Department of Anatomy & Developmental Biology
2020 Honours Programs

2020 Honours Coordinator
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2020 Honours Programs in Anatomy & Developmental Biology

The Honours programs in Anatomy and Developmental Biology consist of a significant research project and a compulsory coursework component. The objectives are to develop students' research skills, allow participants to learn specific techniques and gain a broader understanding of the biomedical sciences, enhance students’ ability to develop a hypothesis from previous studies and critically evaluate the literature. Students will also be given the opportunity to learn how to effectively design suitable experiments to test the project aims and prepare a detailed and scholarly report called Thesis. The Honours program in Anatomy and Developmental Biology provides the opportunity to undertake a specific avenue of research selected from the range of research interests within or outside the Department. These include reproductive biology in humans and other mammals, biomechanics, neurobiology, haematology and various aspects of molecular biology, the biology of cancer and pre-malignant states in humans and animals, connective tissue structure and function, cell biology of epithelial tissues, developmental biology, renal and cardiovascular research.

The course is divided into two generic Biomedical Science Honours units; BMH4100 and BMH4200.

BMH4100 – Biomedicine research project

Synopsis

Students will undertake a supervised research project of a publishable standard. Students will research literature relevant to their topic, carry out a research project and present the results of their study in both written and oral form.

Outcomes

On completion of this unit, students will be able to:
1. Critically review the scientific literature that underpins the area of the research project;
2. Undertake a supervised research project and contribute to project design and management;
3. Apply appropriate laboratory techniques, research methodologies and data analysis methods to collect, interpret and report research findings;
4. Effectively present research and findings orally showing a firm grasp of the area;
5. Analyse research undertaken in the context of the discipline area and report findings in an extended written report.

BMH4200 – Advanced studies in biomedicine

Synopsis

Students will develop analytic abilities and critical thinking skills in specific areas of Biomedical Science. Each module within the unit BMH4200 will include common coursework activities and a common assessment regime.

Outcomes

On completion of this unit, students will be able to:
1. Critically review scientific literature in the discipline area of research;
2. Apply knowledge of current methodologies and concepts to appraise scientific literature in the discipline area;
3. Apply analytical and data analysis techniques relevant to the discipline area of research;
4. Effectively communicate concepts in the discipline area of research both in writing and orally.

**Graduate Attributes**

Monash prepares its graduates to be:

1. responsible and effective global citizens who:
   a. engage in an internationalized world
   b. exhibit cross-cultural competence
   c. demonstrate ethical values

2. critical and creative scholars who:
   a. produce innovative solutions to problems
   b. apply research skills to a range of challenges
   c. communicate perceptively and effectively

**Formal Application Process**

There is a 3-Step application process for Anatomy and Developmental Biology entry:

1. Discuss the projects of interest with the potential supervisors by appointment.
2. Submission of a project application signed by the supervisors to Dr Olga Panagiotopoulou.
3. Formal application to the faculty

   BSc Hons: www.monash.edu/science/current-students/science-honours
   BMS: www.med.monash.edu.au/biomed/honours/

**Assessment Summary**

<table>
<thead>
<tr>
<th>BMH4100 - Biomedicine research project (36 points)</th>
<th>Value (%)</th>
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<tbody>
<tr>
<td>Literature Review &amp; Project Outline</td>
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<td>7.5</td>
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<tr>
<td>Seminar 1</td>
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<td>3.75</td>
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<tr>
<td>Thesis</td>
<td>80*</td>
<td>60</td>
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<td>Seminar 2</td>
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<tr>
<td>Thesis Review</td>
<td>*Contributes to thesis mark</td>
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**TOTAL:** 100% 75%
BMH4100 - Biomedicine research project (36 points)

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<td>Biostatistics Module</td>
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<tr>
<td>Journal Club presentation</td>
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<tr>
<td>Written Critical Review Exam</td>
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<td><strong>TOTAL:</strong></td>
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BMH4100 - Biomedicine research project (36 points)

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<td>Journal Club Presentation</td>
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<tr>
<td>2000 Word Essay</td>
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Teaching approach

Students have the opportunity to undertake Honours projects at affiliated institutes such as the Hudson Institute of Medical Research, Monash Medical Centre, Baker Heart Research Institute or the Monash Centre for Accident Research. The Honours and Biomedical science program within the Department of Anatomy and Developmental Biology is unique in that it is devoted almost entirely to the chosen research project. There are no extensive lecture series or practical courses.

Entry Criteria

Bachelor of Science (Honours) [www.monash.edu/science/current/honours](http://www.monash.edu/science/current/honours)

Bachelor of Science students wishing to undertake an Honours degree in the School of Biomedical Science (SOBS) have increased flexibility to complete an Honours degree in the Department of Anatomy and Developmental Biology. Any major in the School of Biomedical Science will allow students to undertake an Honours degree within the Department of Anatomy and Developmental Biology.

