Federation University

Institute of Innovation, Science and Sustainability

Bachelor of Science Honours Projects (SZ8)

&

SCCOR3001 - Research Projects

2024

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

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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 2024. Note that this is not a complete list of available projects for 2024, 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 2024 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; Information Technology; Food 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 2024.

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 2024. Note that this is not a complete list of available projects for 2024, 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 2024 is 17 November 2023

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 2024.

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 Characterisation of pathogenic potential of *Salmonella spp* isolated from the lowland Copperhead snake, *Austrelaps superbus* Elucidation of mechanisms of intrinsic polymyxin resistance in Gram-negative bacteria Hydration of yeast in brewing: adding value or unnecessary risk? Isolation and characterisation of yeasts from spontaneously fermented Victorian beer products Making a truly Australian beer: searching for native yeasts Thermal stress resistance of Salmonella in chocolate
Prof Stuart Berzins	The development of unconventional T cells in the human thymus Why are elderly people at higher risk from COVID-19?
Dr Rob Bischof	Assessing the impact of nutrition, heat stress and grazing behaviour on the immune status of dairy cows Functional and phenotypic characterisation of airway macrophages Immunomodulatory properties of worms: searching for new anti-inflammatory treatments Testing of novel therapeutics for the treatment of lung disease Understanding the lung microbiome in health and disease
Dr Gregory Davis	Screening of breast cancer type 1 and 2 susceptibility proteins (BRCA1/2) in germ cells DNA damage repair pathways and mutagenesis
Dr Habtamu Derseh	Functional and phenotypic characterisation of airway macrophages Testing of novel therapeutics for the treatment of lung disease
Dr Meagan Dewar	Development and evaluation of field-based detection devices of wildlife pathogens Life cycle adaptions of Little penguins in captivity Microcontaminant impact on the microbiome of Victorian penguin populations 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 Seed ecology and agronomy of a selected Murnong (*Microseris*) yam daisy species
Dr Rebecca Gehling	Authenticating the source of honey, kombucha, or brewing raw materials using rare earth element profiles Bioaccumulation and effect of emerging contaminants in the environment Chemical compounds present in designer drugs previously known as 'legal highs' Chemical profiles of non-alcoholic fermented kombucha beverages Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse
Dr Bill Grant	Transformation of organic fractions during thermophilic composting

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 Development and evaluation of field-based detection devices of wildlife pathogens Hydration of yeast in brewing: adding value or unnecessary risk? Making a truly Australian beer: searching for native yeasts Production of aroma compounds from the fermentation of native Australian honeys Seabird and elasmobranch microbiomes Understanding the lung microbiome in health and disease
Dr Fiona Hogan	Sniffing out koala diet
Dr Andrew Hood	Effects of oxidation conditions on humic and fulvic acids
Dr Apurv Kumar	Can hydrothermal carbonisation process water be used to improve the efficiency of producing hydrogen by electrolysis? Producing conductive carbons from waste resources for batteries
Dr Dylan Liu	Transforming food waste into sustainable nanocellulose materials: join us in catalysing a circular economy revolution
Dr Benjamin Long	Bioaccumulation and effect of emerging contaminants in the environment Microcontaminant impact on the microbiome of Victorian penguin populations Self-assembling peptides as building blocks for 3D printable hydrogels The Bush Medicine Project - Investigation of bioactive compounds in plants used in Indigenous Australian traditional medicine practices of south-eastern Australia
Dr Simone Louwhoff	Garden pH indicators Lichens as indicators of ecosystem functionality in revegetated forests Suitability of Eucalypt species as lichen hosts
Dr Scott Nankervis	Characterisation of pathogenic potential of *Salmonella spp* isolated from the lowland Copperhead snake, *Austrelaps superbus*
Dr Ashley Olson	Development of a novel Bio-acoustic monitoring system to determine habitat usage by the endangered Eastern Bristlebird
Dr Grant Palmer	Assessing the effects of predation risk on threatened small mammals using GUD experiments Drone- and community- monitoring of declining wildlife populations in the Ballarat region
Dr Indu Panicker	Validation of PCR for detection of Giardia and Cryptosporidium
Dr Truong Phang	Drone- and community- monitoring of declining wildlife populations in the Ballarat region
Prof David Piedrafita	Assessing the impact of nutrition, heat stress and grazing behaviour on the immune status of dairy cows Functional and phenotypic characterisation of airway macrophages Testing of novel therapeutics for the treatment of lung disease Understanding the effect of PPID on parasite burden in horses Understanding the lung microbiome in health and disease
Dr Sarah Preston	Drone- and community- monitoring of declining wildlife populations in the Ballarat region Immunomodulatory properties of worms: searching for new anti-inflammatory treatments Life cycle adaptions of Little penguins in captivity Understanding the effect of PPID on parasite burden in horses Understanding the lung microbiome in health and disease

