



THE UNIVERSITY OF
MELBOURNE



DAP Research Projects

2026

Welcome

The decision to undertake an Honours year or a Masters degree is an important one that provides substance to your undergraduate degree. You get to see up close the workings of a research laboratory and gain the ability to put your scientific knowledge into practice.

It can be the first step towards an independent scientific career when you get the chance to pursue a research area of interest. This is likely to be the path for a small minority, but the skills learnt are valuable in many areas of life and in multiple careers. The extra qualification will also help set you apart from competitors when seeking employment or entry into other courses or specialties.

There are many things to consider – the research topic, your need and desire to undertake additional, advanced coursework, the laboratory and its resources, the potential supervisor and the departmental support of students.

The Department of Anatomy and Physiology has a strong record of award-winning research training and mentorship with our graduates securing leadership roles in universities, institutes, industry and in the private sector. We are very proud of our students and have developed a carefully structured program of coursework to complement your developing laboratory and analytical skills. The Department environment provides support in a number of ways for our Honours and Masters students, but perhaps none is more important than the friendship, advice and mentoring they receive from other graduate students.

This booklet provides information that will help you decide on a potential research project in Anatomy and Physiology at Honours and Masters Level and perhaps beyond to your PhD.

Our research is focused on themes related to metabolic and cardiovascular sciences, muscle biology, sensory and systems neuroscience, stem cells, and developmental biology and Learning and Teaching. Take your time and look at the different projects on offer. Identify projects that appeal to you and contact potential supervisors for more information and visit their laboratories. Ask lab heads, staff and students about the projects and your potential career options with the new qualification. Be assured, supervisors are very interested in talking to you and you should be confident in making that approach.

The Department of Anatomy and Physiology offers many exciting research opportunities and we welcome the chance to discuss these with you.

Professor Stuart Mazzone
Interim Head of Department





How to apply

Honours

What is Honours?

Honours is a fourth-year undergraduate course that consists of a combination of a research project and coursework subjects. The course is designed to develop the student's capacity to solve problems, to analyse data, to read and think critically, and to communicate clearly.

- Honours can give you a taste of what working as a scientist would be like as a career, allows you to demonstrate academic excellence in an area of special interest to you, and provides an entry point for further research higher degree study (i.e. PhD). These skills are highly sought after by employers in biological, medical and industrial areas.

What are the entry requirements?

To be considered for entry, applicants must have completed a suitable undergraduate degree (Bachelor of Biomedicine, Bachelor of Science or equivalent) with a major in a relevant discipline with a WAM (weighted average mark) of at least H3 (65%) or equivalent. Students who have completed or are due to complete a Bachelor of Biomedicine at the University of Melbourne should apply to complete Biomedicine Honours. Students who have completed or are due to complete a Bachelor of Science at the University of Melbourne or an equivalent course at another institution should apply to complete Science Honours.

Meeting the minimum Faculty level is not a guarantee of admission and students must be accepted by a supervisor before entry into the course.

How long is Honours?

Honours is a one-year course consisting of 75 points of research and 25 points of coursework, that commences mid-February and finish in November

How to apply

Step 1: Contact Potential Supervisor(s)

Decide which departments, institutes, supervisors and projects you wish to apply for and make contact with the relevant supervisor.

Applicants must contact potential supervisors either before or soon after submitting an online application for entry to an MDHS Honours course. Department and Institute Honours project booklets and websites, the individual information sessions held by departments and institutes are ways of helping you to make contact with potential Honours supervisors.

Step 2: Online Application

Lodge an online application

1. Apply online and select either the Returning Applicants, Current Students and Previous Students or First Time Applicants. Do not select the First Time Applicants option if you have previously completed study or applied to any program at the University of Melbourne.
2. Select 'MDHS Specialisations' as requirement response in the online application form.
3. Provide original or certified transcript(s) for any study not undertaken at the University of Melbourne. You are not required to provide transcripts for study undertaken at this university.

Step 3: Project Preference

Once you have submitted an online course application, you will receive an email within 3 working days with your personal login details to access the Honours Project Preference System - SONIA. Please follow the instruction in the email to set up your password and select your preferences for projects offered within MDHS departments. You may select up to 4 project preferences in Round 1 or 3 project preferences in Round 2, 3 and mid year. You must only preference projects after making contact with the relevant supervisor(s). You are allowed to log into Sonia to change your preferences any time by the closing date.

More information including application dates and online application link: mdhs-study.unimelb.edu.au/degrees/honours/apply-now

Master of Biomedical Science

What is the Master of Biomedical Science?

- The Master of Biomedical Science at the University of Melbourne is a coursework master's degree incorporating a substantial research project. This course is an alternative to the Honours as a PhD pathway. Students undertake a major research project and discipline-specific coursework subjects. In addition, a suite of professional business and communication subjects are offered to complement and enhance the research undertaken and to progress students' career opportunities.

The course encourages students to think innovatively and provides an awareness of the health and economic benefits of biomedical research. Graduates of this course gain an understanding of the research process, specialist knowledge and professional skills that are attractive to employers.

What are the entry requirements?

To be considered for entry, applicants must have completed a suitable undergraduate degree with a major in a relevant discipline with a WAM (weighted average mark) of at least H3 (65%) or equivalent. Meeting this requirement does not guarantee selection.

Note

- Quotas may be applied to the degree as a whole, or to individual disciplines, and preference may be given to applicants with evidence of appropriate preparation or potential to undertake research.
- Entry is subject to the capacity of a participating department to provide adequate supervision in a research project appropriate to the interests and preparation of the individual student and is subject to the agreement of an academic staff member to supervise the project.
- Students entering this course are expected to organise an academic supervisor in the relevant academic unit, and select a research project, as part of the application process. You will be provided with a list of current projects once your application has been assessed and deemed eligible. The theme and scope of the research project is negotiated between the student and supervisor prior to commencement of the course.

How long is the Master of Biomedical Science?

The Master of Biomedical Science is a two year (full time) course consisting of 125 points of research and 75 points of coursework. The course can be commenced at the start of the year or at mid year.

How to apply

- Apply online and select either Current Students and Previous Students or First Time Applicants. Do not select the First Time Applicants option if you have previously completed study or applied to any program at the University of Melbourne.
- Provide original or certified transcript(s) for any study not undertaken at the University of Melbourne.

Selecting a Project

Once you have submitted an online course application, you will receive an email with your personal login details to access the Master of Biomedical Science Project Preference System - SONIA. Please follow the instruction in the email to set up your password and review projects offered within MDHS departments. You must make direct contact with the supervisor and obtain permission to work on their project before submitting your project preference. Once your project has been endorsed, you will be allocated to this project in SONIA.

More information including application dates and online application link: study.unimelb.edu.au/find/courses/graduate/master-of-biomedical-science/how-to-apply/

Difference between Honours and the Master of Biomedical Science

	Honours	Master
Duration	1 year (full time)	2 years (full time), part time available
Level	Undergraduate	Graduate
CSP (commonwealth supported places) available?	Yes	Limited
PhD Scholarship scoring	Considers marks from 3rd year of Bachelor's degree and Honours marks	Only Masters marks are considered
International Market recognition	Australian Honours degrees may not be recognised overseas, as many countries do not have an equivalent degree.	Recognised as a graduate master's degree

How to apply

Research Higher Degrees

What is a PhD?

- A PhD (Doctor of Philosophy) is a 3-year supervised research degree with the possibility of up to 12 months extension. A candidate may be required to supplement their research with enrolment in additional subjects if considered necessary. The research is written up as a thesis (80,000 – 100,000 words) and examined by external experts in the field.

What is a MPhil?

A MPhil (Master of Philosophy) is similar to a PhD but carried out over a shorter period of time of 18 months to 2 years. The research work is written up as a thesis (30,000 – 40,000 words) which demonstrates your knowledge and contribution to the field of research.

What are the entry requirements?

To be considered for entry into a PhD, applicants must have completed

- a four-year bachelor degree (BSc Hons, BBiomed Hons) in a relevant discipline which includes a substantial research component equivalent to at least 25% of one year full time study and achieved a minimum WAM of 80% (the University of Melbourne) or equivalent; or
- a masters degree in a relevant discipline which includes a substantial research component equivalent to at least 25% of one year of full time study and achieved a minimum weighted average of 80% or (the University of Melbourne) equivalent.

To be considered for entry into a MPhil, applicants must have completed

- a four-year bachelor degree (BSc Hons, BBiomed Hons) in a relevant discipline which includes a substantial research component equivalent to at least 25% of one year full time study and achieved a minimum WAM of 75% or higher; or
- a masters degree in a relevant discipline which includes a substantial research component equivalent to at least 25% of one year of full-time study and achieved a minimum weighted average of (University of Melbourne) 75% or higher.

Choosing a supervisor and research area

A critical element of success is choosing a research area that interests you. Departmental websites have information on the range of research areas on offer, as well as areas of interest of academic staff members who can supervise your project.

It is very important for you to talk to supervisors as well as current or previous students. It is one thing to be interested in the project but you need to get along with your supervisor too. If possible, try to get some work experience in the lab to get an idea about the environment.

For future information regarding Research Higher Degrees:

<https://study.unimelb.edu.au/find/courses/graduate/doctor-of-philosophy-medicine-dentistry-and-health-sciences/>

<https://study.unimelb.edu.au/find/courses/graduate/master-of-philosophy-mdhs-biomedical-science/>

<https://biomedicalsciences.unimelb.edu.au/departments/anatomy-and-physiology>

How to apply

- Review the list of prospective projects and supervisors in this handbook or online at <https://biomedicalsciences.unimelb.edu.au/departments/anatomy-and-physiology>
- Identify projects of interest and contact the project supervisor to explain your research interests and provide your curriculum vitae (CV) and academic transcripts.
- Once you have confirmed a project and supervisor apply online at <https://study.unimelb.edu.au/how-to-apply/graduate-research>

Scholarship

Honours

Honours applicants who accept and enrol in an Honours course will automatically be considered for available Honours Scholarships. These are awarded on academic merit.

Highly ranked full-time students who have enrolled in an MDHS program through the Bachelor of Biomedicine (Degree with Honours) and the Bachelor of Science (Degree with Honours) and demonstrated a level of financial needs will automatically be considered for a Frances Elizabeth Thomson Trust Scholarship. The Scholarship will award eligible students with a one- off payment of \$5,000. mdhs.unimelb.edu.au/study/scholarships/n/frances-elizabeth-thomson

Honours & Masters

If you a third-year student currently enrolled in Bachelor of Biomedical Science or Bachelor of Science and are considering enrolling to do Honours or Masters within the Department of Anatomy and Physiology in 2026 you can apply for a Summer Research Studentship or Vacation Scholarship to work on a supervised research project. The studentship provides a small living allowance to enable you to work on a laboratory-based project for a period of 4 or more weeks over the summer break. The purpose of the Summer Research Studentships and Vacation Scholarships is to provide an opportunity for undergraduates to gain first-hand experience in research.

Over the summer break, up to four Studentships and Vacation Scholarships may be available to the best qualified candidates.

You will need to discuss a project with a potential supervisor before applying. Most supervisors listed in this booklet will be happy to discuss summer projects with you.

For application forms and information, Please check out the following pages for further information:

mdhs.unimelb.edu.au/study/scholarships/n/vacation-scholarship

mdhs.unimelb.edu.au/study/scholarships/n/r.d.-wright-prize-and-scholarship

or Biomedical Science Academic Services (biomedsci-academicservices@unimelb.edu.au) for further information.

Graduate degrees

The Melbourne Scholarships Program is one of the most generous and comprehensive in Australia, with a wide range of scholarships available for domestic and international students. There are many different types of scholarships available, with some varying in value, duration and eligibility. Most University of Melbourne graduate students have scholarships to aid with living expenses and course fees. Some scholarships also assist with relocation fees and insurance costs whilst studying at the University of Melbourne.

Graduate Research Scholarships for domestic and international students are awarded on a competitive basis. If successful, students must also meet the entry requirements for a Doctoral degree at the University of Melbourne. More details on the different types of scholarships available, what they cover and eligibility can be found here: scholarships.unimelb.edu.au/awards/graduate-research-scholarships.

Contact information

Honours Coordinators

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Masters Coordinators



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A/Prof. Ben Parker
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Graduate Research Coordinator



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Metabolic and Cardiovascular Sciences





Dodd Group

Contact: A/Prof. Garron Dodd

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Location: Department of Anatomy and Physiology

Our lab investigates how the brain regulates metabolism and how this is disrupted in obesity and type-2 diabetes. Using cutting-edge tools, we identify new drug targets. We seek motivated, curious students eager to explore neuroscience, metabolism, and translational research in a collaborative, high-impact environment.

Rewiring the Brain to Reverse Obesity and Diabetes

Type-2 diabetes affects over 9% of people worldwide. Normally, insulin tells the brain to stop eating, but in diabetes, brain cells get surrounded by a barrier that blocks this signal. You'll use CRISPR, brain surgery, and tissue clearing to uncover how this happens. We're seeking curious, driven students eager to gain cutting-edge skills and launch careers at the forefront of neuroscience and metabolic disease research.

Primary Supervisor:

A/Prof. Garron Dodd

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Co-Supervisor

Ms Cait Beddows

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Project Availability:

- PhD
- Master of Biomedical Science

How Exercise Rewires the Brain to Treat Metabolic Disease

Obesity is a growing global health crisis linked to resistance to key hormones like leptin and insulin in the brain. Exercise can restore this hormone sensitivity, but how remains unclear. In this project, you'll use cutting-edge technologies to uncover how exercise regulates the brain - paving the way for new obesity treatments. We're seeking curious, driven students eager to gain cutting-edge skills and launch careers at the forefront of neuroscience and metabolic disease research.

Primary Supervisor:

A/Prof. Garron Dodd

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Co-Supervisor

Ms Cait Beddows

c.beddows@unimelb.edu.au

Project Availability:

- PhD
- Master of Biomedical Science



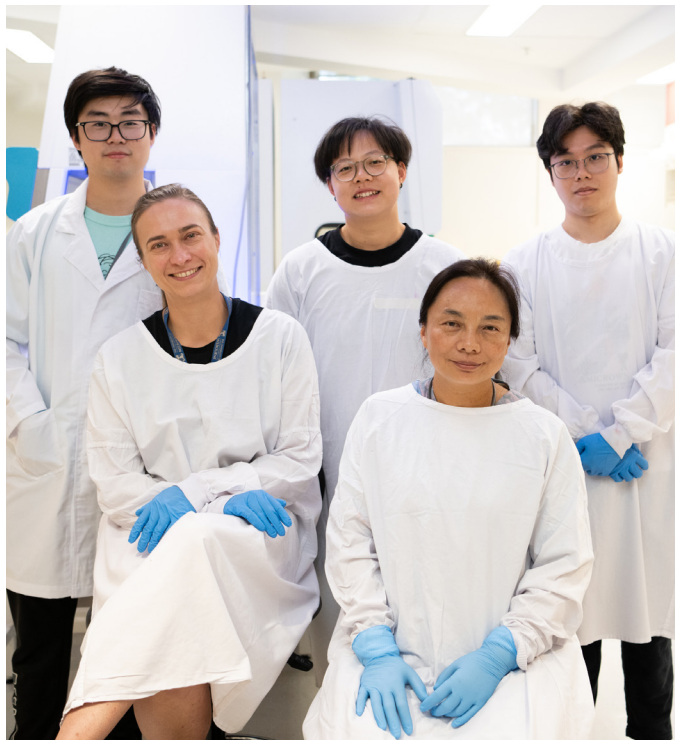
Montgomery Group

Contact: Dr Magda Montgomery
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Location: Department of Anatomy and Physiology

Metabolic dysfunction-associated steatotic liver disease (MASLD), until recently referred to as NAFLD, is the most common chronic liver condition in developed countries, with a global prevalence of >30%. The later stages of MASLD show marked fibrosis, which is associated with the development of life-threatening diseases, including cirrhosis and liver cancer.

Despite this increasing clinical epidemic, the first pharmacotherapy for the treatment of MASLD and liver fibrosis has only been provisionally approved by the FDA in 2024, and novel approaches and ideas are instrumental. That's where we come in!

In addition, there is a close bidirectional relationship between MASLD and insulin resistance/type 2 diabetes, and our lab is additionally interested in understanding the inter-connect between hepatic lipid and glucose metabolism, and blood glucose control.



The identification of novel regulators of lipid metabolism in the liver - potential therapeutic targets for metabolic liver disease and liver cancer?

Metabolic dysfunction-associated steatohepatitis (MASH), previously denoted as non-alcoholic steatohepatitis, is characterized by lipid accumulation, inflammation and frequently fibrosis, and is associated with the development of liver cancer. Hepatocellular carcinoma (HCC) is the second most frequent cause of cancer-related death worldwide with a low 5-year survival rate of only 18%, highlighting the need for novel therapies for both MASH and HCC.

Our team has performed the worlds' first genome-wide CRISPR screen targeting 19,050 genes in liver cells combined with functional assessment of lipid accumulation and sensitivity to cancer therapy. This screen identified 100's of novel regulators of lipid metabolism and cancer growth highly relevant for therapeutic targeting.

This project will focus on uncovering the function and therapeutic potential for some of these novel regulators which will pave the way to understanding if targeting those proteins could be beneficial for MASH and HCC.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science



Parker Group

Contact: A/Prof. Ben Parker

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Location: Department of Anatomy and Physiology

The Metabolic Proteomics and Signal Transduction Group is focused on understanding how signal transduction regulates metabolism with the goal of identifying new therapeutic targets to treat disease. We are particularly interested in studying dynamic changes in proteins and their post-translational modifications, and understanding how these are regulated by genetic variants and metabolic insults to ultimately shape cellular physiology. We primarily focus on metabolic tissues such as the heart, liver and adipose with a strong emphasis on muscle.

Developing spatial proteomics methods to treat cardiometabolic disease

Cells are constantly talking to each other and this communication is defective in nearly every human disease. Spatial-'omics technologies have revolutionized our understanding of how cells in precise locations of a tissue are dysregulated in disease. Single cell and spatial proteomics is the new frontier in this technology and offers distinct advantages to understand cell communication. This project will develop new spatial proteomics methods to understand how proteins in precise locations within specific cells are disrupted in cardiometabolic diseases such as obesity, insulin resistance and type-2 diabetes. Identified proteins will be genetically manipulated using CRISPR/Cas9 followed by physiological assessment of a range of in vivo phenotypes such as metabolic assessment, muscle/heart function, exercise tolerance amongst several others. The outcomes of this project will lead to pre-clinical evaluation of therapeutic targets to treat cardiometabolic disease.

Primary Supervisor:

A/Prof. Benjamin Parker

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Modulating skeletal muscle signal transduction to treat diabetes

Insulin resistance (or pre-diabetes) is the fastest growing disease in the world and it's estimated >2 million Australians are at risk of developing type-2 diabetes. We urgently need new therapeutic treatments to use in conjunction with diet/exercise to treat these diseases. Insulin resistance is characterised by a major defect in the ability of insulin to promote glucose uptake into skeletal muscle. This results in hyperglycemia and several other diabetic complications. We have identified a series of lead candidates that promote insulin sensitivity and glucose uptake into skeletal muscle. These lead candidates include several kinases and phosphatases that regulate phosphorylation-based signaling pathways. This project will perform ex vivo functional screening in a series of pre-clinical models to understand how signaling pathways regulate glucose uptake and metabolism. The project will involve a variety of techniques including isotopic tracing of metabolism, phosphoproteomics and biochemistry.

