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What will be involved?

The main aim of the one-year Postgraduate 4th year BSc(Hons), 4th year BBiomedSc(Hons), PGDipSci and 1st year MSc [and for medical students the BMedSc(Hons)] is to introduce you to the realities and excitement of research. Working closely with your supervisor, you will plan, design and carry out a research project, which could lead to your first publication in a scientific journal. Clearly this is a major undertaking, and you should spend time during your third year finding out about the research interests of the academic staff, choosing a supervisor, and selecting a project – specific details are made available each year before the middle of second semester. You will find that staff are keen to talk to you about their research. If you need assistance in making a final decision, you are welcome to discuss it with me.

Why do 400-level Postgraduate studies? You will find that employers view favourably students who have completed an Honours degree or have gained a PGDipSci or Masters qualification. The extra experience which comes from designing and executing experimental work is a valuable asset for future employment. It also opens up opportunities for specialist teaching appointments, sales and management posts, or technical jobs in research establishments. Your future is limited only by your imagination, and we will do our best to stimulate that and help you on your way.

The next step could be an MSc or PhD degree. A 400-level research degree can launch you into higher research degree programmes of 1 or 3 years in length. In both the MSc and PhD degrees you will work closely with a supervisor to design and carry out a novel research project. The end-product is a PhD thesis, publications in scientific journals and usually participation in national or international conferences. During your PhD studies not only will you become a world authority in your own specialised field, but also an independent scientist capable of designing and performing research projects of the future. Such skills are much sought after both in the scientific and the commercial world either in New Zealand or overseas.

400-level Physiology is enjoyable and rewarding. Come and join us and start to become part of the academic and research community with all its international connections. Feel free to come and see me at any time if you need any help or advice.

Dr Rebecca Campbell, 400-level Coordinator

If interested in physiological research as a MMedSc (medical students), the thesis year of a MSc or a 3-year PhD, please contact the Postgraduate Coordinator, Associate Professor Ruth Empson.

Postgraduate Degree Options and Entry Requirements:

Bachelor of Sciences Honours (BSc (Hons)): A full-time 120-point degree made up of a research dissertation (PHSL 490, 60 points), a research topics paper (PHSL 474, 20 points) and two of three papers that look at specific areas of research in Physiology, PHSL 471, 472, 473 (20 points each).

Entry into Honours Physiology requires completion of five papers of 300-level (four in PHSL 300 and the fifth an approved 300-level paper usually in a related subject) achieving at least a B+ average in the four PHSL 300-level papers. Alongside these five 300-level papers it is strongly recommended that you take a further two papers and that they are at 200-level or above.

Postgraduate Diploma of Science (PGDipSci): A 120-point degree (that can be taken part-time) including a research project (PHSL 480, 40 points), a research topics paper (PHSL 474, 20 points) and three papers that look at specific areas of research in Physiology, PHSL 471, 472, 473 (20 points each).

Note: With HoD permission it is possible to take the PHSL 490 (60 points) research dissertation in place of PHSL 480, in which case the rest of the course is similar to the BSc Honours. The 60-point research dissertation is required if intending direct entry into a PhD.

Prerequisites: BSc including at least a B average (B+ average recommended) in four of PHSL 341, 342, 343, 344, 345 or equivalents.

Bachelor of Biomedical Sciences Honours (BBiomedSc (Hons)): A full-time 120-point programme, comprising a Research Thesis (research proposal, literature review, oral exam, final thesis worth a total of 85% of the course) and Course Work worth 15% of the final mark.

Entry into Honours in Functional Human Biology is by invitation from the Dean of the Otago School of Medical Sciences. Entry requires completion of the requirements for the degree of BBiomedSc with an average grade of at least B+ for the four prescribed 300-level papers. Students must have taken seven papers at 200-level or above during their 3rd year.

Masters of Science (MSc) (can be taken part-time)**:**

- 1st year: papers PHSL 471, 472, 473, 474 (20 points each) and Masters Thesis Preparation PHSL 495 (40 points).
- 2nd year: Research Thesis (12 months of full-time research).

*Prerequisite for **first year MSc**: BSc including at least a B average (B+ average recommended) in four of PHSL 341, 342, 343, 344, 345 or equivalents.*

Note: Instead of 1st year MSc we usually advise taking the PGDipSci course and then progressing to the 2nd year MSc thesis.

*Prerequisite for **second year MSc**: completion of first year MSc with a grade point average of B+. Alternatively PGDipSci or BSc (Hons) students with a B+ grade average in 400-level Physiology can progress directly to second year MSc, i.e., to a thesis-only one-year MSc. A Masters thesis can commence at any time of the year and fees commence from the first of the month in which you start. Most students start at the beginning of the first semester. Note that thesis-only one-year MSc is a 12-month programme and the thesis can only be submitted in the 12th month.*

Bachelor of Medical Sciences Honours (BMedSc (Hons)): A full-time, one-year Research Thesis taken by medical students usually after the 3rd year of the MBChB degree has been completed.

