The following pages contain the 2016 Honours projects offered by the School of Medical Sciences.

If you are interested in applying for any of these projects, you are encouraged to discuss your application with the supervisor(s) listed, prior to lodging a formal application.

For more information on the School of Medical Sciences’ Honours programs, please contact: Dr Narin Osman on 03 9925 6686 or narin.osman@rmit.edu.au

To view application guidelines, visit: www.rmit.edu.au/medicalsciences/honours
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1. Project Title:

Modulation of angiotensin II signalling by hydrogen sulfide.

2. Supervisor/s:

Dr Joanne Hart

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Joanne Hart 9925 7545 joanne.hart@rmit.edu.au

5. Project Description

Aims/Hypothesis:

Aim: Determine the effect of H₂S on AII-mediated signalling in the vasculature.

Hypothesis: H₂S donor treatment will inhibit AT₁ receptor mediated signalling.

Background/Rationale:

H₂S is widely thought of as a toxic gas (that smells like rotten eggs!), however it has been shown to be produced by mammalian cells. There is increasing interest in H₂S in the cardiovascular system, with numerous reports of its involvement in vascular regulation. We recently showed that H₂S treatment in vivo caused a decrease in oxidative stress induced by AII-infusion. This study will investigate whether this is a direct effect on AT1 receptor function.

Outcomes/Benefits:

The results from this project will tell us about the importance of the gaseous transmitter H₂S as a regulator of AII-mediated signalling.

The project involves a number of laboratory techniques including biochemical, molecular biology and in vitro organ bath experiments. Data collected will be analysed and the findings interpreted and presented within the School of Medical Sciences and at National Scientific conferences. The student will be involved in all aspects of this study.

Specialist skills that will be gained by the student in this project:

- Planning and organisation of a scientific study
- Handling of experimental animals
- Proficiency in in vitro organ bath and/or small vessel myograph techniques
- Skills in molecular biology and confocal imaging techniques.
- Skills in data collection and analysis
- Oral presentation skills
- Scientific writing skills

6. Resources

This project will be carried out on campus in the School of Medical Sciences.
1. Project Title:
Role of pannexins in resistance vessel regulation

2. Supervisor/s:
Dr Joanne Hart, School of Medical Sciences, RMIT University
Dr Simon Potocnik, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Joanne Hart, 9925 7545, joanne.hart@rmit.edu.au

5. Project Description
Aims/Hypothesis:
The aim of this study is to examine the localisation and function of pannexin channels in small resistance-like blood vessels.

Background/Rationale:
Pannexins are newly identified, multi-unit channels that are associated with purinergic receptors in some cell membranes. Little is known about their role in regulation of vascular function. We have preliminary data to show that pannexins are located in vascular smooth muscle cell membranes and this project will explore their role in mediating vascular function.

Outcomes/Benefits:
The results from this study will show whether or not pannexins are important in resistance vessel regulation.

The project involves a number of laboratory techniques including immunofluorescence, in vitro small vessel myography and molecular biology techniques. Data collected will be analysed and the findings interpreted and presented within the School of Medical Sciences and at National Scientific conferences. The student will be involved in all aspects of this study.

Specialist skills that will be gained by the student in this project:
- Planning and organisation of a scientific study
- Handling of experimental animals
- Proficiency in in vitro organ bath and/or small vessel myograph techniques
- Proficiency in immunofluorescence and confocal microscopy
- Skills in molecular biology techniques
- Skills in data collection and analysis
- Oral presentation skills
- Scientific writing skills

6. Resources
This project will be carried out on campus in the School of Medical Sciences.
1. Project Title:

Is flavonol 3',4'-dihydroxyflavonol (DiOHF) an effective treatment for type 2 diabetes?

2. Supervisor/s:

Associate Professor Terence P. Herbert, Senior Researcher, School of Medical Sciences, RMIT University
Professor Owen L Woodman, Professor and Head Discipline of Cell Biology and Anatomy,
Deputy Head (R&I) School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Terence P. Herbert, 9925 7339, terence.herbert@rmit.edu.au, www.rmit.edu.au

5. Project Description

Aims/Hypothesis: The aim of this project is to determine whether DiOHF is an effective treatment for type 2 diabetes and to investigate its mode of action.

Background/Rationale:

Type-2 Diabetes is a chronic human disease characterised by high blood glucose concentration which is caused by insulin deficiency often in the context of insulin resistance. 4% of all Australians have diabetes and the Australian Government spends $3 billion per annum on treatment and management of diabetes and diabetes related illness. It’s an extremely serious disease affecting both the macro and microvasculature leading to increased risk of heart disease, strokes, diabetic retinopathy, kidney failure and amputations. Alarmingly the prevalence of type 2 diabetes is predicted to double in the next 10 years due to the increase in obesity, a major risk factor in the development of type-2 diabetes. Although there are pharmacological therapies for the management of type 2 diabetes, these are ineffective at halting the progression of the disease or maintaining long term normoglycemia. Consequently there is a real need to find new therapies for the treatment and prevention of type 2 diabetes. Interestingly, we have preliminary data indicating that a synthetic polyphenol, 3',4'-dihydroxyflavonol (DiOHF), restores glucose tolerance in a glucose intolerant mouse and thus may be a potential treatment for type-2 diabetes. (DiOHF is closely related to natural flavonols which are found in fruits and vegetables and therefore are normal components of the diet.) In this proposal, you will investigate the effects of this DiOHF on the development of glucose intolerance and diabetes in rodent models of type 2 diabetes. You will uncover whether the effects of DiOHF are mediated by a restoration in insulin sensitivity or increased pancreatic beta-cell function and, lastly, you will explore its' molecular mechanism of action using molecular and cellular techniques.

Outcomes/Benefits:

• This project could lead to a novel treatment for type 2 diabetes
• You will leave my laboratory with a repertoire of scientific*, generic and transferrable skills which will be invaluable in your future career.
  *use of diabetic animal models, islet isolation, measuring metabolic parameters (e.g. glucose tolerance, insulin tolerance), cell culture, immunohistochemistry, molecular biology (e.g. qPCR), protein biochemistry (e.g. Western blotting), Cell biology (fluorescence/confocal microscopy)
• You will be expected to attend and present your work at conferences, to publish in high impact International peer-reviewed journals, to work with both international or/and national collaborators.

6. Resources

This project will be carried out on campus in the School of Medical Sciences
1. Project Title:

The role of dysregulated branch chain amino acid metabolism in β-cell dysfunction and onset of type-2 diabetes.

2. Supervisor/s:

Associate Professor Terence P. Herbert, Health Innovations Research Institute (HIRI), School of Medical Sciences, RMIT University
Professor Jiming Ye, Professor of Ageing and Chronic DM, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Terence P. Herbert, 9925 7339, terence.herbert@rmit.edu.au, www.rmit.edu.au

5. Project Description

Hypothesis:
In the insulin resistant state chronically increased BCAA influx exacerbates the development of β-cell dysfunction resulting in the onset of T2DM.

Specific Aims
The overall aim of this proposal is to understand the role of dysregulated BCAA metabolism in the development of pancreatic β-cell dysfunction and T2DM.

The specific aims are:
1. To determine whether decreasing BCAA influx protects against β-cell dysfunction and diabetes in a mouse model of diabetes; the high fat diet fed mouse.
2. To understand the molecular/cellular basis for BCAA-mediated changes in β-cell function and mass in these models.
3. To understand why BCAAs exacerbate free fatty acid-induced cell death in clonal β-cells and primary islets.

Background/Rationale:
Type-2 diabetes Mellitus (T2DM) is highly prevalent and its incidence is increasing at an alarming rate due to the obesity epidemic. Thus, it is critical to understand the causative factors of T2DM as this will ultimately lead to development of desperately needed novel therapeutic interventions. Importantly, pancreatic β-cell dysfunction is essential for the onset of T2DM; yet the underlying mechanisms which cause dysfunction are poorly understood. In this proposal we present compelling evidence that dysregulated branch chain amino acid (BCAA) metabolism/elevated plasma BCAAs, a consequence of insulin resistance, is likely a key determinant in the development of pancreatic β-cell dysfunction through the exacerbation of endoplasmic reticulum (ER) stress. This newly acquired knowledge provides the rationale to now define the role of BCAAs in β-cell dysfunction and the onset of T2DM.

Outcomes/Benefits:
This work will: 1) significantly advance our fundamental understanding of the role of BCAAs in β-cell physiology/pathophysiology; 2) define the role of BCAAs in β-cell dysfunction/death and the development of T2DM, and; 3) provide a rationale to develop nutritional/pharmacological interventions to ameliorate and/or prevent the onset of diabetes.

You will leave my laboratory with a repertoire of scientific*, generic and transferrable skills which will be invaluable in your future career.

*use of diabetic animal models, islet isolation, measuring metabolic parameters (e.g. glucose tolerance, insulin tolerance), cell culture, immunohistochemistry, molecular biology (e.g. qPCR), protein biochemistry (e.g. Western blotting), Cell biology (fluorescence/confocal microscopy)

You will be expected to attend and present your work at conferences, to publish in high impact International peer-reviewed journals, to work with both international or/and national collaborators.

6. Resources
This project will be carried out on campus in the School of Medical Sciences
1. Project Title:
Does dietary magnesium intake affect the development of diabetes and its complications?

2. Supervisor/s:
Dr Tamara Paravicini, Pharmaceutical Sciences, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Tamara Paravicini 9925 7674 Tamara.paravicini@rmit.edu.au

5. Project Description:

Aims/Hypothesis:
This study has two specific aims:
1. To examine how diabetes affects the expression and function of magnesium channels in the kidney and vasculature.
2. To determine whether altered dietary magnesium intake affect the renal and vascular dysfunction caused by diabetes.

Background/Rationale:
Magnesium is one of the most abundant cations in the body, and it plays a critical role in maintaining normal cellular function. Hypomagnesaemia is relatively common in patients with diabetes, and clinical studies have shown an association between low magnesium levels and the severity of diabetic complications in these patients. However, the potential mechanisms by which magnesium may influence the progression of diabetes and subsequent complications remain unknown.

This study will use an animal model of diabetes to assess how the regulation of magnesium transport and signalling is altered during diabetes progression. Plasma magnesium levels will be altered by dietary manipulation (magnesium deficiency or supplementation), and we will examine how magnesium levels affect diabetes-induced damage of the kidneys and blood vessels.

Outcomes/Benefits:
This project will provide students with training in experimental design, data analysis, critical analysis of the scientific literature, animal handing, physiological measurements of renal and vascular function, biochemical and molecular biological techniques. It will provide important information regarding the role of magnesium in the development and progression of diabetes and diabetic complications.

The proposed research project will provide specialist skills and depth of knowledge in cardiovascular and renal physiology, and techniques that are related to this field of research. Further training in data analysis and experimental design will contribute to the student’s ability to think critically and logically, and develop their decision making skills.

6. Resources
This project will be carried out on campus in the School of Medical Sciences.
1. Project Title:
Examining the role of the TRPM7 channel-kinase in cellular growth

2. Supervisor/s:
Dr Tamara Paravicini, Pharmaceutical Sciences, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Tamara Paravicini, 9925 7674, Tamara.paravicini@rmit.edu.au

5. Project Description
Aims/Hypothesis:
This study has two major aims:
1. To characterise whether some putative inhibitors of the TRPM7 ion channel influence ion transport, kinase activity, or both.
2. To determine whether inhibition of TRPM7 kinase activity influences cellular growth.

Background/Rationale:
Magnesium is a highly abundant cation that is critical for normal cellular function. Clinical and epidemiological evidence shows that magnesium levels are reduced in chronic diseases such as hypertension and diabetes, and that this may exacerbate the progression of cardiovascular disease. Recently, TRPM7 has been identified as a magnesium channel that is critical for cellular magnesium homeostasis. Importantly, TRPM7 also contains an active kinase domain, making it a dual function protein able to both transport magnesium and activate intracellular signalling cascades.

Recently, a number of putative inhibitors and activators of TRPM7 have been identified through screening assays, however these compounds have yet to be experimentally validated. Using an in vitro cell culture system this project will investigate whether these compounds can selectively target TRPM7 function, and whether they affect the ion channel activity, the kinase activity, or both. After the initial characterisation, these compounds will used to investigate the role of TRPM7 kinase activity in cellular function

Outcomes/Benefits:
This project will provide students with training in experimental design, data analysis, critical analysis of the scientific literature, cell culture, Western blotting and other biochemical and molecular biological techniques. It will provide an important pharmacological classification of putative TRPM7 inhibitors that will be important for the future use of these drugs in exploring TRPM7 function in vivo.

The proposed research project will provide specialist skills and depth of knowledge in pharmacology and ion channel function, and techniques that are related to this field of research. Further training in data analysis and experimental design will contribute to the student’s ability to think critically and logically, and develop their decision making skills.

6. Resources
This project will be carried out on campus in the School of Medical Sciences.
1. Project Title:
The effect of novel biocompatible magnesium alloy scaffolds on human bone cells

2. Supervisor/s:
Assoc. Prof. Paul Wright (Discipline of Pharmaceutical Sciences: Nanosafety & Toxicology),
School of Medical Sciences, RMIT University
Dr Bryce Feltis (Discipline of Pharmaceutical Sciences: Nanosafety & Immunology), School of Medical Sciences,
RMIT University
Prof. Cuie Wen, School of Aerospace, Mech. & Manufacturing Eng: Engineering Biomaterials, RMIT University
Dr Yuncang Li, School of Aerospace, Mechanical & Manufacturing Eng. Engineering Biomaterials, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate. Professor. Paul Wright, 9925 6512, paul.wright@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To investigate the effects of novel biocompatible magnesium alloys and scaffolds on human bone cell viability, following \textit{in vitro} exposure.

Background/Rationale:
New biocompatible materials suitable for 3-D printing and which can undergo controlled degradation, are urgently needed to provide prosthetic implants that can be rapidly tailor-made for individual patients. Such materials are likely to have altered biological activity and toxicity profiles to previous implants. The Engineering Biomaterials and Nanosafety/Toxicology laboratories at RMIT are collaborating to determine the toxicity profile of these novel materials in bone cells, as they are the main point of contact for these materials in the body.

In this multi-disciplinary project, the student researcher will expose human bone cells to alloys and scaffolds with a range of surface and structural modifications. Cell responses and uptake of material will be measured by \textit{in vitro} plate and flow cytometry assays. These findings will be combined with physicochemical characterisation of the state of materials before and after exposures, to understand the surface interactions and bioactivity relationships involved.

Outcomes/Benefits:
During this project, the student will gain expertise in cell culture, learn about the preparation and application of materials to biological systems, and learn how to employ sophisticated bioassays and flow cytometry to solve research questions – these techniques and skills are highly applicable to both research and industry. The project will also produce highly publishable results and should form the basis for a high impact publication.

Students will develop:
- Specialist skills in an area of medical science – including specialised techniques for cell culturing, as well as advanced laboratory skills in biochemistry, and cell and molecular biology.
- The capacity to perform a variety of procedures and techniques that are essential for the satisfactory completion and reporting of a research project – from conducting multidisciplinary laboratory research in biology (biochemistry, cell and molecular biology, and toxicology) in an efficient and timely manner, as part of the nanosafety/toxicology research group at RMIT.
- Enhanced ability to think critically and logically – from carefully evaluating the relevant published literature in cell biology and materials science and the appropriate application of this knowledge to conduct this multidisciplinary project.
- Independent decision-making skills, relevant to scientific research – from the problem-solving research challenges involved in the adaptation of cell and molecular biology methods to test the effects of materials with distinct physicochemical characteristics and their behaviour in the \textit{in vitro} exposure systems.
- Communication skills relevant to the dissemination of experimental findings – the honours student is expected to prepare a high-quality presentation for a scientific meeting, in addition to submitting the thesis and presenting seminars for their honours.
- A greater depth and breadth of knowledge in their major study discipline– the honours student will be a co-author and contributor to any journal publications resulting from their project.