Primary Supervisor:

A/Prof. Benjamin Parker

ben.parker@unimelb.edu.au

Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Delbridge & Weeks Group

Contact: Dr Kate Weeks

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Location: Department of Anatomy and Physiology

The Cardiac Phenomics Lab, along with the Cardiac Signalling & Metabolism Group, seeks to understand how the heart response to stress can be managed to minimize the damaging impacts of a variety of disease conditions. We investigate responses of the working 'pumping' heart, of specialized muscle tissues and cells from different regions of the heart, and of molecular signalling processes. As our name suggests, we look at how the cardiac 'genome' (the genetically defined heart) is translated in different stressor situations to create the 'phenome' (the structurally and functionally defined heart).

One of our focus areas is to explore the molecular signalling events involved in various heart failure types. Our pre-clinical work focuses on cardiac pathology arising from Type 1 and Type 2 diabetes and on the factors which determine how female and male hearts respond differently to stress and disease challenges. These areas of heart health are of critical significance in shaping the demographics of cardiovascular disease. We use experimental models to mimic human disease conditions, and we look for links between the performance of single muscle cells and the functioning heart.

Our goals are to inform the development of new treatments for diabetic cardiomyopathy and heart failure and to understand how for women and men, cardiac 'difference' may be managed with optimized therapeutic tools. Student projects could incorporate a range of methodologies including animal dietary and pharmacologic treatments, instrumented working heart preparations, immunohistochemistry, cell culture and adenoviral expression manipulation, cell kinetic imaging, biochemical assays, confocal microscopy, big data "omics" (e.g. transcriptomics, proteomics, phosphoproteomics), real-time PCR, and Western blot techniques. Projects are particularly suitable for MSc students, as there is scope for progression to publication within the degree time frame and research work is supported by complementary skills development coursework. As part of the Cardiac Research Consortium (Australia and New Zealand), our projects involve multiple campus opportunities in Melbourne (LaTrobe University, Baker Heart & Diabetes Institute) and New Zealand (University of Auckland). There are also the prospects of Study-away opportunities with international collaborators (USA, Canada, Europe & UK).

New therapeutic leads in heart failure - developing protein phosphatase directed treatments

Heart failure is a debilitating condition in which the ability of the heart to meet the body's demands for oxygenated blood is compromised. Prognosis is poor, with approximately 50 per cent of patients with heart failure dying within 5 years of diagnosis. There is a clear need for new therapeutic strategies for the treatment of heart failure. Much of the research focus to date has been on the 'kinase' superfamily of enzymes – which are cardiometabolic 'on' switches. This project will explore the role of a family of proteins known as 'protein phosphatases' which provide the physiological 'off' switch to oppose kinase action. In this project the particular role of selected phosphatase treatments will be explored. The goals are to examine how phosphatases can be protective in suppressing the development of heart failure, and whether phosphatases can be selectively targeted to delay progression of heart failure. This project will involve work with new 'gene-editing' technology developing experimental models of disease and also involves work with clinical biopsy samples. Students have the opportunity to experience research in the University academic setting in Parkville and also to interact with collaborators at the Baker Heart & Diabetes Institute.

Primary Supervisor:

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Co-Supervisor:

Prof. Lea Delbridge

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Project Availability:

- PhD
- Master of Biomedical Science

Developing novel biomarkers for diabetic heart failure

Impaired diastolic relaxation is an early sign of diabetic cardiomyopathy and involves increased heart wall stiffness and abnormal filling during the diastolic period of the cardiac cycle. The early occurrence of diastolic dysfunction in otherwise 'healthy' asymptomatic diabetic patients has been extensively reported, and is prognostic of later occurrence of heart failure and increased mortality. In the diabetic heart, irreversible modifications of certain cardiac proteins is correlated with impaired heart relaxation. Our data demonstrate that these protein modifications may contribute to impaired cardiac relaxation, indicating that small changes in protein structure can have large implications for diastolic function in diabetes. Specific characterisation of these key protein modifications offers the opportunity for biomarker development for use in the early detection of subclinical diabetic cardiomyopathy and monitoring of therapies. This project will involve work with experimental models of disease and custom designed cell systems. . Opportunities for study away to pursue project research in New Zealand (in Dr Mellor's Laboratory) are also available. This work also involves extensive collaboration with our Los Angeles partners at Cedars Sinai Medical Center.

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Project Availability:

- PhD
- Master of Biomedical Science

Understanding glycogen dysregulation in diabetic heart failure

Globally, diabetes is an epidemic disease with a specific cardiopathology independent of associated cardiovascular risk profiles. Diabetic hearts are more vulnerable to developing failure, especially after a myocardial infarct. Our work focuses on understanding the metabolic and structural changes leading to both diastolic and systolic dysfunction, examining how circulating glucose and insulin impacts on cardiopathology and identifying potential molecular targets for intervention. This project will utilise experimental models of type 1 and type 2 diabetes to investigate the molecular and structural adaptations in the diabetic heart. We use cutting edge gene delivery and gene editing tools to create boutique experimental models of disease. Opportunities for study away to pursue project research in New Zealand (in Dr Mellor's Laboratory) are also available.

Primary Supervisor:

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Co-Supervisor:

Dr Kate Weeks
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Dr Kim Mellor
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Project Availability:

- PhD
- Master of Biomedical Science

Investigating sex differences in heart failure

Heart failure with preserved ejection fraction (HFpEF) accounts for more than 50% of heart failure patients and is particularly prevalent in women. An understanding of the cellular mechanisms underlying HFpEF is limited with no clinical treatments identified. In particular, gender-specific aspects of HFpEF etiology have not been well characterised. We have recently published new findings which reveal the cardiac muscle cell basis for increased cardiac 'stiffness' observed in heart failure. The goal of this project is to explore these new molecular leads, comparing female and male disease states, using Crispr-Cas9 'gene editing' to create animal models. This project involves training and use of cutting edge proteomics analysis approaches to apply big-data investigations searching for disease-causing candidate proteins linked with full-scale disease characterization involving cardiac echo imaging and single cell functional studies.

Primary Supervisor:

Prof. Lea Delbridge

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Co-Supervisor:

Dr Kate Weeks

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Project Availability:

- PhD
- Master of Biomedical Science





Hossain Group

Contact: Prof. Akhter Hossain

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Location: Florey Institute of Neuroscience and Mental Health

Peptidomimetics are therapeutic compounds designed to replicate the function of natural hormones and growth factors. These agents offer a unique blend of benefits—combining the bioavailability and stability typical of small molecules with the high specificity and safety profile associated with larger biologic therapies. Our team has pioneered and patented innovative approaches for designing peptidomimetic drugs that target G Protein-Coupled Receptors (GPCRs), which represent the most expansive category of druggable proteins. To achieve this, we draw on a broad suite of advanced technologies, integrating modern solid-phase peptide synthesis, cutting-edge cellular signalling assays, and in vivo physiological models. This multidisciplinary strategy enables us to explore a wide array of GPCR targets with therapeutic potential across cardiovascular diseases (including fibrotic conditions), metabolic and neurological disorders, and gastrointestinal dysfunctions.

Targeting RXFP4 for treating colon motility disorders

INSL5 (Insulin-like peptide 5) and its receptor RXFP4 (Relaxin Family Peptide Receptor 4) are key regulators of colonic motility and have been increasingly implicated in the pathophysiology of constipation. INSL5 is primarily produced by enteroendocrine L-cells in the distal colon, where it acts on RXFP4-expressing neurons within the enteric nervous system to modulate colonic propulsion. We aim to therapeutically target RXFP4 through the development of INSL5-based drugs, including both agonists and antagonists, to treat disorders of gut motility such as constipation and diarrhoea. To achieve this, we will employ advanced solid-phase peptide synthesis, state-of-the-art cellular signalling assays, molecular pharmacology techniques, and in vivo physiological models.

Primary Supervisor:

Prof. Akhter Hossain

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Co-Supervisor:

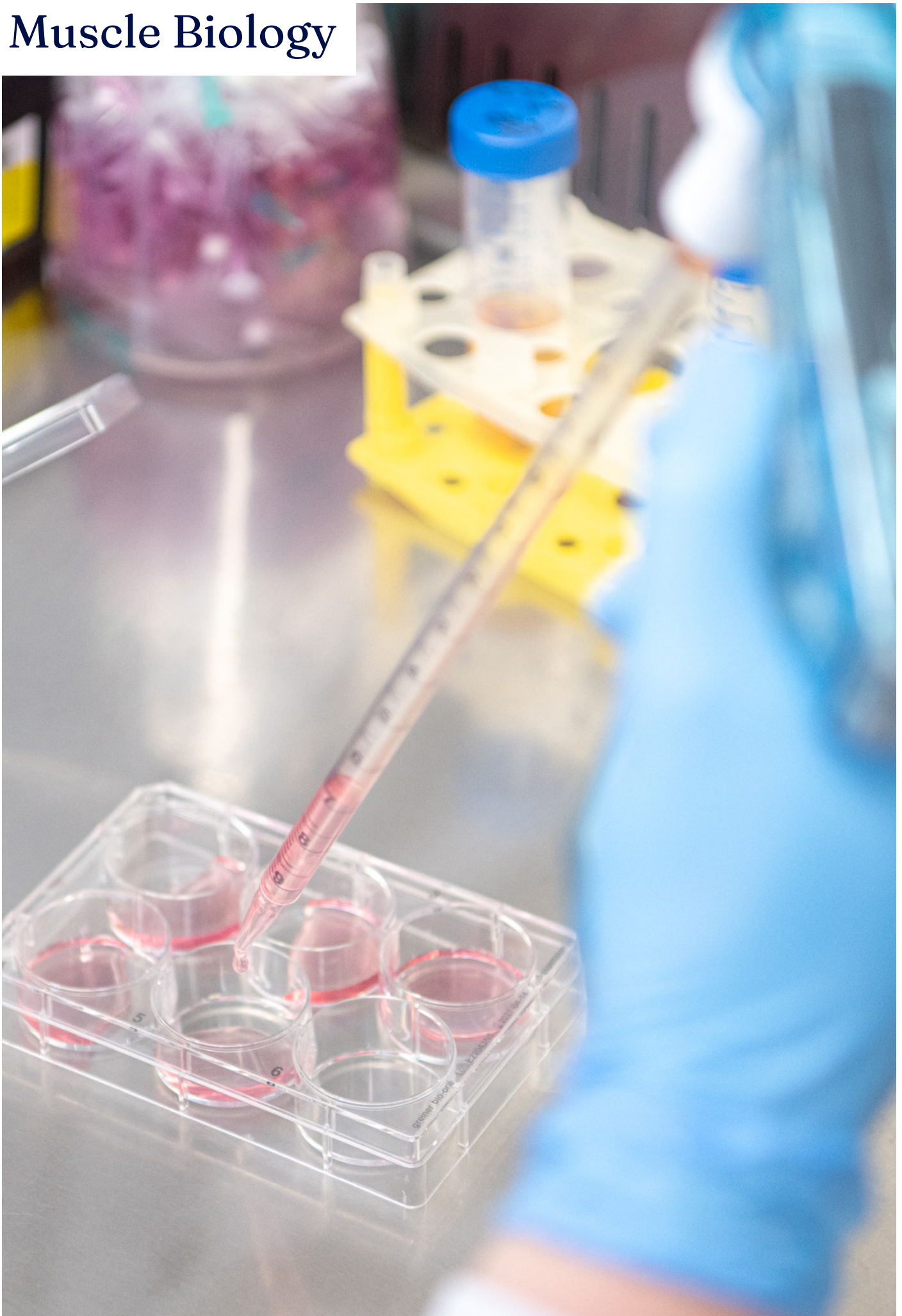
Prof. Ross Bathgate

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Muscle Biology





Ackland group

Contact: Prof. David Ackland

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Location: Department of Biomedical Engineering

Applied anatomy, orthopaedic surgery

Superior capsular repair in the unstable shoulder

In the unstable shoulder, lack of compression of the head of the humerus in the glenoid fossa can result in the humerus translating superiorly and impacting the inferior surface of the acromion. This painful and debilitating condition is frequently associated with rotator cuff tears. This project will explore in a cadaver model a new surgical technique for repairing the superior capsule of the glenohumeral joint to restore stability in the unstable shoulder.

Primary Supervisor:

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Co-Supervisor:

Prof. Minoo Patel

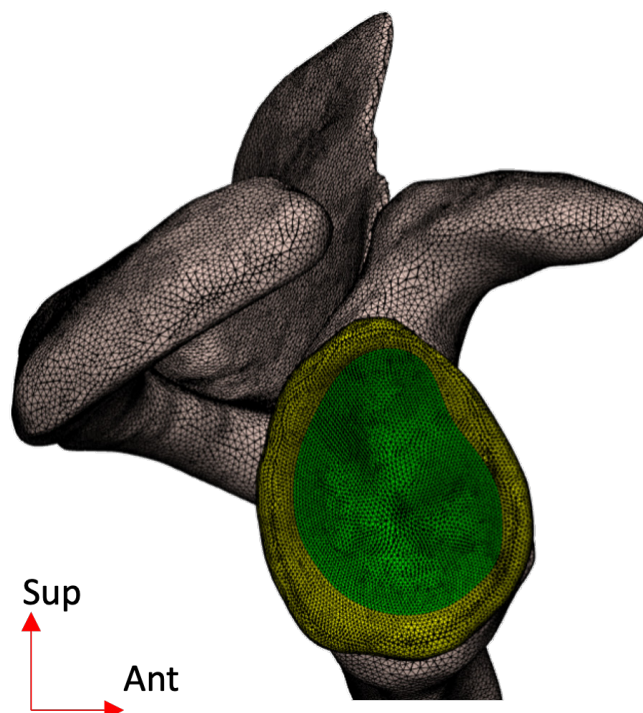
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Dr Kate Hatzopoulos

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Project Availability:

- Honours





Gregorevic Group

Contact: Prof. Paul Gregorevic
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Location: Department of Anatomy and Physiology

Skeletal muscle powers movement, breathing, and hormonal signaling, making it vital for life. It's impacted by ageing, cancer, injury, and disease. At the Centre for Muscle Research, we study muscle biology, growth, and repair using advanced tools to develop new treatments, offering rich training opportunities for future biomedical researchers.

Learning from skeletal muscle to treat cancer

Cancer patients may suffer from cachexia—a syndrome marked by severe loss of muscle and fat—as well as from metastasis. This research theme investigates mechanisms driving cachexia and explores why skeletal muscle is rarely colonised by metastatic cancers. Understanding this resistance may reveal novel strategies for preventing and treating cancer progression and associated complications in patients with advanced disease.

Primary Supervisor:

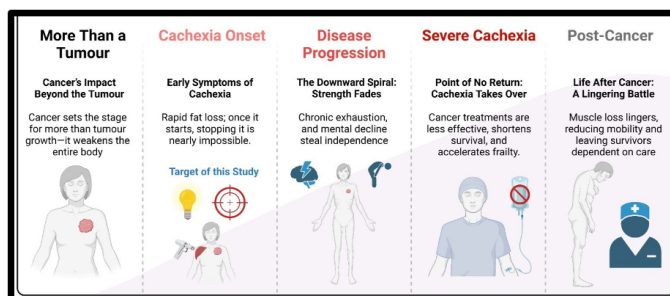
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Co-Supervisor:

Dr Rachel Thomson
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Developing innovative animal and human cell models to study and treat muscular dystrophies

Many neuromuscular disorders lack effective therapies due to limited models for studying disease mechanisms. This program uses gene- and cell-based approaches to develop new in vitro and in vivo models. These will help uncover disease mechanisms and support the development of much-needed therapeutic strategies for neuromuscular conditions.

Primary Supervisor:

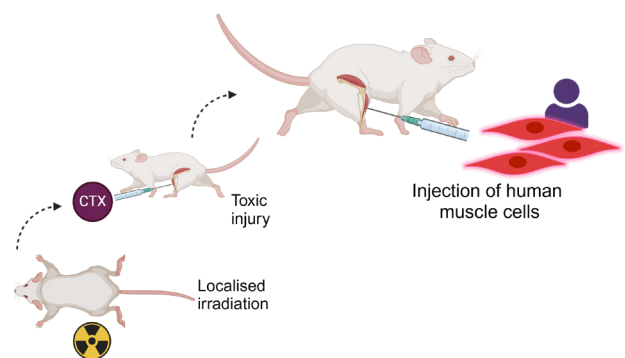
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Co-Supervisor:

Dr Craig Goodman
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Exploring new roles for the TGF β signalling network as a cause of skeletal muscle disorders, and a target for new muscle therapeutics.

The TGF β signalling network regulates skeletal muscle development, adaptation, and repair. This research explores how TGF β is controlled in muscle during health and disease, and how it influences muscle traits. Using gene delivery, cell culture, animal models, and molecular analyses, we aim to discover new strategies to prevent or treat muscle loss.

Primary Supervisor:

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Co-Supervisor:

Dr Craig Goodman
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Unravelling the mysteries of ubiquitin biology as a regulator of skeletal muscle in health and disease.

Muscle size and function are vital for health, metabolism, performance, and aging. E3 ubiquitin ligases and De-Ubiquitinases regulate cell homeostasis, but their roles in muscle are unclear. This research investigates which of these genes influence muscle health and disease, aiming to understand their function and develop therapeutic strategies.

Primary Supervisor:

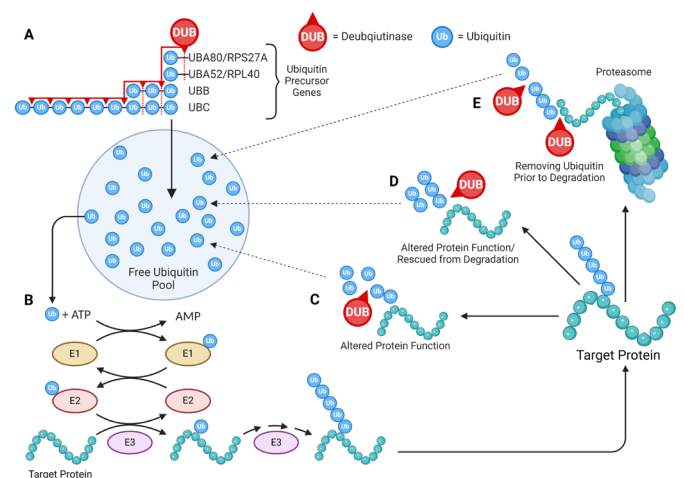
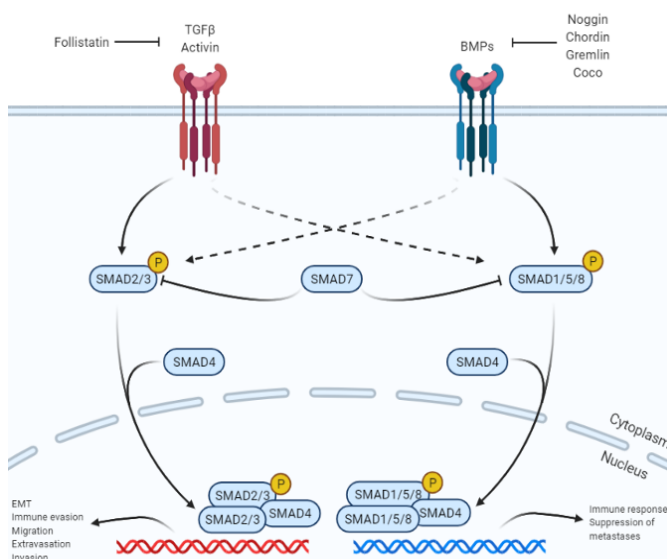
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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours





Ruparelia Group

Contact: Dr Avnika Ruparelia
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Location: Department of Anatomy and Physiology

The Ruparelia lab is investigating the fundamental biology of muscle wasting disorders such as sarcopenia, which is the age-related decline in muscle mass and function, and genetic conditions such as Duchenne muscular dystrophy - examining processes such as muscle fiber atrophy and growth, muscle stem cell dynamics, muscle regeneration, and metabolism. We not only use the unique advantages of the zebrafish model, but also uses a new experimental system – that of the African killifish, whose extremely short lifespan makes it an attractive model for ageing research.

