found that plant invasion studies have been unevenly distributed biogeographically, with the majority conducted in either Temperate or Mediterranean climate regions. The Mediterranean climate is shared by the Mediterranean Basin, California, Chile, the Western Cape of South Africa and Southern Australia. In contrast, related studies in other climate types such as the seasonal tropics are still scarce. Thus, an assessment of the contribution of traits to success of Australian *Acacia* species' invasions under these largely unstudied conditions/climates in the Asia Pacific will help us to better understand invasive mechanisms and subsequently develop control approaches.
This project will aim to provide insights into Australian *Acacia* invasiveness for the more efficacious selection of management practices, including control.

## *Application of novel UV-C radiation technology to minimize aquatic weeds and algae impacts in waterways*

**Location:** Berwick/Gippsland Campus
**Project Leaders:** Dr Kushan Tennakoon, Dr Gayan Kahandawa
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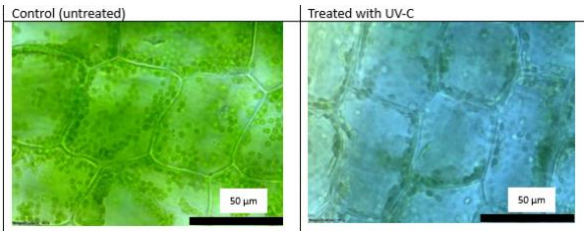
**Project Level:** Honours; SCCOR3001

**Project description:** We have partnered with Southern Rural Water (SRW) in co-designing UV-C radiation technology to efficiently combat submersed aquatic weeds and algae in the irrigation canals and reservoirs. Main aim of this investigation is to minimize current usage of hazardous chemicals and weedicides (Magnacide™ H) by introducing this technology.
This novel technology will create a more sustainable, cost-effective solution than using chemicals, and minimizing impact on irrigation systems during the chemical/ weedicide application seasons to treat weeds. This study pioneers the exploration of UV-C light for managing aquatic weeds, and it is anticipated that this new technology will help reduce the chemical pollution caused by synthetic herbicides currently used to control aquatic weeds in our irrigation channels. We expect to further investigate the potential of integrated use of UV-C treatment with other ecofriendly management actions such as bioherbicides as a long-term solution over traditional synthetic herbicide applications.
The potential Hons student is expected to assess physiological and cellular changes of selected aquatic plants/ algae from UV-C radiation to gather conclusive evidence that aquatic plants and algae can be killed using this UV-radiation. After that, an application will be designed as an apparatus to be used in the field.



### *Investigating Plant Traits in the Climate Future Vegetation Plots – Dandenong, Knox and Maroondah*

**Location:** Berwick/Gippsland/Mt Helen Campus
**Project Leaders:** Dr Kushan Tennakoon, Prof S. K. Florentine (Florry)
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**Project Level:** Honours; SCCOR3001

**Project description:** Climate Future Plots for resilient vegetation under a changing climate is a strategy developed to evaluate revegetation outcomes in a changing climate. Mounting studies are suggesting that climate change is likely to have an increasingly negative impact on revegetated and remnant areas of vegetation in Australia. These predicted warmer and drier climates, combined with extreme weather events such as hotter days, decreased rainfall over winter and spring, a decline in frosts and an increase in fire events and sometimes even relatively wetter periods, will have significant detrimental impacts on the effectiveness of current management interventions. We have established 5 such plots in Dandenong, Knox and Maroondah city council areas. This is a collaborative project between Federation University and Melbourne Water using appropriately selected native and indigenous plant species from a range of provenances. These plants will be monitored long-term.
Project aims:

1. To determine the growth, physiological responses and survival of different native plant species from different provenances under a changing climate
2. To assess how climatic and environmental variables influence plant provenance growth and survival
3. To provide an example of a scientifically robust planting design that has Traditional Owner and community support and relevance for culture and biodiversity.

Sub-aims:

- act as a seed production area for climate adjusted seeds.
- provide recreational and aesthetic value to the communities of that region

Other options: There is also scope to conduct broader vegetation or insect surveys in these plots along with additional campus specific supervisors.

### *Seed ecology and agronomy of a selected Murnong (Microseris) yam daisy species*

**Location:** Berwick/Mt Helen Campus
**Project Leaders:** Dr Kushan Tennakoon, Prof S. K. Florentine (Florry), Dr Nick Schultz
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**Project Level:** Honours; SCCOR3001

**Project description:** Murnong (*Microseris* sp.) has long been recognised as one of the most important staple food sources for Aboriginal people of the grassy plains of south-eastern Australia. However, Murnong on the plains became scarce after the introduction of sheep and rabbits. Murnong persist now in isolated undisturbed grassland remnants and dry sclerophyll forests in Victoria. Recently, Walsh (2016) conducted a taxonomic revision which increased *Microseris* from two to three species. In Victoria *Microseris walteri* (largely found in central and western Victoria), *M. scapigera* (south-west Victoria), and *M. lancelota* (eastern part of Victoria) exist. The Murnong SEED Citizen Science Project (SEED - Studies Exploring Edible Daisies) is a joint Higher Ed and TAFE FedUni project, with the assistance of more than 200 citizen scientists and gardeners. It aims to explore the growth form and distribution of the two local species, analyse their nutritional and medicinal value and build up stocks for education and revegetation projects here in Victoria.
This project will investigate the seed ecology and agronomy of one of the Murnong species. Knowledge of optimum growth requirements of Murnong species is critically important to develop cultivation protocols for eventual bushland and grassland revegetation projects using this culturally significant species. A suitable candidate can (i) examine the influence selected environmental factors such as temperature, light, pH, Salinity, soil moisture, and burial depth on the germination and emergence of the seeds of one of *Microseris* species *in* Victoria, and (ii) examine the effect of different soil types, light and application of synthetic fertilisers on the growth and establishment of the same *Microseris* species under controlled conditions (plant house study to be conducted in the Ballarat Campus).