Dr Jess Reeves	Ecology and Water Chemistry of the Morwell Wetlands Living Bung Yarnda (Lake Tyers) environmental stewardship plan Social Capital for Sustainable Farming
Dr Alicia Reynolds	Authenticating the source of honey, kombucha, or brewing raw materials using rare earth element profiles Bioaccumulation and effect of emerging contaminants in the environment Can hydrothermal carbonisation process water be used to improve the efficiency of producing hydrogen by electrolysis? Chemical compounds present in designer drugs previously known as 'legal highs' Chemical profiles of non-alcoholic fermented kombucha beverages Effects of oxidation conditions on humic and fulvic acids Monitoring wastewater for the presence of emerging synthetic designer drugs of abuse Producing conductive carbons from local lignite for batteries Producing conductive carbons from waste resources for batteries Production of aroma compounds from the fermentation of native Australian honeys Studying the CO_2 gas adsorption properties of local lignite based materials Transformation of organic fractions during thermophilic composting
Dr Nick Schultz	Bioaccumulation and effect of emerging contaminants in the environment Development of a novel Bio-acoustic monitoring system to determine habitat usage by the endangered Eastern Bristlebird Making a truly Australian beer: searching for native yeasts Seed ecology and agronomy of a selected Murnong (*Microseris*) yam daisy species
A/Prof Surbhi Sharma	Can hydrothermal carbonisation process water be used to improve the efficiency of producing hydrogen by electrolysis? Producing conductive carbons from local lignite for batteries Producing conductive carbons from waste resources for batteries Studying the CO_2 gas adsorption properties of local lignite based materials
Dr David Smith	Authenticating the source of honey, kombucha, or brewing raw materials using rare earth element profiles Colorimetric sensing arrays for food and beverages Garden pH indicators Production of aroma compounds from the fermentation of native Australian honeys
Dr Kushan Tennakoon	Habitat specificity and competitive traits of Australian acacias invaded to natural landscapes in Asia Pacific: a global review Pollination and fruit production in the desert quandong Santalum acuminatum at Nanya Research Station Seed ecology and agronomy of a selected Murnong (*Microseris*) yam daisy species
Prof Peter Vamplew	Implementing and evaluating the forall-network approach to deep multiobjective reinforcement learning Investigating and addressing unstable value functions in multiobjective reinforcement learning Utility-based reinforcement learning
Dr Morgan Wallace	The development of unconventional T cells in the human thymus Why are elderly people at higher risk from COVID-19?
Dr Yutang Wang	Sympathetic nerve activity and abdominal aortic aneurysm (AAA)
Dr Faye Wedrowicz	Sniffing out koala diet

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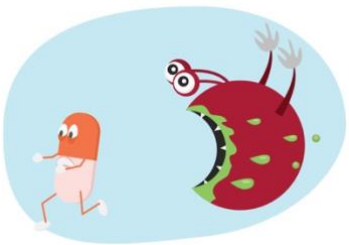
List of Projects

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*



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.

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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).

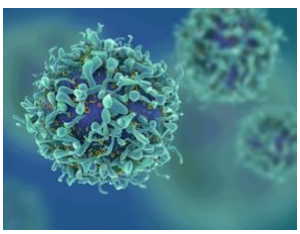
Thermal stress resistance of Salmonella in chocolate

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.