Identifying therapies for muscular dystrophies using zebrafish

Muscular dystrophies have one of the highest burdens of disease, and yet, there is currently no cure for this devastating group of muscle wasting disorders. Therefore, using the advantages of the zebrafish model system combined with genetic approaches, confocal microscopy, immunofluorescence techniques and live imaging, we aim to identify novel disease mechanisms and therapeutic strategies for the treatment of muscular dystrophy.

Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Interrogating the extremes of skeletal muscle plasticity in zebrafish

Muscle fibres differ in their metabolic proteins with slow, oxidative fibres typically small in size with high oxidative capacity, whereas fast, glycolytic fibres are usually larger in size with a low oxidative capacity. While we have shown that muscle is capable of transitioning between these phenotypes the mechanisms regulating these adaptive responses remain unresolved. Here, we will utilise genetic tools to alter fibre size and oxidative capacity and examine its implications on disease.

Primary Supervisor:

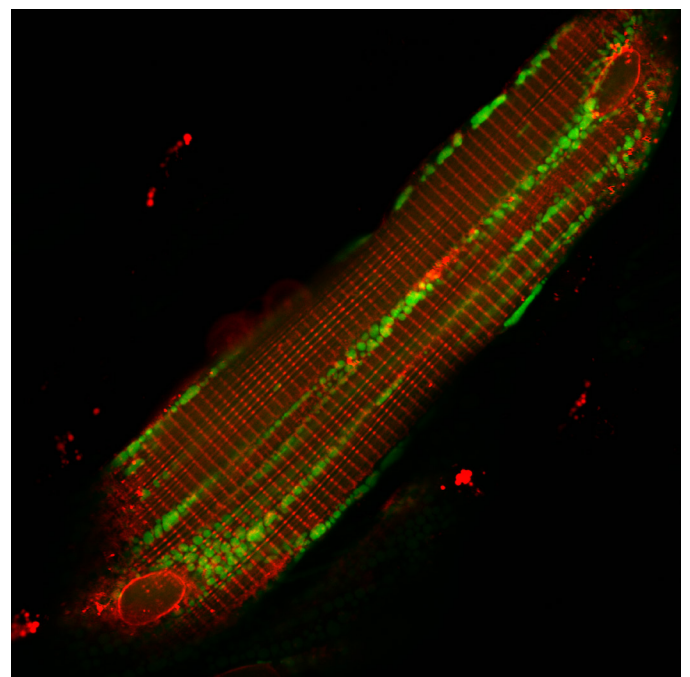
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Co-Supervisor:

Prof. Gordon Lynch
gsl@unimelb.edu.au

Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Characterising muscle ageing in the short lived killifish

Sarcopenia, the age-related decline in muscle mass and function, places a great burden on the health care system. Despite this, very little is known about the molecular pathways that drive this process. To address this, we have developed a new model of ageing - that of the African killifish which has an extremely short lifespan. Here, using cellular, molecular and genetic techniques, we will characterise the muscle of these short-lived vertebrates to determine if they undergo sarcopenia.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours





Lynch Group

Contact: Prof. Gordon Lynch

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Location: Department of Anatomy and Physiology

Skeletal muscle is essential for survival. Not only is muscle the vital organ for movement but the diaphragm muscle sustains life by inflating the lungs for breathing. Skeletal muscle is also an endocrine organ that contracts and releases hormones and factors that communicate with other body tissues to sustain life. Skeletal muscle accounts for half a person's body mass yet we take for granted its crucial role in our health and lifestyle. Many diseases and conditions are linked with changes in muscle structure and function, including: ageing and frailty; cancer; muscle injury, sepsis and other forms of metabolic stress; nerve injury; disuse through inactivity and microgravity; burns; and different forms of muscular dystrophy. These conditions are major health problems globally and contribute to a large burden of disability and suffering. Tackling these muscle-related health conditions requires a coordinated research effort from discovery biology to understand disease mechanisms and translational approaches to take these discoveries from bench to the clinic.

Researchers in the Centre for Muscle Research seek to understand the mechanisms that regulate muscle growth, wasting and metabolism, and to develop new approaches for preventing or treating muscle related conditions, utilising the latest techniques in biology and biomedicine. We also consider skeletal muscle in the context of other diseases, such as heart and cardiovascular diseases, cancer and osteoporosis. We are interested in understanding muscle development and growth, injury and repair, studying the biology and metabolism of muscle stem cells and their commitment to becoming functional muscle fibres. Our researchers design, manufacture and utilise viral vectors to alter gene expression in mouse models of disease and interrogate cellular mechanisms of muscle adaptation, techniques that provide a unique combination of speed, precision and efficacy not achieved through other approaches. The Centre for Muscle Research offers a wonderful training environment for studying muscle biology in health and disease and exceptional career-training opportunities for Honours, Masters and Ph.D. students.

Understanding the plasticity of skeletal muscle in health and disease

Skeletal muscle is comprised of diverse fibre types that differ in size, metabolic and contractile properties; classically referred to as either 'slow, oxidative' or 'fast, glycolytic'. These properties are not fixed but can change in response to imposed demands, a process known as 'plasticity'. Understanding the biological mechanisms regulating fibre phenotype and the adaptive response across muscles of varying phenotypes has not been fully resolved. Addressing these research gaps may also identify potential therapeutic targets to improve quantity and quality of life across many disease conditions. The objectives of this project are to:

1. understand the biological mechanisms regulating fibre size, phenotype and plasticity; and
2. whether modifying skeletal muscle attributes can protect against injury and disease.

This project will utilise genetic, pharmacological and lifestyle approaches to interrogate the molecular, metabolic and contractile properties of fast and slow muscles in a variety of healthy and pathological states; including but not limited to muscular dystrophies, cancer cachexia, muscle injury and repair, and ageing.

Primary Supervisor:

Prof. Gordon Lynch

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Characterising the pathways responsible for ICU-acquired weakness

Muscle wasting is the most common complication of critical illness, occurring in 25-50% of patients. The extent of wasting is determined by the severity of organ failure and lung injury, however, a loss of 20-30% of muscle mass over the first 10 days in ICU is not uncommon. ICU patients generally have increased muscle protein breakdown relative to muscle protein synthesis, leading to a net catabolic state and rapid loss of muscle mass and function. To allow the development of novel and effective treatments to attenuate muscle wasting in ICU patients it is important to identify the signalling pathways and proteins that drive this catabolic state. This project uses animal-based experiments and analyses of muscle biopsies from ICU patients to comprehensively test these mechanisms. Findings from this project will enhance our knowledge about the regulation of skeletal muscle mass during critical illness and will aid in the further development of treatment strategies.

Primary Supervisor:

Prof. Gordon Lynch

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours





Cheng Group

Contact: A/Prof. Louise Cheng
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Location: Peter MacCallum Cancer Centre

We are interested in organ size control and how inter-organ communication mediates crosstalk between organs during development and in cancer.

How do tumor's grow at the expense of other tissues in cancer cachexia

Cancer cells are known to drive altered metabolic circuits to meet the bioenergetic and biosynthetic demands of increased cell growth and proliferation. Under nutrient restriction, when growth of most organs shut down, cancer cells can bypass these brakes imposed on cellular growth, thus gaining a growth advantage under these conditions. Furthermore, during cachexia, which causes more than one third of cancer death, tumour derived factors can also induce the breakdown of fat and skeletal muscles, in order to generate metabolic intermediates necessary for the preferential tumour growth. The signaling between tumors and other tissues is highly complex, and the adaptations that allow cancer cells to preferentially activate growth are largely unknown. The student will work within a existing team to discover some of the mediators of cancer cachexia using *Drosophila* genetics, confocal microscopy, proteomics, metabolomics; the findings will be further validated in human samples.

Primary Supervisor:

A/Prof. Louise Cheng
louise.cheng@petermac.org

Project Availability:

- PhD
- Honours

Non-autonomous regulation of tumour growth

How tumours communicate with tissues to trigger their breakdown is a key unresolved question. We have generated novel genetic tools that allow independent spatial and temporal overexpression or knockdown of genes in multiple tissues simultaneously. Using these tools, this project aims to look at how brain tumours can interact with other tissues.

Primary Supervisor:

A/Prof. Louise Cheng
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Project Availability:

- PhD
- Honours



Parker Group

Contact: A/Prof. Benjamin Parker
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Location: Department of Anatomy and Physiology

The Metabolic Proteomics and Signal Transduction Group is focused on understanding how signal transduction regulates metabolism with the goal of identifying new therapeutic targets to treat disease. We are particularly interested in studying dynamic changes in proteins and their post-translational modifications, and understanding how these are regulated by genetic variants and metabolic insults to ultimately shape cellular physiology. We primarily focus on metabolic tissues such as liver and adipose with a strong emphasis on muscle and bone.

Proteome-wide systems genetics and physiology of muscle function

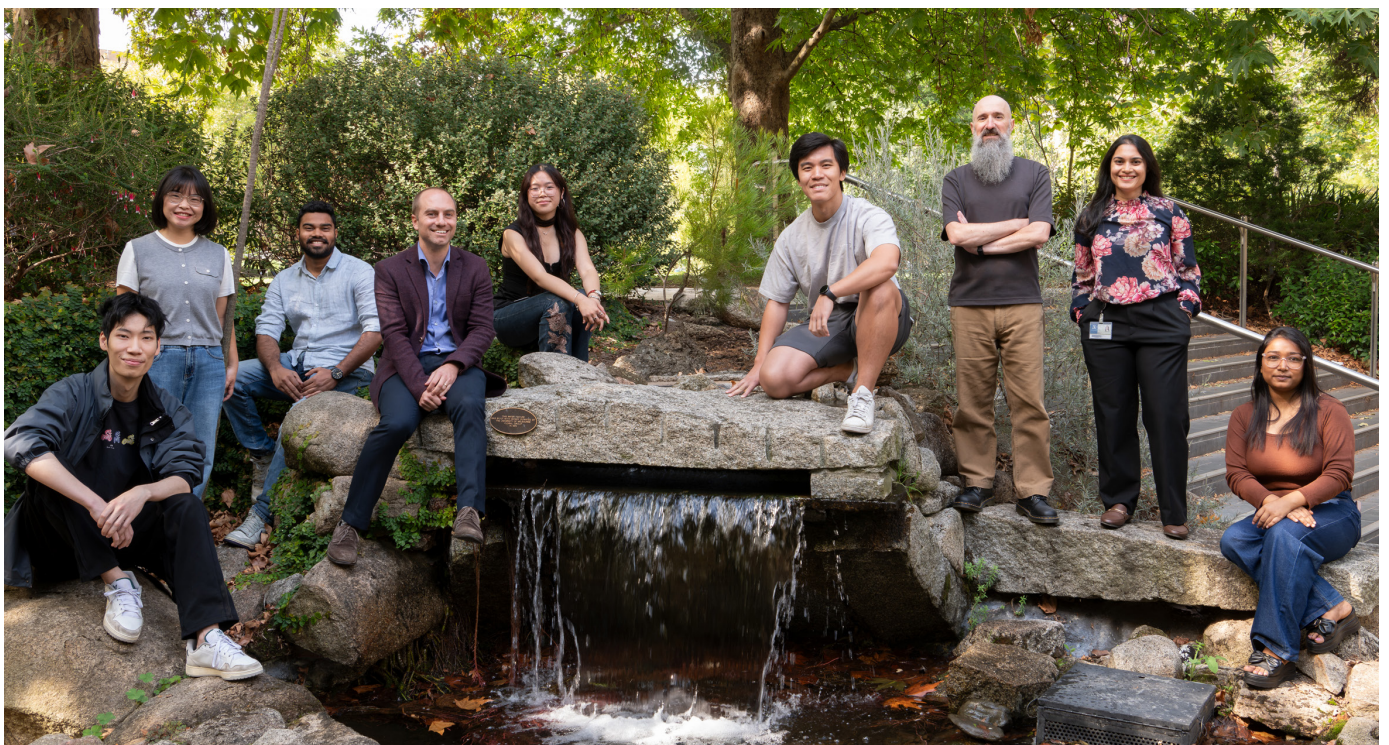
We all possess genetic variants that make us unique. They predispose you to disease or they are protective and make you strong. Identifying these genetic variants is not only the essence of personalised medicine but they can be used as a research tool to identify the function of uncharacterised genes. This study is built on a massive proteomic and genomic dataset that has identified specific genetic variants and novel genes that are correlated with muscle function. This project will use CRISPR/Cas9 to genetically manipulate these genes followed by physiological assessment of cardiac and/or skeletal muscle function combined with biochemistry and molecular analysis. The discovery of novel genes that provide functional protection of muscle is fundamental to the development of novel therapeutic targets.

Primary Supervisor:

A/Prof. Benjamin Parker
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours







Dodd Group

Contact: A/Prof. Garron Dodd

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Location: Department of Anatomy and Physiology

Our lab explores innovative strategies to treat glioblastoma, the most aggressive form of brain cancer. We use cutting-edge tools in molecular biology, neuroimmunology, and drug delivery to uncover new therapeutic targets. We're seeking motivated students eager to advance brain cancer research and drive meaningful clinical impact.

The Next Frontier in Brain Cancer Therapy

Glioblastoma (GBM) is a deadly brain cancer with poor survival and limited treatment options. Our lab discovered a unique extracellular matrix that drives tumour growth, recurrence and blocks drug delivery. In this project, you'll develop new inhibitors in advanced pre-clinical models to break new ground in GBM therapies. We're seeking curious, driven students eager to gain cutting-edge skills and launch careers at the forefront of neuroscience and cancer research.

Primary Supervisor:

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Co-Supervisor

Ms Cait Beddows

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Project Availability:

- PhD
- Master of Biomedical Science



Haidar Group

Contact: Dr Mouna Haidar

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Location: Florey Institute of Neuroscience and Mental Health

Exploring chemogenetic and genetic manipulation of the motor system in motor neuron disease (MND) models to better understand disease onset and progression in MND.

Assessing the therapeutic impact of chemogenetic stimulation of neuropeptide Y cortical interneurons in MND mouse models

The activity of brain motor neurons is modulated by inhibitory neurons or interneurons; whereby reduced interneuron activity is associated with motor neuron overactivity. Indeed, cortical interneurons are lost in MND patients and mouse models. One way to attenuate overactive brain motor neurons is to increase the activity of cortical interneurons. We will use excitatory chemogenetics targeted to a neuropeptide expressing cortical interneuron in MND mouse models and assess the therapeutic impact on (i) cortical activity, (ii) motor symptoms, disease progression and survival, and (iii) neuropathology. This study will establish whether targeting cortical interneurons is a potential therapeutic target for MND.

This project will employ stereotaxic viral surgeries to deliver DREADDs to discrete mouse brain regions, mouse behavioural studies, advanced microscopy and 3D reconstructions, immunohistological and biochemical techniques.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Ivanusic Group

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Location: Department of Anatomy and Physiology

Neurobiology of pain

Pathogenesis of skeletal pain

Skeletal pain is transmitted by two classes of peripheral nociceptors. A δ nociceptors are medium-diameter myelinated neurons that transmit fast, intense pain, of the sort experienced in fracture and breakthrough cancer pain. C nociceptors are small-diameter unmyelinated neurons that encode slow, burning pain, of the sort experienced in cancer and osteoarthritis. A number of different ion channels and receptors are emerging as important modulators of the activity of peripheral bone nociceptors. Identifying these regulators of nerve activity and better understanding their role in generation of bone pain could open up avenues for development of tools to selectively manipulate pain originating from bone. In this project, we will use a variety of techniques and animal models to explore roles for different sensory neuronal subtypes, ion channels and receptors in generating and/or maintaining skeletal pain. We are currently interested in modelling experimental inflammation of the bone marrow, osteoarthritis and bone cancer induced skeletal pain. Students can expect to gain experience in working with one or more animal models of skeletal pathology, an in vivo electrophysiological bone-nerve preparation, neuroanatomical tracing and immunohistochemistry, tissue clearing and light sheet microscopy for 3D visualisation of nerves in bone, small animal handling, anaesthesia, surgery and/or dissection.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Scott Group

Contact: Prof. Ethan Scott

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Location: Department of Anatomy and Physiology

A fundamental challenge to understanding the brain is its complexity: its genetic and developmental programs, its neurons and connections, its balance of permanence and plasticity, and the nuanced information flow through its networks. Across biology, emerging technologies are revolutionising the scope and scale at which we can address such questions. Our group has developed technologies for studying brain-wide sensory networks using calcium imaging and house-built light-sheet microscopes. Because zebrafish larvae are small and transparent, we can image tens of thousands of neurons, simultaneously and individually, as animals perceive and respond to sensory stimuli. We have used this approach to produce the first functional maps, brain-wide at cellular resolution, for auditory, vestibular, and water flow perception in any vertebrate.

Brain-wide networks for perception and learning

While our calcium imaging studies have taught us where and when neurons are active, they have not shown us how or why. In our available projects, we are interested in using a diverse array of methods, including microscope engineering, calcium imaging, optogenetics, mathematical modelling of brain-wide networks, and behavioural analysis to better understand how information flows through the brain during perception, and how changes in information flow encode memories. Applications from people with interest or experience in any of these approaches are welcome to apply.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



McQuade Group

Contact: Dr Rachel McQuade
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Location: Department of Anatomy and Physiology

Our lab is broadly interested in gut physiology and the potential role of impaired gut health on organ function and the subsequent development and progression of disease. We take a holistic approach to gut physiology, with a focus on gut barrier integrity, and the role of enteric neurons, enteroendocrine cells, immune cells and microbiota in the modulation of gut function.

Our projects are multidisciplinary, spanning basic cell biology, pre-clinical models, and human samples with the aim of generating findings that are relevant across experimental systems. Our projects are spread across a variety of conditions/diseases, with current areas of interest in Parkinson's disease, obesity, ageing and chronic systemic inflammation.