6. Resources
The project will be undertaken in the RMIT Nanosafety Research Group’s laboratories at the School of Medical Sciences (Building 223, RMIT Bundoora).
1. Project Title:
Isolation of EC cells and crypts to examine the biophysics of 5-HT release.

2. Supervisor/s:
Dr Paul Bertrand (HIRI), Pharmaceutical Sciences, HDR Coordinator, School of Medical Sciences, RMIT University
Dr Joanne Hart (HIRI), School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Paul P Bertrand, 9925-7898, paul.bertrand@rmit.edu.au

5. Project Description
Aims/Hypothesis:
This project aims to investigate the regulation of 5-HT release from single EC cells using state-of-the-art electrochemical methods. This will allow us to quantify release of 5-HT in real-time and determine the biophysics and molecular regulators of release.

Background/Rationale:
Evoked release of 5-HT (serotonin; 5-hydroxytryptamine) from the gastrointestinal (GI) tract is a critical step in the sensory transduction of chemical and mechanical information from the lumen of the gut to the nervous system. Neuroendocrine cells known as enterochromaffin cells (EC cells) are the site of synthesis, storage and release of 5-HT and alterations in this process can cause or exacerbate disease. Despite this, little is known about how EC cells respond to stimuli and how 5-HT is released is regulated by receptors and channels on the EC cell or the surrounding epithelial cells.

Outcomes/Benefits:
Skills learnt during this Honours are animal handling, microdissection, basic laboratory skills, basic theory of neuronal function and neurophysiological techniques such as electrochemical and electrophysiological recording and pharmacological manipulation of neurotransmission.

6. Resources
On campus in the School of Medical Sciences
1. Project Title:

Characterisation of 5-HT release from intact gastrointestinal tract.

2. Supervisor/s:

Dr Paul Bertrand, (HIRI), Pharmaceutical Sciences, HDR Coordinator, School of Medical Sciences, RMIT University
Dr Trisha Jenkins (HIRI), School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Paul P Bertrand, 9925-7898, paul.bertrand@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to characterise the release of 5-HT from EC cells. It will use a novel electrochemical technique to measure 5-HT release selectively and in real-time from intact preparations of different areas of the gastrointestinal (GI) tract during inflammation or obesity.

Background/Rationale:
Evoked release of 5-HT (serotonin; 5-hydroxytryptamine) from the GI tract is a critical step in the sensory transduction of chemical and mechanical information from the lumen of the gut to the nervous system. Neuroendocrine cells known as enterochromaffin cells (EC cells) are the site of synthesis, storage and release of 5-HT and alterations in this process can cause or exacerbate disease. Despite this, little is known about how EC cells respond to stimuli and how 5-HT is released regulated by epithelial cells, neurons or muscle in the intact GI tract.

Outcomes/Benefits:
Skills learnt during this Honours are animal handling, microdissection, basic laboratory skills, basic theory of neuronal function and neurophysiological techniques such as electrochemical and electrophysiological recording and pharmacological manipulation of neurotransmission.

6. Resources

On campus in the School of Medical Sciences
1. Project Title:
Are adolescents more susceptible to depression than adults?

2. Supervisor/s:
Dr Trisha Jenkins (HIRI), School of Medical Sciences, RMIT University
Dr Sarah Spencer, School of Health Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Trisha Jenkins, 99256523, trisha.jenkins@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To determine if adolescent rodents are more susceptible to depression than adults. We suggest that ‘teen’ mice will have altered behaviour and brain activity compared to their adult counterparts.

Background/Rationale:
One in four young people are living with a mental disorder and 9% of young people (16-24 years old) experience high to very high levels of psychological distress (Australian Institute of Health and Welfare, 2007). The teenage years are a time when individuals develop their identity and sense of self. Several lines of evidence suggest that the brain circuitry involved in emotional responses is changing during the teen years. Functional brain imaging studies for example suggest that the responses of teens to emotionally loaded images and situations are heightened relative to younger children and adults.

Animal models of chronic stress are frequently used to understand the mechanisms underlying the relationship between stress and affective disorders such as anxiety and depression. The current study expands upon a novel chronic psychological stress paradigm for mice that exhibits an anxiety and depressive phenotype. Whether adolescent mice are more susceptible to levels of stress than adults will be investigated.

Outcomes/Benefits:
The student will experience training in experimental design, literature analysis, animal modelling of neurological disease, behavioural testing and lab-based methods including immunohistochemistry of brain tissue, anatomical and computer-microscope analyses and statistical data analysis.

Students will develop:
- Specialist skills in the field of neuroscience, with particular relevance to creating animal models of neurological disease and behavioural neuroscience.
- The skills to perform a variety of laboratory procedures including animal handling, behavioural testing and lab-based methods including tissue sectioning, immunohistochemistry, anatomical and computer-microscope analyses procedures.
- Enhanced ability to search and discuss relevant literature. The student will be part of a research team and participate in discussions with his/her supervisor and other researchers.
- Independent decision-making skills to decide program of work, establish protocols, and suggest further studies.
- Communication skills relevant to the dissemination of experimental findings.

6. Resources
On campus
1. Project Title:
Sensitization of the Chilli pepper receptor TRPV1 in rat sensory neurones.

2. Supervisor/s:
Peter McIntyre, (HiRi), School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Peter McIntyre, 99257085, peter.mcintyre@rmit.edu.au

5. Project Description

Aims/Hypothesis:
The capsaicin receptor, TRPV1, is subject to modulation of its sensitivity by phosphorylation due to intracellular signalling

Background/Rationale:
The capsaicin receptor, TRPV1, is subject to modulation of its sensitivity by post-translational modification due to intracellular signalling
Identifying the components of this of these sensitising pathways has begun but they are not well characterised. A better understanding of the pathways that sensitise this important pain-sensing ion channel could reveal new therapeutic approaches to chronic pain.

Outcomes/Benefits:
The ultimate objective of this project is to identify new targets for therapies to treat chronic pain.
The student will learn to design and perform molecular cellular experiments and conduct cellular pharmacological assays using models of disease, cellular assays and state of the art microscopes and plate readers. These skills are transferrable to other laboratory-based experimental projects. In addition, the student will learn what is required to be part of a modern, successful molecular pharmacology laboratory and how to store “big data” and write-up useful project notes and a final report.

The project will develop skills such as the isolation and assay of rat sensory neurones, the use of cellular assay technologies that rely on calcium sensitive and voltage sensitive – fluorescent dyes and platereaders /or confocal microscopy. The process of designing experiments and defining endpoints for assays will enhance critical, logical thinking. The project will require the development of decision making ability and excellent understanding of the underlying principles and an ability to communicate them and the findings of the project.

6. Resources
This work will be carried out mainly in the laboratory of Professor. Peter McIntyre (Module D, building 223), School of Medical Sciences.
1. Project Title:

The molecular basis of TRPA1 mediated mechanotransduction.

2. Supervisor/s:

Peter McIntyre (HIRi), School of Medical Sciences, RMIT University
Sara Baratchi (HIRi), School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Peter McIntyre, 99257085, peter.mcintyre@rmit.edu.au

5. Project Description

Aims/Hypothesis:
Is TRPA1 a mechanoreceptor?

Background/Rationale:
Mechanosensitive ion channels play a key role in the biology of touch, pain, hearing and vascular reactivity; however the identity of these ion channels and the molecular basis of their activation is poorly understood. TRPA1 is one of the candidate mechanoreceptor expressed in inner ear hair cells and sensory nerves and may help transduce mechanical stimuli induced by sound waves into nerve impulses for auditory sensation.

Outcomes/Benefits:
The aim of this project is to understand the molecular mechanism that controls TRPA1 mechanotrasduction. The student will learn different skills including biomicrofluidics, confocal and super resolution microscopy, cellular assays and western blotting. Further, they will learn how to design experiments and to test hypotheses.

6. Resources

This work will be carried out mainly in the laboratory of Prof. Peter McIntyre (Module D, building 223), School of Medical Sciences.
1. Project Title:

Arteriole on a chip.

2. Supervisor/s:

Dr Simon Potocnik, School of Medical Sciences, RMIT University
Dr Francisco Lopez, School of Electrical and Computer Engineering (Biomedical Engineering), RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Simon Potocnik, 9925 7074, simon.potocnik@rmit.edu.au
Dr Francisco Tovar, 9925 5279 francisco.tovarlopez@rmit.edu.au

5. Project Description

Aims/Hypothesis:
The development of an isolated arteriole preparation to investigate the mechanism of action of ion channels involved in the regulation of endothelial and smooth muscle function in small blood vessels.

An ‘arteriole on a chip’ preparation will improve accessibility to the powerful in-vitro, isolated and cannulated, pressurised and perfused arteriole preparation for vascular research.

Background/Rationale:
The study of function and control in the microcirculation requires a high level of technical expertise to prepare arterioles for in-vitro study. The preparation is time consuming and this restricts investigators to one or two experiments per day. The isolated, cannulated and pressurised and/or perfused arteriole preparation is the most direct way to study the control and function of small arteries. Alternatives include in-vivo microscopy of arterioles in humans or animals or anaesthetised animal preparations and are restricted to a limited number of accessible vascular beds. An ability to easily prepare arterioles for study, from human or animal samples and disease or healthy states, regardless of the vascular bed would be a major advance. The use of micro-engineered channels on a microscope slide sized platform offer the opportunity to support small blood vessels for in-vitro study. This preparation would allow investigation using advanced multi-photon and confocal microscopy, which afford cellular resolution for the investigation of ion channel function. Ideally the time for preparation would be reduced, the number of vessels studied in a day should increase and the efficiency of use of animal and human tissues improved.

Outcomes/Benefits:
Students would learn and become proficient in a range of in-vitro vascular biology, pharmacological techniques. Anatomy and micro-dissection skills would be developed. The design and construction of the ‘arteriole on a chip’ platform will be an important part of engineering a micro system to maintain biological tissue in short term functional state and provide an opportunity to gain experience in the development of engineered solutions to the study of pharmacology and physiology.

Students will develop:
- Practical instruction in the Bundooora vascular research laboratory and in the city, biomedical engineering laboratory will develop specialist skills and the capacity to perform in-vitro pharmacology and physiology experiments and the manufacture of a micro-fluidics research platform.
- The capacity to perform the procedures required will be demonstrated and taught to the student by the project supervisors or graduate students in the respective laboratories.
- The ability to think critically and logically will be developed through experiment planning and discussions with supervisors, with reference to relevant literature and the aims of the project.
- When the student is confident and capable in the techniques required to progress the project they will be encouraged to exercise independence in project planning, timetabling and experiment execution. The project is designed to allow a variety of arteriole function assessments and to explore several applications for the artery on a chip platform. Many combinations of these would contribute significantly to the research field and may be explored independently by the student.
- Communication of the project outcomes at a national scientific conference and through both the honours oral and written (thesis) assessments will be developed and encouraged through a review and mentoring process.
- In combination the project activities outlined above will develop a breadth (practical and theoretical) of understanding in the pharmacology, vascular physiology and engineering discipline areas.

6. Resources

RMIT Bundooora and City campus: The project will likely involve one day/week in microfluidic platform manufacture (city campus) and the remainder in the Vascular Biology laboratory at Bundooora.
1. Project Title:
Does a thyroid-immune interaction lead to cognitive dysfunction in mice?

2. Supervisor/s:
Associate Professor Samantha Richardson, School of Medical Sciences, RMIT University
Dr Sarah Spencer, School of Health Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Samantha Richardson, 9925 7897, samantha.richardson@rmit.edu.au

5. Project Description
Aims/Hypothesis:
AIM: to determine if reduced levels of thyroid hormone in the central nervous system affect development of the brain’s immune cells to cause cognitive dysfunction.

Background/Rationale:
Thyroid hormones are critical regulators of growth and development, particularly of the central nervous system. Insufficient thyroid hormone during brain development leads to mental retardation. Thyroid hormones are synthesised by the thyroid gland and must cross the blood-brain barrier and the blood-cerebrospinal fluid barrier to enter the central nervous system (CNS). Transthyretin is a protein involved in transporting thyroid hormone across the blood-CSF barrier. In the CSF, transthyretin is the major thyroid hormone distributor protein. We have mice that lack transthyretin. They have reduced thyroid hormone delivery within the CNS and are hypothyroid in specific areas of the CNS.

Microglia are cells in the brain that act in immune defence. During development microglia change their morphology and function from round (ameboid) or elongated in shape, with a role in synaptic pruning and neuronal cell death to ramified and relatively quiescent with a role in surveying the CNS for pathogens. The thyroid hormones are crucial in programming this development. We want to determine if transthyretin null mice have altered microglial development and if this leads to cognitive dysfunction.

To test this, we will examine deficits in cognitive dysfunction with a barrage of memory and executive function tests in adult WT and TTR-KO mice. We will correlate this with differences in cortical microglial morphology at various stages of neonatal development and in adulthood.

Outcomes/Benefits:
The student will gain experience in learning to plan experiments; get experience in techniques including CNS dissection, immunohistochemistry, molecular biology and protein biochemistry; learn to analyse, interpret and evaluate data; learn to prepare and present their research in both oral and poster formats. The student will make a valuable contribution to the international effort towards understanding the roles of transthyretin function in the CNS.

Students will develop:
• Specialist skills include the ability to independently perform CNS dissection, immunohistochemistry, molecular biology and protein biochemistry.
• Enhanced ability to think critically and logically and independent decision-making skills will be taught through planning of experiments and the subsequent analysis and interpretation of data.
• Communication skills will be gained by presenting at weekly lab meetings, presenting data as conference posters and school honours seminars.
• A greater depth and breadth of knowledge will be gained by regularly reading the literature and summarising the critical and controversial points in a literature review.

6. Resources
On Bundoora campus in buildings 223 and 201.
1. Project Title:
Towards elucidating a mechanism of transthyretin amyloid formation

2. Supervisor/s:
Associate Professor Samantha Richardson, School of Medical Sciences, RMIT University
Dr Celine Valery, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Samantha Richardson, 9925 7897, samantha.richardson@rmit.edu.au

5. Project Description

Background/Rationale:
Transthyretin (TTR) binds and distributes thyroid hormones around the body (1). Thyroid hormones are required to regulate expression of many genes both during development and in adults. For unknown reasons, TTR can spontaneously dissociate from its native tetrameric conformation and form elongated insoluble fibrils in the hearts of elderly people (2). This occurs in about 25% of men over the age of 80. The cause is unknown and there is no cure. Current treatments involve stabilisation of the tetramer by specific drugs (3).

Aims/Hypothesis:
We have an hypothesis regarding a potential mechanisms by which native TTR forms amyloid (4). This hypothesis will be tested during this project by comparing rates of amyloid formation of TTRs from various vertebrate species, whose amino acids sequences vary in specific regions of interest. Similarly, recombinant TTRs (synthesised in E. coli) whose amino acid sequences have been altered by site-directed mutagenesis will be analysed for rates of amyloid formation.

Outcomes/Benefits:
The student will gain experience in bioinformatics, molecular biology, protein biochemistry, physical biochemistry and biophysics. The student will make a valuable contribution to the international effort towards understanding the mechanism(s) of TTR amyloid formation. S/he will have the opportunity to present research data at a local or national conference, publish in an international journal and be involved in local, national and international collaborations.

6. Resources
This project will be based at RMIT Bundoora but may also require the student to use facilities at Bio21 Institute / University of Melbourne and RMIT city campus.
1. Project Title:
Distribution of thyroid hormone transmembrane transporters in wild type and transthyretin null mice.

2. Supervisor/s:
Associate Professor Samantha Richardson School of Medical Sciences
Associate Professor Janine Danks School of Medical Sciences

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Samantha Richardson, 9925 7897, samantha.richardsopn@rmit.edu.au

5. Project Description
Aims/Hypothesis:
Hypothesis: Transthyretin null mice have altered expression of MCT8 and MCT10 in specific regions of their brains, as a compensatory mechanism for the lack of transthyretin.