Prerequisites: Have satisfactorily completed three or more years of the programme for the degrees of Bachelor of Medicine and Bachelor of Surgery or have alternative qualifications or experience acceptable to the Board of the Faculty of Medicine.

Note: After the BMedSc (Hons) year, students either return to the 4th year of the MBChB programme or convert the BMedSc (Hons) into the first year of a PhD and continue as a 2nd year PhD student in an intercalated MBChB/PhD programme. Students then return the following year to the 4th year of the MBChB programme and the equivalent of the 3rd year of a PhD is achieved during the summer vacation of 4th and 5th year and during the three-month elective period of the 6th year of the MBChB programme. See "Protocol for students undertaking a course of study leading to the degrees of MBChB and PhD" for further information at http://micn.otago.ac.nz/wp-content/uploads/micn/2008/03/MB-ChB-PhD-Protocol-updated-Aug-12-doc3.pdf

Masters of Medical Sciences (MMedSc) (can be taken part-time)**:** A one-year Research Thesis equivalent to the MSc that is available for medical graduates. It allows direct entry into the thesis year without the need for a prior year of 400-level papers. (However depending on the medical graduate's background, some 300- and/or 400-level papers may be required prior to acceptance into the MMedSc programme.)

Prerequisites: Have fulfilled one of the following conditions: (i) been admitted to the degree of Bachelor of Medical Science with Honours (or prior to 2001 the degree of Bachelor of Medical Science); (ii) been admitted to the degrees of Bachelor of Medicine and Bachelor of Surgery by a University in New Zealand or hold an equivalent medical qualification approved by the Board of the Faculty of Medicine; or (iii) have alternative qualifications or experience acceptable to the Board of the Faculty of Medicine.

Doctor of Philosophy (PhD): A PhD involves three years of supervised but independent research, writing and submitting a thesis embodying your results and publishing papers in scientific journals.

Prerequisites: a BSc (Hons) at the 2.1 level or a one-year 120-point MSc thesis (i.e., 2nd year MSc) or a PGDipSci (60-point thesis) with a B+ grade average. ***However higher grades are required to secure scholarships*** *– see page 21. A PhD can commence at any time of the year and fees commence from the first of the month in which you start. University policy relating to the PhD can be obtained from http://www.otago.ac.nz/study/phd/index.html. For application procedures for a PhD in Physiology, please consult http://phsl.otago.ac.nz.*

How to apply:

Before applying for a postgraduate degree you will need to identify the projects and supervisors that you are interested in (see Choosing a Supervisor below). The best way to do this is to read about the research projects offered by Physiology supervisors listed in this booklet and go to the Physiology website for additional information. Once you have identified some projects of interest, make a time to meet with potential supervisors to find out more and make your interest known.

Should you wish to pursue a 400-level degree within the Physiology Department, it is necessary that you engage with our internal selection process that matches potential students with 400-level projects. Once you have decided which projects you would like to be considered for (you can nominate three at the most) you need to fill in an application form with your ranked selections. This can be found on the Physiology website. Please hand in your completed form to Tracey Fleet (Physiology Administration Office, Room G38 Lindo Ferguson Building) by **27 November 2015.** Late applications may be considered if there are projects still available, however, there is generally a waiting list for the more popular projects. See the flow diagram on our website which shows the timeline from application to entry into 400-level in Physiology. Because many students are applying for multiple degree programmes in 2016, some eligible students may be waitlisted or unmatched to projects until early 2016. Should you not be offered the project of your choice, you are welcome to check out projects that are still available within the Department by communicating with Tracey Fleet (tracey.fleet@otago.ac.nz).

Formal application for entry into 400-level BSc Honours or PGDipSci must be completed online via eVision as soon as possible. Once we confirm admission to the Administrator of the Division of Sciences, the decision will be available on eVision. Please make sure you apply as soon as possible.

Invitation into the BBiomedSc (Hons) programme comes from the Dean of the OSMS once 3rd year results are known. Acceptance into the programme is dependent on securing a supervisor.

BMedSc (Hons): Applications generally close at the beginning of August but please check with Mr Bruce Smith, Faculty Manager, medical.faculty@otago.ac.nz for the final date each year. Note that there are scholarships available for BMedSc (Hons) – see page 22 for details.