Ageing and the Gut: Investigating How the Intestinal Barrier Influences Whole-Body Health

This project investigates how ageing affects the gut barrier and how changes in intestinal structure and function may contribute to whole-body health and longevity. The student will work as part of a multidisciplinary team studying the cellular and molecular changes in the gastrointestinal (GI) tract during ageing using a combination of in vivo and ex vivo models. Techniques may include tissue histology, immunofluorescence, protein analysis, Ussing chambers, and measurements of intestinal permeability. There may also be opportunities to explore how diet influences these changes and to analyse samples from human tissues. This project is ideal for students interested in gut physiology, ageing biology, and translational research.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Targeting the Gut-Brain-Immune Axis in Obesity: Investigating the Role of Enteric Neurons and Gut Barrier Integrity

This project explores how obesity affects gut health, with a particular focus on the enteric nervous system and intestinal barrier integrity. Students will work with preclinical models of diet-induced obesity and assess changes in gut function, barrier permeability, inflammation, and neuronal health. The project may involve techniques such as immunohistochemistry, Ussing chamber electrophysiology, Western blotting, and assays for gut permeability and inflammation. There are also opportunities to examine human gut tissue from obese patients, allowing translational insights into mechanisms of gut dysfunction in obesity. This project is ideal for students interested in gastrointestinal physiology, neuroinflammation, and the development of novel therapeutic strategies for metabolic disease.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Barton Group

Contact: Dr Samantha Barton

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Location: Florey Institute of Neuroscience and Mental Health

Our lab uses human induced pluripotent stem cells (iPSC) to model oligodendrocyte and myelin biology in health and in disease. We use human iPSC to generate organoids which contain myelinated axons, astrocytes and microglia which enable us to ask key questions pertaining to myelin biology. We recently established an organoid system that models key aspects of Multiple Sclerosis that includes demyelination, microglial phagocytosis of myelin and remyelination. We are now using this system to delve into the biology underpinning MS and also for drug screening.

Using human iPSC-derived organoids to model Multiple Sclerosis

Using our human iPSC-derived organoid model of Multiple Sclerosis (MS), we now aim to seed in peripheral immune cells isolated from people living with MS. This will enable us to tease out the cellular and sub cellular drivers of de- and re-myelination by studying the communication between peripheral immune cells (namely monocytes or T cells) and the central immune cells (microglia) already in the organoids.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
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- Honours



Palmer Group

Contact: Prof. Lucy Palmer
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Location: Florey Institute of Neuroscience and Mental Health

The Neural Networks group uses various techniques to record from neurons in vivo including two photon calcium imaging, somatic and dendritic patch-clamp electrophysiology and optogenetics. Using these advanced techniques, we investigate neural function during learning and memory in health and disease.

The neural basis of learning and memory

Our memories define who we are. Whether it's a memory from our childhood or a memory from eating breakfast in the morning, all memories combine to contribute to how we react to everyday life. It is crucial that memories are formed and can be recalled at will. How the brain does this is largely mysterious. The brain consists of billions of individual neurons that are connected to one another forming a complex wiring pattern. An individual neuron receives thousands, sometimes tens of thousands, of inputs from other brain cells. Almost all of these inputs land onto a neuron's complex, tree-like branches, called dendrites. Dendrites then combine these thousands of inputs into action potentials, which is transferred to thousands of other neurons (and the process continues). How neural encoding is modulated during learning and memory is largely unknown, and will be explored here using advanced recording techniques.

Primary Supervisor:

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Co-Supervisor:

Prof. Christopher Reid
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

The influence of brain cancer on neural encoding

Brain cancer is unique amongst cancers in that they arise, and grow, within the electrically active microenvironment of the brain. It is now realised that brain cancer cells are electrically active and receive synaptic input from nearby neurons. This synaptic input has a functional impact and has been shown to promote tumour growth. This project will investigate how brain cancer influences neural function using advanced monitoring techniques including two-photon microscopy and patch clamp electrophysiology.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

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Hannan Group

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Location: Florey Institute of Neuroscience and Mental Health

The Epigenetics and Neural Plasticity Laboratory at the Florey Institute of Neuroscience and Mental Health We explore how genes and the environment combine via experience-dependent plasticity in the healthy and diseased brain. Our research includes models of specific neurological and psychiatric disorders which involve cognitive and affective dysfunction, investigated at behavioural, cellular and molecular levels so as to identify pathogenic mechanisms and novel therapeutic targets. Most recently, this has included studies of intergenerational and transgenerational epigenetic inheritance.

We investigate how genetic and environmental factors combine to cause specific cognitive and affective disorders, including Huntington's disease, dementia, depression, anxiety disorders, schizophrenia and autism spectrum disorders. Our research also links data at behavioural and cognitive levels to underlying cellular and molecular mechanisms. We use a variety of behavioural tools, including automated touchscreen testing of cognition and high-throughput data analysis of vocalization and communication, that are directly translatable to clinical tests. We are establishing the extent to which experience-dependent plasticity can modulate behavioural and cognitive endophenotypes, in models with targeted genome editing. This cellular level of understanding is linked, in turn, to molecular mechanisms, including epigenetics, transcriptomics, proteomics and metabolomics. We are also exploring the concept of 'enviromimetics', therapeutics that mimic or enhance the beneficial effects of cognitive stimulation and physical exercise.

Cognitive, social and psychiatric behavioural traits and their pharmacological treatment in a mouse model of neurofibromatosis type 1

Patients suffering from neurofibromatosis type 1 have a mutation in one allele of the neurofibromin 1 (NF1) gene, leading to a variable clinical presentation which may include the formation of tumours, hyperpigmentation marks, vision disorders and scoliosis. However, patients also typically show a range of neuropsychological symptoms including cognitive impairments and learning difficulties, attention deficits, as well as autism and depression. Despite the profound impact on the lives of patients and their families, these symptom complexes remain inadequately addressed by current treatments.

Nf1 +/- mice used in this project are a widely used model for neurofibromatosis type 1, though the study of cognitive and psychiatric behavioural traits has been limited to date and warrants further investigation.

The initial approach will involve the phenotypic characterisation of this mouse model using a broad battery of state of the art rodent behavioural tests, with the aim of examining specific aspects of cognition and attention, social function, as well as anxiety-like and depression-like behaviour. This will include the use of rodent touchscreen tests, which are directly translatable to human patients. In parallel, biochemical and molecular techniques will be used to investigate the brain mechanisms underlying the behavioural deficits observed in these mice. This will be followed by the application of promising drug candidates in a preclinical study using the Nf1 +/- mouse line, with the aim of progressing successful candidates to a clinical study in the near future with our clinical collaborators in Parkville.

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Investigating molecular mechanisms of viral paternal immune activation on offspring brain and behaviour

Brain disorders such as autism spectrum disorder, schizophrenia, depression, and anxiety contribute significantly to the global burden of disease. However, despite substantial progress in genetic research, much of the heritability of these complex conditions remains unexplained. This gap points to the important role of environmental factors, including paternal and maternal exposures prior to conception, in shaping offspring neurodevelopment and risk of psychiatric illness.

This project addresses a critical question: How do viral infections in fathers affect the germline and, in turn, influence the health and behaviour of their offspring? We propose to investigate the role of viral-like paternal immune activation as a driver of heritable epigenetic changes that impact offspring brain development, behaviour, and physiology. This represents a fundamental shift in how we understand the intergenerational consequences of infection, particularly in light of global public health challenges such as the recent COVID-19 pandemic.

We have developed a mouse model of viral paternal immune activation using the viral mimic Poly I:C, where offspring of exposed fathers show significant behavioural alterations and brain developmental abnormalities. Offspring of immune-activated fathers are evaluated using a comprehensive battery of behavioural assays to assess cognition, affect, and social behaviour. In parallel, we will characterise cellular and molecular phenotypes in the brain and immune system, focusing on known pathways disrupted in neurodevelopmental and psychiatric disorders. Advanced statistical analyses will be integrated with behavioural and physiological readouts to identify potential mechanisms linking paternal infection to offspring phenotype. This research has the potential to uncover a novel dimension of infectious disease impact—one that extends beyond the exposed individual to influence the health of the next generation.

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Project Availability:

- PhD
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- Honours

Targeting gut microbiota to understand and therapeutically modulate pathogenesis in Huntington's disease

Huntington's disease is a neurodegenerative disorder involving complex symptomatology, including cognitive deficits (culminating in dementia), psychiatric symptoms (particularly depression) and motor deficits (including chorea). There are no disease-modifying therapies available for this devastating disease, which progresses over 10-20 years before killing patients. Recent years have witnessed the rise of the study of gut microbiota (the billions of bacteria and other microorganisms living in the gastrointestinal tract) as a major research topic for complex central nervous system disorders. This revolution in biomedical research has revealed that, in addition to the trillion or so cells in each of our bodies, we have over a trillion microbes (mainly bacteria) living in and on our bodies, particularly the gut. We were recently the first to discover dysbiosis (altered gut microbiome profile) in Huntington's disease. This was achieved via DNA sequencing using fecal samples from a transgenic mouse model of Huntington's disease (R6/1 mice). This project aims to study new pharmacological and environmental interventions to delay the onset of Huntington's disease in this transgenic mouse model, via experimental manipulations of gut microbiome composition. We will investigate impacts on the dementia and depression-like behaviours, as well as the movement disorder. This project will use environmental and pharmacological modulation, cognitive and behavioural tasks, as well as cellular and molecular approaches, including genetics, genomics and bioinformatics tools.

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Targeting gut microbiota in an animal model of schizophrenia: new hope for translational therapeutics

Importantly, 60% of schizophrenic patients are treatment-resistant and this subpopulation has the highest levels of impaired functioning and rates of hospitalization. Interestingly, chronic gastroenterological issues such as gut inflammation are common co-morbid symptoms of schizophrenia. The potential role for the microbiome in schizophrenia pathogenesis had been highlighted, which is now established to be dysregulated in schizophrenic patients compared to healthy controls. Thus, the collective evidence indicates a crucial role for the gut microbiome in schizophrenia pathogenesis, but the potential implications for treatment-resistant patients remains to be investigated. This proposal will explore the status of the gut microbiota in a well-studied mouse model of schizophrenia, followed by an exploration of how direct modulation of gut microbiota influences the behavioural response. Our findings will inform the role of gut microbiota dysbiosis in schizophrenia, uncovering new aspects of schizophrenia pathology that could lead to novel therapeutic targets to improve the treatment of the cognitive, psychiatric and social symptoms. More broadly, there could also be implications for improving therapeutic approaches for other psychiatric disorders. This project will use microbial, environmental and pharmacological modulation, cognitive and behavioural tasks, as well as cellular and molecular approaches, including genetics, genomics and bioinformatics tools.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Investigating multigenerational effects of paternal immune activation (PIA) on brain function

Brain disorders account for a significant global burden of disease, yet the “missing heritability” in common brain disorders like autism, schizophrenia, depression, and anxiety suggests the involvement of environmental factors, including paternal exposures before conception. This project aims to explore the impact of paternal pathogenic infections on epigenetic inheritance and offspring phenotypes, as part of a paradigm shift in understanding the intergenerational effects of pathogens on public health.

Recent research has revealed the potential of pathogens to influence paternal germ cell epigenetics and modify offspring phenotypes, highlighting the urgent need to investigate the intergenerational impacts of paternal infection on brain development, behavior, and cognition. This is particularly relevant in the context of the ongoing COVID-19 pandemic.

While maternal immune activation's impact on offspring brain function has been studied, the influence of immune activation in the male germline and subsequent offspring phenotypes remains largely unexplored. We will investigate the mechanisms leading to heritable epigenetic changes in sperm due to paternal immune activation and examine their impact on offspring.

By utilizing mimics of infection and inflammation to induce immune responses in fathers, we will evaluate the infection-mediated immune response as an epigenetic modulator of offspring brain and immune system functioning. Through a combination of behavioral tasks, cellular/molecular approaches, and state-of-the-art epigenetic analyses, we aim to gain a comprehensive understanding of the offspring's endophenotypes and elucidate the modulation of the sperm epigenome and its consequences on offspring physiology, metabolism and behaviour. This research may uncover previously unknown interactions between infectious agents and their hosts, shedding light on the intergenerational effects of paternal infection and informing future public health strategies.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

The role of gene-environment interactions and microglia in the pathogenesis of Alzheimer's disease

Alzheimer's disease is a condition that affects the brain and can cause problems with memory, thinking, and behavior. It's a common disease that affects many people as they get older. Scientists have been researching ways to slow down the progression of Alzheimer's disease, and one promising approach is to provide an enriched environment for the mice that have been genetically modified to develop Alzheimer's-like symptoms, such as 5xFAD mice which mimic many features of Alzheimer's disease as they age, including amyloid plaques, neurodegeneration and cognitive deficits, which are also seen in human Alzheimer's disease. Environmental enrichment involves providing the mice with an environment that stimulates their senses and promotes mental and physical activity. This could include things like toys, running wheels, and other items that encourage exploration and exercise. Previous studies have shown that environmental enrichment can improve cognitive function and reduce the progression of Alzheimer's disease in 5xFAD mice. The aim of this project is to investigate the role of a type of cell in the brain called microglia in the beneficial effects of environmental enrichment on behavior and cognition in a mouse model of Alzheimer's disease. Microglia are immune cells that play an important role in protecting the brain from damage and inflammation. However, in Alzheimer's disease, microglia can become overactive and contribute to the damage to brain cells. Our research group plans to use a technique called microglia depletion or microglia gene editing to investigate the contribution of microglia to the beneficial effects of environmental enrichment. This project will use environmental and pharmacological modulation, cognitive and behavioural tasks, as well as cellular and molecular approaches, including genetics, immunohistochemistry and bioinformatics tools.

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Co-Supervisor:

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Project Availability:

- PhD
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- Honours



Mo Group

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Location: Florey Institute of Neuroscience and Mental Health

We are interested in how neural circuits underlie our perception, decision-making, and cognitive processes. We investigate this by live imaging neurons within specific circuits between the cortex and the thalamus while mice make sensory decisions. We also casually manipulate the circuits to see how this affects the behavioural performance and neuronal activity. Computational analysis of population and single cell data help tease apart how electrical activity gives rise to our experiences.

Identifying and manipulating the neural circuits of decision-making

Making choices is a part of daily life yet one of the most challenging but fascinating questions in neuroscience is the neural basis of decision-making. Decision-making arises from activity between cortical areas but this communication also occurs via higher order thalamus. These cortico-thalamo-cortical pathways ubiquitously parallel direct corticocortical pathways in the brain, yet their role in perception has largely been ignored. Our previous work has shown that the transthalamic pathway in the somatosensory system is an essential neural pathway for perceptual decisions (Mo et al., Nat Comms, 2024). This project delves deeper into the role of transthalamic pathways in perceptual choice by combining trans-synaptic tracing (rabies virus), live calcium imaging (miniscopes) and controlled silencing or activation of neural circuits (optogenetics) during a whisker-based perceptual task. Students with experience in mouse behaviour, coding or an interest in neural circuits are encouraged to apply.

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Project Availability:

- PhD
- Honours





Crouch Group

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Assoc. Prof. Crouch's team investigates neurodegenerative diseases of the central nervous system such as motor neuron disease and multiple sclerosis. Our primary interests are elucidating the cellular mechanisms that lead to neuronal death and assessment of putative neuroprotective therapeutic interventions. We utilise models of disease that span in vitro and in vivo paradigms and we also examine human, disease-affected central nervous system tissue.

Investigating fundamental causes of neurodegeneration and assessing putative therapeutic interventions

There is a dearth of effective treatments for neurodegenerative diseases due to an incomplete understanding of disease biology and the underlying processes that lead to neuronal death. To address this, we seek to elucidate disease processes and assess potential neuroprotective therapeutic interventions with a focus on motor neuron disease and multiple sclerosis. Our in vitro paradigms include patient-derived neural cultures and cells obtained directly from mice, with particular interest in the role of the normally supportive glial cells, microglia and astrocytes, investigating how they become disrupted in disease in order to reveal novel therapeutic targets. This cellular work is complemented by in vivo investigations utilising robust transgenic and induced mouse models of neurodegenerative diseases to explore disease processes and assess putative therapeutic interventions in the complete animal. The relevance of these discoveries to neurodegenerative disease is validated by assessment of human disease-affected tissue. Projects utilize methodologies encompassing cell culture, treatment and phenotypic assessment of animals, established biochemical methods (qPCR, western blot, immunolabelling, histochemistry), and more advanced approaches including transcriptomics, proteomics and elemental analyses.

Primary Supervisor:

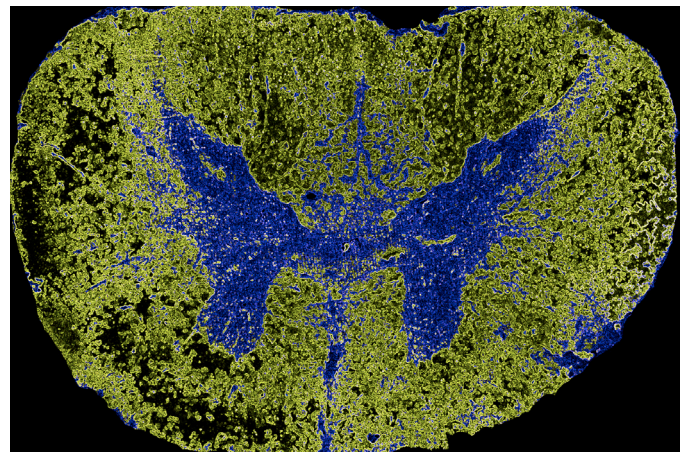
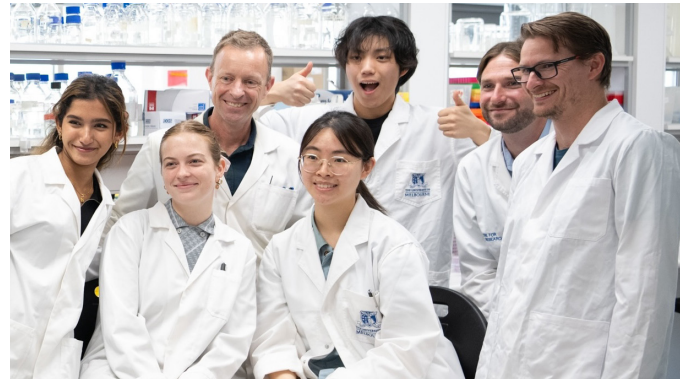
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Project Availability:

- PhD
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- Honours





Fletcher group

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Location: Department of Physiology and Anatomy

The Visual Neuroscience laboratory is interested in understanding the structure and function of the retina. We study two broad classes of retinal disease:

1. Retinal degenerations, including Age-Related Macular degeneration
Retinal degenerations are a family of hereditary diseases that cause a gradual loss of photoreceptors leading to blindness. These diseases occur in around 1:5500 people, but 1:50 are carriers. We are examining the mechanisms of photoreceptor death and whether specific treatments ameliorate or slow the loss of photoreceptors. Understanding how photoreceptors die is of relevance to diseases such as Age-Related Macular Degeneration (AMD), which is one of the leading causes of blindness especially in older people. Photoreceptor death and abnormal growth of blood vessels into the retina are major contributors to blindness in this disease. We use pre-clinical models to understand the underlying mechanisms involved and whether treatments slow the progression of disease. Our ultimate goal is to develop ways of slowing photoreceptor death and also to investigate ways of replacing lost photoreceptors.