A distinction grade average (70%) in 24 points of relevant 3rd year units, of which normally 18 points are developmental biology or biochemistry, human pathology, immunology, microbiology, pharmacology and physiology units. In addition to the requirements listed above, students must meet the entry requirements for the Science honours program relevant to their course of enrolment. Enrolment in an honours project is subject to approval of the supervisor and the Honours Convenor.

Bachelor of Biomedical Science (Honours) [www.med.monash.edu.au/biomed/honours](http://www.med.monash.edu.au/biomed/honours)

An average of 70% or higher in at least 24 points at 3rd year (including 12 points in Biomedical Science core units).

The closing date for Bachelor of Biomedical Science and the Faculty of Science applications is usually mid-November.
The Department of Anatomy and Developmental Biology is one of six departments in the Monash Biomedicine Discovery Institute (encompassing the School of Biomedical Science), which is part of the Faculty of Medicine, Nursing and Health Sciences.

The Department is responsible for the delivery of human anatomy teaching in the medical, physiotherapy, radiography, biomedical science and science degrees. Teaching is conducted at both the undergraduate and postgraduate levels. Human anatomy teaching is overseen by the Centre for Human Anatomy Education, which is located within the Department.

In 2007, the Department introduced the first Bachelor of Science major in Australia in developmental biology. Developmental biology is the discipline concerned with the development of an adult organism from a single cell. The BSc major provides foundation studies in embryology, histology and anatomy, and covers such topics as human development, mechanisms of development, birth defects, stem cells, and regenerative biology and medicine.

Research in the Department is focused on the wider field of developmental biology. Researchers are focused on the molecular mechanisms responsible for development of specific organs, the consequences for adult health of suboptimal fetal development, the health consequences of premature birth, and the roles of stem cells in development as well as in regeneration of organs following disease.

CONTACT
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ABOUT THE MONASH BIOMEDICINE DISCOVERY INSTITUTE (encompassing the School of Biomedical Sciences)

WHO WE ARE
- An institute with the scale and scope to tackle major research questions
- 120+ internationally-renowned research teams committed to addressing global health priorities

WHAT WE DO
- Discovery research to accelerate our ability to prevent, diagnose and treat disease
- Innovate through national and international collaborations and partnerships with researchers, health precincts and industry
With more than 120 internationally-renowned research teams, the Monash Biomedicine Discovery Institute (BDI) is one of the largest and highest-quality biomedical research institutes in Australia. Monash BDI works with national and international collaborators on global health priority areas, including cancer, cardiovascular disease, development and stem cells, infection and immunity, metabolism, diabetes and obesity, and neuroscience.

Our discoveries accelerate the ability to prevent, diagnose and treat disease by leveraging our strong partnerships with researchers, health precincts and industry, together with our access to unparalleled, world-leading research infrastructure.

The Monash BDI encompasses the School of Biomedical Sciences, and is part of Monash’s Faculty of Medicine, Nursing and Health Sciences. The School of Biomedical Sciences delivers biomedical sciences education to more than 2,000 undergraduate students and 300 postgraduate students.

Based at Monash’s Clayton campus, the Monash BDI is structured to include six health-focused discovery programs and five discipline-specific departments. This allows for the cross-pollination of ideas needed to tackle the big questions in biomedical research – it is at the intersection of these global health issues that truly innovative discoveries will be made.

**DISCOVERY PROGRAMS**
- Cancer
- Cardiovascular Disease
- Development & Stem Cells
- Infection & Immunity
- Metabolism, Diabetes & Obesity
- Neuroscience

**DEPARTMENTS**
- Anatomy & Developmental Biology
- Biochemistry & Molecular Biology
- Microbiology
- Pharmacology
- Physiology

**CENTRES**
- Centre for Human Anatomy Education
In the gastrointestinal tract there are complex interactions between multiple cell types, particularly the enteric nervous system, epithelial cells lining the gut lumen, the immune system and the microbiota. Signalling between these tissues regulates normal development and homeostasis. However, there are many aspects of these interactions that are not yet understood. This project aims to investigate some of these interactions, using molecular techniques, tissue culture and live cell imaging.

**Project Title**: Drug and Functional Screening using intestinal organoids

**Main Supervisor**
A/Prof Helen Abud  helen.abud@monash.edu  990 29113

**Other Supervisors**
Dr Rebekah Engel  rebekah.engel@monash.edu  990 29196
Dr Sefi Rosenbluh  Biochemistry and Hudson Institute

**Location**
Clayton Campus, 19 Innovation Walk, Level 3

**Background**: Intestinal organoids derived from human tumours and adjacent normal tissue are a key model for preclinical studies. Organoids recapitulate the cellular composition and functional features of the original patient tissue and tumours. Organoids can be expanded and used in screening approaches to test drug response and other functional assays.