Background/Rationale:
Thyroid hormones are critical regulators of growth and development, particularly of the central nervous system. Insufficient thyroid hormone during brain development leads to mental retardation. Thyroid hormones are synthesised by the thyroid gland and must cross the blood-brain barrier and the blood-cerebrospinal fluid barrier to enter the central nervous system (CNS). Transthyretin is a protein involved in transporting thyroid hormone across the blood-CSF barrier. In the CSF, transthyretin is the major thyroid hormone distributor protein.

Thyroid hormones enter and leave cells via “thyroid hormone transmembrane transporters”. Two thyroid hormone transmembrane transporters which are found in the brains on humans and mice are MCT8 (specific for transporting thyroid hormones) and MCT10 (transports thyroid hormones and other compounds).

We have mice that lack the transthyretin. These transthyretin null mice have reduced thyroid hormone delivery within their CNS and are hypothyroid in specific areas of the CNS. This project will investigate if there are differences in expression levels of two thyroid hormone transmembrane transporters (MCT8 and MCT10) in specific regions of the brains of wild type and transthyretin null mice at several post-natal ages.

Outcomes/Benefits:
The student will gain experience in learning to plan experiments; get experience in techniques including CNS dissection, immunohistochemistry, molecular biology and protein biochemistry; learn to analyse, interpret and evaluate data; learn to prepare and present their research in both oral and poster formats. The student will have the potential to make a valuable contribution to the international effort towards understanding the roles of transthyretin, MCT8 and MCT10 function in the CNS.

References:

6. Resources
Bundoora West Campus
Using self-assembling peptide hydrogels to study cancer cell attachment, proliferation and apoptosis.

Associate Professor Ian A Darby, School of Medical Sciences, RMIT University
Dr Richard Williams, School of Aerospace, Mechanical and Manufacturing Engineering, RMIT University

BH058 Bachelor of Biomedical Sciences (Honours)

Associate Professor Ian Darby, 9925 7624, ian.darby@rmit.edu.au
Dr Richard Williams, 9925 6642, richard.williams@rmit.edu.au

The aim of this project is to study the interaction between cells and a self-assembling peptide hydrogel nanostructure consisting of specific peptides. Peptides or macromolecules that have effects on cell adhesion (integrin binding), cell proliferation and cell death will be incorporated into the hydrogel and we aim to show that these can cause increased cell adhesion and proliferation or in the case of anti-inflammatory molecules; increased cell death by apoptosis.

Two dimensional cultures have long been used to study the behaviour of cells in vitro. There are problems with studying cells in 2 dimensions since they normally exist in a 3 dimensional matrix in vivo and in addition, the rigid non-compliance of plastic plates compared to a compliant 3D matrix results in a very abnormal environment. In this study we will use self-assembling peptides that form nanofibrillar structures in which cells can be cultured. Experiments will be performed to examine the way cancer cells behave (proliferate, migrate and die) in 3D environments that include adhesion sites mimicking fibronectin cell binding sites and also whether we can incorporate proteins that have been shown to increase cancer cell growth and survival (periostin) into the matrix structure. We will also test the effects of anti-cancer molecules such as specific siRNAs (Flightless 1) or other anti-cancer molecules (fucoidan) within the 3D structure. Microscopy will be used to assess cell survival, cell death and cell proliferation using fluorescent markers and confocal.

This project will allow us to test 3D self-assembling structures as potential models of the cancer microenvironment and also as possible methods of drug delivery for anti-cancer effects. Students will gain experience in in vitro methods, sterile technique and microscopy as well as furthering their understanding of cancer cell biology.

The project will develop students' specialist skills in cancer cell biology. Students will learn how to do cell culture including sterile technique and growing cells in 2 and 3 dimensional culture systems. Some basic molecular biology will also be learnt in transfecting cells and using siRNA or RNAi to block gene expression in cells. Students will gain skills in microscopy including confocal microscopy and immunocytochemistry. Some techniques involved will need to be optimised and the student will be involved in thinking critically about how to improve methods used, how to quantitate results and how to validate methods developed during their Hons project. Overall the project will develop the student's knowledge in cancer biology.

School of Medical Sciences laboratories, on campus, Bundoora West
1. Project Title:
Influence of perivascular nerves on arteriole function.

2. Supervisor/s:
Dr Simon Potocnik, School of Medical Sciences, RMIT University
Professor Owen Woodman, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Simon Potocnik, 99257074, simon.potocnik@rmit.edu.au
Professor Owen Woodman, 99257305, owen.woodman@rmit.edu.au

5. Project Description

Aims/Hypotheses:
Identify actions of perivascular nerves in the regulation of arteriole contraction and dilatation. Determine the mechanism of action of TRPV4 ion channels, on autonomic perivascular nerves.

Hypotheses:
1. Activation of the TRPV4 ion channels on the sensory and sympathetic (autonomic) nerves that surround arterioles modifies intrinsic myogenic auto-regulation.
2. Effects of TRPV4 agonists (potential antihypertensive drugs) are mediated by the TRPV4 ion channels on the perivascular nerves, rather than those on the endothelium lining arterioles.
3. TRPV4 alters the elastic compliance of aorta via a neural action distinct to the action on endothelial cells

Background/Rationale:
The transient receptor potential vanilloid 4 (TRPV4) ion channel is prominent in the terminals of nerves that control blood vessel diameter (contraction and dilatation) and the endothelial cells that line the lumen of all blood vessels. In large arteries like the aorta, changes in wall stiffness (compliance) alter body blood flow dynamics, a benefit of exercise is to reduce stiffness and a consequence of aging is an increase in stiffness, which may also contribute to vascular disease (atherosclerosis). Artery stiffness in the aorta and smaller arteries may also be controlled by autonomic and sensory nerves and this control also changes with age. At present the role of the TRPV4 ion channel in neural control of blood vessel stiffness is not well understood, neither is the effect of aging on TRPV4 function. (schema from, Baylie and Brayden 2011, Acta Physiol. 203,99-116.)

Outcomes/Benefits:
In terms of research a major outcome would be the identification of the role played by TRPV4 in neural control of blood vessel function. For the student involved in this project there is the ability to learn from the results of basic research the differences in ion function on nerves and blood vessels. These findings may be key to the understanding of many prevalent vascular and neural disease mechanisms that are actively researched in academic and commercial laboratories.

Students will develop:
- Specialist skills and the capacity to perform in-vitro pharmacology and physiology experiments.
- The capacity to perform the procedures required will be demonstrated and taught to the student by the project supervisors or graduate students working in the laboratories.
- The ability to think critically and logically will be developed through experiment planning and discussions with supervisors, with reference to relevant literature and the aims of the project.
- When the student is confident and capable in the techniques required to progress the project they will be encouraged to exercise independence in project planning, timetabling and experiment execution. The project is designed to allow a variety of arteriole functional assessments and to explore several methods for the determination of TRPV4 function and this may include analysis of older animals (age model).
- Communication of the project outcomes at a national scientific conference and through both the honours oral and written (thesis) assessments will be developed and encouraged through a review and mentoring process.
- In combination the project activities outlined above will develop a breath (practical and theoretical) of understanding in the pharmacology and vascular physiology discipline areas.

6. Resources
The Vascular Biology Laboratories, Building 223, RMIT University Bundoora campus
1. Project Title:

Interaction of PAR1 and PAR2 with TRPV4 and TRPC3 in the regulation of vascular tone.

2. Supervisor/s:

Professor Owen Woodman, School of Medical Sciences, RMIT University  
Dr Simon Potocnik, School of Medical Sciences, RMIT University  
Professor Peter McIntyre, Health Innovations Research Institute, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Professor Owen Woodman, 99257305, owen.woodman@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to investigate the interaction of the Transient Receptor Potential Vanilloid type 4 (TRPV4) and the canonical type 3 Transient Receptor Potential (TRPC3) non-selective cation channels in the regulation of blood vessel diameter.

The hypothesis is that the TRPV4 and TRPV3 ion channels are able to regulate the endothelium-dependent relaxation mediated by PAR1 and PAR2 G protein coupled receptors (GPCRs) and subsequently the level of contraction in the smooth muscle of small and larger arteries.

Background/Rationale:
There is increasing evidence that TRP channels located on the endothelium are important in the regulation of vascular tone, in particular in response to stimulation of GPCRs as well as by shear forces generated by the flow of blood over the endothelial cells. Previous experiments from our laboratory have demonstrated that PAR1 and PAR2 receptors are coupled to TRPV4 in cell based assays. The aim of this project is to further extend those studies to investigate the functional outcomes of such an interaction in the regulation of blood vessel tone. Further, we will explore the potential role of TRPC3, a channel identified on endothelial cells but whose role is yet to be explored in regard to functional outcomes.

Outcomes/Benefits:
The study will include small artery myography to directly study the actions of TRPV4 in vitro using pharmacological tools to determine the mechanisms of action. This technique provides experience in a well characterised procedure for the evaluation of bio-active compounds in vascular tissue and produces publishable research data and a transferable skill for the student.

6. Resources

The project will be conducted on campus at RMIT University Bundoora.
1. **Project Title:**

Investigating a novel tyrosine kinase inhibitor in the regulation of proteoglycan synthesis in vascular cells.

2. **Supervisor/s:**

Dr Narin Osman, VC Senior Research Fellow, School of Medical Sciences, RMIT University

3. **Program Code:**

BH058 Bachelor of Biomedical Sciences (Honours)

4. **Contact:**

Dr Narin Osman, 9925 6686, narin.osman@rmit.edu.au

5. **Project Description**

**Aims/Hypothesis:**

This project will investigate the actions of a novel protein tyrosine kinase inhibitor in the regulation of proteoglycan synthesis in vascular cells. Its potential as a useful drug for the prevention of early vascular changes in atherosclerosis will be determined.

1. Compare the impact of PDGFβ and CSF-1 tyrosine kinase receptor activation on proteoglycan synthesis in vascular cells.
2. Investigate the effects of a novel protein tyrosine kinase inhibitor on the downstream signalling pathways.
3. Determine the functional consequences of tyrosine kinase receptor inhibition in vascular cells.

**Background/Rationale:**

Cardiovascular disease (CVD) is the highest cause of death (30%) globally and a leading cause of the total health burden of disease in Australia (18%). The main cause of CVD is atherosclerosis in large and medium-sized arteries. Atherosclerosis causes thrombosis or severe stenosis, leading to myocardial infarcts. In the past decade, statins (a class of lipid-lowering drugs) have decreased the incidence of myocardial infarcts by about 30%. However, there is still a substantial residual CVD risk. Therefore, we now need to identify new targets for the prevention and treatment of this disease. This project will investigate a novel tyrosine kinase inhibitor of the PDGF tyrosine kinase receptor family. This receptor family regulates proliferation and proteoglycan synthesis in vascular cells. Chondroitin sulfate proteoglycans bind positively charged LDL in the artery wall as one of the early pre-inflammatory steps in atherogenesis. This project will investigate the in vitro efficacy of the novel inhibitor as a prelude to future in vivo studies.

**Outcomes/Benefits:**

This project will enable the student to gain valuable skills and training in a broad range of in vitro and in vivo techniques including cell culture, cell signalling, Western blotting and RT-PCR.

The outcomes will provide a new understanding of the role and mechanism(s) of action of a novel tyrosine kinase inhibitor in vascular cells with a focus on the disease process of atherosclerosis.

Students will develop skills in
- Critical thinking and analysis
- Data acquisition and processing
- Data presentation
- Taking responsibility for own experiments and data and working in a team.
- Scientific writing
- Preparation of materials for talks and poster presentation at a scientific conference.

6. **Resources**

The project will be carried out at the Bundoora campus in the School of Medical Sciences.
1. Project Title:
Investigating the effects of shear stress on retinal choroidal endothelial cell signalling.

2. Supervisor/s:
Dr Narin Osman, VC Senior Research Fellow, School of Medical Sciences, RMIT University
Dr Sara Baratchi, VC Research Fellow HIRi, School of Medical Sciences, RMIT University
Professor Peter McIntyre, Deputy Head HIRi, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Narin Osman, 9925 6686, narin.osman@rmit.edu.au

5. Project Description

Aims/Hypothesis:
Aim: To investigate how shear stress can impact cell surface receptor/channel signalling of retinal choroidal endothelial cells.
Hypothesis: We hypothesise that increased shear stress will result in acute elevated signalling of retinal choroidal endothelial cells and that the activated signalling pathways may lead to endothelial dysfunction and contribute to the development of retinal vascular diseases.

Background/Rationale:
Shear stress from blood flow is the major mechano-transduction force that retinal endothelial cells are exposed to in the retinal vasculature. In other vascular beds shear stress is known to be a key factor in the development of a number of vascular pathologies. Mechano-transduction can involve ion channels, mechano-sensitive receptors, enzymes and intracellular signalling. In the retinal vasculature shear stress is known to occur however there is no information on the identity of cell surface receptors or channel signalling pathways that are activated. It is anticipated that the activated pathways will lead to retinal endothelial dysfunction and results from this project may form the basis for subsequent studies of specific retinopathies.

Outcomes/Benefits:
This project will enable the student to gain valuable skills and training in biochemical methods to investigate the effects of shear stress on choroidal endothelial cell signalling. Techniques will include cell culture, shear stress assays using flow chambers, calcium imaging using confocal microscopy, western blotting. In addition numerous key scientific skills will be developed including critical analysis, data analysis, written and oral presentation. Successful completion of the project may enable attendance and presentation of results at a scientific conference and submission of a scientific manuscript for publication.

6. Resources
The project will be carried out at the Bundoora campus in the School of Medical Sciences.
1. Project Title:

Role of P2X receptors, intracellular Ca2+ and caspases in neuroinflammation and nervous system damage.

2. Supervisor/s:

Dr Martin Stebbing, Discipline of Cell Biology and Anatomy, School of Medical Sciences, RMIT University
Professor Emilio Badoer, Discipline of Pharmaceutical Sciences, School of Medical Sciences, RMIT University
Dr Brett Cromer, (HIRI), School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Martin Stebbing, 9925 7622, martin.stebbing@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To investigate the mechanisms by which P2X receptors form large membrane pores and activate inflammatory signalling in microglia.

Background/Rationale:
In microglia, the immune cells of the brain, P2X4 and P2X7 receptors respond to low and high concentrations of ATP respectively. These receptors behave like conventional ion channels, but upon prolonged activation by ATP can form large membrane pores that allow molecules such as glutamate and DNA binding dyes to cross the cell membrane. Ca2+ entry via P2X receptors is known to activate enzymes called caspases that produce interleukin-1β from its active precursor and activate inflammatory signalling cascades. Caspase activation causes apoptosis in other cell types, but in microglia the caspases are tethered to the plasma membrane and can’t degrade the cell’s internal organelles. We recently obtained exciting new data regarding the role of caspases in microglial activation and large pore formation by P2X receptors. This project will further investigate the mechanisms by which P2X receptors form pores and the role of caspase enzymes in the microglial activation process.

Outcomes/Benefits:
This student will use microglial cell lines and recombinant P2X receptors expressed in HEK293 cells and learn to use a variety of cutting edge cell biology techniques as well as gaining high level analytical and presentation skills. The data obtained will provide a better understanding of the fundamental cellular processes underlying inflammation in the brain. In the long term this should help in development of new treatments for a variety of nervous system disorders known to involve brain inflammation.

The student will be trained in the techniques of confocal microscopy, flow cytometry, calcium imaging and/or high content analysis with the use of fluorescent reporter molecules as well as western blotting and other protein analysis techniques. They will be expected to contribute to the design of experiments and to collect, analyse and interpret the data. They will participate in weekly lab meetings and have a chance to present their work in that forum and gain feedback from researchers and other students on a regular basis. In this way they will gain practice and receive feedback to improve their communication and presentation skills in addition to the other presentations required for their assessment. They will gain a gain a grasp of the literature on this topic and have regular opportunities to discuss the literature and the rationale for their project with their supervisor and the other members of the research laboratory to deepen and broaden their knowledge of the discipline area.

6. Resources

The project will be conducted on campus at RMIT University Bundoora.
1. Project Title:

Role of microglia and brain inflammation in obesity - In vitro studies.