2. Retinal vascular diseases, including Diabetic retinopathy
Diabetes affects 3.8% of the population of Australia, at an annual cost of AUS\$1 billion dollars. Diabetic retinopathy is a common complication associated with diabetes and is the leading cause of blindness in those under 65 years of age. Approximately 10% of all diabetics experience vision threatening retinopathy. One of the major reasons for vision loss is the growth of new blood vessels in the retina (neovascularization). Although a great deal of attention has focussed on the vascular changes associated with diabetes, it is now emerging that changes in neuronal, glial and microglial cell function often occur prior to overt vascular abnormalities. Understanding the link between microglial, glial cell dysfunction and changes in vasculature is vital for gaining a better understanding of the pathogenesis of diabetic retinopathy. The major thrust of our work is understanding the changes in the retina that lead to neovascularization. Ultimately, we seek to identify and implement novel treatments for retinal vascular disease so that we can prevent or slow vision loss.

Pharmacological and laser therapies for age related macular degeneration

Age related macular degeneration (AMD) is a major cause of vision loss in the older community. There are currently no specific treatments for preventing late stage AMD or slowing the progression of the disease to the later vision threatening forms. In this project we will characterise morphological and functional changes in the eye of a pre-clinical model of AMD and test novel pharmacological and laser therapies to ameliorate these changes. This project will involve the use of wide ranging techniques such as assessment of visual function, immunohistochemistry and molecular biology. Ultimately, this study will help to answer whether novel pharmacological or laser therapies can be used as a preventative treatment for AMD.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Identification of inflammatory factors that lead to retinal swelling

The eye is a delicate organ that needs to maintain an immune privileged environment. Uveitis is an inflammation of the eye that if left untreated can lead to blindness. It can be an acute or chronic disease that is classified according to the predominant site of inflammation (anterior, intermediate, posterior, or panuveitis). One concerning outcome of this disease is the development of uveitic macular oedema (retinal swelling) where inflammation leads to the accumulation of fluid within retina. This project will explore the factors that arise from the inflammatory response and whether they cause an alteration in retinal fluid movement. You will use retinal explant culture, immunohistochemistry, cell volume measurement and molecular biology to determine the key mediators of uveitic macular oedema. There is also an opportunity to compare these culture-based effects to clinical samples.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Microglial-induced mechanisms involved in diabetic retinopathy and macular oedema

The retina is highly susceptible to damage arising from the high glucose concentrations present during diabetes. Individuals with type I and II diabetes often develop retinopathy (a vascular pathology) and oedema (fluid-induced swelling). Both these pathologies lead to the development of potentially blinding conditions. The development of retinopathy and oedema results from changes in neurons, glia, microglia and blood vessels. In preclinical models, this project will use immunohistochemistry, molecular biology and in vivo imaging techniques to examine the changes in retinal microglia and how this relates to altered retinal vascular response and swelling of particular glial cells. Understanding these microglial-induced changes is critical to explaining the retinal pathology that develops during diabetes.

Primary Supervisor:

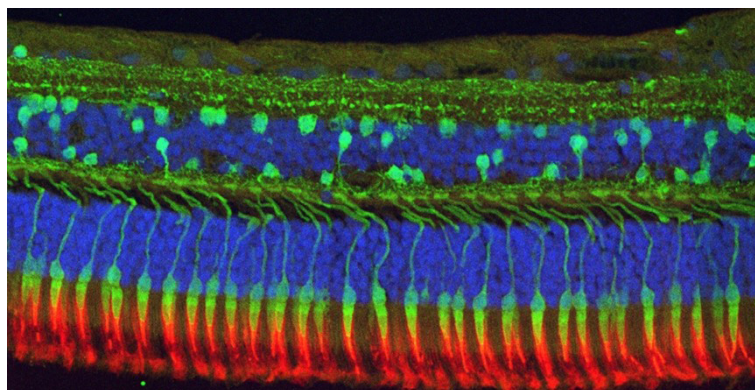
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Co-Supervisor:

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Project Availability:

- PhD
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- Honours





Reid Group

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Location: Florey Institute of Neuroscience and Mental Health

- Developing and characterising various genetic mouse models of epilepsy.
- Using genetic mouse models of epilepsy to understand mechanisms and identify new targets and treatments. This involves multiple techniques including behavioural studies, brain-slice electrophysiology, EEG recording, immunohistochemistry, transcriptomics and drug administration.
- Understanding biophysics of ion channels using electrophysiological methods. Techniques involved include two-electrode voltage clamp, voltage-clamp fluorometry and patch-clamp.
- Investigating the relationship between genetic cardiac arrhythmia in sudden unexpected death in epilepsy. Techniques involved include behavioural studies, EEG and ECG recordings, and drug administration.

Biophysics of leaky HCN ion channels

Project aims to understand the biophysics of ion channels (HCN and potassium channels) using a combination of electrophysiological methods including two-electrode voltage clamp, voltage-clamp fluorometry and patch-clamp. Elucidating the biophysics of these channels that are involved in epilepsy will allow us to understand how epilepsy variants affect the properties of these channels and develop targeted treatments that correct the broken channels.

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Understanding mechanisms and identifying new targets and treatments using various genetic mouse models of epilepsy

Project is an umbrella project which aims to develop and characterise various genetic mouse models of epilepsy, which will be used to understand mechanisms and identify new targets and treatments. This project involves multiple techniques including behavioural studies, brain-slice electrophysiology, EEG recording, immunohistochemistry, transcriptomics and drug administration. Some of the mouse models are already up and running in the lab, including mouse models of developmental and epileptic encephalopathy (Hcn1M294L, Gabra, Cux2 etc) and Dravet syndrome (Scn1a). These mice are modelled after genetic variants of patients and mainly recapitulated patient phenotypes. The next step of this project is to understand mechanisms underlying epileptic phenotypes and identify effective therapeutics (which involves screening small molecules, currently available antiseizure medications and toxins) that can reduce symptoms.

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Abbott Group

Contact: Prof. David Abbott

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Location: Florey Austin

The Epilepsy Neuroinformatics group undertakes advanced neuroimaging analysis methods development and applied research to further our understanding of the human brain in health and disease.

A particular emphasis of the research is towards methods that can help better understand the causes and consequences of epileptic seizures. This includes implementing, developing and applying advanced image analysis procedures for structural and functional magnetic resonance imaging (MRI, fMRI) and electroencephalography (EEG) – including simultaneous EEG and fMRI. These non-invasive imaging modalities, together with advanced computational methods, are capable of mapping human brain activity at millimetre spatial resolution and millisecond temporal resolution. Our work is being translated to healthcare in clinical research programs, including the ground-breaking Australian Epilepsy Project. This is delivering advanced clinical decision support to treating clinicians to improve the lives of people with epilepsy.

Development and application of functional MRI analysis methods.

These projects aim to optimise data processing and analysis methods to extract as much useful information as possible from human functional magnetic resonance imaging (fMRI) brain scans. This includes task-based activation and resting state functional connectivity. The projects would suit students with strong computing skills and an interest in computer programming, engineering, mathematics, statistics, informatics, physics and/or medicine. Projects available include:

Artifact reduction in fMRI: Functional MRI (fMRI) is subject to unwanted noise sources such as brain pulsation and subject motion that can substantially impact the quality of results. Our group continues to make advances in methods to denoise functional MRI. There are opportunities to contribute to these projects, including application to clinical studies such as the Australian Epilepsy Project.

Functional connectomics: Application of analysis methods to extract meaningful insights into functional brain organisation in healthy people and people with epilepsy.

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Project Availability:

- PhD



Vaughan Group

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Location: Florey Austin

The Vaughan research group, based at the Heidelberg campus of the Florey Institute at Austin Health, is dedicated to advancing the diagnosis and treatment of epilepsy through innovative brain imaging. We specialise in the clinical translation of advanced neuroimaging methods to understand where seizures begin, how they spread, and how best to guide therapy.

Our research spans the full spectrum of epilepsy, from the first seizure through to chronic disease that requires surgical intervention. A major focus is on people whose MRI scans appear “normal” using standard clinical techniques. We apply cutting-edge methods—including functional MRI, diffusion MRI, quantitative susceptibility mapping, and fixel-based analysis—to reveal subtle structural abnormalities and network dysfunction. Our work has helped identify imaging-based epilepsy subtypes and uncovered network-level changes, such as in MRI-negative temporal lobe epilepsy.

We are leaders in the use of simultaneous EEG-fMRI, a technique that combines brainwave recording with functional imaging to map the brain regions responsible for epileptic discharges. Our lab has pioneered methods for modelling these networks and identifying seizure-generating regions, including deep and non-lesional targets. We work closely with neurologists and neurosurgeons to validate our findings using stereo-EEG, an invasive technique for localising seizures and delivering targeted lesions through radiofrequency ablation.

We have strong expertise in quantitative and structural MRI, particularly through our leadership in the Australian Epilepsy Project. Our team developed the imaging protocol that is now used nationally for this study, and analysed imaging data from over 1,200 participants across multiple centres. We use advanced techniques to detect focal lesions that may cause epilepsy—especially when conventional imaging is inconclusive—and to characterise how epilepsy affects the brain more broadly. We also investigate how epilepsy affects cognition and mental health, using imaging to explore the basis of symptoms such as memory impairment, depression, and psychosis of epilepsy. Our recent work also explores how anti-seizure medications influence brain network organisation. Our lab offers a rich, multidisciplinary environment where students gain experience in neuroimaging analysis, clinical neuroscience, and collaborative translational research. We welcome students who are passionate about improving care for people with epilepsy and contributing to the future of personalised neurological medicine.

Predicting Seizure Onset Zones Using EEG-fMRI and Machine Learning

This project is part of a broader research initiative aiming to improve surgical outcomes for people with drug-resistant epilepsy. Our specific focus is to develop novel biomarkers of the seizure onset zone by integrating non-invasive EEG-fMRI data with intracranial EEG recordings (stereo-EEG).

Targeting the correct brain regions with stereo-EEG electrodes remains challenging, as placements are currently guided by low-resolution information and clinical heuristics. In this project, we will develop new functional MRI biomarkers for better, data-driven, electrode implantation and surgical planning. Network metrics—such as functional and effective connectivity—are of particular interest in this work. We will validate fMRI-derived metrics against the clinically-determined seizure onset sites on invasive stereo-EEG recordings. Next, we will use imaging features to train machine learning models for personalised prediction of seizure onset zones across the brain, including regions not sampled by electrodes. These ‘virtual electrode’ models will help estimate the full extent of epileptogenic tissue, improving the planning of minimally invasive surgery to achieve seizure freedom. This work contributes to a new precision-medicine approach for epilepsy surgery.

Using previously acquired recordings, work in this project will focus on data analysis and interpretation. Key tasks include multimodal data registration (EEG-fMRI and stereo-EEG), extraction of connectivity metrics, and development of machine learning classifiers using tools in R or Python.

This project is ideal for students interested in neuroimaging, computational neuroscience, and clinical translation. Familiarity with Linux systems and experience (or motivation to learn) Python, MATLAB, R, or machine learning techniques will be advantageous. The project offers the opportunity to contribute to clinically meaningful advances in epilepsy surgery, as part of a multidisciplinary team at the Florey Institute.

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Project Availability:

- PhD
- Master of Biomedical Science



Lankadeva Group

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Location: Florey Institute of Neuroscience and Mental Health

The cardiovascular and immunology branch of Critical Care Research at the Florey Institute is focused on understanding changes in immunological function during cardiac surgery and in the post-operative environment that can increase susceptibility to hospital-acquired infections.

Assessing immune cell function in patients undergoing cardiac surgery and post-operatively in critical care.

Hospital-acquired infections remain a serious and unresolved complication following heart surgery requiring cardiopulmonary bypass (CPB), also known as 'the heart-lung machine'. These infections not only delay recovery but also significantly increase the risk of in-hospital mortality and future hospital readmissions. Alarming, one in five deaths following heart surgery is attributable to hospital-acquired infections, and affected patients are six times more likely to be readmitted, highlighting a major gap in perioperative care for patients undergoing essential surgical procedures to improve their heart health. Emerging evidence suggests that the body's natural inflammatory response to the trauma of heart surgery and the heart-lung machine may suppress the immune system, impairing its ability to defend against infection. Similar immune dysfunction has been observed in patients after major trauma or sepsis, but it remains poorly understood in the context of heart surgery. We aim to test the hypothesis that heart surgery involving CPB induces temporary but profound innate immune suppression. At Austin Health, we will conduct an observational study involving patients undergoing elective coronary artery bypass grafting or heart valve replacement/repair procedures. By tracking immune function before, during, and after surgery, we will determine how and when the body's first line of defence—particularly neutrophils and antigen-presenting cells—becomes dysfunctional. Neutrophils are a key component of the innate immune response, acting as 'first responders' to invading pathogens. Our study will assess their capacity to engulf and kill pathogens across the perioperative period. Techniques expected to be mastered during this honours' year involve working with patient blood samples, using in vitro functional assays to measure phagocytosis and intracellular reactive oxygen species production, using a flow cytometer to acquire data and analysing immune cell subsets.

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Co-Supervisor:

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Project Availability:

- Honours



Mazzone Group

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Location: Department of Anatomy and Physiology

The Respiratory Sensory Neuroscience Laboratory investigates how the nervous system senses and responds to signals from the airways and lungs. Our research focuses on the sensory neuron populations that innervate the respiratory tract, as well as the brain circuits that interpret and integrate this sensory information. We combine transcriptomic profiling to uncover the molecular identity of respiratory sensory neurons, viral tract tracing and cutting-edge molecular physiology to map functional brain circuits, and human functional brain imaging to explore neuroplasticity in patients with respiratory disease.

Investigating brain networks processing respiratory sensations

Respiratory sensory neurons are critical for the ongoing physiological control of breathing as well as protecting against potentially damaging stimuli that could adversely affect ventilation. They do so by providing inputs to complex brain networks responsible for generating respiratory sensations and resultant behaviours. Changes in the excitability of these brain networks may be important for the development of coughing, dyspnoea and hyperreactivity characteristic of many lung diseases. In this project we are mapping the neural connections of airway sensory circuits in the central nervous system and employing molecular physiological approaches using optogenetics and chemogenetics to better define how respiratory sensations are encoded in the brain. Techniques include viral vector production, small animal surgeries, molecular physiology studies, microscopy.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Neuroinflammatory mechanisms in influenza viral infections

Influenza is a major cause of pulmonary disease. We have discovered bidirectional interactions between the nervous and immune systems that are important for determining the severity of influenza infections. This project will use surgical and molecular approaches in mice to further investigate the neural contributions to pulmonary inflammation during influenza. Techniques include small animal surgeries, chemogenetics, transcriptomics, proteomics, immunohistochemistry, flow cytometry, microscopy.

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Project Availability:

- PhD
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- Honours

Neural Circuits Regulating Aversive Sensory Processing

Avoiding harm is critical for survival, yet the central neural circuits responsible for generating behavioural responses to noxious stimuli remain poorly understood. The brain continuously receives diverse sensory inputs from both internal (visceral) and external (somatic) sources and must integrate or filter this information to produce appropriate responses. Disruptions in these processes are believed to contribute to a range of neurobehavioral and sensory disorders. This project aims to characterise a central neural circuit involved in processing aversive-like sensations from the respiratory system and peripheral structures. Noxious signals from the airways travel through the vagal ganglia to brain regions involved in processing pain and sensation, including the brainstem, thalamus, and frontal cortex. A similar pathway exists for pain signals from the body, such as the sciatic nerve. Both systems feed into a brain network that helps regulate and dampen sensory input, likely playing a key role in how we adapt our behaviour to avoid harm. Students will be trained in a range of techniques including small animal surgery, behavioural assays, chemogenetics, transcriptomic profiling, immunohistochemistry, and advanced microscopy and analyses.

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Project Availability:

- PhD
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- Honours



Yao Group

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Location: Department of Anatomy and Physiology

The Yao laboratory is focused on understanding how dysregulation of the autonomic nervous system contributes to diseases such as hypertension and heart failure, sepsis and inflammation. We take a multi-disciplinary approach to understanding how changes in the neurochemistry and function of key autonomic brain cells and circuits lead to autonomic dysregulation and disease progression. Techniques we frequently use in the laboratory include: in vivo electrophysiology, immunohistochemistry, anatomical neural circuit tracing and advanced microscopy. Current projects include, investigating the role of inflammatory cytokines in hypertension and studying the brains immune cells and their dysregulation in driving adverse outcomes in sepsis.

Microglia changes associated with hypertension

Hypertension contributes to cardiovascular disease, which is one of the most prevalent causes of morbidity and mortality in the world. There is good evidence to suggest that there are changes in the brain centres that control cardiovascular function in pre-clinical animal models of hypertension such that there is impaired regulation of cardiovascular neurons in hypertension. This project will investigate changes in microglia morphology and their association with perivascular macrophages and blood vessels in critical brain circuits that control cardiovascular function. This project will involve experiments using in vivo techniques, surgery, immunohistochemistry and advanced microscopy.

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Project Availability:

- PhD
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- Honours

Maljevic Group

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Location: Florey Institute of Neuroscience and Mental Health

The most severe paediatric epilepsies are associated with genetic mutations in ion channels and synaptic proteins, and they are defined by the presence of medication-refractory seizures, neurodevelopmental delay, psychiatric presentations, dystonic movements and autism spectrum disorder. Our group specialises in modelling these epilepsy forms (also known as developmental and epileptic encephalopathies) using human induced pluripotent stem cells to investigate the disease mechanisms and test innovative therapies through applications of cutting-edge functional and genomic approaches.

Disruption of early neurogenesis in iPSC-derived models of neurodevelopmental disorders

Developmental and epileptic encephalopathies (DEE) are severe conditions marked by early-onset seizures and significant cognitive and developmental impairments. Genetic mutations in a range of genes are central to DEE onset and progression. Our project aims to investigate the underlying developmental disruptions in DEE using patient-specific induced pluripotent stem cell (iPSC)-derived models of early neurogenesis.

To dissect the complex mechanisms of DEE pathogenesis, we will combine stem cell culture and immunocytochemistry with high-throughput imaging and AI-based analysis. This integrated approach will enable detailed, unbiased quantification of neurodevelopmental phenotypes across large datasets, advancing our understanding of early disease mechanisms.

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Project Availability:

- PhD
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Parish Group

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Location: Florey Institute of Neuroscience and Mental Health

The Stem Cells and Neural Repair laboratory has a broad research interest in using human stem cells to model neurological diseases, and develop new therapies. The team places a strong emphasis on understanding and modeling human neural development, with the idea that recapitulating many of these events will influence regeneration. The team continues to develop methods to control the fate of human stem cells into defined neuronal populations that can be used to in neural transplantation. They additionally develop methods to promote the integration, function and safety of these stem cell-derived transplants – targeted at treating Parkinson's disease and stroke. Parallel work in the lab uses stem cells from Parkinson's disease and motor neuron disease patients to create advanced models in which to unravel our understanding of disease processes and consequently development of new drug therapies.