The development of unconventional T cells in the human thymus

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



Project description: There is growing interest in the function of unconventional T cells and their role in diseases such as COVID-19, cancer and allergies. In many instances, the T cells in these patients are abnormal, but it is unclear whether this has occurred as a result of the disease, or if the development of these cells was defective. The developmental pathway of these cells is poorly defined in humans so this project will use cells from human blood, cord blood and thymus to study gene expression and function as the cells mature.

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

Why are elderly people at higher risk from COVID-19?

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

Project description: Immunity is known to wane with age, but this does not apply to all people equally. In fact, while the risk of serious illness from COVID-19 is highest in the elderly, vaccinated people aged over 70 will usually only experience mild symptoms and will recover well. If we could predict which people among the elderly were at highest risk, health care providers could provide more effective protection. We are investigating whether characteristics of the immune system can predict which individuals are likely to have weak immune response to COVID-19 and require additional protection.

Key words: *Immunology, T cells, immune response, 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*

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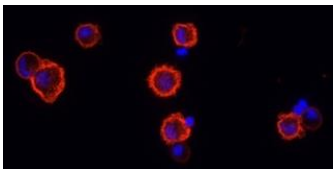
Functional and phenotypic characterisation of airway macrophages

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.

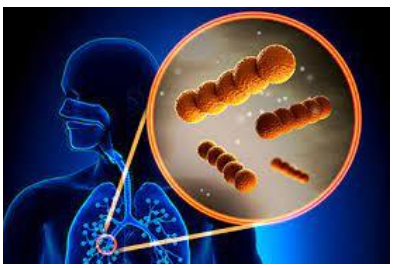
Key words: *lung disease, translational model, sheep*

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*



Screening of breast cancer type 1 and 2 susceptibility proteins (BRCA1/2) in germ cells

Location: Gippsland Campus
Project Leader: Dr Gregory Davis
Email: greg.davis@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: Mutations in key DNA damage repair proteins BRCA1 and BRCA2 lead to a marked increase in breast cancer in humans. Both BRCA1/2 are associated with repairing breaks in DNA that could otherwise result in disease associated mutations if not repaired. Although the role of BRCA1/2 is understood, how BRCA1/2 are recruited to sites of DNA damage are poorly understood. This study will use the model organism *C. elegans* to explore proteins that associate with BRCA1/2 in germ cells. This will include RNAi screening, genetic cloning (CRISPR) and fluorescent microscopy. It is anticipated that this project will identify key proteins that recruit BRCA1/2 and enhance their function in the DNA damage repair process.

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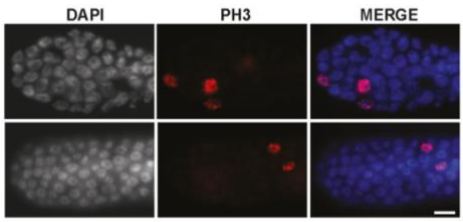
DNA damage repair pathways and mutagenesis

Location: Gippsland Campus
Project Leader: Dr Gregory Davis
Email: greg.davis@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: DNA damage repair contributes to genomic stability in all eukaryotes. Due to this, the pathways associated with DNA damage repair are highly conserved from yeast through to humans. While these are well characterised, the recruitment and maintenance of these repair mechanisms is largely unknown. This project will use the multicellular model organism, *Caenorhabditis elegans*, to explore key genes required for repairing DNA damage and their contribution to maintaining chromosomal integrity in early embryonic events. This project will involve several approaches including genetics, immunohistochemistry, cloning and fluorescence microscopy.

Key words: *DNA damage, genome, mutagenesis*



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*

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*

Sniffing out koala diet

Location: Berwick/Gippsland Campus
Project Leaders: Dr Fiona Hogan, Dr Faye Wedrowicz
Email: fiona.hogan@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: In this project you will join the team at OWAD Environment and their detector dogs to search for koala scats in SE Queensland. Specially trained detector dogs will be employed to sniff out koala scats in the field. Koala scats will be collected, along with leaf samples from close by trees. Back in the laboratory you will develop molecular markers which can be used to identify the species of the leaf, DNA isolated from the scat sample will then be matched to the references, and the diet of the koala revealed. Knowledge of koala diet will help land managers to direct conservation efforts, as well as provide information about what plant species should be used in revegetation efforts aimed at koala conservation. Skills acquired in this project will include experience working as an environmental consultant, working knowledge of detector dog work for conservation, animal scat ID training, field skills, and laboratory skills including DNA isolation, PCR, Next Gen Sequencing and bioinformatics. This project will involve spending around one month in the field with OWAD Environment http://www.owad.com.au/ in SE Queensland. Timing of this trip is unknown and as such you must be available to travel/stay away from home for the time required. You must also have a very good fitness level, as field work with detection dogs is intense and involves long days.

