University of Otago
ŌTĀKOU WHAKAIHU WAKA

Physiology
Te Tari Mātai Whaiaroaro

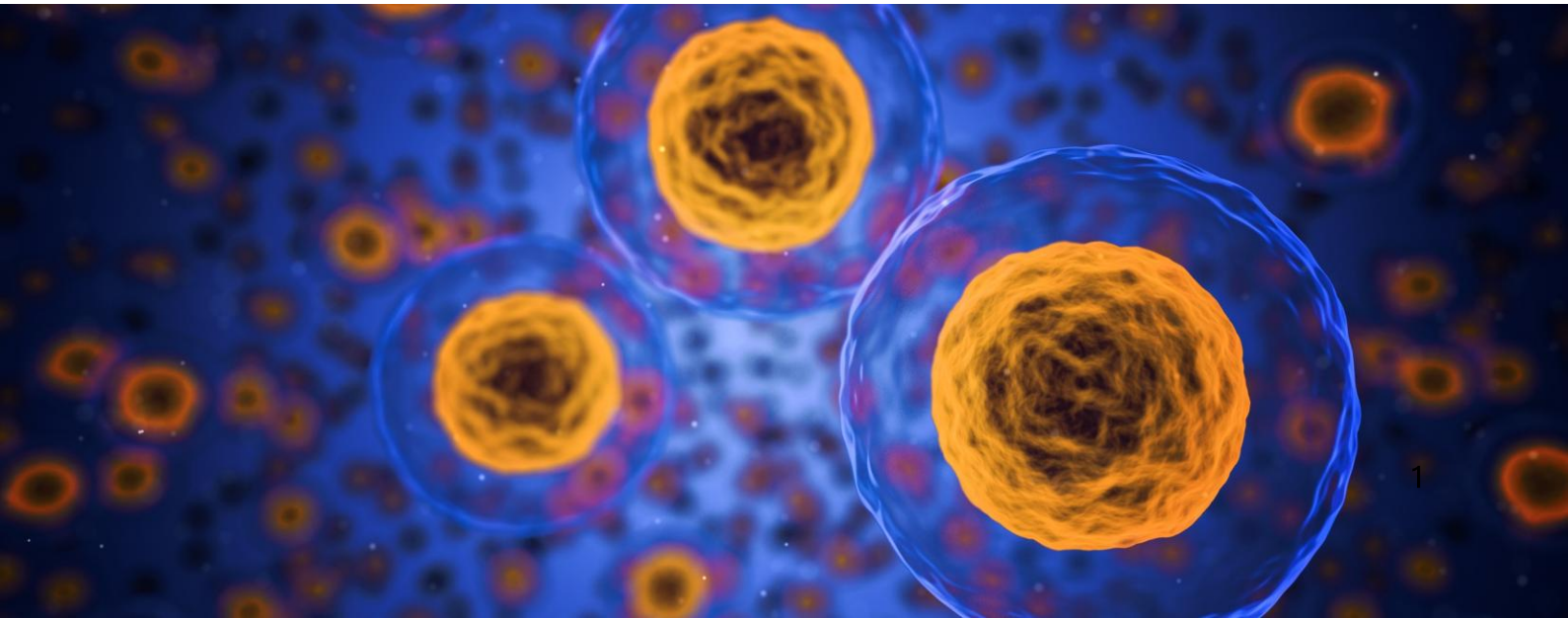
Department of Physiology

Te Tari Mātai Whaiaroaro

400-level 2027

Information and Application Process

Please read this document carefully because it contains important information about the 400-level programme in Physiology, including entry requirement and how to arrange a PHSL/GENE/NEUR PGDipSc or BSc (Hons), or BBiomedSc (Hons) project with a supervisor in the Department of Physiology.



Te tukanga tono | Application process

If you are interested in a 400-level qualification in the Department of Physiology, as well as obtaining the necessary grades to be eligible (see "400-level Degree Options and Entry Requirements" below), you will need to secure a supervisor for your research project. The process for arranging a PHSL/NEUR/GENE PGDipSc or BSc (Hons) project, or a BBiomedSc (Hons) project in the Department of Physiology is below.

How to apply for a research project

1. Read the project descriptions (pages 5-12).
2. E-mail the supervisors offering the projects in which you are interested to arrange a meeting to discuss the projects in-person or by Zoom.
3. Decide the projects for which you would like to be considered (up to three, in rank order) and the qualification for which you are applying. Please note, supervisors may be offering both lab-based projects and non-lab based projects (e.g. data set analysis, written component).
4. Complete the online application form by Monday 9th November 2026.
5. Late applications will be considered depending on supervisor and resource availability.