Generating neuronal subpopulations from pluripotent stem cell sources and their application in disease modelling and brain repair

To date a large proportion of preclinical research and drug screening/development has relied on animal-based models that, whilst having an important place in contributing to new insights into the disease, evidently differ in gene expression, anatomy and the physiology underpinning neural circuitry. Such discrepancies likely underpin failure of many clinical trials that showed preclinical potential.

Human induced pluripotent stem cells (hiPSC), and their ability to generate neural populations relevant to disease, are having a major impact for studying and developing therapies for neurodegenerative diseases. The Parish team has access to (or generated in-house) hiPSC lines from MND and Parkinson's disease patients. Furthermore the team has developed protocols to generate defined neural (and non-neural) populations from these stem cells to study disease mechanism, and with new insight into disease mechanisms, identify new therapeutic targets.

Under this umbrella of advanced human disease modelling our team is investigating:

- The interplay of different neuronal populations involved in aspects of disease with the idea that an improved understanding of this may present new targets to slow or halt disease progression.
- The neurovascular niche. The blood brain barrier normally functions to protect the brain from insults (toxin, viruses etc) yet shows signs of loss of integrity in neurodegenerative diseases. We are modelling the various dysfunctional components within the barrier
- We are creating chimeric models of human disease by means of transplanting healthy and diseased human PSC-derived neurons in the brain of rodents. This enables our ability to study disease processes in the living brain, and over protracted timeframes not feasible in vitro.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- Honours



Stamp & Hao Group

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 Location: Department of Anatomy and Physiology

Proper development and function of the digestive tract is crucial for good health. Gut function relies on the co-ordinated activity of neural circuits in the enteric nervous system (ENS), a network of neurons and glia located within the wall of the gastrointestinal tract. Our lab focuses on investigating the plasticity of the enteric nervous system and the development of stem cell therapy to treat digestive diseases.

A gut feeling about new therapies for brain cancer treatment

Gliomas are a very aggressive form of brain cancer, with a very poor 5-year survival rate. Gliomas can arise from over-proliferation of glial cells or neural stem cells in the brain. Glial cells are a prominent part of the enteric nervous system, but gliomas in the gut are very rare and are generally benign. How are enteric glial cells protected against developing aggressive tumours? In this project, we will use a novel line of transgenic mice to investigate enteric glial cell proliferation and changes in their DNA repair pathways.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science



Examining the impact of environmental toxins on gut health

Environmental pollutants, such as microplastics and per- and polyfluoroalkyl substances (PFAS), have become a growing concern due to their widespread presence and potential adverse effects on human health. The gastrointestinal tract is a primary route of exposure to these pollutants, and emerging evidence suggests that they may disrupt gut homeostasis and contribute to the development of various gastrointestinal disorders. This project aims to investigate the impact of microplastics and PFAS on gut health using a combination of in vivo and in vitro approaches. Using a mouse model of chronic exposure, the effects of these pollutants on gut function, intestinal barrier integrity, and gut microbiome composition will be investigated. Concurrently, high-throughput screening assays with intestinal epithelial cell lines and organoid models will be developed to identify cellular pathways and mechanisms underlying the potential gut-disrupting effects of microplastics and PFAS, employing methods like cytotoxicity assays, transcriptomics, and proteomics. This comprehensive approach aims to elucidate the functional consequences and cellular mechanisms underlying the impacts of these pollutants on health, contributing to preventive measures, and potential therapeutic interventions for associated gastrointestinal disorders.

Primary Supervisor:

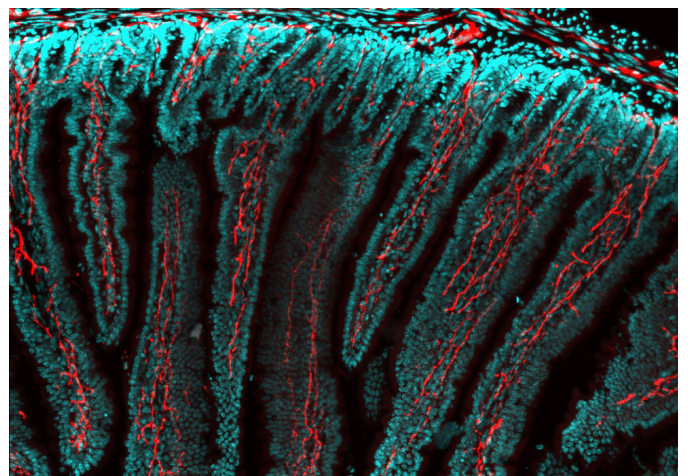
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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science





Clark group

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Location: Melbourne Brain Centre / Kenneth Myer Building

Neuropsychiatric disorders such as Bipolar Disorder and Schizophrenia are severe and incurable diseases in urgent need of improved treatments. Our genes play a key role in who develops neuropsychiatric disorders, but we have little understanding of how. Our research sits at the intersection of genomics and neuroscience, utilising a number of genomic approaches to investigate gene expression and function in the human brain and in neuropsychiatric disorders. We are investigating how the expression and splicing of genes can change to create disease risk and how characterising these changes can help us understand what causes neuropsychiatric disorders and identify novel treatment targets.

A second interest of our research is to develop novel sequencing methods, with a focus on Nanopore sequencing, a technology that can sequence both DNA and native RNA. We are applying Nanopore sequencing to many research questions and developing novel applications for this technology.

Discovering novel RNAs and proteins with Proteogenomics

Discovering the functions of genes is essential to understanding health, development and disease. Investigating the RNAs and proteins made by genes is a key step in determining their functions. However, many RNAs and proteins remain unknown to science. We have developed GenomeProt, a new software tool, that combines long-read RNA-sequencing and mass-spectrometry to comprehensively identify and quantify both known and novel RNAs and proteins in any sample. GenomeProt finds new proteins within gene 5' and 3' UTRs; translated non-coding RNAs; and the translation of novel RNAs into new proteins. The opportunity exists for a student to discover the novel RNAs and proteins present in human brain, organoids and cancers and characterise their functions. The student could focus on the lab side and/or the bioinformatic aspects of this project, which would suit students interested in either laboratory work or computational analysis.

Primary Supervisor:

Dr Mike Clark

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Deciphering how our genes control human brain development

Human brain development is an exquisitely complex process, which is tightly controlled by networks of gene products. Almost all human genes make multiple mRNA products (known as isoforms), but current technologies lack the ability to identify and functionally characterise the repertoire of gene isoforms controlling brain development. This project will profile gene isoforms in developing brain cells using long-read single cell RNA sequencing, a ground-breaking new technique for characterising isoform expression in individual cells, and determine their functional roles. We are using both in-vivo samples and the differentiation of stem-cells into brain organoids to investigate human brain development. This project will illuminate the role of gene isoforms in brain development and form a foundation for understanding how gene isoforms regulate brain cell functions and fates. The opportunity exists to perform bioinformatic analysis of single-cell expression data and/or lab-based discovery of isoform functions and would suit students interested in either laboratory work or computational analysis.

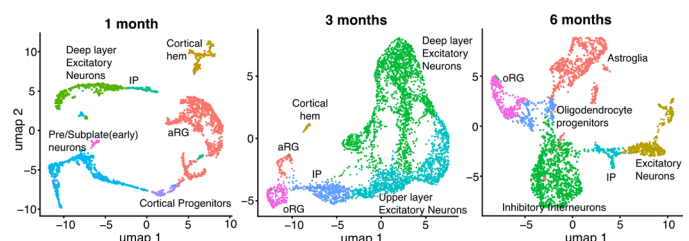
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Coding the future: next-gen bioinformatic tools for nanopore data

Oxford Nanopore sequencing is a cutting-edge technology for gene expression analysis with a number of unique features, including sequencing of native RNA, real time data output and long-reads with no length limit. In addition, nanopore sequencing can also detect epigenetic modifications of DNA and RNA. This combination of unique attributes allows the use of nanopore sequencing in many novel (as well as existing) applications. Our lab has developed new tools and applications for nanopore single-cell RNA-seq; RNA splicing analysis; and sequencing of native RNA, but there is much more that could be done to enable gene expression analysis, data visualisation, single cell sequencing and more. The opportunity exists for a student interested in bioinformatics or computational biology to develop new software tools and applications for nanopore sequencing to help address previously intractable biological questions.

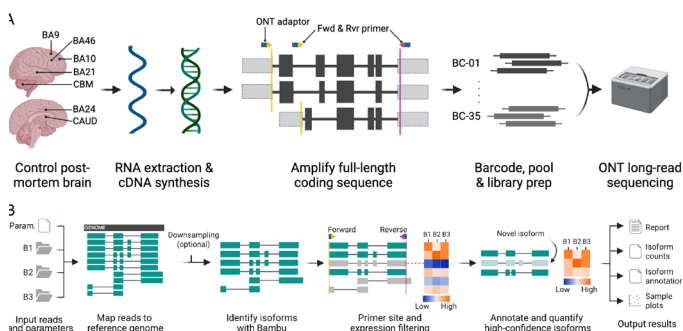
Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



How do our genes cause neuropsychiatric disorders?

Our genes play a key role in our risk for developing neuropsychiatric disorders such as schizophrenia, bipolar disorder and depression. However, while many risk genes have been discovered, we don't have a good understanding of what goes wrong with these genes or how they increase risk of disease. Our research has identified many new RNA products from neuropsychiatric risk genes, some of which may confer disease risk. This project will use a combination of cutting-edge technologies, (including Nanopore long-read sequencing, stem-cell models of disease, antisense oligonucleotides, mass spectrometry and bioinformatics) to investigate the function of these RNAs and their protein products and decipher how these genes cause risk for disease. This project will provide crucial new knowledge into the causes of neuropsychiatric disorders and potentially identify novel targets for future therapeutics. The opportunity exists to focus on the lab side and/or the bioinformatic aspects of this project and it would suit students interested in either laboratory work or computational analysis.

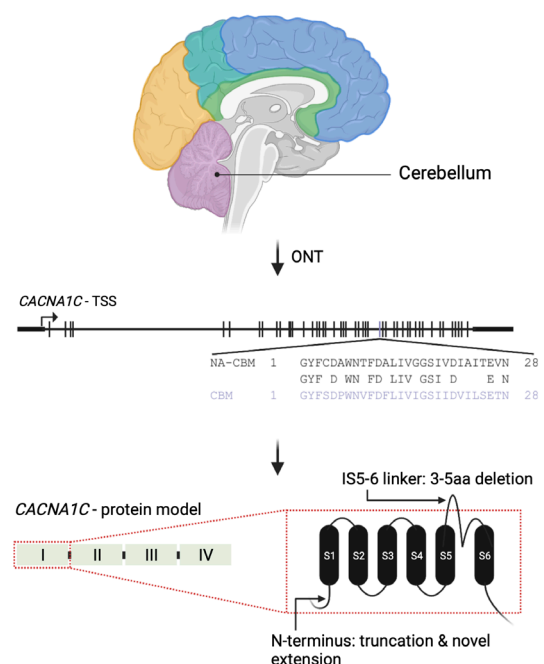
Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours





Gunnersen Group

Contact: A/Prof. Jenny Gunnersen
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Location: Department of Anatomy and Physiology

In the Neuron Development and Plasticity Laboratory, our research is focussed on:

- (i) the molecular and cellular mechanisms controlling synapse development;
- (ii) synapse formation/strengthening and how these processes contribute to the pathology of psychostimulant abuse and neuropathic pain.

Investigating a new pharmacological approach to treating relapse in cocaine use disorder.

Relapse prevention is a major clinical challenge in the treatment of substance use disorders. Although pharmaceutical treatments are available for nicotine, alcohol, and opioid use disorders, none have been approved by the US Food and Drug Administration (FDA) for cocaine and other stimulant use disorders, despite a promising recent clinical trial result. In Australia, use of cocaine and other stimulants is growing - between 2016 and 2020, cocaine consumption increased 86% (Australian Criminal Intelligence Commission, 2021) and, in 2021, Australia had the highest average total stimulant consumption of the 28 countries compared (Australian Institute of Health and Welfare). Globally, cocaine use disorder contributes ~1.15 million disability adjusted life years, and 0.594 million years of life lost, to the burden of disease. The FDA is seeking to boost development of pharmacological therapeutics and encourages drug repurposing. The aim of this project is to investigate a promising and novel therapeutic approach to combatting relapse in an animal model of cocaine use disorder.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Neuronal proteins regulating synaptic pruning.

The remarkable functional efficiency of brain neuronal networks has likely arisen from the way in which network connectivity is refined during development: initially, connections between neurons (synapses) in the brain circuitry are overproduced; this is then followed by a remodelling phase in which active synapses are strengthened and retained, while excess weak or inactive synapses are removed, or “pruned”. Modelling suggests that these processes evolved because they conferred functional advantages and endowed brains with greater information processing capacity. Synapse pruning is performed mainly by microglial cells, “professional phagocytes” of the immune system that move into the developing brain early in the pre-natal period and reside there throughout life. Pruning of excess synapses via microglial phagocytosis (a term used for engulfment or “eating”) is not only vital for normal brain development, it is also essential for the mature brain to adapt to sensory input and effectively participate in learning and memory. While rapid progress has been made in understanding how excess, weak or inappropriate synapses are tagged for removal by microglia, we know much less about how neurons, themselves, regulate microglial pruning. This project will investigate how particular neuronal proteins regulate this process and the signalling mechanisms involved.

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Project Availability:

- Master of Biomedical Science
- Honours

Developing a new biological treatment for chronic pain.

Chronic pain negatively impacts all facets of life in a 'vicious cycle', largely because current treatments are insufficient and have unwanted side-effects. An estimated 3.6 million Australians suffer from chronic pain, 25% of patients visiting the GP suffer from chronic pain and, in 1 in 5 of these people, nerve injury is the cause. When nerves are damaged (e.g. in an accident, or from surgery, chronic disease, viral infection or cancer therapy), the nervous system becomes hypersensitive, leading to persistent pain even after the injury has healed. The social, health and economic burden of chronic pain in Australia is expected to exceed \$215 billion by 2050 - we urgently need new, effective treatments for chronic pain. This project will test a new biological therapy against a new chronic pain target using cell and animal models.

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Project Availability:

- Master of Biomedical Science
- Honours





Murray Group

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Human demyelinating diseases, such as multiple sclerosis (MS), have a devastating impact on quality of life. The Myelin Biology Lab investigates the development and repair of myelin - the insulating sheath wrapping around many axons in the peripheral (PNS) and central nervous systems (CNS). We use mice as a model system to study how myelin develops and is repaired after brain injury. Current projects utilise cellular and mouse models and focus on the signalling and transcriptional mechanisms that control myelination, and in optimising strategies to promote myelin repair.

Can mimetics of BDNF promote remyelination after injury?

In CNS demyelinating diseases, oligodendrocytes (the cells that generate myelin) progressively die. However, they possess an innate capacity to regenerate themselves and repair the lost myelin. Unfortunately, over time and repeated demyelinating events, this capacity for regeneration and repair reduces. We have identified that BDNF plays an important role in myelin development and repair. Building on these findings, we have developed novel low molecular weight peptides designed to selectively mimic the agonist properties of BDNF. This project is multifaceted in that it aims to use in vitro assays to optimise and characterise novel next-generation peptides, and use in vivo assays to investigate whether these novel BDNF mimetic peptides can promote myelin repair using animal models of nervous system demyelination.

Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Analysis of myelin specific transcription factors

The myelin sheath - a multi-layer membrane that wraps around many nerves in the central nervous system (CNS) - is critical for optimal brain function. Myelin sheaths are made by cells called oligodendrocytes and most myelin sheaths are formed in early postnatal development, but new sheaths can be added throughout life either after brain injury or in response to learning. However, the molecular mechanisms that regulate these dynamic changes in myelin sheath growth have not been identified. The overall aim of this project is to identify and characterise novel molecular mechanisms that control myelin sheath growth in the CNS. We will use innovative interdisciplinary methods to identify novel signaling pathways and protein interactions that control oligodendrocyte development and function.

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Project Availability:

- PhD
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- Honours



Gantner Group

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Location: The Florey Institute of Neuroscience and Mental

The Gantner lab investigates the genetic determinants of synucleinopathy with a focus on novel stem cell models of neurodegeneration. By seeking out the mechanism of why some neurons are particularly susceptible to degeneration we are hoping to develop targeted and personalised therapies for clinical translation in Parkinson's disease, Multiple System Atrophy, Dementia with Lewy Bodies and REM Sleep Behaviour Disorder.

Untangling synuclein in REM Sleep Behaviour Disorder

REM Sleep Behaviour Disorder is characterised by the loss of muscle atonia during REM Sleep - leading patients to 'act' out their dreams. Post-mortem samples have shown pathological accumulation of alpha-synuclein in the brain stem. In this project, we aim to generate the neurons responsible for REM Sleep atonia and investigate how and why they are susceptible to alpha-synuclein pathology.

Primary Supervisor:

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Project Availability:

- Master of Biomedical Science
- Honours

Stem Cell and Developmental Biology





Smith Group

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Location: Department of Anatomy and Physiology

The Smith group is focussed on identifying the genetic and cellular regulators of heart development; in other words: how do we build a heart? The heart develops by differentiating cells and organising them in a stereotypical pattern to build this organ. The fact that this structure is more or less identical between individuals demonstrates that a tightly controlled genetic program instructs this process. The lab is interested in identifying such genes, determining how they function, and uncovering the cellular processes they regulate. We use the zebrafish model for much of our discovery-based projects. The zebrafish is an excellent genetic model and the transparency of the embryos and availability of fluorescent transgenic reporter lines permits live imaging of organogenesis. For some projects, we translate our discoveries to mouse models to investigate evolutionary conservation. The long-term objective of the lab is to contribute to our knowledge of how to build a heart, gathering along the way information that will assist bioengineering efforts and help with diagnosis and treatment of genetic-based heart disease.

Formation of the trabecular layer during cardiac development

The project is focussed on understanding a specialised tissue in the heart, called cardiac trabeculae. Trabeculae are ridges or protrusions that grow into the lumen of the heart, helping to make it more efficient. Questions around this project include understanding the genetic regulation of how this tissue is patterned, and what signalling cues are needed to both promote its growth as well as make sure there isn't excessive growth. We use the zebrafish model for much of our research. Methods used in the project will include embryology (of zebrafish), microinjection techniques, drug and chemical treatments, genetic crosses, molecular techniques (such as DNA extraction, PCR, gel electrophoresis, RNA synthesis), phenotypic screening by bright-field and fluorescence microscopy, confocal microscopy, image analysis, and statistical analysis.

Primary Supervisor:

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Co-Supervisor

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Project Availability:

- PhD
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Identifying the role novel proteins have on implantation and placentation: implications for pregnancy complications

Up to 15% of pregnancies develop complications due to poor embryo implantation or defective placental development. These early steps are essential for a healthy and successful pregnancy. Implantation involves the outer wall of the fertilised embryo (termed trophoblast) embedding into the uterine wall, invading the maternal tissue, and establishing the placenta: an integrated and highly vascularised interface for nutrient and waste exchange. If trophoblasts are too invasive, the placenta embeds too deeply, which can result in severe haemorrhage and is a significant contributor to maternal death. At the opposite extreme, insufficient trophoblast invasion can result in a placenta that is too shallow, which is associated with a spectrum of pregnancy complications including preterm birth, preeclampsia, and foetal growth restriction. The developmental problems that stem from a complicated pregnancy have lifelong consequences of significant emotional, medical, and economic burden. Understanding the process of implantation and impaired placental development is necessary for the development of preventative measures and is of significant clinical need. This project will investigate mouse models with abnormal implantation and placental development. It will determine how and why disease occurs and investigate potential therapeutic interventions.