### *Utility-based reinforcement learning*

**Location:** Mt Helen Campus or Online
**Project Leader:** Prof Peter Vamplew
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**Project Level:** Honours

**Project description:** In recent years reinforcement learning has been a hot topic in artificial intelligence research, achieving spectacular results such as defeating the human world champion at Go by learning from experience to maximise a reward signal. However, researchers have realised that the connection between the reward signal and the resulting behaviour may not be straightforward and so designing appropriate rewards is difficult. Multi-objective RL addresses this via multi-policy learning whereby the agent learns multiple policies for different interpretations of that reward signal. We have proposed that the multi-policy concept can be adapted to conventional single-objective RL where scalar rewards are used (https://arxiv.org/abs/2402.02665). This project will implement and evaluate one or more of the approaches proposed in that paper.

## *Micro v Macro: The role of macrophages in immunity to bacteria and evasion tactics used by Salmonella*

**Location:** Mt Helen Campus
**Project Leaders:** Dr Morgan Wallace, Dr David Bean
**Email:** m.wallace@federation.edu.au, d.bean@federation.edu.au
**Project Level:** Honours; SCCOR3001

**Project description:** The activation of macrophages is key to mounting effective immune responses to bacterial pathogens. Macrophages detect bacteria using a variety of pathogen-specific receptors, and become activated, secreting proinflammatory cytokines and chemokines that recruit other immune cells to the site of infection. Macrophages also play a major role in pathogen clearance, through phagocytosis and digestion of bacteria in phagolysomes, and subsequently the activation of adaptive immune responses. Most pathogenic bacteria have evolved means of immune evasion that limit activation of and differentiation of macrophages, or inhibit digestion inside phagolysosomes. This project will utilise THP-1 cells, a human leukemia monocytic cell line to investigate the ability of *Salmonella* to infect human monocytes and evade macrophage mediated immune mechanisms. As not all *Salmonella* are created equal, and this project will compare different *Salmonella* subspecies and their effect on macrophages.

**Key words:** *Macrophage, monocyte, immunity, salmonella*

## *Age-related changes in immunity to vaccines*

**Location:** Mt Helen Campus
**Project Leaders:** Dr Morgan Wallace, Prof Stuart Berzins
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**Project Level:** Honours; SCCOR3001

**Project description:** Immune function is known to decrease with age and this decline has implications for vaccine efficacy in the elderly. Understanding how immune function changes over time, and how this correlates with protection and disease incidence, may enable us to better predict the risk of chronic disease and target treatments and vaccine doses more effectively. This project will study vaccine responses in people across a range of age groups, focusing on correlation of their immune cell frequency and function with their level of vaccine response. We will focus on individuals vaccinated against COVID-19 because older people are at high risk of serious illness from COVID-19 so understanding the immune response is critically important in this setting.

**Key words:** *Immunology, adaptive immune response, immunosenescence*

## *Sympathetic nerve activity and abdominal aortic aneurysm (AAA)*

**Location:** Mt Helen Campus
**Project Leader:** Dr Yutang Wang
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**Project Level:** Honours; SCCOR3001

**Project 1 description: Renal denervation and AAA.** AAA represents a weakened and dilated region of the abdominal aorta. Its rupture is responsible for 200,000 deaths worldwide each year. There is no drug to slow down AAA development and rupture highlighting an urgent need to investigate the pathogenesis of AAA and to develop drugs to treat this disease. Our preliminary study showed that renal denervation decreased AAA formation in mice. This project aims to investigate the mechanism underlying renal denervation's protective effect on AAA. It involves histology, immunohistochemistry, quantitative PCR, and biochemical analysis.

**Project 2 description: Sympathetic inhibition and AAA.** The aorta is innervated with sympathetic nerves and it has been that sympathetic nerve activity is increased in AAA. This project aims to investigate the effect of inhibition of α and β adrenoceptors on the formation of AAA. This project involves the preparation of AAA in mice via subcutaneous infusion of angiotensin II. The techniques include research animal handling, histology, immunohistochemistry, and quantitative PCR.

**Project 3 description: Norepinephrine and cell migration.** AAA is characterised by enhanced inflammation. Preliminary finding suggests that norepinephrine may promote cell migration. This project aims to investigate the effect of norepinephrine on the cellular migration of inflammation cells. The techniques involved include cell culture, cell migration assay, and quantitative PCR.

**Project 4 description: Norepinephrine and vascular smooth muscle cell (VSMC) apoptosis.** AAA is characterised by enhanced VSMC apoptosis. This project aims to investigate the effect of norepinephrine on VSMC apoptosis. The techniques involved include cell culture, apoptosis assay (flow cytometry and TUNNEL assay), and quantitative PCR.

**Key words:** *aortic aneurysm, norepinephrine, neurons, cell migration, α blocker, β blocker*