MMedSc: For information on the application process, contact Mr Bruce Smith, Faculty Manager, medical.faculty@otago.ac.nz

Choosing a Supervisor:

Staff, Postgraduate and Honours students in this Department are engaged in a wide variety of research. The lists below indicate our research strengths and what project areas are available. Look at the research poster displays in the Department and on the webpages of the Physiology Department and Otago School of Medical Sciences. These describe our research interests in more detail and provide lists of recent publications. For topics that interest you, read some of the publications, talk to the associated staff and discuss/develop possible project topics with potential supervisors, Visit their research laboratory, talk to their current postgraduate students. Don't rush into a decision on your project! If you want to discuss your options, make an appointment to see the Postgraduate Coordinator, Assoc Prof Ruth Empson. If you have any general questions, contact our Departmental Administrator, Tracey Fleet, email: tracey.fleet@otago.ac.nz

Research Strengths:

Our research falls into the following main areas:

- **Cellular & Molecular Neuroscience:** Colin Brown, Rebecca Campbell, Ruth Empson, Allan Herbison, Phil Heyward, Brian Hyland, Karl Iremonger, Phil Sheard and Alex Tups
- **Cardiovascular & Respiratory Physiology**: Pat Cragg, Jeff Erickson, Alison Heather, Pete Jones, Rajesh Katare, Regis Lamberts and Daryl Schwenke
- **Membrane & Ion Transport**: Andrew Bahn, Grant Butt, Steven Condliffe, Martin Fronius, Ruth Empson, Kirk Hamilton, Pete Jones and Fiona McDonald

Research Projects

Supervisors and projects available for 2016

Dr Andrew Bahn

Dysregulated ghrelin signalling in pancreatic β-cells under hyperuricemic conditions - the cause for the onset of type 2 diabetes mellitus?

Ghrelin is mainly secreted by the stomach and by binding to the growth hormone receptor it controls growth hormone release, feeding and adiposity. Interestingly, ghrelin is also secreted from pancreatic β-cells, and it controls in an autocrine fashion glucose induced insulin secretion (GIIS). We have previously established that elevated plasma levels of uric acid (hyperuricemia), a metabolic end-product known to cause gout, contribute to impaired insulin secretion via increase of AMP-kinase (AMPK) expression and phosphorylation. Moreover, hyperuricemia leads to pancreatic β-cell death mediated by AMPK and an elevated miR-34a expression. Ghrelin inhibits insulin secretion by activation of AMPK and reduction of intracellular cAMP levels to counteract the GIIS pathways. On the other hand, ghrelin can protect β-cells from fatty acid induced apoptosis. We are now interested in identifying the molecular link between the hyperuricemic effects on insulin secretion and β-cell survival and the ghrelin signalling pathways to further decipher mechanisms responsible for the onset of type 2 diabetes.

This research project will involve hyperuricemic and/or hyperglycaemic mouse models and cell model studies combining different animal, molecular biological, cell culture and hormone assay techniques. Students who are interested in the topic and keen to meet a challenge to perform state of the art research on causes for the onset of type 2 diabetes mellitus are encouraged to apply.

Drs Andrew Bahn & Jeff Erickson

Regulation of CaMKII activity in pancreatic beta cells by uric acid

Calcium/calmodulin-dependent protein kinase II (CaMKII) plays a number of significant roles in human physiology. Dysfunction or dysregulation of CaMKII underlies the development of arrhythmias and heart disease, while modulation of CaMKII activity facilitates synaptic plasticity in the brain. Recent evidence suggests that CaMKII also plays a vital role in calcium homeostasis and glucose-induced insulin secretion in pancreatic beta cells. We have previously established that elevated plasma levels of uric acid (hyperuricemia), a metabolic end-product known to cause gout, contribute to impaired insulin secretion and beta cell death in the pancreas. We are now interested in identifying mechanisms that link the hyperuricemic effects on insulin secretion to the development of type 2 diabetes.

Thus, we propose to examine the roles of urate transporter GLUT9, CaMKII and calcium homeostasis under hyperuricemic conditions in pancreatic beta cells.

This research project will involve tissue analysis from hyperuricemic and/or hyperglycemic mice and cell model studies combining different molecular biological techniques as well as calcium imaging. Students who are interested in the topic and keen to meet a challenge to perform state of the art research on diabetes mellitus are encouraged to apply.

Drs Andrew Bahn & Martin Fronius

New concepts in blood pressure regulation: high sodium and fructose diet induced hypertension

Increased plasma concentrations of Na^+ and urate are associated with hypertension and cardiovascular disease. The effects of dietary increased sodium and urate levels (the latter caused by high fructose diet) on the vasculature are unknown. Accumulating evidence suggests that sodium as well as urate regulate gene expression in endothelial cells, which is associated with endothelial dysfunction. We are interested to identify the molecular mechanisms how sodium and urate alone or in a concerted action impairs endothelial function in order to cause cardiovascular disease. The project focuses on the role of urate transporters and ENaC as metabolic sensors of urate and Na^+ homeostasis and novel mediators of endothelial function.

The research will involve tissue analysis (vessels) from high salt diet and hyperuricemic mice and cell model studies (HUVEC cells) combining different animal, cell culture and molecular biological techniques as well as electrophysiology. Students who are interested in the topic and keen to meet a challenge to perform state of the art research on an emerging and exciting new subject are encouraged to apply.