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Co-Supervisor

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Project Availability:

- PhD
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- Honours



Hime Group

Contact: Prof. Gary Hime
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Location: Department of Anatomy and Physiology

The Hime groups studies regulation of organ development and regeneration using *Drosophila* as a model organism. Many differentiated but renewable cell types are derived from relatively small populations of dedicated precursors, or stem cells.

The ability to replenish differentiated cells depends on the continued survival and proliferation of their respective stem cell populations. If we are to realise the goals of re-programming tissue differentiation, growing organs for transplantation in vitro, regeneration of damaged organs in vivo and targeted effective treatments for cancer it is essential that we understand the molecules and mechanisms that stem cells utilise for renewal and differentiation. We also utilise *Drosophila* to model human genetic variants that are suspected to be associated with disease states in order to gain evidence for pathogenicity.

Drosophila models of human disease

The rapid advances in sequencing of human genomes has identified many variant gene sequences that may be associated with genetic diseases. It can be difficult to unambiguously associate genetic variants with phenotypes without a direct assay. We are using *Drosophila* to model the effects of genetic variants associated with human disease to determine how the variants affect gene function. This project will involve generation of transgenic strains that express human gene variants to attempt to genetically rescue loss of function alleles, or generation of *Drosophila* alleles analogous to the human genetic variants via CRISPR. Variant alleles will be phenotyped via immunostaining, confocal microscopy and transcript expression to determine if they are pathogenic in nature.

Primary Supervisor:

Prof. Gary Hime
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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Identification of novel regulators of stem cell differentiation

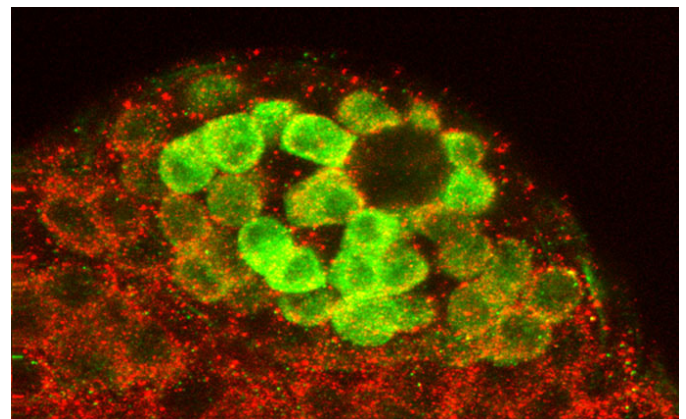
We have conducted genetic screens which have identified new mutations that affect the ability of *Drosophila* male germline and somatic stem cells to differentiate. This project will involve genetic analysis and DNA sequencing to identify genes associated with specific mutations and phenotypic characterization of the mutant to determine the mechanism affecting stem cell differentiation. Techniques will involve genetic manipulation via RNA interference and CRISPR, microdissection and immunostaining of tissues, qRT-PCR analysis of gene expression and confocal microscopy.

Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



Regulating fertility: identifying new regulators of gamete formation

Production of spermatozoa and oocytes are highly regulated processes that involve genes interacting with environmental signals to produce spermatozoa from a population of germline stem cells and oocytes from dedicated progenitors. This project will use a variety of genetic techniques (RNA interference, CRISPR, mutant analysis) with advanced microscopy and cellular analysis to identify new regulators of this process. We work with groups studying human infertility to identify genes that affect human male and female fertility and as these genes are often involved in other disease processes they provide warnings for overall human health.

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Amitosis: Understanding how cells can divide without undergoing mitosis

We have identified that during *Drosophila* salivary gland development an increase in cell number occurs without mitotic activity. This is an unusual form of cell division that is specific to polyploid cells, and occurs in greater than 30% of human tumours. We will use *Drosophila* genetics to discover how this process is regulated and potentially identify new ways of treating tumour growth. These cells also display a variant form of cell polarization and we also seek to understand how this affects secretory tissue function.

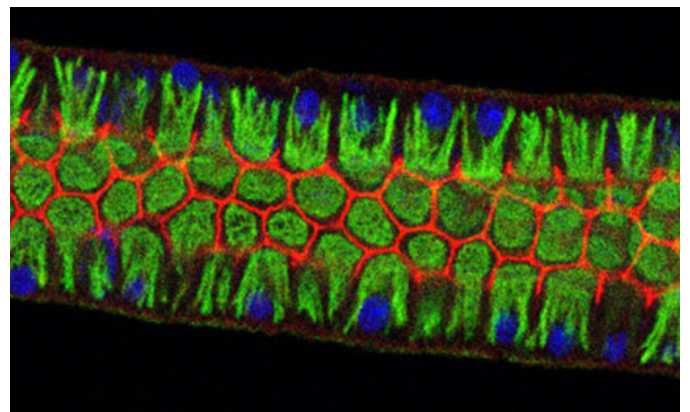
Primary Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours





Eckersley-Maslin Group

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Location: Peter MacCallum Cancer Centre

The Eckersley-Maslin (EckMas) laboratory investigates how chromatin landscapes shape current and future cell identity. Both embryogenesis and tumourigenesis are associated with changes in cellular phenotypes and functions, a process termed plasticity. Our laboratory uses insights from development, where cell plasticity is tightly controlled and regulated, to get new insights into how cell plasticity is adopted by cancers to promote therapy resistance, metastases and relapse.

Discovering regulators of lineage plasticity in non-small cell lung cancer

Lung cancer is the leading cause of cancer-related deaths worldwide. A significant factor in the high death rate of lung cancer is the acquisition of resistance to targeted therapies in patients. This is exemplified in a rare subtype of non-small cell lung cancer patients treated with targeted therapies who have good initial therapeutic responses but then experience disease recurrence due to “lineage plasticity”. Lineage plasticity refers to the ability of cells to transition from one committed cellular behaviour to another. Lineage plasticity enables lung cancer cells to completely transform and escape therapy. Currently there are no therapies to combat lineage plasticity in lung cancer patients due to the absence of any clear actionable targets to develop drugs against.

This project will aim to identify novel regulators of lineage plasticity in non-small cell lung cancer. The project will use an in vitro cell line model of non-small cell lung cancer that is both capable of, and reports upon, lineage plasticity. The prospective student will have the opportunity to use a range of cutting-edge technologies including; CRISPR-Cas9 genetic knockout screens, epigenomic and transcriptomic analyses, cell culture and molecular biology techniques. The project is suitable for a student wishing to be solely lab based or those who also wish to do both experiments and bioinformatic analysis.

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Co-Supervisor:

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Project Availability:

- Master of Biomedical Science
- Honours

Investigating novel epigenetic regulators using embryonic stem and cancer models

Epigenetics helps define current cell states, yet also shapes how cells respond to external cues such as differentiation or stress. The epigenetic plasticity of a cell describes how flexible this regulation is. Early embryonic cells are highly plastic in that they are able to generate all adult cell types. As development progresses, this plasticity is lost as normal healthy adult cells are locked in their identity. Crucially, aberrant reactivation may contribute to pathologies such as cancer. Our laboratory explores how epigenetic plasticity is controlled and regulated in development, applying these principles to understand how it is exploited by cancers.

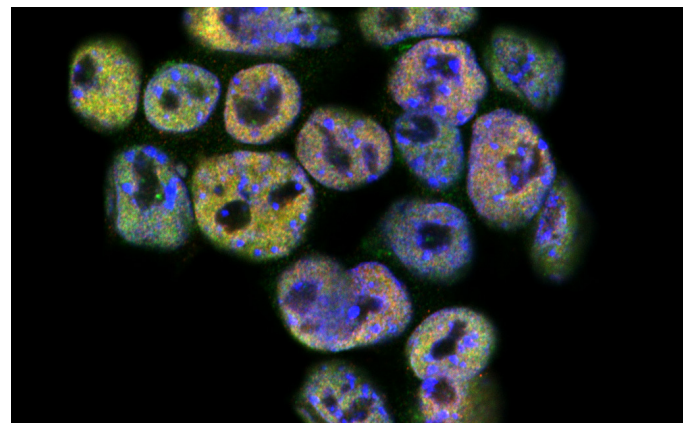
This project will investigate a class of poorly understood epigenetic regulators that are associated with severe developmental disorders and also implicated in cancers. The project will use high throughput CRISPR screens to systematically assess functional importance of these epigenetic regulators in embryonic stem cell and/or cancer cell models. Subsequent molecular experiments will uncover the mechanism and functional significance of these epigenetic regulators in shaping developmental and/or cancer processes. The prospective student will have the opportunity to use a range of cutting-edge technologies including chromatin assays, CRISPR-Cas genome engineering, epigenomic and transcriptomic analyses, cell culture and molecular biology techniques. The project is suitable for a student wishing to be solely lab based or those who also wish to do both experiments and bioinformatic analysis.

Primary Supervisor:

A/Prof. Melanie Eckersley-Maslin
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Project Availability:

- PhD



Using machine learning to uncover how developmental transcriptional programs contribute to cancer

The Eckersley-Maslin laboratory, based at Peter MacCallum Cancer Centre, uses both computational and experimental approaches to investigate the epigenetic and chromatin regulation of cell identity and adaptation using development and cancer models. Many principles of embryonic development are shared with cancers. In both contexts, cells readily acquire new identities, which are otherwise constrained in healthy adult cells. Embryonic cells and cancer cells have high proliferative potential and have the capacity to generate heterogeneous mixtures of cell types and states. Accordingly, cancers often undergo dedifferentiation and upregulate transcripts associated with stem cells and embryonic states.

We have recently applied machine learning to systematically assess the extent and impact of upregulating transcriptional networks associated with the earliest stages of human embryonic development in cancers. In many contexts, upregulation of transcripts associated with early embryonic states is associated with altered outcomes for patients. In this project we will extend these models to include other important developmental stages using the existing frameworks. This project will involve collating and integrating transcriptomic datasets to build developmental atlases, training and validating machine learning models, testing models on simulated datasets and ultimately running the models on large cancer datasets (e.g. TCGA, CCLE).

Note this is a dry-lab only research project and requires prior bioinformatic/computational biology experience (e.g. knowledge of R)

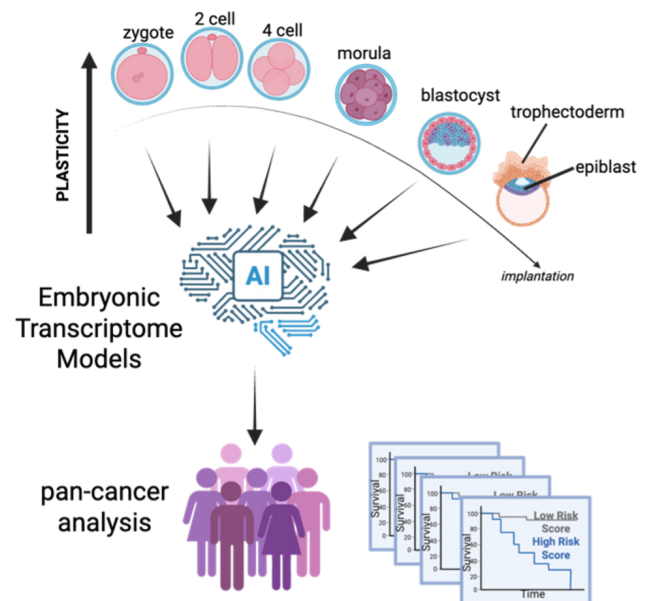
Primary Supervisor:

A/Prof. Melanie Eckersley-Maslin

melanie.eckersleymaslin@unimelb.edu.au

Project Availability:

- Master of Biomedical Science
- Honours





Stamp & Hao Group

Contact: Dr Lincon Stamp/ Dr Marlene Hao
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Location: Department of Anatomy and Physiology

Proper development and function of the digestive tract is crucial for good health. Gut function relies on the co-ordinated activity of neural circuits in the enteric nervous system (ENS), a network of neurons and glia located within the wall of the gastrointestinal tract. Our lab focuses on investigating the plasticity of the enteric nervous system and the development of stem cell therapy to treat digestive diseases.

Engineering stem cells for the enteric nervous system

Hirschsprung disease is a congenital disorder characterised by the absence of enteric neurons in the distal intestine, leading to functional obstruction. It is fatal if left untreated. The only current treatment option for Hirschsprung patients is surgical resection of the affected segment of gut, however, 50% of patients continue to have chronic ongoing complications, including enterocolitis (infection and inflammation of the gut). This condition arises from defects in the migration, proliferation, or survival of neural crest-derived cells that give rise to the enteric nervous system during embryonic development. This project explores the potential of stem cell therapy to restore the missing enteric neurons. We will be investigating a novel engineered stem cell line, including the addition of channelrhodopsin-2 and genetically encoded calcium indicators to examine neuronal function, both in vitro and in vivo.

Primary Supervisor:

Dr Atefeh Namipashaki
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Co-Supervisor:

Dr Lincon Stamp
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Project Availability:

- Master of Biomedical Science
- Honours

Stem cell therapy for Upper GI Disorders

Gastric motility disorders including gastroparesis and achalasia are rare but debilitating conditions that can result in chronic pain and potentially life-threatening symptoms, as well as elevated risk of esophageal cancer. These conditions are caused by the selective loss of the local inhibitory motor neurons and/or interstitial cells that are essential for generating appropriate motility patterns to move gastric content. The prevalence of gastroparesis in particular is increasing with the increased use of GLP-1 receptor agonists, like Ozempic. In this project, we are investigating the underlying pathophysiological changes and seek to develop cell therapy as a potential novel treatment option to replace the missing cells using induced pluripotent stem cell technology in mouse models of these conditions.

Primary Supervisor:

Dr Madeleine Di Natale
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Co-Supervisor:

Dr Lincon Stamp
lstamp@unimelb.edu.au

Project Availability:

- Master of Biomedical Science
- Honours

Modelling Digestive Diseases in vitro

The enteric nervous system (ENS) is affectionately known as the “second brain”. Located within the wall of the gastrointestinal tract, the ENS is key for control of digestive function. However, there are many digestive disorders that arise from defects in enteric neuron development or function. While miswiring in the central nervous system is known to be the cause of many neuropsychiatric disorders, how neuronal wiring in the ENS leads to defects in its function has not been previously investigated. Using induced pluripotent stem cell (iPSC) technology, we aim to model how ENS miswiring occurs in patients with digestive diseases. Using novel hydrogel technology and biomimetic printing, we will develop in vitro models of the ENS to examine how neuronal connections form during normal development, and in different gastrointestinal motility disorders, including Hirschsprung Disease.

Primary Supervisor:

Dr Marlene Hao

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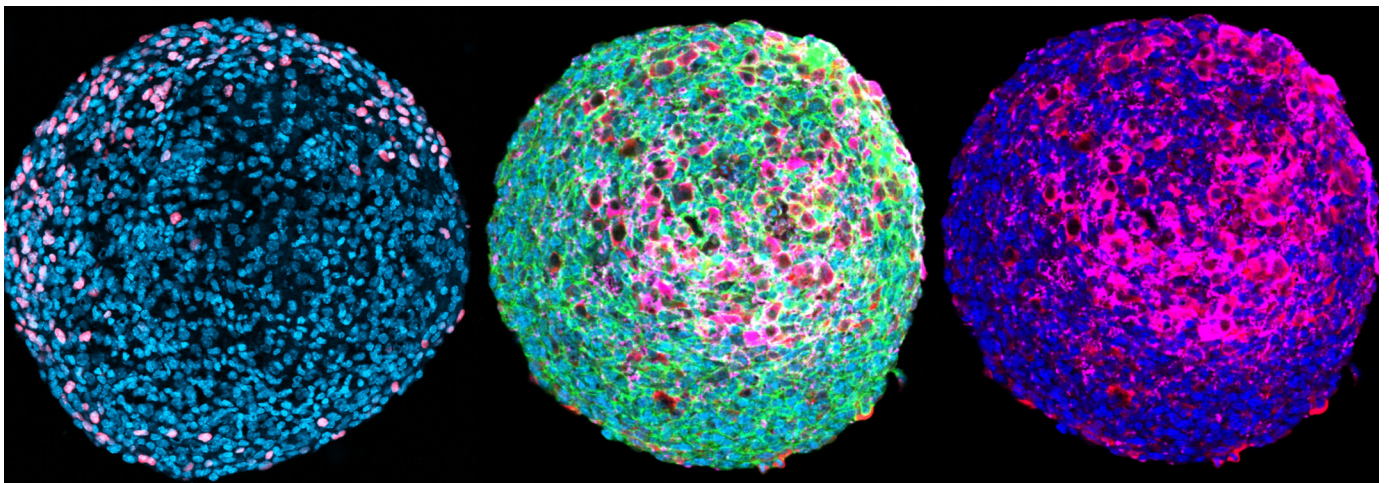
Co-Supervisor:

Dr Lincon Stamp

lstamp@unimelb.edu.au

Project Availability:

- Master of Biomedical Science
- Honours





Wells Group

Contact: Prof. Christine Wells
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Location: Melbourne Brain Centre / Kenneth Myer Building

Immune cells support tissue regeneration and repair by producing growth factors that stimulate tissue repair. The Wells lab uses pluripotent stem cells to model human myeloid cells - macrophages and dendritic cells. Using innovative sequencing technologies we have discovered several growth factors that appear to be uniquely made by macrophages. The current lab focus is to understand how and why macrophages make these factors, as well as the functional impact these factors have on tissue repair.

Characterisation of myeloid-derived growth factors

Students will undertake characterisation of a newly discovered isoform of a growth factor made by macrophages. They will gain experience in basic cell and molecular biology techniques, including culture of pluripotent stem cells, isolation of mRNA and protein, quantitative PCR, flow cytometry and microscopy. Students will also receive training in primer design, and the use of genome browsers. Students will use genetic databases and the scientific literature to investigate potential disease associations with genetic polymorphisms associated with newly discovered growth factors.

Primary Supervisor:

Prof. Christine Wells
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Co-Supervisor:

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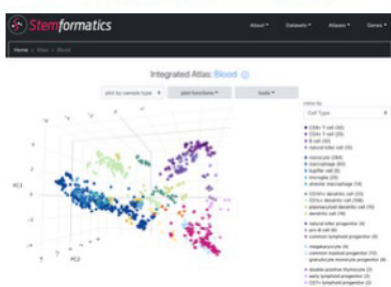
Project Availability:

- Honours

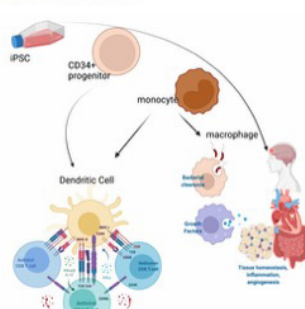


Stem Cell Systems Laboratory Christine Wells

I) Using computational approaches to model cell identity, function



II) Pluripotent-stem cell models of myeloid biology





Pébay and Di Biase Group

Contact: Dr. Maria Di Biase/ Prof. Alice Pébay
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Location: Department of Anatomy and Physiology

We generate stem cells from adult human tissue, specifically induced pluripotent stem cells (iPSCs), to overcome some of the obstacles in studying human brain development. Utilising iPSCs, we aim to refine and advance models of neural connectivity in vitro and uncover the molecular and cellular foundations of healthy development and major psychiatric illnesses. Our research incorporates neuroimaging observations of the living human brain and brings together a diverse team with expertise in neuroscience, psychiatry, neuroimaging, and computer science. Our ultimate goal is to translate the knowledge gained from these studies into improved therapies for psychiatric illnesses.