Transforming food waste into sustainable nanocellulose materials: join us in catalysing a circular economy revolution

Location: Mt Helen Campus
Project Leader: Dr Dylan Liu
Email: dylan.liu@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: Are you passionate about sustainability and innovation? Do you want to contribute to meaningful, ground-breaking research that aligns with the United Nations' Sustainable Development Goals? If so, I invite you to become an integral part of our transformative research journey.

The Challenge

Globally, nearly one-third of all food produced is wasted, posing serious environmental, economic, and social issues. In Australia alone, food waste has amounted to a staggering $20 billion loss and contributed to millions of tonnes of greenhouse gas emissions. This wasteful cycle is opposed to the urgent need for sustainable practices.

Our Breakthrough

Researchers at Federation University have pioneered a revolutionary, cost-effective method to repurpose food waste into high-performance nanocellulose materials. These bio-derived substances boast exceptional properties such as remarkable mechanical strength, superior chemical stability, and optimal biocompatibility.

In this Honours project, you will:

- Optimise the innovative process of nanocellulose production from various types of food waste.
- Investigate the multi-faceted applications of nanocellulose.
- Evaluate the environmental impact of this transformation, thereby contributing to a circular economy.

Join us in crafting a greener, more sustainable future for all.

To find out more, please check this link.

Bioaccumulation and effect of emerging contaminants in the environment

Location: Mt Helen/Gippsland Campus
Project Leaders: Dr Benjamin Long, Dr Nick Schultz, Dr Rebecca Gehling or 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 solid phase extraction (SPE, QuEChERS) and HPLC-MS/MS.

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

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

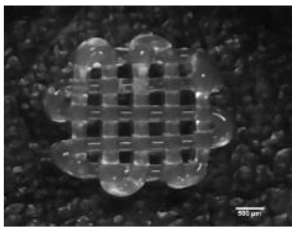
Project description: Pharmaceuticals as organic microcontaminants are an emerging problem in the environment. While these pharmaceuticals are well known to disturb the gut microbiome there is also increasing evidence to show that pharmaceuticals in environmentally relevant concentrations can exert the 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*

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).



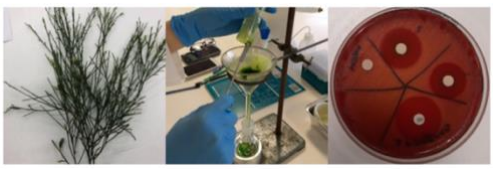
Key words: *hydrogels, peptides*

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; SCCOR3001

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*



Lichens as indicators of ecosystem functionality in revegetated forests

Location: Gippsland/Berwick Campus
Project Leaders: Dr Simone Louwhoff, Dr Philip Barton
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 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. They also play an important ecological role and it is important to recognise their potential contribution to revegetated forests. Lichens have been used to monitor ecosystem function or health (described as including maintenance of productivity, nutrient cycling, and disturbance response) of a forest. Their presence can, therefore, be used as an indication that this has been re-created at a revegetated site. The overall objective is to determine if individual lichen species or lichen assemblages can be used to determine the success of a revegetation project in mimicking the ecosystem functionality usually associated with remnant vegetation. Students will identify the lichen flora of revegetation projects in different successional stages, and compare lichen species in revegetated patches with those in remnant patches in similar ecological vegetation classes (EVCs).