Drs Andrew Bahn & Rajesh Katare

Cardiac stem cell function under hyperuricemic conditions

Stem cells are known to be the regenerative backup system of tissues in cases of tissue damage or degeneration and they have been found in almost every organ including the heart. Cardiac stem cells (CSCs) can be found in the myocardium and epicardium of the heart, where they function to regenerate the diseased myocardium. In order to perform at its full potential, stem cells are dependent on their environment, which may be compromised in hyperglycaemia and hyperuricemia in patients with diabetes mellitus. Stem cells are currently in the spot light to become the magic tool for tissue repair for clinicians in many diseases

such as neurodegenerative diseases, type 2 diabetes mellitus or heart disease. However, knowledge about the effect of the environment on stem cell function is limited. We are interested in the effects of hyperuricemia (high plasma urate levels) on CSC function to decipher the pathways that affect CSC performance for stem cell therapy.

This research project will involve hyperuricemic and/or hyperglycaemic mouse models, human tissue samples and cell model studies combining different animal, molecular biological and cell culture techniques. Students who are interested in the topic and keen to meet a challenge to perform state of the art research on stem cells are encouraged to apply.

Associate Professor Colin Brown

Central regulation of birth and lactation

Oxytocin contracts the uterus for birth and stimulates milk let-down during suckling. We have recently found that some neurons that project to oxytocin neurons begin to synthesise the neuropeptide, kisspeptin, just before birth and that kisspeptin excites oxytocin neurons only in late pregnancy and lactation. Kisspeptin neurons express prolactin receptors and prolactin levels are high during pregnancy. Hence, we hypothesise that prolactin stimulates kisspeptin synthesis to stimulate oxytocin neurons during birth and lactation. This project will use genetic deletion of the prolactin receptor from kisspeptin neurons in mice to determine how this impacts birth and lactation. See more of what we do at: http://www.neuroendocrinology.otago.ac.nz/

Associate Professor Grant Butt

My lab is interested in the interaction between the intestinal epithelium and the commensal microbiota. Metabolites from the microbiota are thought to affect the development of the intestinal epithelium. This project will use human colonic enteroids grown from adult intestinal stem cells to investigate the effects of short chain fatty acids, which are the main metabolites produced by commensal bacteria, on the development of the colonic epithelium.

Dr Rebecca Campbell

Not available for 2016.

Dr Steven Condliffe

Molecular mechanisms behind membrane delivery of epithelial ion channels

My major research interest is how membrane fusion proteins interact with ion channels to control both their insertion into the plasma membrane and subsequent transport activity. In epithelial cells, these mechanisms are distinct for apical versus basolateral channels and therefore play critical roles in epithelial polarity. In particular, we are currently investigating the apical membrane delivery of two different channel: 1) ANO1, a Ca^{2+}-activated Cl^- channel that participates in transepithelial Cl^- secretion and is also upregulated in various cancers of epithelial origin and 2) the epithelial Na^+ channel (ENaC), a key determinant of salt and water balance. Various techniques are employed to elucidate these mechanisms including patch-clamp electrophysiology, protein biochemistry and molecular biology. Interested students can contact Steven via email to discuss potential projects on this theme in further detail.

Assoc Prof Pat Cragg

Not available for 2016.

Associate Professor Ruth Empson

Understand cerebellar function

The cerebellum integrates sensory and motor information so that we can successfully interact with the world around us. It does this by continually comparing electrical information from other brain regions and then modifies its own output accordingly; the circuitry operates a little like a record and playback device that constantly tests and adjusts its electrical output in real time. Of course our world is highly complex and for the cerebellum to manage the huge diversity of information we experience every day, its circuitry must also be capable of learning our automatic behaviours.

Problems arise if the cerebellum is damaged, as during stroke, degeneration, e.g., severe movement ataxias, or even by excessive alcohol. The outcome is poor motor control. However, it is becoming increasingly recognised that the cerebellum makes additional contributions since disruptions to the cerebellum accompany autism and schizophrenia.

In this project you will have the opportunity to study the cerebellar circuitry using electrophysiological and imaging techniques together with detection of important proteins (by immunohistochemistry and western blotting immunodetection). Further details can be obtained by informal discussion with Assoc Prof Empson.

Dr Jeff Erickson

The role of oxidized CaMKII in apoptosis after myocardial infarction

CaMKII activation has emerged as a primary pathological event in oxidation-induced cardiac cell death, positioning CaMKII as a potential therapeutic target in the treatment of heart disease. With this in mind, our research focuses on investigating the role of oxidized CaMKII in cell death following myocardial infarction, particularly in the context of diabetes. Contributions by a talented 400 level student would be possible for a project examining apoptotic signaling in diabetic animal and human myocardium (with and without myocardial infarction) using protein blotting, histochemistry, and cell imaging techniques.

Dr Martin Fronius

Blood pressure regulation by shear stress

The ability of vessels to sense shear stress is crucial for the regulation of blood pressure. This project aims to explore how shear stress is sensed through ion channels that are expressed in the luminal membrane of endothelial cells. This local conversion of mechanical stress in into cellular signals is crucial for vascular responses that are required for blood pressure regulation.

The focus of this project is to identify the mechanisms how endothelial channels (ENaC, $P2X_4$) interact with the extracellular matrix of cells.