What happens next?

1. Your research project application and academic record will be given to the academic with whom you are interested in working, who will decide on whether to accept your application.
2. You will be informed of your application outcome by email in early December.
3. If your research project application is successful:
4. For PGDipSci or BSc (Hons), complete your formal application for entry on eVision by 10 December 2026. Once we (or GENE/NEUR) confirm admission with the Division of Sciences Administration, you will be notified of acceptance on eVision.
5. For BBiomedSc (Hons), entry is subject to approval of the Pro-Vice-Chancellor (Health Sciences) on the advice of the Board of Studies for Biomedical Sciences. Acceptance into the programme is organised by the BBiomedSc Administration but is dependent on securing a research project and supervisor.
6. If you are eligible but not matched with any of your choices, you will be provided an opportunity to discuss alternative projects with other supervisors.

Ngā karahipi | Scholarships

The University offers various scholarships for 400-level students. In addition, Māori and Pacific Peoples students can apply for a School of Biomedical Sciences Scholarship for 400-level ($7,500 tuition fee waiver).

- All scholarships can be found here.
- Māori Biomedical Sciences Scholarships can be found here.
- Pacific Peoples Biomedical Sciences Scholarships can be found here.

Questions? Contact:

- Daryl Schwenke (daryl.schwenke@otago.ac.nz), 400-level convener, for questions about the 400-level programme.
- the relevant supervisor for questions about the projects.
- phsl.400@otago.ac.nz for questions about your Research Project application.

Ngā Herenga Tohu Paetahi | Degree Requirements

PGDipSci

Prerequisites: BSc (B average recommended in four of PHSL 300-level papers or equivalents).
Programme: A 120 point programme comprising PHSL 471 and 472 (20 pts each), PHSL474 (20 pts) and either PHSL490 (60 pts) or PHSL480** (40 pts).
***NOTE: PHSL480 comprises a smaller research project and may be more suited for a non-lab based research project. If a student elects to enroll in PHSL480, an extra non-physiology 400-level paper worth 20 points must be taken in order to make up the full 120 points required for degree completion.*

BSc (Hons)

Prerequisites: At least five 300-level papers including at least four of PHSL341-345 (B+ average recommended in the four PHSL 300 papers).
Programme: PHSL 471 and 472 (20 pts each), PHSL474 (20 pts) and PHSL490 (60 pts).

BBiomedSc (Hons) in Functional Human Biology

Prerequisites: A BBiomedSc degree with an average grade of at least B+ for the four prescribed 300 papers, must have passed a fifth 300-level paper in their third year of study (for a total of 90 points at 300-level), and should normally have passed papers worth at least 108 points at 200-level or above in their third year of study.
Programme: A 120-point programme, comprising a research thesis and course work.

See: https://www.otago.ac.nz/courses/qualifications/bachelor-of-biomedical-sciences

N.B. Entry into the two-year MSc programme is organized through a different process; please contact the Physiology Postgraduate Coordinator, Assoc Prof Martin Fronius (martin.fronius@otago.ac.nz) for information on the process.

Pārongo Hōtaka | Programme information

PHSL 471 Systematic Physiology and PHSL 472 Neurophysiology

These 20-point papers each consist of seminars on research frontiers in physiology. Each paper requires preparation and participation (e.g. discussion, presentation, etc.), and is assessed by written examination.

PHSL 474: Research Topics

This 20-point paper consists of an extensive 'Literature Review' related to each student's dedicated research dissertation (as described for PHSL490). It is specifically unique for each student, guided by the supervisor and is internally assessed.

PHSL 490: Research Dissertation

This is a 60-point project, usually but not exclusively lab-based, involving original research and is assessed by a dissertation in the form of a thesis (80%), and two oral presentations related to the dissertation (20%), which are presented to the Department in early April and late September. All steps

of the project are guided by the supervisor. Dissertation submission is in mid-October.

PHSL 480: Research Dissertation

This is a 40-point project addressing a research question and is well-suited for a non-laboratory based project. The PHSL480 project is assessed by a dissertation and two oral presentations. All steps of the project are guided by the supervisor. Dissertation submission is in mid-October.