2. Supervisor/s:

Dr Martin Stebbing, Discipline of Cell Biology and Anatomy, School of Medical Sciences, RMIT University
Professor Emilio Badoer, Discipline of Pharmaceutical Sciences, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Martin Stebbing, 9925 7622, martin.stebbing@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To investigate the effects of adipokines, and other hormones that are elevated in obesity, on the immune cells of the brain and the inflammatory processes they mediate.

Background/Rationale:
Obesity is associated with changes in regulation of appetite such that it becomes very hard to lose weight. These changes are associated with inflammation in areas of the brain that control food intake. Microglia, the brains immune cells, are implicated in causing this inflammation. Various adipokines released from fat tissue and other hormones are elevated in obesity including leptin, resistin and insulin. Several of these hormones have been implicated in causing or modulating inflammation and are known to freely enter regions of the brain involved in regulation of food intake. Despite this, the effects of these hormones on microglia have not been fully investigated. This project will employ various in vitro assays of microglial function using advanced techniques and equipment to investigate the effects of leptin, resistin and insulin on the inflammatory processes that occur in the brain.

Outcomes/Benefits:
The study will involve isolating and culturing microglia and learning cell culture techniques to maintain primary cultures of rat microglia and microglial cell lines. The student will obtain skills in a variety of cutting edge cell biology techniques as well as high level analytical and presentation skills.

The outcomes of this work will lead to a greater understanding of the mechanisms of brain inflammation during obesity and allow further insight into the mechanisms preventing weight loss in obese people. This work will support efforts to reduce the huge impact of obesity related disorders on our community.

The student will be trained in the techniques of confocal microscopy, flow cytometry, calcium imaging and/or high content analysis with the use of fluorescent reporter molecules. They will be expected to contribute to the design of experiments and to collect, analyse and interpret the data. They will participate in weekly lab meetings and have a chance to present their work in that forum and gain feedback from researchers and other students on a regular basis. In this way they will gain practice and receive feedback to improve their communication and presentation skills in addition to the other presentations required for their assessment. They will gain a gain a grasp of the literature on this topic and have regular opportunities to discuss the literature and the rationale for their project with their supervisor and the other members of the research laboratory to deepen and broaden their knowledge of the discipline area.

6. Resources

The project will be conducted on campus at RMIT University Bundoora.
1. Project Title:
Understanding why stroke patients lose weight and experience muscle wasting.

2. Supervisor/s:
Dr Alyson Miller, Vice-Chancellor’s Senior Research Fellow, School of Medical Sciences (http://www.rmit.edu.au/staff/alyson-miller)

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Alyson A. Miller, 9925 7589, alyson.miller@rmit.edu.au

5. Project Description
Aims/Hypothesis:
This honours project aims to understand the mechanisms that lead to weight and muscle loss after stroke. In particular, the project will test the hypothesis that suppression of the ‘ghrelin system’ is major contributor, and that restoring the actions of ghrelin is an effective therapeutic approach.

Background/Rationale:
The survival of stroke patients is not only defined by the extent of brain damage, but also, to a large degree, by post-stroke complications such as weight loss. Weight loss may have obvious causes such as impaired feeding, inactivity, and paralysis. In addition, metabolic imbalance may also occur as result of neuroendocrine sympathetic activation, inflammation, dysregulation of appetite, and fever. The net effect is an overall anabolic deficit and catabolic over activation. As a result, accelerated tissue degradation occurs, presenting as overall weight loss /or muscle loss. Of importance, evidence indicates that weight loss is correlated with poor stroke outcome. Moreover, muscle loss is particularly detrimental because post-stroke rehabilitation is largely dependent on global muscle function and strength. Treating stroke-related weight loss and muscle wasting is therefore clearly important and has the potential to improve the survival and rehabilitation.

Appetite and feeding behaviours, and thus ultimately body metabolism, are regulated by a complex balance of stimulatory and inhibitory signals in the central nervous system, particularly in the hypothalamus. Central to this control system are the peptides ghrelin and leptin, both of which signal nutritional status and energy storage levels to these hypothalamic-feeding centres. Ghrelin production by the stomach is increased in the body in response to weight loss, resulting in increased food intake, fat accumulation, and muscle gain (anabolic). On the other hand, leptin increases during weight gain to suppress food intake and fat accumulation (catabolic). We have novel evidence that the actions of ghrelin (and perhaps leptin) are dysregulated after stroke. Indeed, despite profound and sustained weight loss and muscle wasting, we have found that the ‘ghrelin system’ is paradoxically suppressed in mice after stroke, whereas leptin-mediated signalling may be enhanced. In light of these findings, we hypothesize that dysregulation of ghrelin- or leptin-mediated signalling may be a cause of post-stroke weight loss and muscle wasting. Moreover, we hypothesize that restoring the reciprocal actions of ghrelin and leptin after stroke may be an effective therapeutic approach.

Outcomes/Benefits:
It is anticipated that this project will not only provide a better understanding of the mechanisms that contribute to post-stroke weight loss and muscle wasting, but has the potential to tackle an unmet need for novel treatments for stroke-related weight loss and muscle wasting, and thus ultimately stroke survival and rehabilitation. This work should also lead to highly influential publications in the stroke research field.

Besides providing a better understanding of an discipline area of medical science, this project will also give the student a ‘taste’ of medical research and give them insight into the necessary skills and attributes for a successful career in medical research. During the year the student will gain expertise in a number of transferrable technical approaches (and associated analyses) and will be expected to develop an ability to think critically and intellectualize their findings in the context of established literature. The student will be supervised by an experienced supervisor, who has successfully supervised several Honours (all attaining H1 degrees) and PhD students. Over the course of the year, the ultimate goal will be to foster independence in making decisions and in troubleshooting technical problems, which are essential skills for a career in medical research. Furthermore, the student will be provided ample opportunities to learn how to communicate their research findings to the wider scientific community and if appropriate, will have the opportunity to attend and present their research findings at a national scientific meeting (e.g. Australasian Society of Clinical and Experimental Pharmacologists & Toxicologists).

6. Resources
School of Medical Sciences, On campus.
1. Project Title:

Why are patients with Chronic Obstructive Pulmonary Disease (COPD) at increased risk for stroke?

2. Supervisor/s:

Dr Alyson Miller, Vice-Chancellor’s Senior Research Fellow, School of Medical Sciences, RMIT University
(http://www.rmit.edu.au/staff/alyson-miller)
A/Prof Ross Vlahos, Senior Research Fellow, School of Health Sciences, RMIT University
A/Prof Steven Bozinovski, Senior Research Fellow, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Alyson A. Miller, 9925 7589, alyson.miller@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This honours project aims to better understand why patients with Chronic Obstructive Pulmonary Disease (COPD) are more likely to have a stroke than patients with normal lung function. In particular, this project will test the hypothesis that cigarette-induced damage to cerebral blood vessels is an important contributing mechanism.

Background/Rationale:
COPD is a major incurable global health burden and is predicted to become the 3rd largest cause of death worldwide by 2020. Cigarette smoking is the major cause of COPD and accounts for more than 95% of cases in industrialized countries. Importantly, approximately 30-50 % of all COPD deaths are due to co-existing cardiovascular disease and thus far, no therapies have been shown to reduce the risk of death in COPD patients. Patients with COPD are more likely to have a stroke than people without COPD and the exact reason for this is unknown. However, recent work in our laboratories suggest a number of potentially important causes including increased: (i) systemic oxidative stress; (ii) lung and brain inflammation; (iii) platelet activation; and (iv) cerebral blood vessel damage. This Honours project will focus on investigating the latter of these potential causes. Specifically, this exciting project will test the hypothesis that cigarette smoke results in damage to cerebral blood vessels, which in turn increases, the susceptibility of the brain to stroke-related damage.

Outcomes/Benefits:
Using pioneering pre-clinical models of stroke and COPD, this project is anticipated to provide a better understanding of why COPD patients are at greater risk of having a stroke. Moreover, this work should ultimately lead to the identification of novel mechanisms and therapeutic targets amenable to drug development.

Besides providing a better understanding of an discipline area of medical science, this project will also give the student a ‘taste’ of medical research and give them insight into the necessary skills and attributes for a successful career in medical research. During the year the student will gain expertise in a number of transferrable technical approaches (and associated analyses) and will be expected to develop an ability to think critically and intellectualize their findings in the context of established literature. The student will be supervised by three experienced supervisors, which have successfully supervised several Honours (all attaining H1 degrees) and PhD students. Over the course of the year, the ultimate goal will be to foster independence in making decisions and in troubleshooting technical problems, which are essential skills for a career in medical research. Furthermore, the student will be provided ample opportunities to learn how to communicate their research findings to the wider scientific community and if appropriate, will have the opportunity to attend and present their research findings at a national scientific meeting (e.g. Australasian Society of Clinical and Experimental Pharmacologists & Toxicologists).

6. Resources

School of Medical Sciences, On campus.
1. **Project Title:**

The effect of UV radiation on the activation of cell surface proteases in keratinocyte-derived skin cells.

2. **Supervisor/s:**

Associate Professor Terry Piva, School of Medical Sciences, RMIT University

3. **Program Code:**

BH058 Bachelor of Biomedical Sciences (Honours)

4. **Contact:**

Associate Professor Terry Piva, 9925 6503, terry.piva@rmit.edu.au

5. **Project Description:**

**Aims/Hypothesis:**

To investigate the role of furin activity in increased cell surface proteases in UV-irradiated keratinocyte-derived skin cells.

**Background/Rationale:**

Many bioactive molecules (e.g., cytokines, growth factors etc) that play a significant role in modulating skin cell function are cleaved from their membrane-bound precursor by the action of metalloproteases. It has been shown, following UV exposure, FasL and TNFα among other molecules released by keratinocytes and melanocytes can cause immunosuppression and/or inflammation in the skin for 7+ days. It is during this period that some cells sustaining DNA damage will proliferate and pass on mutations to daughter cells. If this process is repeated often enough then the cell has the possibility of becoming tumourigenic.

We have shown that keratinocytes and melanocytes exposed to UVB and/or UVA have increased levels of a number of cell surface proteases including TACE, matrilysin or MMPs. Most of these cell surface proteases are metalloproteases and they must first be activated by proprotein convertases such as furin. Through the use of cultured human skin keratinocytes and melanocytes the mechanism by which UV radiation modulates the activity of these cell surface proteases will be examined. For comparison skin cancer cells will also be examined in this study. Students will gain expertise in cell culturing, as well as advanced laboratory skills in biochemistry (enzyme activity, ELISAs), cell (morphology and survival rates) and molecular biology (gene and protein expression) while undertaking this project.

**Outcomes/Benefits:**

This project will provide important information on the role furin plays in the activation of cell surface metalloproteases in skin cells exposed to UV radiation, which could result in the development of new inhibitors, which may help reduce the incidence of skin cancer. Results from this project will be published in dermatology/photobiology journals and presented at a national or international conference.

Students will develop:

- Specialist skills in an area of medical science – including specialised techniques for primary cell culturing, as well as advanced laboratory skills in biochemistry, and cell and molecular biology.
- The capacity to perform a variety of procedures and techniques that are essential for the satisfactory completion and reporting of a research project – from conducting multidisciplinary laboratory research in cell biology (biochemistry, cell and molecular biology) in an efficient and timely manner.
- Enhanced ability to think critically and logically – from carefully evaluating the relevant published literature in cell biology and metabolic biochemistry and the appropriate application of this knowledge to conduct this project.
- Independent decision-making skills, relevant to scientific research – from the problem-solving research challenges involved in the adaptation of cell and molecular biology methods to investigate the effect of nutrients on cell metabolism and function.
- Communication skills relevant to the dissemination of experimental findings – the Honours student is expected to prepare a high-quality presentation for a scientific meeting, in addition to submitting the thesis and presenting seminars as part of their project.
- A greater depth and breadth of knowledge in their major study discipline – the Honours student will be the first author and major contributor on any journal publications resulting from their project, and will also be the first author on abstracts presented at national scientific meetings.

6. **Resources**

The project will be conducted on campus at RMIT University Bundoora.
1. Project Title:
Effect of UV radiation on cell signalling pathways in melanocyte-derived cells.

2. Supervisor/s:
Associate Professor Terry Piva, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Terry Piva, 9925 6503, terry.piva@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To investigate the role BRAF plays in UV-induced cell signalling pathways and subsequent TNFα release from melanocyte-derived cell lines.

Background/Rationale:
While it is well known that excessive sun exposure can increase a person's risk factor of developing a skin cancer, the mechanism by which UV radiation induces cell signalling pathways is not as well understood. In the formation of melanoma from melanocytes a number of gene mutations are known to occur, including that of BRAF and p16. BRAF mutations are found in 50-70% melanomas, usually as a result of a V600E mutation. This mutation results in increased activity of this signalling protein and while therapeutic agents are known to induce regression of melanomas in vivo, the patient after a period of time relapses and dies. This suggests that other signalling pathways are activated when the mutated BRAF has been inhibited. It is known that following exposure to UV radiation both melanocytes and melanoma cells secrete the inflammatory cytokine TNFα. The inflammation induced by TNFα can create an environment in which tumour growth is favoured, which may occur in the early stages of melanoma development on the skin. This study will investigate the main cell signalling pathways in both melanocytes and melanoma cells to observe which one(s) is/are responsible for mediating the secretion of TNFα following exposure to UV radiation. In order to delineate the role BRAF may play in this process, melanoma cells possessing either wild type or mutated BRAF will be used in this study.

Outcomes/Benefits:
This project will provide important information on the role BRAF plays in mediating TNFα release from UV-irradiated melanoma and melanocytes. Students will gain specialized expertise in cell culturing, as well as advanced laboratory skills in biochemistry, and cell and molecular biology, while undertaking this project. Results from this project will be published in the dermatology/cell signalling journals and presented at a national or international conference.

Students will develop:
• Specialist skills in an area of medical science – including specialised techniques for primary cell culturing, as well as advanced laboratory skills in biochemistry, and cell and molecular biology.
• The capacity to perform a variety of procedures and techniques that are essential for the satisfactory completion and reporting of a research project – from conducting multidisciplinary laboratory research in cell biology (biochemistry, cell and molecular biology) in an efficient and timely manner.
• Enhanced ability to think critically and logically – from carefully evaluating the relevant published literature in cell biology and metabolic biochemistry and the appropriate application of this knowledge to conduct this project.
• Independent decision-making skills, relevant to scientific research – from the problem-solving research challenges involved in the adaptation of cell and molecular biology methods to investigate the effect of nutrients on cell metabolism and function.
• Communication skills relevant to the dissemination of experimental findings – the Honours student is expected to prepare a high-quality presentation for a scientific meeting, in addition to submitting the thesis and presenting seminars as part of their project.
• A greater depth and breadth of knowledge in their major study discipline – the Honours student will be the first author and major contributor on any journal publications resulting from their project, and will also be the first author on abstracts presented at national scientific meetings

6. Resources
The project will be conducted on campus at RMIT University Bundoora.
1. Project Title:

_In vitro_ anti-androgen effects of the nutraceutical 5β-scymnol.

2. Supervisor/s:

Associate. Professor Theo Macrides, Discipline of Laboratory Medicine: Biochemistry & Natural Products, School of Medical Sciences, RMIT University
Associate. Professor Paul Wright, Discipline of Pharmaceutical Sciences: Nanosafety and Immunotoxicology, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Theo Macrides, 9925 7070, theo.macrides@rmit.edu.au

5. Project Description

Aims/Hypothesis:

To investigate the anti-androgen effects of 5β-scymnol in a range of _in vitro_ test systems, including androgen-sensitive cell lines and androgen metabolism in microsomes.