**Project Aims**: This project aims to develop a functional and/or drug screens in organoids.

**Techniques**: This project will involve growth of human colonic organoids. Genetic and/or drug libraries will then be screened. Outputs of the assay would include measurement of growth, apoptosis, morphology and molecular changes in intestinal organoids.
**Project Title**: Investigating the progression of neuroendocrine prostate cancer

**Research Theme**: Prostate Cancer

**Main Supervisors**
- Prof Gail Risbridger
  - gail.risbridger@monash.edu
  - 9902 9558

**Other Supervisors**
- Dr Roxanne Toivanen

**Location**
- Clayton Campus, 19 Innovation Walk, Level 3

**Outline of Project**

**Background**: Prostate cancer is the most commonly diagnosed cancer in Victoria. As most prostate tumours rely on androgen hormones for growth, the most common therapies for metastatic prostate cancer are drugs which inhibit androgen signalling. However, some patients develop neuroendocrine prostate tumours, which are highly aggressive and resistant to androgen inhibitors. Currently, there is limited understanding of how neuroendocrine tumours emerge in patients, and therapeutic options are limited.

Our laboratory has successfully developed a model where patient samples of neuroendocrine prostate cancer can be grown and studied in the laboratory. These samples represent an invaluable resource for studying the biology of these tumours and testing novel therapeutics.

**Project Aims**: The goal of this project is to use patient-derived models of neuroendocrine prostate cancer to study disease progression and test effective therapeutic strategies.

**Techniques**: The project will involve a variety of techniques including working with human tumours, tissue culture and immunohistochemistry.
**Project Title**
*Identifying new treatments for drug-resistant cancer*

**Main Supervisor**
Prof Gail gail.risbridger@monash.edu 9902 9558
Risbridger

**Other Supervisors**
Dr Mitchell Lawrence, A/Prof Renea Taylor

**Location**
Clayton Campus, 19 Innovation Walk, Level 3

**Outline of project**

**Background:**
Over the last decade, new treatments have extended the survival of men with advanced prostate cancer. Unfortunately, patients eventually develop resistance to all current treatments. Therefore, effective new therapies are needed for drug-resistant cancers.

Our group is tackling this challenge in a new way - by growing tumours from different patients in the lab. Using this novel technique, we can compare how tumours respond to novel treatments. Our results are already showing that some tumours are more sensitive than others to specific treatments. These exciting results are helping us prioritise drugs for further clinical validation.

**Project aim:**
In this project, we will test the response of different patients’ tumours to novel drugs targeting the epigenome and DNA damage repair. Subsequently, we will identify molecular features that distinguish between sensitive and resistant tumours. These important results will provide new insight into better treatments for tumours that have failed current therapies.

**Techniques to be used:**
This project will use techniques a range of techniques including organoid cell culture, *ex vivo* treatments of patient-derived tumours, immunohistochemistry and pathology.
# Project Title

**Understanding brain-intestinal communication.**

## Research Theme

**Neurobiology and Genetics**

## Main Supervisor

Roger Pocock  
roger.pocock@monash.edu  
99050658

## Location

15 Innovation Walk, Clayton Campus

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### Background:

Obesity is a pervasive worldwide health concern. However, we do not fully understand the genetic causes of obesity. Therefore, **identification of conserved molecular mechanisms driving fat storage and food-seeking behaviour** is fundamental to understanding this disorder. In published work (Juozaityte et al. *PNAS* 2017), we revealed that the conserved ETS-5 transcription factor acts from two pairs of neurons to systemically control intestinal fat levels and food-seeking behaviour in *Caenorhabditis elegans*. We subsequently performed chromatin immunoprecipitation experiments to identify direct transcriptional targets of ETS-5 that may be important to control obesity. This project will use state-of-the-art fat and behavioural analysis to dissect novel molecular pathways that are controlled by ETS-5 to regulate obesity and behaviour.

### Project Aims:

In this project, we will identify molecular mechanisms through which the brain and intestine communicate with each other to control fat levels and animal behaviour. Based on our preliminary data we believe that we have discovered a new means of controlling brain-intestinal communication, which may be useful in therapies for obesity and eating disorders.

### Techniques to be utilised:

This project will utilise techniques in genetics, *in vivo* neurodevelopmental dissection, molecular biology, biochemistry, microscopy.

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Animal transgenically expressing fluorescent proteins to enable visualisation of the nervous system.
**Background:** Stem cells have great potential for regenerative studies and disease therapeutics. However, we do not fully understand how stem cells develop *in vivo*, limiting their therapeutic potential. To study stem cell development *in vivo*, the well-defined *Caenorhabditis elegans* stem cell niche has proven an excellent model. Using RNA sequencing and gene knockout studies we have identified multiple novel transcription factors that are important for stem cell development. This project will use state-of-the-art techniques to dissect the mechanistic functions of these transcription factors in stem cells.

**Project Aims:** In this project, we will decipher the function of conserved transcription factors in *C. elegans* stem cell development. We believe that this work will identify novel mechanisms through which stem cells may be manipulated.