Research Projects

Our research falls into the following main areas:

- **Cardiovascular Physiology:** Jeff Erickson, Martin Fronius, Pete Jones, Rajesh Katare, Megan Leask, Michelle Munro, and Daryl Schwenke.
- **Neuroendocrinology:** Colin Brown, Rosie Brown, Rebecca Campbell, Karl Iremonger, Joon Kim, and Alex Tups.
- **Membrane & Ion Transport:** Tanya Cully, Fiona McDonald.

Cardiovascular Physiology Projects

Associate Professor Jeff Erickson

(jeff.erickson@otago.ac.nz)

Development of novel anti-arrhythmic compounds.

Our laboratory is developing new compounds to combat cardiac arrhythmia in the clinical setting. These new compounds need to be tested in cellular systems before they can be approved for further research. Thus, we are looking for motivated students who have a keen interest in cardiovascular disease and drug development. We're offering a range of projects that will allow applicants to test these new compounds using high throughput imaging techniques. If you're keen to be part of a discovery-based team and identify future therapies to prevent arrhythmia, send a message and we'll set up a chat!

Associate Professor Martin Fronius

(martin.fronius@otago.ac.nz)

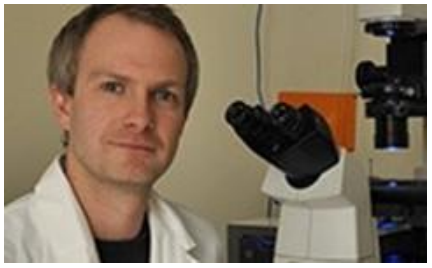
Is vaping the new smoking?

The project aims to investigate if and how vape aerosols interfere with ion transport in human lung epithelial cells. Gas exchange and the innate immune system in our lungs rely on transepithelial ion transport processes, facilitated by the epithelia covering the surfaces of the lungs. Cigarette smoke has been identified to interfere with ion transport processes, contributing to lung pathologies such as chronic bronchitis and chronic obstructive pulmonary disease (COPD). Although the number of cigarette smokers is declining, vaping is becoming increasingly popular and is perceived as a 'healthy' alternative to smoking. Early studies suggest that chemicals in vape aerosols have similar effects on epithelial ion channels as cigarette smoke leading to the question - is vaping going to be the new smoking?

The project will expose human lung epithelial cells (H441 cells) to vapes and measure how this affects ion transport processes by performing Ussing chamber electrophysiology. Further, transcriptome analysis will be performed to identify putative targets affected by vaping. The research aims to provide evidence for future policy making whether vaping can indeed be considered as an alternative to smoking.

Professor Pete Jones

(pete.jones@otago.ac.nz)



Role of RyR2 mediated calcium release in arrhythmia and Alzheimer's disease.

We are seeking students to join our research group for various projects that relate to the following research theme: Calcium release is critical for contraction in the heart and synaptic transmission in the brain. In both tissue types, the ryanodine receptor (RyR2) mediates a large part of this release. When the carefully controlled release of calcium through RyR2 goes wrong it leads to disease. Our lab aims to understand the molecular mechanisms which lead to abnormal RyR2 function.
Several projects are available looking at the function and structure/ location of RyR2 within cardiac cells and neurons with the purpose of better understanding arrhythmias and Alzheimer's disease.

Professor Rajesh Katare

(rajesh.katare@otago.ac.nz)

Molecular mechanisms underlying healthy ageing.

Unfortunately the Katare Laboratory is unavailable for 2027.

Ageing is an inevitable process accompanied by a gradual decline in physiological functioning. Advances in healthcare and improvements in diet have significantly increased life expectancy. However, this increased longevity has also led to a higher incidence of chronic diseases. The Honours project will explore the molecular mechanisms associated with cardiovascular disease. The project provides an opportunity to learn several molecular techniques, such as PCR, protein quantification, immunohistochemistry, and ELISA, and how to apply contemporary statistical analyses to larger clinical datasets.

Applicants for the 2028 Honours program are encouraged to enquire early in 2027.

Dr Megan Leask (Kāi Tahu)

(megan.leask@otago.ac.nz)

Zebrafish models for the study of cardiometabolic conditions.

In the ENHANCE lab we study genetic predisposition to disease using zebrafish. We are interested in several different conditions including polycystic ovary syndrome, gout, type-2-diabetes, neurodegenerative diseases and cardiovascular disease. We use genome-wide association studies to identify genes that are involved in these conditions and then using CRISPR-Cas9 knock these genes out in zebrafish. Once stable mutants are established we explore the resultant phenotypes using different technical assays including qRT-PCR, immune recruitment assays, brain activity mapping, ovary measurements and confocal microscopy. If you are interested in a project in the ENHANCE lab please reach out and we can discuss the kinds of assays that you could undertake for your 400-level project.