Background/Rationale:

Overproduction of the testosterone metabolite, dihydrotestosterone (DHT), is a leading cause of many androgen-excess disorders, including those related to the skin (acne, oily skin or hyperseborrhoea, female hirsutism, and male pattern baldness) and prostate (prostate cancer and benign prostatic hyperplasia). Scymnol is a marine therapeutic natural product (nutraceutical) with clinical efficacy against acne and hyperseborrhoea, and recent _in vitro_ data has shown that scymnol decreased DHT levels in rat liver microsomes while metabolising exogenous testosterone. The ability of scymnol to treat androgenic skin conditions and modify testosterone metabolism provides a mechanistic basis to further develop scymnol as a novel therapeutic agent for treating the spectrum of androgen-excess disorders.

In this study, the student researcher will investigate androgen-sensitive mammalian cell lines exposed to scymnol, employing a range of cell function assays. This will involve individual and co-exposure of cells to scymnol and androgens, and the assays include cell viability and proliferation, and cell surface marker expression.

Outcomes/Benefits:

Whilst undertaking this project, the student will gain specialised expertise and advanced laboratory skills in cellular and molecular biology, biochemistry, and toxicology, which are in high demand in the pharmaceutical and biomedical industries. Results from this project will be published in high-impact scientific journals, and presented at national or international conferences.

Students will develop:

- Specialist skills in an area of medical science – including specialised techniques for cell culturing and natural product development, which are in high demand in the pharmaceutical and biomedical industries.
- The capacity to perform a variety of procedures and techniques that are essential for the satisfactory completion and reporting of a research project – from conducting multidisciplinary laboratory research in biology (cell, molecular biology, and toxicology) and biochemistry (separation science, mass spectral techniques and natural product chemistry) in a timely and efficient manner, as part of the active and productive NPRG research team at RMIT.
- Enhanced ability to think critically and logically – from carefully evaluating the relevant published literature in biochemistry, cell and molecular biology, and the appropriate application of this evidence-based research for therapeutic drug development.
- Independent decision-making skills, relevant to scientific research – from the problem-solving research challenges involved in the adaptation of cell, molecular biology and biochemical methods to test the effects of scymnol in the _in vitro_ exposure systems.
- Communication skills relevant to the dissemination of experimental findings – the honours student is expected to prepare a high-quality presentation for a scientific meeting, in addition to submitting the thesis and presenting seminars for their honours.
- A greater depth and breadth of knowledge in their major study discipline – all NPRG honours students are first authors and major contributors of conference presentations and journal publications resulting from their project.

6. Resources

The project will be undertaken in the laboratories of the RMIT Natural Products Research Group (NPRG) and Toxicology/Nanosafety Research Group at the School of Medical Sciences (Building 223, RMIT Bundoora West). Scymnol research at RMIT involves the commercial partner MacLab Pty. Ltd.
1. Project Title:
Assessment of planned, calculated and measured dose and two dimensional fluency maps of Intensity Modulated Radiation Therapy (IMRT) for prostate cancer.

2. Supervisor/s:
Dr Pradip Deb, School of Medical Sciences, RMIT University
Dr Siva Sarasanandarajah, Peter MacCallum Cancer Institute

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Pradip Deb, 99257324, Pradip.deb@rmit.edu.au

5. Project Description

Aims/Hypothesis:
The aim of this study is to assess the progress of IMRT planned doses and two dimensional fluency maps for prostate cancer treatment obtained from commercially available treatment planning system via pre-treatment phantom based measured doses and measured 2-D fluency images.

Background/Rationale:
Prostate is one of the very common treatment sites that are well suited for IMRT. Because of the very complexity of this treatment technique (e.g., use of small segments and of dynamic delivery systems), patient specific verifications is required for IMRT and that each plan should be checked thoroughly prior to dose delivery. The verifications of point dose measurements and two dimensional (2-D) fluency image analyses are important as a pre-treatment quality assurance checks. Point dose measurements and 2-D fluency verifications were carried out over 300 patients in the last five years at Peter Mac (Box Hill). At this stage, it is important to assess the similarity, differences and clinical relevance between the planned dosimetry and the real time measured dosimetry.

Outcomes/Benefits:
The outcome of this research will be very useful to assess and modify (if any) the current clinical practice of treatment verification procedure and implement new strategies if required. The potential student will learn the importance of CT simulation procedure, treatment planning procedure and the independent verification procedure in a clinical cancer department. This research will improve the student’s critical thinking capability, analytical capability, problem solving ability and most importantly to participate in a clinical environment to collaborate and learn the practice of interdisciplinary aspects of cancer treatment and management.

This project is a direct application of Radiation Therapy IMRT treatment process. It will address the program objectives as follows:
• Specialist skills – IMRT planning, Dose delivery, LINAC Dose QC
• While doing the experiments for this project student will learn different techniques of dose delivery, dose recording and assessing process.
• Student will be able to think critically while comparing the planned dose, calculated dose and delivered dose and also assessing the trends in last five years and hence gain independent-thinking skills.
• Student will write thesis and present finding in seminars.

6. Resources
The phantom experiments with LINAC and IMRT planning will be carried out at the Peter Mac Cancer Centre and the data analysis will be done on campus in the RMIT Bundoora West campus.
1. Project Title:

The effect of fatigue on gait mechanics during power running or sprint activities.

2. Supervisor/s: (include affiliations)

Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Isaac Selva Raj, 9925 7037, isaacselva.raj@rmit.edu.au

5. Project Description

Aims
1. To investigate the relationship between gait mechanics and fatigue in high-level team based sports (e.g. Netball, Football, Soccer, Hockey).
2. To identify the key features of gait (running pattern) that are associated with fatigue in power running and sprint activities.

Hypothesis
1. Gait mechanics are significantly affected by fatigue levels.
2. Key or basic gait mechanic measures can be readily used to assess player fatigue.

Background/Rationale:
Player fatigue is an important issue in high-level team based sports. It is important to monitor player fatigue levels in order to rotate players and reduce the risk of injury. It is currently not known as to what measures of gait are good indicators of player fatigue. This project will identify the measures of gait that can be readily used to assess or identify player fatigue.

Outcomes/Benefits:
The findings of this study may provide important information about player fatigue levels. This information is useful to conditioning and support staff across a range of team based sports. It may assist staff to make better decisions about player fatigue and need to rotate the player. The benefits for the student include (1) developing expertise in the field of gait biomechanics, (2) a thorough knowledge of the scientific process, and (3) the opportunity to publish in peer-reviewed publications and conference proceedings.

The Honours student will develop:
• Specialist skills in 3D gait biomechanics (kinematics) including data capture, analysis and interpretation
• The capacity to perform a variety of sophisticated biomechanical procedures and techniques
• Enhanced ability to think critically and logically
• Communication skills (e.g. scientific report writing) relevant to the dissemination of experimental findings; and
• A greater depth and breadth of knowledge in the field of biomechanics

6. Resources
This project will be conducted on campus in the School of Medical Sciences.
Can specific targeted exercise programs improve gait in older adults?

Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Dr Jason Wong, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.

BH058 Bachelor of Biomedical Sciences (Honours)

Associate Professor Noel Lythgo, 9925 6518, noel.lythgo@rmit.edu.au

The aim of this project is to assess whether exercise programs that target the strength and power of the hip flexors, hip abductors and ankle plantar flexors can improve gait in older adults. It is hypothesised that improvements in the power and strength improve gait capacity.

Recent work has shown, through computational biomechanical modelling, that gait is Risk of falling increases as people age and also when gait variables change. Walking is considered to be a 'controlled fall' where power is generated through the lower body to extend the leg to prevent the act of falling and collapsing to the ground. As people age, they typically partake in increased sedentary behaviour which also contributes to loss of muscle mass (sarcopenia), which will contribute to a resultant loss in the ability to generate muscular power. It is therefore important to assess the physical and physiological mechanisms of why older people fall more regularly so that effective falls prevention programs can be implemented to minimise the significant financial and health burden that is associated with falling.

It is expected valuable insight into falls will be obtained that can be used for optimising exercise prescription. The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment and testing along with data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an Honours degree.

The Honours student will gain specialist skills in 3D gait biomechanics (kinetics and kinematics) and exercise testing including data capture, analysis and interpretation, muscular power assessment and functional testing. They will develop communication skills to enable health screening, exercise testing and reporting results to participants. Students will be encouraged to critically analyse their work, work independently as well as part of a research team, and present their findings at critical time points (proposal, ethics, literature review, recruitment, project management, outcome presentation, thesis examination) for critical review (eg journal club). The additional research year will enhance the student’s knowledge in their discipline and their ability to apply their findings to the broader community in a timely manner.

This project will be conducted on campus within the School of Medical Sciences.
1. Project Title:

The efficacy of gait (running) and jumping analysis techniques to assess and monitor fatigue and recovery from lower limb muscular injury in high-level team based sports.

2. Supervisor/s:

Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Noel Lythgo, 9925 6518, noel.lythgo@rmit.edu.au

5. Project Description

Aims
To investigate the efficacy of gait and jump analysis techniques (3D and 2D) to assess and monitor fatigue and recovery after lower limb injury (e.g. calf and hamstring strain) throughout a season in high-level team based sports (e.g. netball, football).

Hypotheses
1. Biomechanical gait and jump (3D and 2D) analysis techniques provide additional important information about player readiness to return to sport after lower limb injury (e.g. hamstring and calf strain injury).
2. These techniques provide additional important information about player fatigue levels.

Background/Rationale:
It is known that muscle weakness, reduced flexibility and poor running technique are factors that may predispose a player to lower limb injury (e.g. hamstring strain) [1, 2]. To date, no study has specifically investigated the efficacy of using gait and jump analysis techniques (3D and 2D) to assess and monitor fatigue levels and recovery from lower limb outcomes.

Outcomes/Benefits:
The findings of this study may provide important information about player fatigue and recovery from injury. This information is useful to medical and conditioning staff across a range of team-based sports.


6. Resources

This project will be conducted on campus in the School of Medical Sciences.
1. Project Title:

Why do gait (walking) changes emerge in apparently healthy older adults? Are these changes associated with increased knee and hip joint loads?

2. Supervisor/s:

Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Noel Lythgo, 9925 6518, noel.lythgo@rmit.edu.au

5. Project Description

Aims

To investigate the alterations in leg joint musculoskeletal function behind the walking pattern changes (e.g. reduced walking speed) that emerge in apparently healthy elderly adults when walking across level and uneven terrain (e.g. stairs).

Hypotheses

1. Gait changes that emerge in healthy older adults are primarily due to a loss of ankle joint power generation.
2. During walking, healthy older adults increase knee and hip joint activity in order to compensate for a loss of ankle joint power during gait.
3. Increased knee and hip joint power generation increases joint load.

Background/Rationale:

There is no consensus as to why gait changes emerge in healthy older adults. At around 60 to 70 years of age, and perhaps earlier for females, gait changes become increasingly evident in healthy older people. A significant issue associated with these changes is a reduced ability to safely traverse level and uneven terrain. This is well demonstrated by the steady age-related rise in serious injuries resulting from pedestrian accidents.

Outcomes/Benefits:

Walking is a fundamental activity that is important for physical and mental well-being as well as independent functioning. This project addresses a significant issue for the National Research Priority of Promoting and Maintaining Good Health in older age. It will identify the neuromuscular mechanisms underlying these changes. The benefits for the student include (1) developing expertise in the field of biomechanics, (2) a thorough knowledge of the scientific process, and (3) the opportunity to publish in peer-reviewed publications and conference proceedings.

The Honours student will develop:

• Specialist skills in 3D gait biomechanics (kinetics and kinematics) including data capture, analysis and interpretation
• The capacity to perform a variety of sophisticated biomechanical procedures and techniques
• Enhanced ability to think critically and logically
• Communication skills (e.g. scientific report writing) relevant to the dissemination of experimental findings; and
• A greater depth and breadth of knowledge in the field of biomechanics

6. Resources

This project will be conducted on campus in the School of Medical Sciences.
1. Project Title:

Using an external focus of attention in closed motor skills.

2. Supervisor/s:

Dr Lyndell Bruce (Exercise Science – RMIT University)
Dr Carl Woods (Sport and Exercise Science – James Cook University)

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Lyndell Bruce, 9925 7349, lyndell.bruce@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To investigate if an external focus of attention is beneficial in performing a closed skill

Background/Rationale:
Within the motor learning discipline, it is well understood that a learner's focus of attention is a key contributor toward the effectiveness of their performance outcome, and the retention of their learnt skill (Peh, Chow, & Davids, 2011; Wulf, McNevin, Fuchs, Ritter, & Toole, 2000). Attentional focus refers to the arrangement and direction of available resources toward a certain performance aspect, and can be either external (i.e. attention is directed toward the performance effect on the environment) or internal (i.e. attention is directed toward the movements operationalising the performance) (Wulf & Su, 2007). Performance and retention comparisons have demonstrated that an external attentional focus harbours a greater learning effect and corresponding performance outcome than what can be generated through an internal attention focus (for example, see Wulf, 2002; Zachery, 2005; Wulf, McConnel, Gartner, & Shwartz, 2002; Vance, Wulf, Tollner, McNevin, & Mercer, 2004).

Outcomes/Benefits:
Extending our understanding of how an external focus of attention impacts performance in closed skills will inform practitioners of training and performance strategies.
The student will gain an understanding of the research process, including designing methodology, data collection, statistical analysis and writing skills.

A student can expect to;
• Understand how to design and implement a skill acquisition research project
• Enhance their analytical skills and ability to think critically and logically
• Become an independent learner, make decisions themselves, and develop the troubleshooting skills required to conduct research in Exercise Science
• Develop their communication skill, both oral and written, in order to disseminate their experimental findings
• Develop a greater understanding of the depth and breadth of knowledge within Exercise Science

6. Resources

This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants
1. Project Title:
Athlete and coaches preferred performance analysis tools.

2. Supervisor/s:
Dr. Lyndell Bruce, Exercise Science, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr. Lyndell Bruce, 9925 7349, lyndell.bruce@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To examine the preferred method/s that coaches and/or athletes like to receive information from performance analysts

Background/Rationale:
Coaches and/or athletes are often provided with information from performance analysts in a variety of forms including excel spreadsheets, video, presentations, etc. Often this information is provided on an ad hoc basis dependent on what the performance analyst thinks is important or based upon previous experience. This study is designed to examine a variety of different hardware and software options and feedback styles to determine which are preferred by coaches and/or athletes.

Outcomes/Benefits:
Results of this study will provide a greater understanding of the preferred information sources for coaches and/or athletes with regard to performance feedback. This will allow performance analysts to tailor their approach to coaches and/or athletes and further enhance their working relationship.
The student will gain an understanding of the research process, including designing methodology, data collection, statistical analysis and writing skills. In addition, the student will learn and develop specialist skills in the use of performance analysis software, which can then be adopted to match the needs of most sports.

A student can expect to;
• Understand how to design and implement a performance analysis research project
• Enhance their analytical skills and ability to think critically and logically
• Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
• Develop their communication skill, both oral and written, in order to disseminate their experimental findings
• Develop a greater understanding of the depth and breadth of knowledge within Exercise Science
• Develop and refine specialist skills in the use of performance analysis software

6. Resources
This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants.
1. Project Title:
Performance parameters of basketball.

2. Supervisor/s:
Dr. Lyndell Bruce, Exercise Science, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr. Lyndell Bruce, 9925 7349, lyndell.bruce@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To determine the factors which predict successful outcomes in basketball

Background/Rationale:
The use of global positioning systems (GPS) in sport to track athlete movement have been, in the most part, limited to outdoor use whereby the systems can interact with satellites. Recent advances in technology are permitting wider access to monitoring performance in an indoor environment. As a result, physiological data from in game and training environments in indoor team sports has not been examined to the same extent as outdoor sports. This project is designed to use these advances in technology to investigate the performance parameters of basketball.

Outcomes/Benefits:
Results of this study will provide a greater understanding of the current performance parameters of basketball from an individual and team perspective. Access to current game and training data will allow sports scientists and coaches to potentially create a more effective training structure and environment
The student will gain an understanding of the research process, including designing methodology, data collection, statistical analysis and writing skills. In addition, the student will learn and develop specialist skills in the use of notational analysis software and GPS technology, which can then be adopted to match the needs of most sports.