**Techniques to be utilised:** This project will utilise techniques in genetics, *in vivo* stem cell analysis, confocal microscopy, biochemistry and CRISPR.

Structure of the *C. elegans* germline which contains undifferentiated stem cells.
Kidney Development and Disease (Smyth Lab)

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Characterising novel genes which cause congenital kidney disease</th>
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<tr>
<td>Main Supervisor</td>
<td>Ian Smyth</td>
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<td><a href="mailto:ian.smyth@monash.edu">ian.smyth@monash.edu</a></td>
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<td>99029119</td>
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<tr>
<td>Location</td>
<td>19 Innovation Walk</td>
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**Background:**
Our group is involved in an Australia-wide program (www.kidgen.org.au) which aims to identify novel causative genes in patients with kidney disease. Individuals with inherited kidney disease who do not have mutations in known genes will have their genomes sequenced to identify novel genetic causes for their conditions.

**Project Aim/s:**
We use CRISPR/Cas9 genome engineering approaches to model disease causing mutations in mice. Using these models, honours students will have a unique opportunity to establish how novel disease genes function in the kidney, how their protein products regulate cell biology and how their mutation leads to congenital renal malformations.

**Techniques:**
This project will utilise CRISPR/Cas9 approaches to introduce changes in mice which we will then study using histology, OPT imaging, immunostaining and RNA sequencing. Causative genes will be studied *in vitro* using tissue culture and various biochemical approaches will be employed to best understand gene and protein function.
Project Title: Understanding the pathogenesis of polycystic kidney disease

Main Supervisor: Ian Smyth  
i.an.smyth@monash.edu  
99029119

Location: 19 Innovation Walk

Background:
Polycystic kidney disease (PKD) is the most common potentially lethal Mendelian disease, affecting around 1/1000 people. It arises when cells of the kidney tubules over-proliferate, forming cysts which gradually expand and ablate normal kidney tissue. We have shown that the Aurora A Kinase is a central regulator of the development of cystic disease in a number of in vivo models of PKD.

Project Aim/s:
In this project we will examine a number of different mechanisms by which Aurka might be regulating the growth of renal cysts to better understand the how the protein functions, and to investigate it as a possible therapeutic target for treating the disease.

Techniques:
This project will examine mouse and cellular models of PKD and the biochemical functions of AURKA. It will utilise a broad range of techniques to do so including histology, immunohistochemistry and transcriptional profiling. Specific cell signalling pathways will be studied in vitro using tissue culture and various biochemical approaches to best understand gene and protein function.
**Project Title**  
Watching the Hippo pathway in real time in growing organs

**Main Supervisor**  
Kieran Harvey  
kieran.harvey@monash.edu

**Other Supervisors**  
Samuel Manning  
sam.manning@monash.edu

**Other Supervisors**  
Benjamin Kroeger  
benjamin.kroeger@monash.edu

**Location**  
Anatomy and Developmental Biology Department

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**Background**
A new frontier in biomedical research will involve watching individual proteins work in real time, in living organs. Traditionally, researchers have drawn conclusions about gene function using indirect techniques that only allow us to infer what a gene normally does, without actually watching it work. For example, we create organisms that lack a particular gene and determine whether something goes wrong. If the loss of gene X causes organs to overgrow, then we assume that gene X normally limits organ size. This has been an extraordinarily powerful approach for interrogating gene function, but it cannot substitute the ability to watch gene products executing their function in real time, which allows determination of exactly when, where and how they work.

**Project aim/s**
We will investigate the role of the Hippo tumour suppressor pathway in organ growth by watching, for the first time, its activity, in growing organs, in real time. This will provide novel insights into normal organ growth and pathogenic organ growth in diseases such as cancer.

We aim to observe Hippo pathway activity in real time in the following situations:

a) When organs are actively growing
b) When organs stop growing
c) In regions of organs that are subject to mechanical compression
d) Throughout the cell cycle

**Techniques**
You will be taught an array of techniques including ex vivo organ culture, live multi-photon microscopy, image analysis and *Drosophila* genetics.
**Project Title:** Investigating mechanisms of cGAS-STING activation

**Main Supervisor:** Dr Dominic De Nardo  
[dominic.denardo@monash.edu](mailto:dominic.denardo@monash.edu)  
Tel: 99029557

**Other Supervisors:** Prof Benjamin Kile  
[Benjamin.Kile@monash.edu](mailto:Benjamin.Kile@monash.edu)  
Tel: 9051580

**Location:** Department of Anatomy and Developmental Biology, Monash Biomedicine Discovery Institute

**Background:**
The innate immune system senses and responds to endogenous and exogenous danger signals in order to protect the host. cGAMP synthase (cGAS) detects viral double stranded DNA (dsDNA) in the cytosol leading to the activation of Stimulator of IFN Genes (STING) and production of type I interferons (IFNs) and inflammatory cytokines as part of an anti-viral inflammatory response. However, unwarranted activation by host dsDNA is implicated in a number of serious autoimmune and neurodegenerative conditions (e.g. Parkinson’s disease). Further, human expressing gain-of-function mutations in STING exhibit a life threatening autoinflammatory disease termed, STING-associated vasculopathy with onset in infancy (SAVI). The precise mechanisms controlling STING activation however, remain poorly described.