Key words: *lichen, indicators, ecosystem functionality, revegetation, monitoring, restoration*

Suitability of Eucalypt species as lichen hosts

Location: Gippsland Campus
Project Leaders: Dr Simone Louwhoff, Dr Philip Barton
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? While lichens are frequently overlooked, they can play an important ecological role in eucalypt forests. Preliminary observations show that *Eucalyptus radiata* in lowland forest is a suitable host for 15 species with lichens extending far into the canopy. Due to their continuously flaking and shedding bark, many eucalypts are poor lichen hosts. However, species that retain their finely textured bark almost to the outer canopy branches, provide suitable habitats for several different lichens. Although no lichens appeared restricted to *E. radiata*, some degree of specificity with eucalypts has been observed, including the bright yellow, leprose lichen *Chrysothrix candelaris*. Other large trees comprising the over storey in lowland forest (*E. obliqua and E. consideniana*), also have bark persistent into the canopy branches but, overall, only limited research into their suitability as a lichen host has been conducted. The overall objective is to conduct a systematic field survey of eucalypts as lichen hosts, with a special focus on host specificity and observation of lichens and burnt bark. These data can be used to contribute knowledge to restoration efforts and what tree species to plant to maximise potential for lichen diversity. Students will develop vegetation and lichen identification skills (including microscopy and thin layer chromatography), skills in analysing the biodiversity data sets, and scientific writing. This project will aim to (1) identify the lichen flora on eucalypt trees in different vegetation types, (2) investigate if some trees host more species than others, and if some lichens are specific to particular eucalypts, (3) comment on the potential value of some lichens to be indicators of eucalypt forest integrity, and (4) investigate a connection between lichens and burnt eucalypt bark.

Key words: *lichen, indicators, host specificity, lichen hosts, ecosystem, ecological role*

Characterisation of pathogenic potential of Salmonella spp isolated from the lowland Copperhead snake, Austrelaps superbus

Location: Mt Helen Campus
Project Leaders: Dr Scott Nankervis, Dr David Bean
Email: s.nankervis@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: *Salmonella* is a leading cause of gastroenteritis in humans. Perhaps less well known is that it is also a common commensal in reptiles, including Australian snakes. Typically, *Salmonella* colonisation of snakes occurs with non-*enterica* subspecies, including *S. arizonae* and *S. diarizonae.* These subspecies tend to be underrepresented in cases of human illness. The current project aims at understanding the human pathogenic potential of reptile isolates, while elucidating factors which make them efficient colonisers of reptiles.

Salmonella enterica serogroups capable of infecting humans do so using Type 3 Secretion Systems (T3SS) encoded on genomic regions known as *Salmonella* Pathogenicity Islands (SPIs); these SPIs encode a variety of needle-like protein structures known as injectosomes that deliver effector proteins to host cells, enabling the *Salmonella* to interact with the host cell membrane, internalise, and evade host cell immune responses, enabling them to set up an intracellular niche from which they replicate and cause disease. We have initial data revealing the presence and/or absence of 4 common genes predicting the inclusion of major SPIs in our *Salmonella* isolates and would like to continue this work to provide a comprehensive screen of all Copperhead *Salmonella* isolates in our collection. This will then extend to cell culture experiments in which both adhesion and invasion assays are used to characterise the ability of these isolates to interact with human host cell membranes and invade these human host cells using a common model of *Salmonella* invasion/adherence – the human colon carcinoma cell line CaCo2. Further work may include the creation of effector-GFP fusions to enable confocal microscopic examination of effector localisation on or within human host cells.

Federation University

Institute of Innovation, Science and Sustainability

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.

Assessing the effects of predation risk on threatened small mammals using GUD experiments

Location: Nanya Research Station
Project Leader: Dr Grant Palmer
Industry collaboration: Dr Helen Waudby (DPE, NSW)
Email: g.palmer@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: The Scotia Mallee region, including Nanya Research Station, supports a diversity of small ground-dwelling mammals, including threatened species such as southern Ningaui (*Ningaui yvonneae*), Bolam's mouse (*Pseudomys bolami*), sandy inland mouse (*P. hermmansburgensis*), stripe-faced dunnart (*Sminthopsis macroura*), and more recently, the dusky hopping mouse (*Notomys fuscus*).
Fire is a key factor shaping habitat in this region, with the post-fire age of a site influencing vegetation structure and composition. Younger post-fire classes of vegetation presumably provide less cover than older sites, and may be associated with greater levels of predation on small mammals by predators, including introduced foxes and cats. Giving-up density (GUD) experiments provide an informative approach to quantifying foraging outcomes in relation to predation risk for small mammals, in heterogeneous landscapes (Bedoya-Perez *et al.* 2013).
This Honours project will investigate the effect of fire history and habitat structure on predation risk for small, threatened mammals at Nanya Research Station. The study will include GUD experiments to establish the foraging outcomes and predation risk for these species in the Scotia Mallee region. This work will inform conservation and management activities (particularly fire, predator and habitat management) for these species in the region. This work will involve collaboration with Department of Planning & Environment, NSW and has $10,000 funding support in place.