A student can expect to;
• Understand how to design and implement a performance analysis research project
• Enhance their analytical skills and ability to think critically and logically
• Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
• Develop their communication skill, both oral and written, in order to disseminate their experimental findings
• Develop a greater understanding of the depth and breadth of knowledge within Exercise Science
• Develop and refine specialist skills in the use of performance analysis software
• Develop and refine specialist skills in the use of GPS hardware and software.

6. Resources
This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants.
1. Project Title:

Performance parameters of martial arts.

2. Supervisor/s:

Dr. Lyndell Bruce, Exercise Science, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr. Lyndell Bruce, 9925 7349, lyndell.bruce@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To determine the factors which predict successful performance outcomes in martial arts

Background/Rationale:
There has been very little research in the area of martial arts, specifically research examining the successful performance indicators need to win a bout. Most martial arts have strong origins in Eastern culture, and tactical and technical knowledge has been passed through generations. There are many similarities and differences between the different martial arts styles. This project will begin to examine some of these styles with a particular focus on Muay Thai.

Outcomes/Benefits:
Understanding the factors that contribute to a successful outcome in martial arts may assist coaches and trainers in modifying the practice environment to achieve greater success for athletes.

The student will gain an understanding of the research process, including designing methodology, data collection, statistical analysis and writing skills. In addition, the student will learn and develop specialist skills in the use of notational analysis software, which can then be adopted to match the needs of most sports.

A student can expect to:
- Understand how to design and implement a performance analysis research project
- Enhance their analytical skills and ability to think critically and logically
- Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
- Develop their communication skill, both oral and written, in order to disseminate their experimental findings
- Develop a greater understanding of the depth and breadth of knowledge within Exercise Science
- Develop and refine specialist skills in the use of performance analysis software.

6. Resources

This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants.
1. Project Title:
Wellness measures as a tool to monitor athlete load.

2. Supervisor/s:
Dr. Lyndell Bruce, Exercise Science, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Lyndell Bruce, 9925 7349, lyndell.bruce@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To examine the usefulness of wellness measures/tools in the monitoring of athlete load

Background/Rationale:
In sports, performance results are dependent on maintaining an optimal balance between training and recovery. Athletes confronted with demanding competition schedules and high training loads are at risk of injury, illness and unintentional overreaching when sufficient recovery is not attained (Le Meur et al, 2013). Wellness measures/tools are increasing being used by elite sporting teams to measure player fatigue and monitor training loads. These measures are often subjective and have not been validated or compared to more objective measures of training load.

Outcomes/Benefits:
Furthering the understanding of wellness measures/tools may assist in decreasing the risk of injury and prevent overtraining.
The student will gain an understanding of the research process, including designing methodology, data collection, statistical analysis and writing skills.

A student can expect to:
• Understand how to design and implement an exercise science research project
• Enhance their analytical skills and ability to think critically and logically
• Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
• Develop their communication skill, both oral and written, in order to disseminate their experimental findings
• Develop a greater understanding of the depth and breadth of knowledge within Exercise Science

6. Resources
This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants.
1. Project Title:

Assessment and Mentoring Program for Pre-service Physical Education Teachers.

2. Supervisor/s:

Dr Kate Jenkinson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University
Dr Amanda Benson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Kate Jenkinson, 9925-7337, kate.jenkinson@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to identify the key outcomes of an assessment and mentoring program for pre-service physical education teachers and how these provide opportunities for an industry ready graduate.

Background/Rationale:
In the teacher education context, most peer mentoring programs have focused on pre-service teachers and a qualified teacher mentor within school settings (Hobson, et.al., 2009; Ambrosetti, Knight & Dekkers, 2014). Few studies have focused on mentoring between pre-service teachers; specifically in physical education teacher education (PETE) programs. Providing authentic learning opportunities for students in a PETE program and ensuring today’s students, who will be tomorrow’s educators, possess the requisite competencies to navigate physical education teaching is imperative.

Outcomes/Benefits:
The expected outcome of this research is to gain an insight into the effect of peer mentoring in a University pre-service physical education setting.
The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment and testing along with data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an honours degree. In addition, the student will be engaged in the refinement of scientific writing through the writing of their thesis and the preparation of a peer reviewed journal article.

**Please note this project requires the person to have a Physical Education undergraduate degree or equivalent experience.**

By completing this project, the Honours student will gain specialist skills in the area of physical education and mentoring. They will also develop communication skills to manage student and project timelines and engage participants in sharing their experiences in focus group scenarios. Analysis of both qualitative and quantitative data will also be required.


6. Resources

This project will be partially conducted at RMIT in the School of Medical Sciences and partially off campus at potential recruitment environments such as schools. It would therefore be an expectation that a Working with Children’s Check is obtained.
1. Project Title:
Examining physical activity during a school day- accelerometer data analysis.

2. Supervisor/s:
Dr Kate Jenkinson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University
Dr Amanda Benson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr. Kate Jenkinson, 9925-7337, kate.jenkinson@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To examine the contribution of different curriculum areas and school-based programs to the physical activity and sedentary behaviour guidelines.

Background/Rationale:
Physical activity has important health benefits however, adherence to the physical activity guidelines is challenging (Department of Health and Human Services, 1996; Haskell, 2007; Physical Activity Guidelines Advisory Committee, 2008; World Health Organization, 2004). The difficulty that adolescents have in meeting these guidelines may be influenced by the large amount of time that students spend in schools. Students spend half or more of their time per day in the school environment completing largely sedentary behaviour (Carlson, Sallis, Chriqui, Schneider, McDermid & Agron, 2013). Therefore the importance of the curriculum and school-based programs to promote opportunities for physical activity become increasingly important.

Outcomes/Benefits:
The expected outcome of this research is to understand the level of physical activity completed in a school day in different curriculum areas and school-based programs.

The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment, testing and data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an honours degree. In addition, the student will be engaged in the refinement of scientific writing through the writing of their thesis and the preparation of a peer reviewed journal article.

6. Resources
This project will be partially conducted at RMIT in the School of Medical Sciences and partially off campus at potential recruitment environments such as schools. It would therefore be an expectation that a Working with Children’s Check is obtained.
1. Project Title:
Effectiveness of game sense in school physical education and/or sporting environments.

2. Supervisor/s:
Dr Kate Jenkinson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University
Dr Lyndell Bruce, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr. Kate Jenkinson, 9925-7337, kate.jenkinson@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to identify the effectiveness of game sense in school and/or sporting environments and how this influences teacher, coaches and participant outcomes.

Background/Rationale:
There is very little research investigating game sense in Australia (Pill, 2014). Game Sense potentially provides more holistic learning experiences than those created in traditional learning environments as it moves the focus to game play and not the discrete skills or techniques that traditional approaches require (Light, Curry & Mooney, 2014). Understanding the mechanisms around game sense will enable better teaching and/or coaching practices and potentially greater student engagement and participation.

Outcomes/Benefits:
The expected outcome of this research is to gain information on the effectiveness of game sense within schools/sporting environments and how this influences teacher, coach, and participant learning. The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment and testing along with data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an honours degree. In addition, the student will be engaged in the refinement of scientific writing through the writing of their thesis and the preparation of a peer reviewed journal article.

By completing this project, the Honours student will gain specialist skills in identifying, using and analysing data. They will also develop communication skills required to manage participants and project timelines.


6. Resources
This project will be partially conducted at RMIT in the School of Medical Sciences and partially off campus at potential recruitment environments such as schools. It would therefore be an expectation that a Working with Children’s Check is obtained.
1. Project Title:

Game sense-Teachers’ experiences delivering game sense pedagogy.

2. Supervisor/s:

Dr Kate Jenkinson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University
Dr Amanda Benson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Kate Jenkinson, 9925-7337, kate.jenkinson@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to identify the influences on the successful delivery of game sense pedagogy by teachers and how these provide opportunities for teacher and student learning.

Background/Rationale:
The game sense teaching approach is not yet fully understood by many nor has it been adopted by teachers in some Australian schools (Pill, 2014). Previous research on the delivery of game sense or game-centred approaches by teachers have found challenges including the teachers’ own fragile conceptual understandings and pedagogical expertise as well as the current institutionalised practices within most physical education programmes such as directive, skill-based approaches (Harvey, Cushion & Sammon, 2015 Light, Curry & Mooney, 2014). There are many influences on the delivery of game sense including both the teacher and participant.

Outcomes/Benefits:
The expected outcome of this research is to gain information on factors that influence the delivery of game sense within schools and how these influences can inform better teaching and learning outcomes.
The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment and testing along with data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an honours degree. In addition, the student will be engaged in the refinement of scientific writing through the writing of their thesis and the preparation of a peer reviewed journal article.

References:

6. Resources

This project will be partially conducted at RMIT in the School of Medical Sciences and partially off campus at potential recruitment environments such as schools. It would therefore be an expectation that a Working with Children’s Check is obtained.
1. Project Title:

Influences on girls' participation in sport in Victorian schools.

2. Supervisor/s:

Dr Kate Jenkinson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University
Dr Amanda Benson, Discipline of Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr. Kate Jenkinson, 9925-7337, kate.jenkinson@rmit.edu.au

5. Project Description

Aims/Hypothesis:
This project aims to identify the influences on girls' participation in sport in Victorian schools.

Background/Rationale:
It is important to examine the practices inherent within sports which might deter children from participating (Bailey, Wellard & Dismore, 2005). Many girls often reject an overly competitive teaching and sporting climate, even the very able and physically active, and prefer individual, creative or co-operative activities (Kay, 1995). As declines are evident in girls' participation in physical activity, physical education and sport, highlighting barriers to participation could enable school sport providers, and physical educator's opportunities to engage all girls.

Outcomes/Benefits:
The expected outcome of this research is to gain insight into the influences on girls sport and how these influences effect their participation. This knowledge may inform the provision by those stakeholders providing girls sporting opportunities.

The student can also expect to learn about processes that are involved with conducting a research project including writing research protocols, participant recruitment and testing along with data analysis. This will be achieved through conducting a research project and attending workshops and seminars as required for successful completion of an honours degree. In addition, the student will be engaged in the refinement of scientific writing through the writing of their thesis and the preparation of a peer reviewed journal article.

By completing this project, the Honours student will gain specialist skills in identifying, using and analysing data using software. They will also develop communication skills to manage project timelines and engage participants in research including possible development of a range of research instruments: questionnaires, observation tools, focus groups and statistical analysis of data.

References

6. Resources
This project will be partially conducted at RMIT in the School of Medical Sciences and partially off campus at potential recruitment environments such as schools. It would therefore be an expectation that a Working with Children's Check is obtained.
1. Project Title:
Identification of muscle contribution to resistance training exercises.

2. Supervisor/s:
Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.
Mr. Yoong Ping Lim, Discipline Exercise Sciences, School of Medical Sciences, RMIT University.

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Isaac Selva Raj, 9925 7037, isaacselva.raj@rmit.edu.au

5. Project Description
Aims/Hypothesis:
Biofeedback can provide improved exercise outcome for an isolated muscle strengthening program.

Background/Rationale:
The evaluation of most exercise programs usually measures a gross outcome measure; in particular, there is little consideration on how each muscle contributes to an exercise routine. Given, multiple muscles span an anatomical joint (also known as an over-determined system), there are scenarios where strengthening of an isolated muscle is preferred (e.g., falls prevention in the elderly, strengthening of trunk muscle, and body building). Previous studies suggest biofeedback can assist a person to vary how muscles contribute to an exercise. This project explores the various biofeedback methods that improve the outcome for an isolated muscle strengthening program. The specific aims are to design low-cost and quantitative assessment tools for exercise practitioners.

Outcomes/Benefits:
To our knowledge, there is no low-cost and quantitative assessment tool to evaluate the exercise outcomes of isolated muscle strengthening program. The proposed assessment tool can potentially improve therapy and muscle strengthening outcomes.

The student will experience and learn a multi-disciplinary research program. The student will develop the research skills in the areas of exercise sciences, muscle physiology, electronics, programming, signal processing and statistical knowledge for research purposes. Scientific writing skills can be acquired via journal and conference publications.

6. Resources
This project will be conducted in Exercise Sciences, Bundoora Campus, RMIT University.
1. Project Title:

Energy expenditure during common resistance training exercises.

2. Supervisor/s:

Dr Isaac Selva Raj, Discipline Exercise Sciences, School of Medical Sciences, RMIT University
Professor Stephen Bird, Discipline Exercise Sciences, School of Medical Sciences, RMIT University
Dr Jason Wong, Discipline Exercise Science, School of Medical Sciences, RMIT University
Associate Professor Noel Lythgo, Discipline Exercise Sciences, School of Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Isaac Selva Raj, 9925 7037, isaacselva.raj@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To characterise energy expenditure during common resistance training exercises.

Background/Rationale:
The American College of Sports Medicine (ACSM) has developed metabolic equations for the estimation of energy expenditure during aerobic or steady-state exercise. However, there are no such equations for resistance training exercises and there is little research on the topic, making it difficult to characterise energy expenditure during a session of resistance exercise. Therefore, this project is designed to characterise energy expenditure during common resistance training exercises and develop predictive equations for energy expenditure during these exercises.

Outcomes/Benefits:
The results of this project will allow the prediction of energy expenditure during common resistance training exercises. This will make it possible to estimate overall energy expenditure during a bout of resistance exercise. Comparisons can then be made between bouts of aerobic and resistance exercise.

The student will gain an understanding of a multi-disciplinary approach to the research process, including designing methodology, data collection, statistical analysis and writing skills. In addition, the student will learn and develop specialist skills in the measurement of strength and energy expenditure, and the supervision of resistance training.

A student can expect to:
- Understand how to design and implement a multi-disciplinary research project
- Enhance their analytical skills and ability to think critically and logically
- Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
- Develop their communication skills, both oral and written, in order to disseminate their experimental findings
- Develop a greater understanding of the depth and breadth of knowledge within Exercise Science
- Develop skills in the measurement of strength, the estimation of energy expenditure, and the supervision of resistance training.

6. Resources

This project will be carried out on campus (RMIT University – Bundoora campus) and at a location convenient to the participants.
1. Project Title:

Validity, reliability and utility of contemporary physical activity monitors.

2. Supervisor/s:

Dr Jason Wong, Discipline of Exercise Sciences, Medical Sciences, RMIT University
Dr Isaac Selva Raj, Discipline of Exercise Sciences, Medical Sciences, RMIT University
Associate Professor Noel Lythgo, Discipline of Exercise Sciences, Medical Sciences, RMIT University
Associate Professor Amanda Telford, Discipline of Exercise Sciences, Medical Sciences, RMIT University
Mr Yoong Pim Lim, Discipline of Exercise Sciences, Medical Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Jason Wong, 9925 7454 jason.wong@rmit.edu.au

5. Project Description

Aims
To investigate the validity, reliability and utility of contemporary activity monitors.

Background/Rationale:
Recently, inexpensive and "easy-to-wear" activity monitors have been developed to record physical activity/inactivity and estimate energy expenditure in healthy populations. Other features of these monitors include self-monitoring and motivation to exercise adherence. Many authorities advocate at least 2.5 hours per week of moderate to vigorous PA to reduce the risk of chronic diseases such as type 2 diabetes mellitus and cardiovascular disease. The use of objective measures may thereby facilitate the attainment of daily goals to obtain health benefits. For example, results from a meta-analysis found that participants who used pedometers increased their PA by 27% (Bravata, Smith-Spangler et al. 2007). However, the validity, reliability and utility of these activity monitors are unknown. This project will investigate four commercially available activity monitors.

Outcomes/Benefits:
The assessment of physical activity (PA) in a free-living environment is important for understanding the relationship between PA and health. Development of highly portable, inexpensive and "easy to wear" activity monitors (based on triaxial accelerometry technology) has contributed to an increased use of these devices by the general public and their potential utility to investigate sedentary behaviour and exercise adherence. This project will also investigate the development of algorithms for triaxial accelerometry so as to accurately assess sedentary and non-sedentary behaviour.