Candidates that are interested in this exciting and challenging project will be trained in different techniques. This includes *in vitro* transcription of RNA, site-directed mutagenesis, heterologous expression of proteins in *Xenopus* oocytes and functional recordings of ion channel activity in response to shear stress by the two-electrode-voltage-clamp technique. For any inquiry and/or more detailed information please contact me by e-mail (martin.fronius@otago.ac.nz).

Dr Kirk Hamilton

My main research interest is the regulation, function and trafficking of ion channels of epithelial tissues. I employ electrophysiological (patch-clamp and short circuit current measurements) and molecular biochemical techniques (immunofluorescence, immunoprecipitation, co-immunoprecipitation, cell surface immunoprecipitation, gel electrophoresis, biotinylation, PCR) to address basic questions of cell physiology of ion channels.

Any student interested in doing a research project with me should come and discuss potential projects with me.

Professor Alison Heather

Detecting designer androgens – the sports doping arms race

The use of performance-enhancing drugs is banned for all forms of sport. Despite this, some athletes continue to use contraband substances in their efforts to be the best athlete in their sport. The most abused substances are androgens because of their well-described effects on promoting skeletal muscle growth and bone strength. Androgens are a class of sex steroids that have their effects in the body through the activation of the androgen receptor. In recent years, designer androgens have been discovered as sports doping substances. A number of these are classed as selective androgen receptor modulators (SARMs) – molecules specifically designed to act in a tissue-specific manner having strong effects on muscles and bones, but less potent effects on reproductive tissues. Understandably, because of their skeletal muscle effects, these are prime substances to be abused by athletes. In this project, *in vitro* androgen bioassays will be used to determine the potency of several SARMS that have recently been discovered in use by athletes in competition. These are novel structures that have never been commercially marketed or used as clinical treatment, and possibly represent the deliberate synthesis of SARMS specific for sports doping and with the intention of avoiding standard detection assays. Whether these SARMS are biologically active is unknown and what their potency is relative to known anabolic androgenic steroids, tetrahydrogestrinone and nandrolone, is also unknown. The data from this project will be used to notify regulatory authorities of the androgenic potential of these SARMS.

Professor Allan Herbison

Not available for 2016.

Dr Philip Heyward

Modulation of brain neuron electrophysiology by pathways signaling inflammation

Signaling pathways commonly associated with inflammation in the body are now known to regulate normal brain neuron development and function, and are implicated in progressive neuropsychiatric and degenerative brain disorders including bipolar disorder, Alzheimer's disease and Parkinson's disease. 4th year research projects available in 2016 will use in vitro electrophysiological and imaging techniques to investigate the modulation of neuronal excitability, membrane ion channels and synaptic circuit function by inflammatory mediators

and associated intracellular pathways. These studies will focus on brain regions affected early and severely in neurodegenerative diseases, using in vitro mouse brain slice preparations. Please contact Dr Phil Heyward to discuss these projects in more detail.

Professor Brian Hyland

Not available for 2016.

Dr Karl Iremonger

Calcium imaging in CRH stress neurons

This project will use a genetically encoded calcium sensor (GCaMP6f) to image calcium levels in CRH neurons in brain slices from mice. This project will also involve immunohistochemical labeling of CRH neurons to confirm that the calcium sensor is specifically targeted just to CRH neurons.

Exploring the impact of noradrenaline and oxytocin on CRH neuron excitability

This project will use patch-clamp electrical recordings from CRH neurons in brain slices from mice. The effects of noradrenaline and oxytocin on CRH neuron excitability will be investigated.

Dr Pete Jones

Generating Novel Biosensors to Monitor Oxidative Stress in the Heart

Protein oxidation, a consequence of reactive oxygen species (ROS), is a fundamental form of intracellular signalling. ROS production is differentially regulated in discrete regions of the cell, but despite the importance of these 'ROS microdomains' there are currently no tools with the necessary spatial resolution to examine them. In the heart, oxidation is a key regulator of contraction and excess ROS leads to disease, particularly following ischemia-reperfusion injury. ROS augments contraction by increasing calcium release. The calcium release unit in cells of the heart is located within a unique structure, the cardiac dyad, with highly restricted diffusion and localised ROS production. This creates a discrete ROS microdomain. In this project we propose to create genetically encoded ROS sensors targeted to the calcium release unit to pioneer the study of the dyad ROS microdomain. We will use these mice to determine when and how ROS within this microdomain is altered. This will allow us to unravel the interplay between ROS

and calcium signalling. Understanding how and when the ROS microdomain surrounding the calcium release unit is perturbed will offer a new perspective on how calcium homeostasis is maintained physiologically and becomes corrupted during disease.