Stem cell modelling of neuropsychiatric disorders

This project provides a unique opportunity to explore the developmental origins of schizophrenia—a severe mental health disorder—using cutting-edge patient-derived stem cell models. By generating both 2D and 3D neural models from induced pluripotent stem cells (iPSCs) sourced from patients, you will tackle the complexities of human brain development research. The project involves the generation of in vitro neurodevelopmental models, their in-depth characterisation through techniques such as calcium imaging and single cell RNA sequencing, and the computational analysis of these data. The overarching goal is to unravel the molecular and cellular foundations of schizophrenia and we are dedicated to translating our research findings into groundbreaking treatments.

Primary Supervisor:

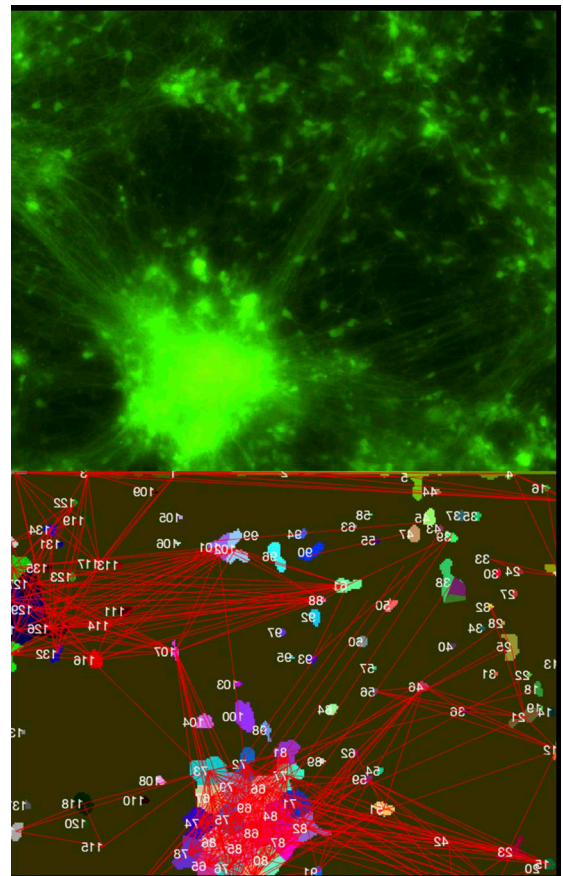
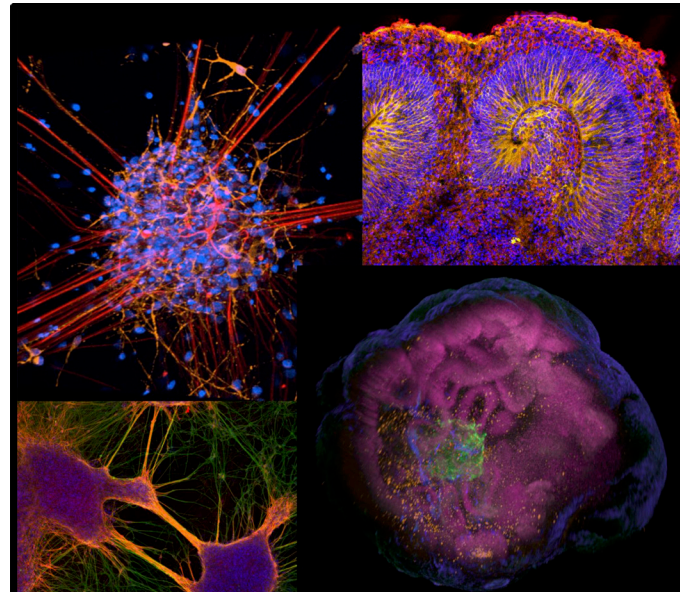
Dr. Maria Di Biase
dibiasem@unimelb.edu.au

Co-Supervisor:

Prof. Alice Pébay
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Project Availability:

- PhD
- Master of Biomedical Science





Nayagam Group

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Location: Department of Anatomy and Physiology

Permanent, bilateral hearing loss is the most common side-effect from cisplatin chemotherapy. Recent studies have discovered a critical role for macrophages in cisplatin-induced hearing loss, presenting opportunities to modulate their inflammatory activity. This study will aim to identify the key molecular drivers of cisplatin-induced macrophage inflammation, thereby accelerating targeted treatments to prevent hearing loss whilst receiving chemotherapy.

Understanding macrophage biology in the inner ear

This project will seek to better understand macrophage signalling and biology under normal conditions, and following exposure to platinum-containing compounds, such as cisplatin. Students will learn how to culture human pluripotent stem cells, differentiate these into macrophages, run flow cytometry analyses and perform immunohistochemistry and fluorescence imaging.

Primary Supervisor:

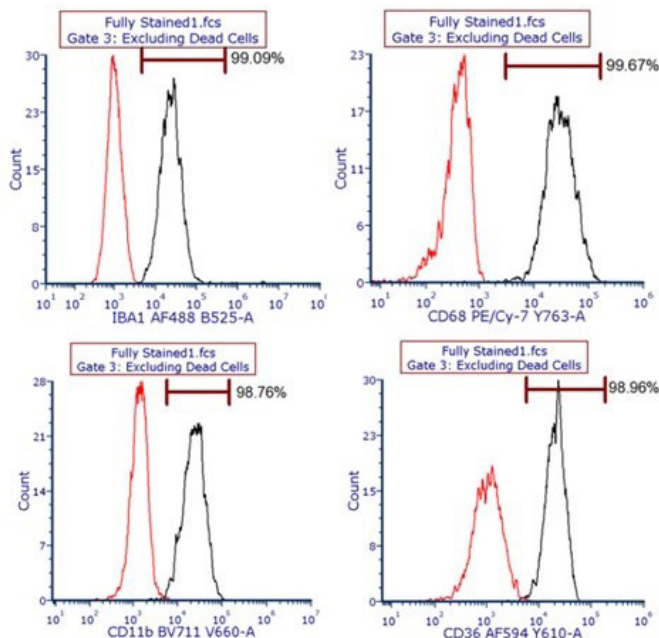
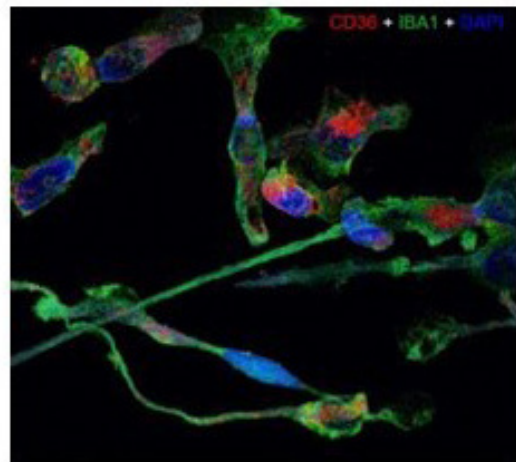
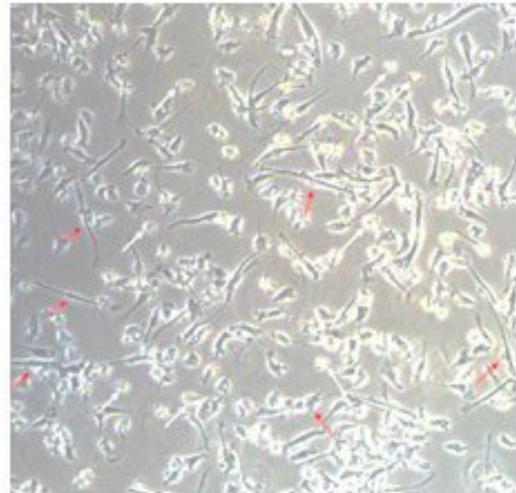
A/Prof. Bryony Nayagam
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Co-Supervisor:

Prof. Christine Wells
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Project Availability:

- PhD
- Honours





Scholarship of Teaching and Learning (SOTL)





Clark Education Group

Contact: Dr Charlotte Clark

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Location: Department of Anatomy and Physiology

Our research into the Scholarship of Teaching and Learning (SoTL) evaluates techniques, strategies and technologies that enhance learning within Biomedical Science education. We focus on development and evaluation of reflective practice through quantitative and qualitative analyses. More broadly, we also examine the value and learning benefits associated with educational innovation.

Development of reflection as a critical skill to enhance learning

Reflection is an important part of the learning process but is not commonly explicitly taught as a skill. We investigate the relationship between reflection and learning through analysis of reflective tasks integrated into various subjects delivered within the School of Biomedical Sciences. Our analyses include exploring whether students focus on the learning process compared to the product of their learning; exploring the transformative nature of reflection; and exploring the development of graduate attributes, and employability skills through engagement with reflection.

Primary Supervisor:

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Co-Supervisor

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Project Availability:

- Honours

Evaluation of innovative teaching and learning activities

Scholarly evaluation of current and innovative teaching and learning activities is essential. We investigate student learning in Biomedical Science. Our analyses include exploring the value of student class attendance; developing processes to facilitate and assess student collaboration; utilising analytics to explore student engagement with learning resources; application of design thinking in education; and exploring student misconceptions within biomedical sciences. Specific research projects can be further developed based on student interest and passion.

Primary Supervisor:

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Project Availability:

- Honours



Fong Group

Contact: A/Prof. Angelina Fong
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Location: Department of Anatomy and Physiology

We are keenly interested in how technology and digital tools can enhance, and support student learning and improve educational outcomes. As part of the “age of technology”, current students are presented with a broad range of learning resources and educational tools. These tools can range from online videos, discussion boards, virtual environments, to Chatbots powered by Generative Artificial Intelligence (GenAI). It is unclear if and how these tools can be used to benefit students and their learning as rate of change increases with the emergence of the “intelligence age” and GenAI. We are also interested in understanding the underlying motivations and expectations of students as they engage with their learning and education, whether it be with the subject material, or with their learning environments. Together, these research areas will provide insights into how to design learning environments, and resources to best support students to promote their education.

Investigating student motivation and engagement with their learning and teaching environments.

Current students are presented with a broad range of learning resources, and educational tools in their learning environment. Instructors are keen to integrate a large variety of tools and resources for students with the underlying intent of improving the educational outcomes. The intention of these resources and activities are usually rooted in improving the educational and learning outcomes or developing transferrable skills in students to improve their prospects as defined by the graduate attributes. However, it is not clear exactly how students interact and engage with the variety of resources available, or if the students perceive these resources as useful. Furthermore, it is unclear what are the student motivations and reasonings for when and how they engage with different resources, and environments. These can extend to and include online learning resources and environments, or the physical classes rooms. Projects under this study may include evaluating student engagement and interaction with online learning resources and tools, including virtual lab environments, online video recordings, interactive learning resources, use of GenAI in aiding learning. Longer projects may include co-creating and developing new learning resources and assessing their efficacy in improving student learning. The exact nature of the research project may be directed by the student’s individual interest in discussion with the supervisors.

Primary Supervisor:

A/Prof. Angelina Fong
angelina.fong@unimelb.edu.au

Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Mapping the Landscape of Student Perceived Skill Acquisition.

Throughout their undergraduate journey, students are exposed to a diverse array of learning experiences designed to cultivate both subject-specific knowledge and transferable skills aligned with industry demands and graduate attributes. Educators integrate a variety of learning activities and environments to help students cultivate these crucial transferable skills. How do students perceive and recognize the skills they are acquiring throughout their degree programs? There is anecdotal evidence that students are often unaware of these competencies they are developing, how they value these skills, and whether they can articulate their skill set effectively. There is limited insight into how students believe these acquired skills will contribute to their future careers or further academic pursuits.

This project investigates student perceptions of skill acquisition throughout their undergraduate studies, focusing assessing student awareness, and exploring their perceived relevance to future careers or academic pursuits. The study will examine key skill areas, such as teamwork, leadership, communication, digital literacy, feedback literacy. Additionally, the research may explore the effectiveness of various pedagogical approaches and curricular elements in fostering skill recognition and articulation among students.

Longer-term projects could involve developing and implementing interventions designed to enhance student awareness of skill acquisition, including co-creating resources and effective messaging techniques to promote students’ ability to recognize, articulate, and leverage their skills acquired.

This project aims to contribute to more effective curriculum design and improved graduate employability outcomes.

The exact nature of the research project may be directed by the student’s individual interest in discussion with the supervisors.

Primary Supervisor:

A/Prof. Angelina Fong
angelina.fong@unimelb.edu.au

Project Availability:

- PhD
- Master of Biomedical Science
- Honours



SMART

(Student Motivation, Activity, and Research for Teaching)

Contact: A/Prof. Joseph (Yossi) Rathner
Email: Joseph.Rathner@unimelb.edu.au
Location: Department of Anatomy and Physiology

Our research group applies the Science of Learning to better understand how students approach their studies in today's higher education landscape and to develop more effective academic skills. We employ a rigorous, mixed-methods approach that combines student surveys with controlled experiments to test hypotheses about learning approaches

In the rapidly evolving educational environment, accelerated by the COVID-19 pandemic, we're investigating the impact of asynchronous learning models and educational technologies on student engagement and outcomes. Our research focuses on several key areas:

1. Note-taking strategies in digital environments: We're examining the differences between transcription and effective note-taking, particularly in the context of recorded lectures. Through controlled experiments, we're testing how various note-taking methods affect information retention, comprehension, and academic performance.
2. Cognitive load and information processing: Our studies investigate how the cognitive demands of different learning approaches impact students' ability to process and understand course material. We're particularly interested in how multitasking (e.g., listening while transcribing) affects learning outcomes.
3. Elaborative learning techniques: We're exploring the effectiveness of strategies like mind mapping and concept mapping in enhancing understanding and retention. Our experiments compare these techniques with more traditional study methods to identify best practices for deep learning.
4. Pre- and post-lecture learning strategies: Through both surveys and controlled studies, we're assessing how pre-lecture preparation and post-lecture review techniques influence learning outcomes. This includes investigating the impact of providing lecture transcripts on student engagement and comprehension.
5. Developmental aspects of learning strategies: Our longitudinal studies track how students' learning approaches evolve throughout their academic careers, helping us understand how to tailor support at different stages of higher education.
6. Balancing accessibility and active engagement: We're investigating how to optimize the use of learning aids like transcripts and recorded lectures to enhance accessibility without promoting passive learning behaviors.
7. Technology-enhanced learning environments: Our research examines how various digital tools and platforms affect student engagement, time management, and overall academic performance.

By combining survey data on student perceptions and experiences with empirical evidence from controlled experiments, we aim to bridge the gap between student practices, institutional policies, and effective pedagogical approaches. This comprehensive approach allows us to develop evidence-based recommendations for both students and educators.

Our ultimate goal is to enhance student learning by promoting strategies that foster deep understanding, critical thinking, and long-term retention of knowledge. We're committed to helping students develop robust academic skills that will serve them throughout their educational journey and beyond.

Through this research, we're contributing to the ongoing transformation of higher education, ensuring that technological advancements and pedagogical innovations are harnessed to truly enhance the learning experience. Our findings inform the development of more effective teaching methods, learning resources, and institutional policies, ultimately leading to improved student outcomes and a more engaging, efficient educational experience.

Optimising Student Learning Strategies in Higher Education: A Scientific Approach to Understanding and Enhancing Academic Performance in the Digital Age

Key skills students will develop:

1. Survey Design and Analysis
2. Focus Group Interviews
3. Controlled Intervention Studies
4. Statistical and Qualitative Data Analysis
5. Participant Management:
 - Recruiting participants
 - Main contact for participants
 - Maintaining communication
 - Managing relationships

Research focuses on technology-enhanced learning:

- Online simulated practical classes
- Asynchronous learning environments
- Augmented/virtual reality experiences
- Digital tools for note-taking, retention
- Adaptive learning platforms
- AI in learning and teaching

Students involved in all research stages:

- Research design discussions
- Ethics applications
- Developing data collection instruments
- Data collection and analysis
- Interpreting results

Project offers opportunity to contribute to cutting-edge research in educational psychology and learning sciences. Students develop skills in mixed-methods research and participant management, enhancing future employability.

Findings contribute to evidence-based practices in higher education, potentially influencing teaching methods and institutional policies. Students gain:

- Understanding of learning behaviours and technology's impact on education
- Critical evaluation skills for educational interventions
- Experience with quantitative and qualitative methods
- Ability to approach complex problems from multiple angles
- Relevant skills for technology-driven educational contexts

Research experience equips students with:

- Practical skills
- Analytical thinking
- Understanding of educational research methodologies

This project develops transferrable skills, enhances understanding of learning processes, and provides opportunity to impact educational practices through rigorous, innovative research. Students will be well-positioned as valuable contributors to the field of education and beyond, prepared for evolving digital learning environments and various career paths.

Primary Supervisor:

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Co-Supervisor:

Dr Makhala Khammy

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours

Fit for Success: Leveraging Exercise to Enhance Academic Performance

1. Survey Design and Analysis:
 - Create and implement surveys on student perceptions, experiences, and learning behaviours
2. Focus Group Interviews:
 - Conduct and analyse qualitative data
 - Develop qualitative research skills
3. Controlled Intervention Studies:
 - Design and execute experiments assessing physical activity's impact on academic outcomes
 - Develop skills in experimental design, participant recruitment, and data collection
4. Physical Fitness Assessments:
 - Conduct VO2 max tests and other fitness evaluations
 - Operate specialized equipment and interpret physiological data
5. Participant Management:
 - Develop skills in managing people and tasks, ensuring participant engagement
6. Data Management and Analysis:
 - Organize and manage large datasets
 - Apply statistical methods to interpret quantitative data
 - Use AI tools for coding and interpreting interview data
7. Ethics Applications:
 - Assist in preparing ethics applications for human research
 - Understand ethical considerations in human participant research
8. Collaboration with External Partners:
 - Work with Melbourne University Sport staff
 - Gain experience in interdisciplinary collaboration and stakeholder management

Students will be involved in all research stages, from study design to data analysis and interpretation. They'll gain hands-on experience with quantitative and qualitative methods, developing a well-rounded skill set applicable to various research contexts.

This project offers an opportunity to contribute to innovative research that could significantly impact university policies and student support practices. Students will develop valuable transferable skills in project management, data analysis, scientific communication, and participant management, preparing them for future careers in research or related fields.

Primary Supervisor:

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Co-Supervisor:

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Project Availability:

- PhD
- Master of Biomedical Science
- Honours



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Get in touch

If you're considering studies at the University of Melbourne,
we'd love to hear from you online or meet you on campus.

Sign up and submit enquiries online at:

<https://biomedicalsciences.unimelb.edu.au/departments/anatomy-and-physiology>

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