Please see the lab website for more information: https://enhancelabnz.github.io/leasklab/team/

Dr Michelle Munro

(michelle.munro@otago.ac.nz)

Calcium handling proteins and cardiac ultrastructure.

Contraction of the heart relies on the tightly regulated movement of calcium within the myocytes. Calcium mishandling occurs in cardiac diseases, which can lead to impaired contractility and the development of irregular contractions (arrhythmias). We are seeking students to join our group to work on projects exploring the organisation, expression and regulation of key calcium handling proteins in cardiac diseases including atrial fibrillation, diabetes and heart failure. A range of techniques are used in our lab including calcium imaging, immunolabelling, fluorescent imaging, super-resolution microscopy and western blotting, with projects using cell models or patient samples.

Sex differences in the diabetic heart.

Diabetic patients have an increased risk of developing cardiovascular complications, including heart failure. While there is a higher prevalence of diabetes in men, diabetic women have a higher risk of developing these complications. The cause for this disparity is unclear, however one potential mechanism is a difference in fibrotic remodeling between female and male diabetic hearts.
This project investigates the pattern of cardiac fibrosis and response to anti-fibrotic treatment in male and female diabetic mice. Techniques in this project include echocardiography, immunofluorescence and confocal imaging.

Professor Daryl Schwenke

(daryl.schwenke@otago.ac.nz)

Autonomic control of the heart in heart failure.

My research is interested in how the brain communicates with the heart for the precise control of cardiac function (autonomic control), and how this highly coordinated communication is dangerously disrupted following an acute myocardial infarction.

Data Set-Based Research Project.

A data set-based research project (i.e. non-laboratory; all data has been collected) is available for a highly motivated 400-level candidate:

- assessing the potential role of cerebral blood flow for driving an increase in cardiac sympathetic nerve activity following a myocardial infarction

Neuroendocrinology Projects

Associate Professor Rosie Brown

(rosie.brown@otago.ac.nz)

Establishing mouse models of peripartum mood disorders.

Maternal mood disorders affect 1 in 5 new mothers in Aotearoa New Zealand, and yet the underlying mechanisms leading to disrupted maternal mood are poorly understood. Pregnancy-induced changes in the brain are highly conserved across mammals, and animal models are critical for understanding how hormones act on neural circuitry to induce healthy adaptations in mood and behaviour. This project aims to establish an animal model of disrupted maternal mood during pregnancy, and assess how hormonal action in the brain is altered in this model.

Professor Rebecca Campbell

(rebecca.campbell@otago.ac.nz)

Understanding the brain circuits controlling fertility.

Research in our lab is aimed at understanding the brain circuits that regulate fertility and the central defects that contribute to infertility. We are particularly focused on understanding how brain wiring and communication is altered in the common endocrine disorder polycystic ovary syndrome (PCOS) and how androgen excess impacts female physiology. We are also interested in exploring how neurons essential to fertility regulation, the gonadotropin-releasing hormone (GnRH) neurons, may also be important in controlling non-reproductive behaviours and cognition. Most projects in my lab involve working with transgenic mouse models, immunohistochemistry, light and confocal microscopy, behavioural assessment and the application of imaging software and analysis.

Below are potential project themes available in 2027. All projects will include co-supervision from members of my team and/or collaborators.

- ***Does loss of progesterone negative feedback drive PCOS-like plasticity in the female brain?*** (co-supervised by **Dr Kelly Glendining** and **Dr Elodie Kip**)
- ***Can tissue-specific silencing of androgen receptors rescue PCOS-like pathology in peripheral tissues?*** (co-supervised by **Caitlin MacRae** and **Dr Elodie Kip**)
- ***Defining the role of GnRH neuron subpopulations in memory and olfaction.*** (co-supervised by **Dr Halima Siddiqui** and **Dr Joon Kim**)

Associate Professor Karl Iremonger

(karl.iremonger@otago.ac.nz)

Unfortunately the Iremonger Laboratory is full for 2027 and will not be taking additional honours students at this time.

Our laboratory focuses on understanding how the excitability of corticotropin-releasing hormone (CRH) neurons are regulated. CRH neurons are activated in response to stress and are responsible for controlling the levels of stress hormones in the body. We are particularly interested in determining how neuromodulators regulate CRH neuron activity and function both before and after stress. This project will involve calcium imaging of CRH neurons in brain slices from mice. The effects of neuromodulators on CRH neuron excitability will be investigated.