**Project aim/s:**
In this study we will examine STING activation, trafficking and downstream signalling responses under a range of conditions, including in the absence of potential regulating proteins. This work will help better define this critical inflammatory pathway.

**Techniques to be utilised:**
This project will utilise a range of cutting-edge molecular, cell biology and biochemical approaches (e.g. CRISPR/Cas9 gene editing, viral transduction, confocal microscopy) as well as standard techniques (Western Blotting, quantitative-PCR, DNA cloning) in models of inflammation to investigate, dissect and discover mechanisms that control activation of cGAS-STING signalling pathways.

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**Kile Laboratory**

[https://www.monash.edu/discovery-institute/kile-lab/home](https://www.monash.edu/discovery-institute/kile-lab/home)
**Background:**
Calcium ions (Ca\(^{2+}\)) are one of the most critical signalling molecules which play an important role in many physiological processes, prominently including muscle contraction, neuronal excitation and cellular metabolism, therefore, Intracellular Ca\(^{2+}\) dysregulation is a proximal cause of many diseases. Mitochondria, an intracellular Ca\(^{2+}\) store, directly regulates cellular Ca\(^{2+}\) dynamics. Balancing the mitochondrial Ca\(^{2+}\) depends on the specific ion channel on mitochondrial membrane. In past decade, most of the molecular machineries modulated mitochondrial Ca\(^{2+}\) homeostasis have been identified. Ca\(^{2+}\) influx into mitochondria is mediated by mitochondrial calcium uniporter (MCU) complex, which resides on inner membrane to guarantee Ca\(^{2+}\) uptake upon cytoplasmic Ca\(^{2+}\) increase. So far, it is widely believed that MCU complex is the main route for Ca\(^{2+}\) flux into mitochondria. However, in our previous study we found that an undefined MCU-independent transporter might also contribute to the mitochondrial Ca\(^{2+}\) uptake in *C. elegans*.

**Project aim/s:**
In this project, a typical ethyl methanesulfonate (EMS) screen will be conducted to identify the potential mitochondrial calcium transporter. This project aims to understand the mechanisms of mitochondrial Ca\(^{2+}\) regulation, which provides the potential pharmacological targets of mitochondrial Ca\(^{2+}\) machineries for the treatment of related diseases in humans.

**Techniques to be utilised:**
We will investigate the regulatory mechanism through a multidisciplinary approach which combines calcium imaging, patch-clamp, genetic manipulation and behavioural analysis with biochemical methods.
Project Title: Maternal nutrition and offspring kidney development

Other Supervisors: Prof John john.bertram@monash.edu 99029101

Other Supervisors: Dr Kieran Short

Location: Clayton Campus, 19 Innovation Walk, Level 3

Background:
The intrauterine environment is critical for fetal growth and organ development. Animal models have demonstrated the vulnerability of the developing kidney to a suboptimal maternal environment. Modifying maternal nutritional status can alter the number of nephrons or functional units formed in the offspring's developing kidneys and have long-term consequences for renal health.

Project aim/s:
In this project, we will investigate the effect of maternal fat feeding on the cellular mechanisms of nephrogenesis.

Techniques: This is an excellent opportunity to learn about developmental programming. You will learn mouse embryonic and neonatal dissection, immunohistochemistry labelling techniques, confocal microscopy and 3D imaging. You will also use stereology to estimate nephron number.
Oocyte and Embryo Development Laboratory

www.med.monash.edu.au/anatomy/research/oocyte-and-embryo-

### Project Title
**Study of mitochondrial biogenesis and dynamics during oogenesis**

### Main Supervisor
Prof John Carroll  
j.carroll@monash.edu  
990 24381

### Other Supervisor
Dr Deepak Adhikari  
deepak.adhikari@monash.edu  
990 20120

### Location
Clayton Campus, 19 Innovation Walk, Level 3

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**Background:** Mitochondria are double-membraned cellular organelles containing their own mtDNA and they play crucial roles in energy production, calcium metabolism, and apoptosis. In contrast to nuclear DNA, mtDNA is transmitted exclusively through maternal inheritance, i.e. through eggs. During oocyte development, both the number of mitochondria and mtDNA copy number increase rapidly. At the same time mitochondria are highly dynamic and undergo fission, fusion, transport and degradation during oocyte maturation. Recent findings suggest that mitochondrial dynamics is closely related to the cellular metabolism. It is not clearly understood how these processes during oocyte development are interrelated and are affected by maternal aging and obesity, both of these conditions are known to affect the quality of eggs generated.