A student can expect to:
• Understand how to design and implement a multi-disciplinary research project
• Enhance their analytical skills and ability to think critically and logically
• Become an independent learner, make decisions themselves, and develop the trouble shooting skills required to conduct research in Exercise Science
• Develop their communication skill, both oral and written, in order to disseminate their experimental findings
• Develop a greater understanding of the depth and breadth of knowledge within Exercise Science
• Develop specialist skills in the measurement of muscle strength and the use of LLLT.

Reference:

6. Resources

This project will be carried out on campus (RMIT University – Bundoora campus).
1. Project Title:

Effects of sleep fragmentation on reward processes and mood in rodents.

2. Supervisor/s:

Dr Sarah J. Spencer, School of Health Sciences, RMIT University
Dr Melinda L. Jackson, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Sarah J. Spencer, 9925 7745, Sarah.spencer@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To examine the effects of sleep fragmentation on reward sensitivity in adult rats.

Background/Rationale:
Sleep fragmentation is often found in many common diseases, including obstructive sleep apnoea, and is a part of the normal aging process. Sleep loss has been associated with depressed mood in humans, however the mechanisms remain unclear. This study aims to examine the effect of mild sleep disruption on behavioural and neural outcomes of mood and reward processing in rodents.

Outcomes/Benefits:
Rats will undergo either 24-h of experimentally-induced sleep fragmentation, 7 days of experimentally-induced sleep fragmentation, or 24-h of normal sleep. Following this, we will assess performance in a variety of cognitive behavioural tests relating to reward. We will first provide the rats with a choice between normal drinking water and sweetened water (sucrose), and we will record sucrose consumption as a measure of sucrose anhedonia. Reduced sucrose intake is reflective of depression and anhedonia in rodent models. We will also train the rats in a conditioned place preference/aversion (CPP/CPA) test, a commonly used behavioural task to assess the rewarding or aversive nature of particular stimuli.

In addition to assessing behaviour, we will take tissue samples for immunocytochemistry assessments of Fos expression patterns in reward-related brain regions including the ventral tegmental area and prefrontal cortex. Thus, the student will gain wide experience in a variety of laboratory techniques to investigate this topic. The student will also be introduced to scientific thinking, writing, and presentation skills.

6. Resources

This project will be carried out on campus. Laboratory is located in Module C.
1. Project Title:
Lung inflammation in cigarette smoking: IL-17A as a key culprit in smoking-related lung disease.

2. Supervisor/s:
Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description
Background/Rationale:
Chronic Obstructive Pulmonary Disease (COPD) is a major incurable global health burden and will become the third largest cause of death in the world by 2020. It is currently believed that an exaggerated inflammatory response to inhaled irritants, in particular cigarette smoke, causes progressive airflow limitation. This inflammation leads to oxidative stress, emphysema, small airway fibrosis and mucus hypersecretion. IL-17A is a newly discovered cytokine that has rapidly emerged as a major player in lung disease.

Aims/Hypothesis:
In this project you will investigate whether targeting IL-17A ameliorates experimental COPD in a murine model of the disease.

Outcomes/Benefits:
The significance of this work will be that IL-17A may be a novel target that can be exploited therapeutically to slow or prevent cigarette smoke-induced emphysema and reduce the severity of inflammation in COPD.

Student learning: The student will learn a number of skills including in vivo disease models, lung function measurement, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

6. Resources
This project will be carried out on campus.
1. Project Title:

Panax Ginseng for the treatment of COPD.

2. Supervisor/s:

Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences,
Professor Jiming Ye, School of Health Sciences, RMIT University
Professor Charlie Xue, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description

Background/Rationale:
Chronic Obstructive Pulmonary Disease (COPD) is a major incurable global health burden and will become the third largest cause of death in the world by 2020. It is currently believed that an exaggerated inflammatory response to inhaled irritants, in particular cigarette smoke, causes progressive airflow limitation. This inflammation leads to oxidative stress, emphysema, small airway fibrosis and mucus hypersecretion. However, COPD responds poorly to current anti-inflammatory treatments including potent glucocorticosteroids, which produce little or no benefit. As a result, many COPD sufferers are increasingly using traditional and complementary medicines for symptom management, including herbal medicines. Ginseng is one of the most popular tonic herbs worldwide and been used for various health conditions including cancer, diabetes, atherosclerosis, inflammation and cognitive impairments. The active and inactive constituents of ginseng include ginsenosides, polysaccharides, polyynes, flavonoids, and volatile oils. Among these, ginsenosides are mostly characterised and well-studied as the main active compounds of ginseng.

Aims/Hypothesis:
In this project you will investigate whether ginseng and ginsenosides ameliorate experimental COPD in a murine model of the disease.

Outcomes/Benefits:
The significance of this work will be that ginseng and ginsenosides may be exploited therapeutically to reduce inflammation in COPD and slow or prevent emphysema.

Student learning: The student will learn a number of skills including in vivo disease models, lung function measurement, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

6. Resources

This project will be carried out on campus.
1. Project Title:

Role of glutathione peroxidase-1 in influenza virus-induced lung disease.

2. Supervisor/s:

Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description

Background/Rationale:
Influenza A virus infection has claimed millions of lives worldwide and continues to impose a major economic burden on health care systems. Co-ordinated efforts to control this infection are problematic due to (i) resistance to anti-virals, (ii) the requirement for strain-specific vaccination and (iii) the ongoing threat of new pandemic strains of virus. Thus, new pharmacological strategies that ameliorate influenza viral lung pathology are urgently required. Animal and human studies provide compelling evidence that immune cells such as macrophages, neutrophils and T lymphocytes, which are critical for efficient viral clearance, initiate and exacerbate lung pathology following infection. An understanding of the mechanisms by which the various inflammatory cell types of the immune system cause such pathology may reveal novel targets for pharmacological modulation of host immune responses. An emerging paradigm in this regard is the significant contribution of reactive oxygen species (ROS). Immune cell ROS can be extremely toxic and capable of inducing significant injury to surrounding lung tissue when produced in excess. Moreover ROS are likely to promote the characteristic ‘cytokine storm’ of influenza A pandemic strains. The normal lung has developed defences to ROS-mediated damage, which include the anti-oxidant enzymes such as glutathione peroxidase-1 (Gpx-1).

Aims/Hypothesis:
In this project you will use a multidisciplinary approach to extensively evaluate the role of Gpx-1 in influenza virus-induced lung inflammation and damage. This will be achieved by using mice deficient in Gpx-1 and pharmacological interventions.

Outcomes/Benefits:
The significance of this work will be that Gpx-1 may be a novel target that can be utilized for both seasonal and pandemic control of influenza virus-induced mortality and morbidity.

Student learning: The student will learn a number of skills including in vivo disease models, FACS analysis of cell populations, quantitative PCR, lung function measurement, histology, virus and cell culture, ELISA, zymography and Western blotting.

6. Resources

This project will be carried out on campus.
1. Project Title:

Role of IL-17A in COPD.

2. Supervisor/s:

Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description

Background/Rationale:
Chronic Obstructive Pulmonary Disease (COPD) is a major incurable global health burden and will become the third largest cause of death in the world by 2020. It is currently believed that an exaggerated inflammatory response to inhaled irritants, in particular cigarette smoke, causes progressive airflow limitation. This inflammation leads to oxidative stress, emphysema, small airway fibrosis and mucus hypersecretion. IL-17A is a newly discovered cytokine that has rapidly emerged as a major player in lung disease.

Aims/Hypothesis:
In this project you will investigate whether targeting IL-17A ameliorates experimental COPD in a murine model of the disease.

Outcomes/Benefits:
The significance of this work will be that IL-17A may be a novel target that can be exploited therapeutically to slow or prevent cigarette smoke-induced emphysema and reduce the severity of inflammation in COPD.

Student learning: The student will learn a number of skills including in vivo disease models, lung function measurement, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

6. Resources

This project will be carried out on campus.
1. Project Title:
Cigarette Smoking: a potential cause of neuroinflammatory brain damage.

2. Supervisor/s:
Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Dr Sarah Spencer, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description
Background/Rationale:
Smoking is one of the biggest causes of lung dysfunction including cancer and Chronic Obstructive Pulmonary Disease (COPD). It is currently believed that inhaled irritants, in particular cigarette smoke, cause an exaggerated inflammatory response that leads not only to progressive airflow limitation and cumulative lung damage, but may also impact the brain. Thus cigarette smoking is a major risk factor for Alzheimer’s disease and ageing-related pathological changes in the brain. The role of the inflammatory response in this pathology remains poorly understood.

Aims/Hypothesis:
In this project you will investigate the mechanisms underlying cigarette smoke-induced brain inflammation and cognitive dysfunction in a mouse model of cigarette smoking-induced COPD.

Outcomes/Benefits:
The significance of this work will be that by understanding the mechanisms underlying cognitive dysfunction and brain inflammation in COPD we may be able to develop therapies to prevent or slow down cognitive dysfunction caused by cigarette smoking.

Student learning: The student will learn a number of skills including in vivo disease models, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

6. Resources
This project will be carried out on campus.
1. Project Title:

Role of anti-oxidants in acute exacerbations of COPD.

2. Supervisor/s:

Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Ross Vlahos, 9925 7362, ross.vlahos@rmit.edu.au

5. Project Description

Background/Rationale:
Chronic Obstructive Pulmonary Disease (COPD) is a major incurable global health burden and will become the third largest cause of death in the world by 2020. It is currently believed that an exaggerated inflammatory response to inhaled irritants, in particular cigarette smoke, causes progressive airflow limitation. This inflammation involves the production of various cytokines and chemokines, induction of various proteases, oxidative stress, small airway fibrosis, mucus hypersecretion and emphysema. Patients with COPD are also prone to respiratory infections (commonly called acute exacerbations of COPD - AECOPD) that cause an accelerated decline in lung function, hospitalisation and even death. These respiratory infections consist of bacteria and viruses that get into the lungs of people with COPD. People with COPD find it extremely difficult to fight off these respiratory infections. We have developed mouse models of AECOPD that replicate the features of human disease. Oxidative stress plays a major role in COPD and AECOPD because cigarette smoke contains more than $10^{15}$ oxidants per puff, many of which are relatively long-lived. These oxidants give rise to Reactive Oxygen Species (ROS), which are a family of highly reactive molecules that are generated enzymatically by various cells in the lung in response to a variety of chemical and physical agents. However, the normal lung has developed defences to ROS-mediated damage, which include the anti-oxidant enzymes NADPH oxidase-2 (Nox-2) and glutathione peroxidase-1 (Gpx-1).

Aims/Hypothesis:
In this project you will investigate whether Nox-2 and Gpx-1 ameliorates experimental AECOPD in a murine model of the disease. This will be achieved by using mice deficient in these anti-oxidant enzymes and pharmacological interventions.

Outcomes/Benefits:
The significance of this work will be that Nox-2 and Gpx-1 may be novel targets that can be exploited therapeutically to treat exacerbations of COPD.

Student learning: The student will learn a number of skills including in vivo disease models, FACS analysis of cell populations, quantitative PCR, lung function measurement, histology, virus and cell culture, ELISA, zymography and Western blotting.

6. Resources

This project will be carried out on campus.
Can respiratory infections cause neuroinflammation and cognitive dysfunction in high risk COPD patients?

**2. Supervisor/s:**
Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University  
Dr Sarah Spencer, Associate Professor Ross Vlahos, School of Health Sciences, RMIT University  
Professor Stephen Robinson, School of Health Sciences, RMIT University

**3. Program Code:**  
BH058 Bachelor of Biomedical Sciences (Honours)

**4. Contact:**  
Associate Professor Ross Vlahos, 9925 6674, steven.bozinovski@rmit.edu.au

**5. Project Description**

**Background/Rationale:**
People with Chronic Obstructive Pulmonary Disease (COPD) cannot breathe effectively as their lungs have been permanently damaged by cigarette smoke and/or environmental pollution. People with COPD also suffer from recurrent chest infections known as exacerbations caused by bacteria and/or viruses, which not only damage the lung, but also result in elevated systemic inflammation. Frequent exacerbators are at increased for developing depression and display significant cognitive impairment.

This project will focus on two important biomarkers in COPD. Our laboratory has identified Serum Amyloid A (SAA) as a biomarker for COPD that is particularly high during severe exacerbations associated with a bacterial and viral co-infection. SAA has also been shown to be elevated in the brains of people with neuropathological diseases such as Alzheimer’s disease and the prevalence rate of Alzheimer’s disease or other dementia in COPD subjects is reported to be in excess of 35%. Another important biomarker for COPD exacerbations is IP-10, which is an interferon regulated gene that is particularly elevated during viral infections. Most recently, Dr Spencer and colleagues have identified IP-10 as a biomarker for neuroinflammation and cognitive dysfunction.

**Aims/Hypothesis:**
In this project you will investigate a validated experimental model of co-infection with influenza A virus and *streptococcus pneumonia* and measure cognitive dysfunction during the acute and recovery phase of infection. You will also measure SAA and IP-10 in the blood and brain and determine its relationship with cognitive dysfunction. In addition, you will test agents that modify the activity of SAA and IP-10, which will reveal new approaches to treating neuroinflammation causes by chest infections.

**Outcomes/Benefits:**
The significance of this work will be that by understanding the mechanisms underlying cognitive dysfunction and brain inflammation in COPD exacerbations, we may be able to develop therapies to prevent this important clinical problem that is not addressed by current medications.

Student learning: The student will learn a number of skills including in vivo disease models, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

**6. Resources**
This project will be carried out on campus.
1. Project Title:

Novel therapeutic strategies for treating co-infection with virus and bacteria in COPD.

2. Supervisor/s:

Associate Professor Steven Bozinovski, School of Health Sciences, RMIT University
Associate Professor Ross Vlahos, School of Health Sciences, RMIT University
Dr Desiree Anthony, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Associate Professor Ross Vlahos, 9925 6674, steven.bozinovski@rmit.edu.au

5. Project Description

Background/Rationale:
The World Health Organisation predicts that Chronic Obstructive Pulmonary Disease (COPD) will become the third leading cause of death worldwide by 2020. In Australia, COPD costs around 1 Billion dollars a year in direct health care expenditure; most of which is spent when patients experience Acute Exacerbations of COPD (AECOPD). AECOPD are commonly caused by a viral and/or bacterial infection and are associated with increased airway and systemic inflammation.

An important emerging paradigm is that inflammation is normally coupled to a secondary resolution phase mediated by anti-inflammatory mediators. Excessive inflammation or inadequate resolution will contribute to tissue destruction underlying COPD. We have recently identified a G-coupled protein receptor (GPCR) termed ALX/FPR2 as an important mediator of mucosal inflammation that displays ligand-biased signalling. Ligand-biased signalling refers to the ability of molecules to promote distinct receptor conformations that yield opposing functional outcomes.

Aims/Hypothesis:
The purpose of this project is to evaluate the potential of peptide or small molecule modulators of ALX/FPR2 receptor activity in order to alter ligand-biased signalling towards a pro-resolution state. This project will combine start of the art analysis in both model cell systems and also in whole animal experimental models of disease. The work will provide in-depth assessment of the potential of ALX/FPR2 receptor ligands as therapeutic agents to treat a major area of unmet medical need.

Outcomes/Benefits:
The significance of this work will be that by understanding the mechanisms underlying and impaired pathogen clearance and excessive inflammation in COPD exacerbations, we may be able to develop therapies to prevent this important clinical problem that is not addressed by current medications.

Student learning: The student will learn a number of skills including in vivo disease models, histology, morphometry, quantitative PCR, FACS analysis of cell populations, cell and tissue culture, ELISA, zymography and Western blotting.

6. Resources

This project will be carried out on campus.
1. Project Title:
Using a novel thyroid hormone analogue for the treatment of brain injury in intrauterine growth restriction.