Dr Joon Kim

(joon.kim@otago.ac.nz)

Unfortunately the Kim Laboratory is full for 2027 and will not be taking additional honours students at this time.

Our research group focuses on understanding how the brain connects internal states and behaviour. We are particularly interested in the role of brain stress circuits on generating anxiety, depression, aggression, and motivation behaviours.

Applicants for the 2028 Honours program are encouraged to enquire early in 2027.

Associate Professor Alex Tups

(alexander.tups@otago.ac.nz)

Neuroendocrine control of obesity and diabetes.

If you want to find out why jetlag causes obesity or why Alzheimer's disease is called type 3 diabetes join the Tups lab for pursuing your BSc Honours studies. Projects are available to study the neuroendocrine control of obesity and glucose homeostasis or their interaction with the circadian clock as well and brain function. You can choose to either work with zebrafish or mouse models. We will focus on mechanistic work to combine genetic, pharmacological, or nutritional approaches to find novel treatments for metabolic health.

Dr Jenny Clarkson

(jenny.clarkson@otago.ac.nz)

Unravelling the neural circuits controlling menopausal hot flushes.

Potential projects in the lab for 2027 would be aimed at understanding how kisspeptin neurons switch from controlling fertility to driving hot flushes during menopause. Techniques used in this project could include immunohistochemistry, light microscopy, in vivo fibre photometry, temperature telemetry, and behavioural tracking. Research in our lab is aimed at understanding the changes that occur in the brains of females as they age. During menopause 70% of women will experience hot flushes, yet we don't fully understand the neural circuitry that cause hot flushes. Recent work suggests that dwindling levels of estrogens causes kisspeptin neurons, which normally control fertility, to become hyperactive and cause dysregulated activation of thermoregulatory circuits.

Professor Colin Brown

(colin.brown@otago.ac.nz)

Central regulation of body fluid balance in pregnancy and lactation.

Maternal blood volume expands during pregnancy to cope with the cardiovascular demands of pregnancy and lactation. It has been known for over 50 years that this blood volume expansion is driven by the hormone, vasopressin, secreted by hypothalamic neurons. However, the mechanisms that drive the changes in vasopressin neuron activity in pregnancy remain unknown. We are now positioned to determine these mechanisms using a new technology, Neuropixels, for electrophysiological recording of vasopressin neurons in anaesthetised virgin, pregnant and lactating rats. This project will provide the opportunity to learn surgical techniques and computational data analysis, and is best suited to someone interested in computational neuroscience.

Membrane & Ion Transport Projects

Professor Fiona McDonald

(fiona.mcdonald@otago.ac.nz)

Epithelial sodium channel and its effects on breast cancer progression.

Breast cancer is the most common cancer affecting New Zealand women and 90% of breast cancer deaths occur due to metastasis. A process called epithelial-mesenchymal transition (EMT), whereby cells change their structure and shape, and begin to proliferate and migrate, contributes to breast cancer progression and metastasis. During EMT cancer cells lose their epithelial phenotype, including cell-cell and cell-basement membrane connections, and gain mesenchymal characteristics, such as increased proliferation and migration. Our data has highlighted a role for the epithelial sodium channel (ENaC) in EMT, with a loss in ENaC expression potentially driving EMT. Projects will investigate the effect of ENaC on cancer hallmarks or signaling pathways in breast cancer cells, using techniques such as cell migration, cell proliferation, invasion, cell-extracellular matrix interactions, and western blot.

Dr Tanya Cully

(tanya.cully@otago.ac.nz)

Calcium and ROS signalling in skeletal muscle.

The Cully lab explores how two important cellular signals, calcium and reactive oxygen species (ROS), interact in healthy and diseased skeletal muscle. Disruptions in these signalling pathways are linked to a range of muscle disorders, where excessive calcium entry and oxidative stress can contribute to muscle damage and inflammation.

Students will have the opportunity to investigate how different sources of ROS influence calcium regulation in skeletal muscle and how these processes may contribute to muscle degeneration. The project will use a range of quantitative techniques and data analysis approaches to examine changes in muscle function and cellular signalling.

The research aims to improve our understanding of the mechanisms underlying muscle disease and identify potential targets for future therapies. This project is well suited to students with an interest in muscle physiology, cell biology, human health, and biomedical research, and provides valuable experience in experimental design and quantitative analysis.