**Project Aims:** In this project, we will investigate the aspects of mitochondrial dynamics and mtDNA replication during oogenesis and their effects in the quality of eggs. These findings will have broad implications for understanding the roles of mitochondria in the development of eggs and for the future development of assisted reproductive technologies.

**Techniques:** This project will utilise genetically modified mouse models, which will be studied by techniques like ovary histology, in vitro oocyte maturation, live cell imaging, immunofluorescence, quantitative PCR.
Polo Lab: Epigenetics and Reprogramming Laboratory

https://research.monash.edu/en/persons/jose-polo
https://supervisorconnect.med.monash.edu/users/jpolo

<table>
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<th>Prof. Jose Polo</th>
<th><a href="mailto:jose.polo@monash.edu">jose.polo@monash.edu</a></th>
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<tr>
<td>Other Supervisors</td>
<td>Dr. Bo Sun</td>
<td><a href="mailto:yuboyang.sun@monash.edu">yuboyang.sun@monash.edu</a></td>
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<td>Dr. Anja Knaupp</td>
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<td>Dr. Kathryn Davidson</td>
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<td>Dr. Jan Schroder</td>
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Location
Department of Anatomy & Developmental Biology
Monash Biomedicine Discovery Institute
Australian Regenerative Medicine Institute
Level 3, 15 Innovation Walk, Monash University, Clayton, Victoria 3800

Background:
The laboratory is interested in both the transcriptional and epigenetic mechanisms that govern cell identity, in particular pluripotency and the reprogramming of somatic cells into induced pluripotent stem (iPS) cells. Being able to reprogram any specific mature cellular program into a pluripotent state and from there, back into any other particular cellular program, provides a unique tool to dissect the molecular and cellular events that permit the conversion of one cell type to another. Moreover, iPS cells and the reprogramming technology are of great interest in pharmaceutical and clinical settings, since the technology can be used to generate animal and cellular models for the study of various diseases as well in the future to provide specific patient tailor made cells for their use in cellular replacement therapies. However, despite being one of the major growing research fields, very little is known about the epigenetic and transcriptomic changes that occur during this process. Understanding the events leading to the generation of iPS cells is a necessary step to ultimately use iPS cell technology for therapeutic purposes. By using a broad array of approaches through the use of mouse models and a combination of different molecular, biochemical, cellular techniques and genome-wide approaches, our lab will aim to dissect the nature and dynamics of such events.

Project aims:
1. The kinetics and universality of the epigenetic and genomic changes occurring during reprogramming
2. The composition and assembly kinetics of transcriptional regulation complexes of pluripotency genes
3. How the cell of origin influences the in vitro and in vivo plasticity potential of cells generated during the reprogramming process
4. Induced human early embryogenesis
5. Neuronal maturation and neurodegeneration
6. Mechanism of transdifferentiation
7. In vitro disease modelling
8. Resolving cell heterogeneity by single cell “omics”

Techniques: We use mouse models and a combination of different molecular, biochemical, cellular techniques and genome wide approaches (RNA-seq, MS-MS, ATAC-seq, ChIP-seq, SC-RNA-seq, etc.) to dissect the nature and dynamics of such events.
Project Title: Jaw Fracture Repair and Biomechanics of Chewing

Main Supervisor: Dr Olga Panagiotopoulou
Contact: olga.panagiotopoulou@monash.edu (03) 99050262

Other Supervisors:
- Professor Dana Kulic
dana.kulic@monash.edu
- Dr Bernard Chen

Location: 10 Chancellors Walk, Level 1, Room C142

Background:
Mandible (lower-jaw) fractures account for ~30-40% of all instances of maxillofacial trauma and can occur due to a variety of incidents (e.g. assault, oropharyngeal/congenital disorders, cancer, vehicular accidents, sporting accidents or falls). Current treatment aimed at restoring mandibular function and aesthetics by immobilizing the fracture with fixation mini-plates and screws is not free of morbidity. Approximately 10–30% of mandibular fracture patients experience postoperative complications, such as mal-union (bone segments not fusing properly), malocclusion (tooth misalignment), infection, and joint dysfunction. Moreover, there is no consensus on the optimal surgical interventions for certain types of mandible fracture. We propose that a significant cause of post-surgical complication is the appearance of strain environments in the fracture zone and around the implants, which are not conductive to healing.

Project Aims:
To study the biomechanical function of the jaw during a complete chewing cycle in healthy controls and post fracture fixation.

Techniques:
3D virtual reconstruction of CT scans, 3D implant design, Dynamic Finite Element Modelling, Theoretical mathematical models.