Dr Rajesh Katare

microRNA-499 and -30c in the diabetic heart

People with diabetes mellitus are more likely to suffer from cardiovascular disease, which is the leading cause of death in these patients. The pathophysiology behind the development of diabetic heart disease is still not clear. This project will aim to demonstrate the pathological role of microRNAs (short, noncoding RNAs that are implicated in various diseases) in development of diabetic heart disease. This project will be specifically determining the role of microRNA-499 and -30c in diabetic heart. Student will be exposed to diverse techniques including, culture and therapeutic modulation of cardiomyocytes and in vitro molecular analysis (real time PCR, western blotting and in situ hybridization) to test the hypothesis. Please contact me for further discussions. rajesh.katare@otago.ac.nz

Dr Regis Lamberts

Adrenergic control of the diabetic heart

Most patients with type 2 diabetes develop some form of heart disease. In our cardiovascular laboratory, we investigate the pathophysiology of the adrenergic control of the diabetic heart. Potential projects are to study the underlying signal transduction mechanisms of the diabetic heart in a rat model or in human cardiac samples, or the neuronal innervation of the diabetic rat heart. I am looking for an enthusiastic student who might be interested in undertaking a BSc (Hons) or BBiomedSc (Hons) project. Please feel free to contact us for additional information. (regis.lamberts@otago.ac.nz)

Associate Professor Fiona McDonald

Epithelial sodium channel and hypertension.

Blood pressure is controlled through a variety of mechanisms including a crucial role for the kidney epithelial sodium channel (ENaC) that rescues sodium from the developing urine into the circulation. Liddle's syndrome is a severe form of inherited hypertension caused by gain of function mutations in genes coding for ENaC. Thus we know that ENaC is important for maintaining normal sodium homeostasis and blood pressure control. A number of proteins interact with ENaC to modulate its actions, e.g., COMMD family proteins, ubiquitin ligases, proteases and trafficking proteins. In this project you will use a variety of techniques such as live-cell imaging, knockdown of protein expression, and ion transport assays to investigate the consequences of proteins interacting with ENaC and the implications for blood pressure control. Please contact me to discuss specific projects that are available.

Associate Professor Fiona McDonald & Dr Kirk Hamilton

Is retromer needed for ion channel trafficking and epithelial polarity?

To achieve the optimal balance of intracellular and extracellular ion concentrations the numbers of ion channels situated at the cell surface are tightly regulated. Retromer is a recently described intracellular complex that controls whether cell surface proteins are recycled to the cell surface or degraded. In this project we will determine if two epithelial ion channels (ENaC and KCa3.1) are regulated by retromer, and whether the polar distribution of these ion channels in epithelia are altered when retromer is disabled. The results will have implications for further understanding of electrolyte balance and blood pressure control.

Dr Daryl Schwenke (with A/P Chris Pemberton & Prof Chris Charles (University of Otago, Christchurch))

Identifying the physiological relevance of acyl vs non-acyl ghrelin for modulating cardiac sympathetic nerve activity following acute myocardial infarction

The peptide hormone Ghrelin has been shown to have striking cardioprotective properties, particularly via it's sympatho-inhibitory effects following acute myocardial infarction. Interestingly, although two circulating isoforms of ghrelin exist, acyl and des-acyl ghrelin, all of ghrelin's biological activity has been attributed to the acyl isoform because it has long been accepted that des-acyl ghrelin is void of any biological activity. Recent evidence, however, suggests that des-acyl ghrelin may also play a pivotal role in several physiological systems,

independent of acyl ghrelin. Accordingly, this study aims to identify whether ghrelin's sympathoinhibitory properties following acute MI are attributable to acyl, des-acyl, or a combination of both isoforms of ghrelin, and thus establish the therapeutic potential of des-acyl ghrelin in the sympathetic-cardiac axis.

Drs Daryl Schwenke & Pete Jones

Assessing calcium-dependent constriction of pulmonary vascular smooth muscle (VSM) in obesity

The literature describes an intriguing phenomena known as the 'obesity paradox' whereby obese humans with cardiovascular disease appear to have a better prognosis than that of non-obese subjects. Recent data show that the pulmonary vasculature of obese rats appears to be 'protected' against developing severe pulmonary hypertension (PH). However, the underlying reason for this apparent paradox remains unclear. Evidence in the literature suggests that the VSM of both pulmonary vessels in obese Zucker rats may be less sensitive to agonist-induced constriction, compared to lean rats, and that this effect may be associated with uncoupling of agonist-Ca^{2+} signaling interaction. Moreover, the development of PH is associated with augmentation of both SOCE Ca^{2+}-influx and Rho-kinase-mediated Ca^{2+}-sensitization in animal models and humans. This study aims to assess whether uncoupling of the agonist–Ca^{2+} signaling interaction within the VSM of obese Zucker rats accounts for the 'blunted' development of PH during chronic hypoxia.