Validation of PCR for detection of Giardia and Cryptosporidium

Location: Berwick Campus
Project Leaders: Dr Indu Panicker,
Dr Richard Bradbury (JCU)
Email: indu.p@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: *Giardia* and *Cryptosporidium* are protozoan parasites with zoonotic potential, that infect a wide host of animals and humans. The role of marsupials as a reservoir for zoonotic transmission of these protists is speculated. The common ringtail possums cohabitating with humans, may act as a reservoir for zoonotic transmission of these protists. However, it has not been known whether the common ringtail possum is infected with *Giardia* or *Cryptosporidium*. This study will investigate the occurrence of *Giardia* and *Cryptosporidium* species in the common ringtail possums. The study involves sample collection, DNA extraction from faecal sample and validation of nested PCR. This will be a pilot study of the potential for the common ringtail possums to be reservoirs of *Giardia* and *Cryptosporidium* infection.

Drone- and community- monitoring of declining wildlife populations in the Ballarat region

Location: Mt Helen Campus
Project Leaders: Dr Sarah Preston, Dr Truong Phang, Dr Adriene Lavinia (Ballarat Wildlife Park), Dr Grant Palmer
Email: sj.preston@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: A collaboration between the Ballarat Wildlife Park (BWP), and Federation Universities' School of Engineering, Information Technology and Physical Sciences and School of Science, Psychology and Sport will provide the BWP and community with an open access database of historical and current wildlife populations. To begin, the student will conduct a literature review to identify historical numbers and best practice for identification and recording of wildlife, particularly relating to koalas. Next the student will work with Fed Uni scientists to develop an automated koala tracker using drone surveillance technology. Machine learning approaches will be optimised to automatically count koalas from the thermal images taken by the drone. This will be integrated with counts already collected from the community. The integration of technology and community surveillance will result in an open access research and community tracking App. Tourists and locals and members that visit to BWP will be educated on the declining koala habitat and encouraged to download the App and help monitor the declining population. BWP will use this data to make animal conservation decisions, growing their business in local wildlife conservation.

Federation University

Institute of Innovation, Science and Sustainability

Immunomodulatory properties of worms: searching for new anti-inflammatory treatments

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

Project description: Inflammation is a hallmark of both acute and chronic diseases and is a key driver of increased morbidity in our modern lifestyle. Chronic inflammation is problematic for a range of diseases including arthritis, asthma, diabetes, cancer, neurogenerative and cardiovascular disease. The mainstay treatment relies on anti-inflammatory medication that can lead to broad complications. There is a massive need to explore the potential for new anti-inflammatory agents that are safer, less toxic and more specific in their actions. In some of these diseases, certain white blood cells known as monocytes play a major role in promoting the inflammatory response.
Helminth parasite (ie 'worms') secrete specific molecules known as galectins that modulate the immune response and switch off inflammation. However, little is known about the specific immunomodulatory effects that parasite-derived galectins have on monocytes. Using a combination of bioinformatics, cell culture, flow cytometry and statistical modelling techniques, this project will investigate whether galectins derived from worms can modulate immune responses, and will help to identify new candidate molecules for anti-inflammatory therapeutics.