Finite element models of a healthy and fracture fixed jaw during chewing. Warm and cold colours show areas with high and low strain respectively. Note the increased strains around the implants.
Integrated Morphology and Paleontology

http://www.sapalaeo.com

<table>
<thead>
<tr>
<th>Project Title</th>
<th>Mapping the Marsupial Mind: Does brain shape and size correlate with behavioural adaptations?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomedicine Discovery Program Research Theme</td>
<td>Development and Stem Cells</td>
</tr>
<tr>
<td>Main Supervisor</td>
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<tr>
<td>Other Supervisors</td>
<td>Alistair Evans  <a href="mailto:alistair.evans@monash.edu">alistair.evans@monash.edu</a>  03 9905 3110</td>
</tr>
<tr>
<td>Location</td>
<td>C154 (10 Chancellor’s Walk, Clayton Campus)</td>
</tr>
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</table>

**Background:** There are substantial differences between marsupial and placental mammal brains, including a fundamentally different relationship between brain and body size. Recent research has explored the question of overall marsupial brain size and the potential relationship to behavioural adaptations, the issue of brain shape within Australian marsupials remains largely unexplored. Exploring the proportion and shape of major cerebral cortical areas (particularly as expressed by impressions within the skull) may shed light on how the brains of kangaroos, possums, quolls and other marsupials reflect their particular adaptive niches; and will allow for consideration of recently extinct marsupials like the thylacine (‘Tasmanian tiger’).

**Project aim/s:** In this project, we will investigate the shape of the brain within living marsupial species to determine what associations exist between brain size, discrete cerebral regions, and behavioural categories from locomotion to diet to sociality. By developing new methods and approaches based on interpreting the endocranial surfaces of the skull to establish interpretable, 3D data on brain shape, this project will develop critical data on living marsupials that will be directly applied to interpret brain shape in the thylacine. This will include the first analysis of the thylacine brain shape through combined computerised tomography (CT) and magnetic resonance imaging (MRI).

**Techniques to be utilised:** This project will utilise techniques applicable to a range of comparative anatomy and modern biological studies including medical imaging-based reconstruction of organs from CT and MRI data, 3D morphometrics, 3D data processing and 3D printing, and statistical analysis of shape. Equally this project will develop new methods and approaches to quantify brain shape that are not reliant on brain tissue itself, which will expand comparative approaches across larger datasets and diversity of living and extinct marsupial species.
**Project Title**

*A closer look at Neanderthal and modern human bite force capability and masticatory efficiency*

**Main Supervisor**
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**Other Supervisors**
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Rachel Sarig  
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**Location**
Building 13C, Clayton campus

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**Background:**
Changes in diet and in food processing technology have been a driving force in human evolution, leading to a decrease of the magnitude of masticatory strains that resulted in craniofacial growth variation. In this project we want to understand if Neanderthal cranio-dental morphology, characterised by an overall robusticity with a forwardly projecting face and extensive anterior dental wear, was truly adapted to resist powerful bite forces. In particular, we will look at Neanderthal anterior dentition using a completely innovative approach that integrates advanced statistical methods with state-of-the-art 3D medical imaging.

**Project aim/s:**
This Honours project is part of a large international study, funded by the Australian Research Council, that aims to biomechanically understand how Neanderthal use their anterior dentition as a “third hand” in tearing, holding and shaping a variety of objects for daily task activities. The focus of this Honours project is to examine if Neanderthal anterior wear was really unique among humans. One of the most distinctive features of Neanderthal anatomy is certainly the extensive and unique way of how Neanderthals used their frontal teeth, with evenness in wear across the anterior dentition that is not observed in any other modern human groups. However, new tooth wear pattern analyses revealed that heavy anterior dental wear was not unique to Neanderthals. Thus, it is not clear whether Neanderthal wear patterns of incisors and canines indicate widespread tooth-tool-uses and whether their patterns differ from those of modern humans.

**Techniques to be utilised:**
We will address this question by using a highly sophisticated and well-established method, called Occlusal Fingerprint Analysis (OFA), a virtual approach that considers the functional aspects of tooth macrowear occurring during the masticatory cycle. We will also use advances in dental macrowear studies for state-of-the-art dental arch virtual restorations of important human fossil specimens.
Background:
Mitochondria are essential components of eukaryotic cells, carrying out critical physiological processes that include energy production and calcium buffering. Fundamental to their function is the ability to transition through fission and fusion states, which are regulated by several large GTPases. In particular, mitofusin-2 (Mfn2) is an essential molecule that mediates the fusion of the outer mitochondrial membrane. Mutations in Mfn2 cause the most common inherited disorder of the peripheral nervous system, Charcot-Marie-Tooth disease. However, despite its importance, the precise cellular role of Mfn2, the pathways in which it acts, and how its function is regulated remain to be resolved.

Project aim/s:
In this project, we will investigate novel genetic and protein interactors of the Mfn2 using the nematode C. elegans. The findings will reveal important new insights into the normal function of Mfn2, and how dysfunction of this protein causes neurodegeneration in humans.