Drs Daryl Schwenke & Rajesh Katare

Can early exercise intervention prevent the adverse changes in coronary blood flow associated with diabetic heart disease; assessed using Synchrotron Radiation Microangiography

The onset of heart disease in diabetes begins at a very early stage with impaired coronary blood flow as a precursor for functional and structural deterioration. Exercise is generally viewed as an excellent prophylactic strategy for ameliorating or preventing the onset of type 2 diabetes because of the benefits on weight management, blood glucose control, and insulin sensitivity. Indeed, mild exercise effectively reverses endothelial dysfunction in 'pre-diabetic' subjects, based on impaired glucose intolerance. Importantly, studies have shown 'intense' exercise as an effective means of reversing the progression of diabetic heart disease, in part because exercise can ameliorate vascular dysfunction. However, once diabetic heart disease has become well established, this intense level of exercise required to impede the progression of cardiac dysfunction is often unsustainable for most

patients.

This study proposes that initiation of a 'moderate' and sustainable exercise regime in the early stages of diabetes, before cardiac dysfunction begins, will ultimately prevent the onset of diabetic coronary artery dysfunction. We will use microRNAs (miRs) as a non-invasive biomarker to identify changes in cardiac function over the duration of exercise.

Associate Professor Phil Sheard

We investigate age-related changes in the nervous system and skeletal muscles with the overall aim of understanding the causes of sarcopenia, the progressive weakness that is a feature of old age.

We have an opportunity for a student to investigate the death of lower motoneurons in the spinal cords of elderly mice, and the findings may have implications also for other conditions and diseases that arise due to early death of neurons, such as motoneuron disease (ALS). The project will use immunohistochemistry coupled with widefield fluorescence and confocal microscopy to examine the trafficking of important substances in and out of the neuronal nucleus.

Dr Alex Tups

The influence of the clock on body weight

We are seeking honours students to join a multidisciplinary research group at the Centre of Neuroendocrinology.

Our group is studying the neuroendocrine regulation of body weight and its interaction with the mammalian circadian clock. Influences of high fat feeding on brain inflammation and circadian rhythms will be investigated in mice. The student can chose from various projects that focus on different aspects of brain inflammation, obesity and circadian rhythm disorders.

Our research combines molecular biological and neuroanatomical techniques with metabolic phenotyping and behavioural analyses.

Paper Descriptions:

PHSL 471 Systematic Physiology

PHSL 472 Neurophysiology

PHSL 473 Cellular Physiology

These three 20-point papers are taught in series (usually in the sequence PHSL 472, 473 and 471) and each consists of an eight-week seminar series exploring research frontiers in physiology. In these papers you will come to appreciate the way in which hypotheses are developed and substantiated and how to abstract information and present it. Each paper requires preparation and participation in class and is examined one week after the end of its seminar series, prior to the start of the next paper.

PHSL 474: Research Topics

This 20-point paper is a self-directed literature survey in areas of physiology that form the background to work undertaken in the research project. It is specifically designed for each student, guided by the supervisor and is internally assessed by three essays.

PHSL 490: Research Dissertation (Hons)

This is a 60-point supervised laboratory project involving original research leading to the production of a dissertation in the format of a thesis. All steps of the project are guided by the supervisor. Specific projects offered by available supervisors are listed above. PHSL 490 also involves ~15-min oral presentations to the Department in April and September/October. Thesis submission is in late October.

PHSL 480: Research Project (PGDipSci)

This is a 40-point supervised laboratory project involving original research and leading to the production of a research report in the format of a thesis. All steps of the project are guided by the supervisor. A ~15-min oral presentation on the project to the Department is required in April and in September/October. Deadline for thesis submission is late October.

PHSL 495: Masters Thesis Preparation (first year MSc)

This is a 40-point research project for MSc students guided by the supervisor. It involves submission of a preliminary proposal by the end of Semester One, and a formal written research proposal (literature review, bibliography, aims and objectives, methodology, and results and interpretation of the pilot study) to show the full project is feasible by late October. It also involves collaboration with the supervisor in applying for ethical approval for the project and, towards the end of second semester, a ~15-min oral presentation to the Department outlining the project.

Note: In the Department of Physiology you are advised to take the PGDipSci (instead of the 1st year MSc) and then to progress to the 2nd year of an MSc.

BMED 4BF: BBiomedSc Thesis in Functional Human Biology (4th year)

This paper code encompasses a 120-point programme where you are engaged in full-time research (Research Thesis) worth 85% of the course and Course Work worth 15%. The Research Thesis comprises an initial research proposal (April), a literature review (June) and a final thesis (November). All steps of the research are guided by the supervisor. A ~15-min oral presentation to the Otago School of Medical Sciences on the research proposal in early April and on the research outcomes in early October are also required. Deadline for thesis submission is 1 November, followed by an oral examination in early/mid November.

PHSL 4F*: BMedSc (Hons)*

The degree is for MBChB students and involves a full-time year of research in a field of medical science (requiring the production of a thesis).

PHSL 5: Master's Thesis (second year MSc)

For this you are engaged in full-time research for 12 months, or part-time research for 24 months, culminating in the production of a thesis and an oral presentation to the Department. Information on University policy relating to the MSc thesis can be obtained at http://www.otago.ac.nz/study/masters

Note: Scholarships are available for this thesis year – see p. 22 for further details.