Key words: *parasites, vaccine, immune system, worms, ovine*

Life cycle adaptions of Little penguins in captivity

Location: Mt Helen/Berwick Campus
Project Leaders: Dr Sarah Preston, Dr Philip Barton, Dr Meagan Dewar, Dr Adriene Lavinia (Ballarat Wildlife Park)
Email: sj.preston@federation.edu.au
Project Level: Honours; SCCOR3001

Project description: Ballarat Wildlife Park (BWP) is home to a colony of 20 Little penguins *(Eudyptula minor)*. In the wild, Little penguins spend approximately 80% of their time at sea, returning to land to breed, moult and rest. It is un known how this lifecycle structure and associated feeding habits are adapted in captivity. This project will use advanced statistical approaches such as mixed model non-linear regression models to analyse three years of daily feed intake data from the Little penguin colony and correlate weight gain/losses to their lifecycle. Trends in this dataset will be identified and compared to similar datasets of wild Little penguin colonies where possible. The project will also involve site visits to the park where the student will have the opportunity to weigh and handle the little penguins and network with the staff at the BWP. A major outcome of the project will provide new insight to the habituation of little penguins in captivity.

Understanding the effect of PPID on parasite burden in horses

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

Project description: Pituitary pars intermedia dysfunction (PPID) is an endocrine condition affecting twenty percent of aged equines. PPID results in elevated cortisol levels causing immunosuppression and hence commonly suffer fatal infections and/or inflammatory conditions. Furthermore, immunosuppression may lead to increased parasite susceptibility. Research on PPID associated parasite burden is sparse. High worm burden may manifest as weight loss, illness and colic. Colic presents as abdominal pain and can require surgery or euthanasia. This study aims to determine if equines with PPID have increased susceptibility to parasites. Resulting information may help devise new parasite treatment and management plans for PPID and healthy equines. This study (in collaboration with the University of Melbourne) will also investigate the immune cells in horses with PPID compared to age-matched horses and susceptibility to parasites.

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

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, Dr Andrew Hood
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

Transformation of organic fractions during thermophilic composting

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 uses samples from a commercial composter to investigate changes in the humic-like structures during thermophilic composting, mesophilic curing and maturation stages. After extracting and quantifying fulvic and humic-like fractions, the project will use 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 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

Can hydrothermal carbonisation process water be used to improve the efficiency of producing hydrogen by electrolysis?

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

Project description: Producing hydrogen by electrocatalytically splitting water typically involves two reactions: Hydrogen Evolution Reaction (HER) at the anode and Oxygen Evolution Reaction (OER) at the cathode. State-of-the-art PEM electrolysis technologies are dependent on fresh water. However, OER requires high potentials, limiting the energy efficiency of the overall process. Energy efficiency could be improved by oxidising small organic compounds (eg, aldehydes, alcohols and ammonia) to produce industrially relevant chemicals in situ instead of OER. This approach is called value added electrolysis (VAE)
Hydrothermal carbonisation is a well-known technique for processing organic waste which produced a chemical-rich water by-product containing a variety of organic compounds.
This project evaluates the composition of water from hydrothermal carbonisation for the purpose of hydrogen generation to explore the feasibility of VAE from waste-water streams. Composition of this chemical-rich water produced from a waste using hydrothermal carbonisation will be determined using infra-red spectroscopy, chromatography and mass spectroscopy. There may be an opportunity to evaluate the electrochemical properties of the water.

Producing conductive carbons from local lignite for batteries

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

Project description: Activated carbons, due to their low cost, low density and high surface area, are actively studied as a promising choice for electrodes in a variety of electrochemical/green energy storage devices including batteries (Li+, Na+, K+, Zn+) and supercapacitors (pseudocapacitor, symmetric, asymmetric and hybrid capacitors). These devices form an integral part of next generation portable electronics, hybrid electrical vehicles and solar energy harvesting.
Lignite is commonly available low-value carbon in Victoria. It has an interesting microporous structure with a variety of oxygen functional groups similar to those found in many oxidised nanostructured carbon materials. This project will be focussed on identifying methods and approaches for upcycling this resource into high-value carbons for application in battery electrodes. Wet chemistry and high temperature treatment methods will be explored for this project.

Producing conductive carbons from waste resources for batteries

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: Recycling and upcycling of **s**olid organic waste is a high-priority for VIC govt as it essential for a sustainable circular economy . The project will be focussed on upcycling waste carbon (sewage waste, biosolids, farm waste) into high-value carbons such as electrodes used in batteries. The project will use a high-temperature, high-pressure approach called hydrothermal carbonisation (HTC) which utilises sub-critical conditions for processing and transforming materials. Other wet-chemistry approaches may be used in combination with HTC for electrode development.
This a literature and laboratory (Gippsland Campus) based project.