2. Supervisor/s:
Dr Mary Tolcos, School of Health Sciences, HiRi, RMIT University
This project will also involve interaction with Prof David Walker (The Ritchie Centre), Dr Flora Wong (The Ritchie Centre) and Dr Steven Petratos (Monash University)

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Mary Tolcos, 9594 5379 mary.tolcos@hudson.org.au (RMIT email available in Dec)

5. Project Description
Aims/Hypothesis:
To determine whether postnatal treatment with a novel thyroid hormone analogue will repair brain injury sustained from intrauterine growth restriction.

Background/Rationale:
Intrauterine growth restriction (IUGR) is defined as a failure of the fetus to reach its genetic growth potential. It occurs in 4-8% of pregnancies making it second only to premature birth as a leading cause of perinatal morbidity and mortality in babies without major birth defects. IUGR can occur as a result of an inadequate supply of oxygen and nutrients to the fetus due to acute or chronic placental insufficiency via idiopathic impaired placentation. IUGR fetuses have protective mechanisms that direct their reduced blood flow towards vital organs such as the brain and heart at the expense of other organs. Despite this growth–restricted babies are often born with abnormal brain development and brain injury particularly within the cerebral white matter and cerebellum. As a result of this injury, children who were growth restricted in utero have an increased risk of learning difficulties, intellectual and cognitive deficits, motor deficits, cerebral palsy and autism.

We have a rodent model of IUGR, where the brain, although spared relative to other organs, is still retarded in growth and development. To induce IUGR in rodents we ligate the uterine vessels during pregnancy to restrict blood flow and nutrient supply to fetuses on both sides of the uterine horns. Control (sham-operated, non-ligated) and IUGR pups are then treated with either saline or the thyroid hormone analogue for the first week of life. The brains are then collected at various postnatal ages following treatment for histological, immunohistochemical and molecular assessment.

Outcomes/Benefits:
With no treatment for brain injury, our challenge is to develop safe and effective therapies. This study will test the therapeutic potential of a novel thyroid hormone analogue in an animal model of fetal growth restriction, to provide the essential information for a clinical drug trial with growth-restricted human infants.

Students will learn paraffin sectioning, histology, immunohistochemistry, qPCR, image analysis and brain development. Tissues are currently being generated but students will have the opportunity to watch IUGR surgeries off-site (The Ritchie Centre, Monash Medical Centre, Clayton) if they wish.

6. Resources
On campus
1. **Project Title:**

Long-term effects of high dose caffeine treatment on the developing brain.

2. **Supervisor/s:**

Dr Mary Tolcos, School of Health Sciences, HiRi, RMIT University  
Dr Robert De Matteo, Department of Anatomy and Developmental Biology, Monash University

3. **Program Code:**

BH058 Bachelor of Biomedical Sciences (Honours)

4. **Contact:**

Dr Mary Tolcos, 9594 5379, mary.tolcos@hudson.org.au (RMIT email available in Dec)

5. **Project Description**

**Aims/Hypothesis:**
To determine the long-term impact of high dose caffeine exposure on the developing ovine brain.

**Background/Rationale:**
Babies born premature often develop apnoea of prematurity, a condition where breathing ceases for up to 20 seconds. If left untreated apnoea of prematurity can cause brain injury via reduced cerebral oxygen delivery, or even death. Caffeine therapy has become an integral part of management of apnoea of prematurity in preterm infants. Infants who do not respond to standard recommended caffeine treatment (20mg/kg loading dose of caffeine citrate followed by 5-10mg/kg daily dose) may require higher doses. However there is a paucity of evidence to show that doses above the “standard dose” are safe for the developing brain in either the short- or long-term.

One clinical trial has now reported that higher doses of caffeine increases the incidence of cerebellar haemorrhage in preterm babies. Over the past 5 years our preclinical animal experiments have also indicated that high dose caffeine has adverse effects on the fetal sheep brain. However, we do not know whether these adverse brain effects resolve, or increase over time.

We have developed a large animal model of fetal caffeine exposure where we expose the pregnant ewe to high dose caffeine from 0.7 to 0.8 of gestation; this age approximates to 27-34 weeks of human gestation, a period when caffeine is usually prescribed in preterm babies. We then allow the sheep to deliver naturally and raise the lambs until 8 weeks of age after which we collect the brains for magnetic resonance imaging (MRI), histology and immunohistochemistry.

**Outcomes/Benefits:**
This study will determine whether high dose caffeine, commonly used to treat apnoea of prematurity, results in sustained, long-term damage to the brain. Combined with our previous findings that high dose caffeine is detrimental to the developing brain in the short-term, this study will help to inform neonatologists of the potential risks of high dose caffeine use in preterm infants.

This project will use a sheep model to determine the long-term impact of chronic high dose caffeine exposure on the brain and cerebellum. Students will learn paraffin sectioning, histology, immunohistochemistry, image analysis and brain development. Brain tissue has already been generated (and brains have already been imaged using MRI) but students will have the opportunity to watch fetal sheep surgeries off-site (The Ritchie Centre, Monash Medical Centre, Clayton) if they wish.

6. **Resources**

On campus
1. Project Title:
Effects of Intrauterine Growth Restriction on Cortical Laminar Development: Relevance to Autism?

2. Supervisor/s:
Dr Mary Tolcos, School of Health Sciences, HIRi, RMIT University
Dr Sarah J. Spencer, School of Health Sciences, HIRi, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Mary Tolcos, 9594 5379, mary.tolcos@hudson.org.au (RMIT email available in Dec)

5. Project Description
Aims/Hypothesis:
To assess development of the cerebral cortex in control and intrauterine growth-restricted fetuses.

Background/Rationale:
Intrauterine growth restriction (IUGR) is defined as a failure of the fetus to reach its genetic growth potential. It occurs in 4-8% of pregnancies making it second only to premature birth as a leading cause of perinatal morbidity and mortality in babies without major birth defects. IUGR can occur as a result of an inadequate supply of oxygen and nutrients to the fetus due to acute or chronic placental insufficiency via idiopathic impaired placentation. IUGR fetuses have protective mechanisms that direct their reduced blood flow towards vital organs such as the brain and heart at the expense of other organs. Despite this, brain development is adversely affected as a result of IUGR; children who were growth restricted in utero have an increased risk of learning difficulties, intellectual and cognitive deficits, motor deficits, cerebral palsy and autism.

Recent evidence now suggests that development of the cerebral cortex in particular cortical layering is disrupted in the brains of autistic patients and that this accounts for abnormal functioning of the brain. It is also thought that these changes manifest in fetal life. We have a rodent model of IUGR, where the brain, although spared relative to other organs, is still retarded in growth and development. To induce IUGR in rodents we ligate the uterine vessels during pregnancy to restrict blood flow and nutrient supply to fetuses on both sides of the uterine horns. We then collect the brains from fetuses and neonates at various postnatal ages for histological, immunohistochemical and molecular assessment.

Outcomes/Benefits:
These studies will allow us to determine whether abnormal cortical layer development is impaired in the IUGR brain and whether these early life changes may explain the link between IUGR and autism. Students will learn paraffin sectioning, histology, immunohistochemistry, qPCR, image analysis, and brain development. Tissue has already been generated but students will have the opportunity to watch IUGR surgeries off-site (The Ritchie Centre, Monash Medical Centre, Clayton) if they wish.

6. Resources
On campus
1. Project Title:
Exposure of the fetal brain to high dose caffeine: impact on synaptogenesis and cortical activity.

2. Supervisor/s:
Dr Mary Tolcos, School of Health Sciences, HiRi, RMIT University
Dr Robert De Matteo, Department of Anatomy and Developmental Biology, Monash University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Mary Tolcos, 9594 5379, mary.tolcos@hudson.org.au (RMIT email available in Dec)

5. Project Description

Aims/Hypothesis:
To determine if high dose caffeine exposure affects synaptogenesis and cortical activity in fetal sheep.

Background/Rationale:
Babies born premature often develop apnoea of prematurity, a condition where breathing ceases for up to 20 seconds. If left untreated apnoea of prematurity can cause brain injury via reduced cerebral oxygen delivery, or even death. Caffeine therapy has become an integral part of management of apnoea of prematurity in preterm infants however infants who do not respond to the standard recommended caffeine treatment (20mg/kg loading dose of caffeine citrate followed by 5-10mg/kg daily dose) may require higher doses. Unfortunately there is very little preclinical data to show that high dose caffeine is safe for the developing brain. In fact one clinical trial has now reported that high dose caffeine increases the incidence of cerebellar haemorrhage in preterm babies. Over the past 5 years our preclinical animal experiments have also indicated that high dose caffeine has adverse effects on the fetal sheep brain. To date we have not assessed whether the development of synapses (synaptogenesis) or cortical activity is affected by high dose caffeine in the fetal brain.

We have developed a large animal model of fetal caffeine exposure where we expose the pregnant ewe to high dose caffeine from 0.8 to 0.88 of gestation. During this time, fetuses are chronically instrumented so that we can record fetal wellbeing, fetal physiology and brain activity using electrocortiography (ECoG). At the completion of the experiment we collect the brains for histology, immunohistochemistry and quantitative RT-PCR.

Outcomes/Benefits:
This study will determine whether high dose caffeine, commonly used to treat apnoea of prematurity, alters cortical activity, synapse development and/or the expression of key synapse proteins. Combined with our previous findings that high dose caffeine is detrimental to the developing brain in the short-term, this study will help to inform neonatologists of the potential risks of high dose caffeine use in preterm infants.

This project will use a fetal sheep model to determine the effect of chronic high dose caffeine exposure on the brain. Students will learn paraffin sectioning, histology, immunohistochemistry, image analysis, qRT-PCR and brain development. These experiments are currently underway and we anticipate that all brain tissue will be collected prior to the start of the project. Students will have the opportunity to watch fetal sheep surgeries off-site (The Ritchie Centre, Monash Medical Centre, Clayton) if they wish.

6. Resources
On campus
1. Project Title:

Effects of dietary composition on brain inflammation in adolescence and adulthood.

2. Supervisor/s:

Dr Sarah J. Spencer, School of Health Sciences, RMIT University
Professor Jiming Ye, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Sarah J. Spencer, 9925 7745, sarah.spencer@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To examine the effects of diets high in fat, cholesterol, and fructose, on brain inflammation in adolescence and adulthood.

Background/Rationale:
Obesity is epidemic in our society and is a particular problem in teenagers who are increasingly leading a sedentary lifestyle accompanied by poor diet. Diets high in fat, when consumed long-term, can lead to brain inflammation that exacerbates obesity by interfering with satiety signalling. Here we will investigate how different diets influence brain inflammation in these populations.

Outcomes/Benefits:
We will give rats one of either high fat, high cholesterol, high fructose, or normal chow diet for 12 weeks, commencing in the “teenage” (i.e. peripubertal) or adult periods.

We will measure food intake and weight gain, as well as performance in a variety of behavioural and metabolic tests. We will also take tissue samples for immunohistochemistry, gene expression, and inflammatory protein levels. Thus, the student will gain wide experience in a variety of laboratory techniques to investigate this topic. The student will also be introduced to scientific thinking, writing, and presentation skills.

6. Resources

This project will be carried out on campus. Laboratory is located in Module C.
1. Project Title:

Effects of anti-inflammatories on brain inflammation caused by high fat diet in adolescence and adulthood.

2. Supervisor/s:

Dr Sarah J. Spencer, School of Health Sciences, RMIT University
Dr Luba Sominsky, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Sarah J. Spencer, 9925 7745, sarah.spencer@rmit.edu.au

5. Project Description

Aims/Hypothesis:
To examine the effects of anti-inflammatories (ginseng and EGCG) on brain inflammation after high fat diet in adolescence and adulthood.

Background/Rationale:
Obesity is epidemic in our society and is a particular problem in teenagers who are increasingly leading a sedentary lifestyle accompanied by poor diet. Diets high in fat, when consumed long-term, can lead to brain inflammation that exacerbates obesity by interfering with satiety signalling. Here we will investigate if anti-inflammatories (ginseng and EGCG) can ameliorate brain inflammation after high fat diet.

Outcomes/Benefits:
We will give rats either, high fat, or normal chow diet for 12 weeks, commencing in the “teenage” (i.e. peripubertal) or adult periods. This will be accompanied by either no anti-inflammatory agent or one of ginseng or EGCG given chronically in the drinking water.

We will measure food intake and weight gain, as well as performance in a variety of behavioural and metabolic tests. We will also take tissue samples for immunohistochemistry, gene expression, and inflammatory protein levels. Thus, the student will gain wide experience in a variety of laboratory techniques to investigate this topic. The student will also be introduced to scientific thinking, writing, and presentation skills.

6. Resources

This project will be carried out on campus. Laboratory is located in Module C.
1. Project Title:
Can ginseng in adolescence and adulthood improve reproductive deficits caused by high fat diet?

2. Supervisor/s:
Dr Luba Sominsky, School of Health Sciences, RMIT University
Dr Sarah Spencer, School of Health Sciences, RMIT University

3. Program Code:
BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:
Dr Luba Sominsky, 99257266, luba.sominsky@rmit.edu.au

5. Project Description
Aims/Hypothesis:
To examine the effects of ginseng on the poor reproductive potential caused by high fat diet in adolescence and adulthood

Background/Rationale:
The incidence of obesity is constantly increasing worldwide, particularly in teenagers, who have become increasingly sedentary. The lifestyle of poor diet and little physical activity has been shown to negatively affect fertility. Here we will investigate if ginseng, an anti-inflammatory compound, can ameliorate the negative effects on reproductive potential caused by high fat diet.

Outcomes/Benefits:
We will give rats either high fat or normal chow diet for 12 weeks, commencing in the “teenage” (i.e. peripubertal) or adult periods. This will be accompanied by either no anti-inflammatory agent or ginseng that will be given chronically in the drinking water.

We will measure blood, gonadal and brain reproductive indices. For this, we will collect tissue samples for immunohistochemistry, gene expression and protein levels. The student will gain wide experience in a variety of laboratory technique to investigate this topic. The student will also be introduced to scientific critical thinking, writing, and presentation skills.

6. Resources
This project will be carried out on campus. Laboratory is located in Module C.
1. Project Title:

Why do muscles waste in smoking-related lung disease?

2. Supervisor/s:

Dr Samantha Passey, School of Health Sciences, RMIT University
Associate Professor Ross Vlahos, School of Health Sciences, RMIT University

3. Program Code:

BH058 Bachelor of Biomedical Sciences (Honours)

4. Contact:

Dr Samantha Passey, 9925 7899, samantha.passey@rmit.edu.au

5. Project Description

Aims:

In this project you will use a multidisciplinary approach combining established animal models, cell culture and gene and protein profiling to investigate the effects of oxidative stress on muscle and whether antioxidants are effective in reducing oxidative damage.

Background/Rationale:

Chronic obstructive pulmonary disease (COPD; emphysema) is a debilitating disease characterised by progressive airflow limitation. Patients with COPD often suffer from severe muscle wasting, which increases their risk of death and reduces quality of life. Preventing or reversing wasting offers a major advance in COPD treatment, increasing quality of life and survival. Common clinical strategies to improve muscle mass and function in COPD patients include anabolic hormones, nutritional intervention and exercise training; unfortunately these treatments often have limited clinical success and currently there are no effective treatments for muscle wasting. Our research aims to develop new therapeutic approaches to reverse or prevent muscle wasting.

Elevated oxidative stress is emerging as an important factor in the pathology of COPD, and can be caused both by oxidants within cigarette smoke and by reactive oxygen species (ROS) released by inflammatory cells within the lungs. Although studies have shown that there is oxidative damage in various tissues of COPD patients, currently very little is known about the effects of oxidative stress in muscle of COPD patients or the potential effects of antioxidants in reducing muscle wasting by reducing the respiratory and systemic oxidative burden.

Outcomes/Benefits:

The project will have a significant impact on our understanding of the responses of muscle to oxidative stress and will help to identify and test novel strategies to tackle muscle wasting in COPD.

Student learning: The student will learn a number of skills including in vivo disease models, quantitative PCR, cell culture of mouse and human muscle cells, microscopy, histology, ELISA and western blotting.

6. Resources

This project will be carried out on campus