MICN 8F: Medicine MMedSc

The degree is for MBChB students or MBChB graduates and involves a year of full-time research, or part-time research for 24 months, in any field of medical science, often a clinical discipline, at Masters level (requiring the production of a thesis).

Postgraduate Scholarships and Stipends:

University Scholarships for Master Thesis/PhD

Masters thesis and PhD students can apply for University Scholarships at any time throughout the year as part of their admission process. However, all prospective students must apply to the Department first for admission into each programme (see our website for application process).

Masters: $13,000 for 12 months + payment of domestic tuition fees. Up to 60 scholarships are available per year to support domestic Master's students. Up to 4 scholarships are available per year to support international Master's students ($13,000 for 12 months + payment of international tuition fees).

PhD: $25,000 pa + payment of fees for 3 years. These are available to both domestic and international students.

Scholarships also cover the costs incurred in the production of four hard-bound copies of the completed thesis. Scholarships **exclude** student services fee and insurance.

For further details including application forms for these scholarships, please refer to the Otago University website at: http://www.otago.ac.nz/study/scholarships/

Departmental Masters Scholarship for Thesis Year

The Department offers one MSc Scholarship per year which comprises $13,000 for 12 months + domestic fees + costs incurred in the production of four hard-bound copies of the MSc thesis. Applications will be considered in January each year.

Scholarships from Research Grants

Some PhD and Masters thesis scholarships can be funded from research grants but these are rare and usually require earlier deadlines for applications.

BMedSc (Hons) Scholarships

There are various scholarships available to New Zealand citizens/permanent residents only. See the Faculty of Medicine website for details to see which scholarships you are eligible to apply for - http://micn.otago.ac.nz/current-students/scholarships/bmedsc-hons. The closing date for applications is 1 October in the year previous to commencement of study for BMedSc (Hons).

400-level Scholarships and Stipends for Honours, PGDip or 1st year Masters

Neither the University nor the Department offer these for 400-level students. However, students who gain high grades in their 300-level studies can be awarded a University of Otago Scholarship for 400-level studies, which translates into a small monetary award if they undertake 400-level studies the following year.

Supplementary income from demonstrating

There are opportunities for all Masters thesis and PhD students to earn supplementary income as a demonstrator (hourly rate currently, $14.89/hr to $29.38/hr depending on experience + 8% holiday pay). A similar opportunity exists for 400-level students but as a 400-level course is only nine months, be cautious about the time commitment to demonstrating. The time commitment to demonstrating must be prior discussed with the supervisor.

Careers for Physiology Postgraduates:

With an Honours, PGDipSci or MSc degree in Physiology, or a BBiomedSc(Hons) in Functional Human Biology, the groundwork is laid for a wide variety of successful careers. Some, such as academic and research positions, take direct advantage of the specialist knowledge and technical research skills you have gained during your Physiology course. However, your scientific training will also have developed many more generic intellectual skills, for example obtaining, interpreting and retaining of information, time management and so on. These skills will last a lifetime and will place you well in many competitive job-seeking situations in areas outside the direct focus of your undergraduate degree. A degree in Physiology thus not only opens up careers in the biological and health sciences, but also a wide range of other appealing and absorbing jobs in which a high-level tertiary qualification in science is advantageous.

Physiology graduates with Honours, PGDipSci and MSc degrees and Functional Human Biologists with an Honours degree in BBiomedSc thus succeed in a wide range of environments, including:

- research assistants and technologists in medical and paramedical laboratories, hospitals, Crown Research Institutes, Universities, and the pharmaceutical and agricultural industries;
- lecturers and teachers in universities, polytechnical institutes, and secondary schools;
- allied health professions such as optometrists, audiologists, clinical perfusionists, clinical physiologists and technicians (renal dialysis, respiratory, cardiac, sleep);
- aviation and space industries;
- researchers and directors in the film and television industries;
- representatives of pharmaceutical firms and scientific equipment suppliers;
- sports institutes and academies;
- medical doctors, dentists, pharmacists, physiotherapists, and patent attorneys;
- business administrators and managers, often (but not always) in enterprises with scientific, biological or health science linkages.

If you have more questions about particular types of employment we can often put you in touch with a Physiology graduate with experience in the field in which you are interested.

For those captivated by the excitement of research and the opportunity of being at the frontiers of knowledge, studying for a PhD is your next career step – particularly if your goal is an academic career. A PhD involves three years of supervised but independent research, writing and submitting a thesis embodying your results and publishing papers in scientific journals. Following the award of your PhD, you will almost certainly need to demonstrate your ability for fully independent research by spending two or three years in Post-Doctoral Fellowships, probably in the United States or Europe. Fortunately Otago graduates have an excellent reputation and are keenly sought. Finally will come the search for a more permanent position. The prospects for employment opportunities for academic scientists are good, and are likely to be further strengthened as New Zealand joins the global move towards a knowledge-based economy, in which science will play a central role.

For further information on studying in the Department, or on entry requirements, careers and PhD and Masters thesis scholarships, you are advised to contact:

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