Studying the CO_2 gas adsorption properties of local lignite based materials

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

Project description: Separation, capture and storage of CO_2 is essential to a variety of industrial processes including blue hydrogen production. This project focusses on exploring lignite-based materials and understanding their capacity to adsorb CO_2. The project will use thermogravimetric analysis to measure gas adsorption and desorption properties of a range of materials that already exist in the laboratory. There may be opportunities to produce hybrid materials with tailored porosity and composition to improve CO_2 adsorption behaviours.

Authenticating the source of honey, kombucha, or brewing raw materials 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 like 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 couple 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
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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 likely focus on differentiating honey based on its botanical origin, but the intention is to also expand the scope of the project to examine beer and other components of 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: Many plants can be used as colour responsive pH indicators. The red cabbage 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*

Production of aroma compounds from the fermentation of native Australian honeys

Location: Gippsland Campus
Project Leaders: Dr David Smith, A/Prof Andrew Greenhill, Dr Alicia Reynolds
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Project Level: Honours; SCCOR3001

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 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.

Pollination and fruit production in the desert quandong Santalum acuminatum at Nanya Research Station

Location: Berwick/Mt Helen Campus
Project Leaders: Dr Kushan Tennakoon, Dr Philip Barton
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Project Level: Honours; SCCOR3001

Project description: A project is available for a suitable candidate to examine the pollination biology and fruit production of the desert quandong *Santalum acuminatum* at Nanya Station. *Santalum acuminatum* is a hemi-parasitic plant in the sandalwood family. The aim of this project is to identify key insect species involved with the pollination of quandong trees, and how this translates to fruit production and seed set. The project will involve field work to survey insects while trees are flowering, and repeat surveys to assess seed production. There is also scope to conduct broader vegetation or insect surveys as well as spatial data analysis to investigate the drivers of pollinator biodiversity or quandong tree distribution in this unique semi-arid ecosystem. Would suit a student looking for or a mid-year intake.

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

Location: Berwick/Mt Helen Campus
Project Leaders: Dr Kushan Tennakoon,
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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).

Implementing and evaluating the forall-network approach to deep multiobjective reinforcement learning

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

Project description: Multiobjective reinforcement learning (MORL) extends the reinforcement learning paradigm from simple, single-objective tasks (e.g. 'win this game of Go') to more complex problems with multiple, conflicting objectives (such as trading off economic and environmental factors). One interesting characteristic of MORL is that multiple optimal policies exist, representing different trade-offs between the objectives, and an agent can potentially learn multiple policies at the same time. While some approaches have been made to developing multi-policy Deep MORL algorithms they currently exhibit some inefficiencies in learning. This project will implement and empirically evaluate a novel approach (the forall-network which uses a unique network architecture to directly support multi-policy learning).

Investigating and addressing unstable value functions in multiobjective reinforcement learning

Location: Mt Helen Campus or Online
Project Leader: Prof Peter Vamplew
Email: p.vamplew@federation.edu.au
Project Level: Honours

Project description: Multiobjective reinforcement learning (MORL) extends the reinforcement learning paradigm from simple, single-objective tasks (e.g. 'win this game of Go') to more complex problems with multiple, conflicting objectives (such as trading off economic and environmental factors). While standard RL methods like Q-learning have been extended to handle multiple objectives, we have observed in recent experiments that they can suffer from instabilities in their value function, which can slow learning or lead to sub-optimal solutions. This project will identify the conditions under which this instability can arise, quantify the impact on the learning performance, and explore possible approaches to address this issue.

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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. However, researchers are increasingly realising that defining appropriate rewards to produce the desired behaviour may be difficult outside of simple, well-defined domains like games. In particular agents which aim to optimise simple rewards derived directly from their environment may exhibit unexpected and undesirable behaviour. This project will investigate whether the application of the concept of non-linear utility to rewards may result in different, possibly preferable behaviour. In particular it will consider whether this approach in combination with the concept of expected scalarised reward from multiobjective reinforcement learning may result in improve risk-aware behaviour in stochastic environments.

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*