Techniques to be utilised:
This project will utilise techniques in molecular biology, genetics, and fluorescence microscopy.
**Background:**
Injuries to the nervous system can cause lifelong disabilities due to ineffective repair of the damaged nerve fibres and thus, understanding the basic molecular mechanisms regulating axonal regeneration is essential for the development of effective therapies. This research project will use the nematode *C. elegans* as a model system to study the molecular mechanisms behind axonal regeneration, and will utilise a UV laser to cut individual axons in living animals, allowing their response to injury to be monitored over time.

**Project aim/s:**
Define the function of key molecules implicated in a highly efficient mechanism of axonal regeneration known as axonal fusion.

**Techniques to be utilised:**
This project will utilise techniques in genetics, fluorescence microscopy, and molecular biology.
**Project Title**: Identifying novel sex determination genes responsible for DSD

**Main Supervisor**: Professor Vincent vincent.harley@hudson.org.au 03 8572 2527

**Location**: Hudson Institute of Medical Research

**Background:**
Disorders of sex development (DSDs), formerly intersex are congenital conditions where gonadal or anatomical sex is atypical. DSDs encompass a wide range of abnormalities, including hypospadias (abnormal urinary opening in males), gonadal dysgenesis (underdeveloped or imperfectly formed gonads), and ambiguous genitalia and sex reversal (i.e. XX males and XY females).

**Project aim/s:**
Our aim is to identify genes causing DSDs, and the molecular mechanisms underlying testis and ovary formation in the mammalian embryo.

**Techniques to be utilised:**
This proposal will provide new insights into the molecular control of testis development, and thus offer the potential to improve diagnosis and clinical management of DSD. Approaches include human genetics, as well as molecular, cell and developmental biology.

**Reading**

NHMRC Program on DSD: http://dsdgenetics.org/

Regulatory networks during gonadal development. Genes in upper case cause DSD when mutated.
Sex Determination and Gonadal Development Laboratory


<table>
<thead>
<tr>
<th>Project Title</th>
<th>FGF signalling and sex reversal</th>
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<tbody>
<tr>
<td>Main Supervisor</td>
<td>Professor Vincent Harley</td>
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<td>03 8572 2527</td>
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<td>Other Supervisors</td>
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<td>03 8572 2505</td>
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<tr>
<td>Location</td>
<td>Hudson Institute of Medical Research</td>
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**Background:**
We have identified the first FGFR2 mutations in XY female sex reversed DSD patients. One case, a heterozygous FGFR2c-C342S mutation in a patient with both 46,XY gonadal dysgenesis and Crouzon syndrome is unusual since gonadal defects have not yet been reported in Crouzon patients.

**Project aim/s:**
We will use our ‘knockin’ Fgfr2cC342Y and ‘knockout’ Fgfr2c/- mouse models to understand the role of FGFR2 in testis determination and disease and to identify FGFR2-regulated genes and signalling pathways which might be defective in DSD patients.

**Techniques to be utilised:**
Analyses of male and female markers will be carried out, as well as markers of FGF signalling. Training includes basic cell and molecular biology as well as: embryonic microdissection, whole mount/section in situ hybridisation and immunofluorescence.

A. Structure of the FGFR2 protein and position of two human mutations in XY females in red.

B. Immunofluorescence of embryonic gonads from FGFR2c-C342Y knock-in mouse showing nearly complete sex-reversal (middle panel).
**Project Title**
*How are male and female brains different?*

**Main Supervisor**
Professor Vincent Harley

vincent.harley@hudson.org.au

03 8572 2527

**Location**
Hudson Institute of Medical Research

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**Background:**
Male and female brains differ in anatomy, chemistry and behaviour. The prevailing dogma that oestrogen is the key factor involved in brain sex differentiation was challenged by our discovery of a direct role in the brain for the Y chromosome gene, SRY in the control of voluntary movement, only in males.

**Project aim/s:**
This project seeks to identify the target genes that the SRY transcription factor controls in the brain.

**Techniques to be utilised:**
Approaches include cell and molecular biology techniques (RNA seq, ChIPseq) and rodent dissection of the substantia nigra.

**Reading:**
**Project Title**: Development of project management skills in undergraduates

<table>
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<tr>
<th>Main Supervisor</th>
<th>Dr Julia Young</th>
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<tbody>
<tr>
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<td>99050202</td>
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<tr>
<td>Location</td>
<td>19 Innovation Walk</td>
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**Background:**
Undergraduate students learn many concepts and facts in their studies, but equally important is the development of transferable skills. One skill that can be used in a variety of fields of employment is project management. We are investigating ways to develop this skill in second year undergraduate students, in the completion of a semester-long project.

**Project aims:**
To investigate methods to help second year undergraduate students to develop skills in project management.

**Techniques:**
This project will use surveys and focus groups, and analysis of quantitative and qualitative data.
**Project Title**: Students behaving badly. Student perceptions of professional behaviour and the role of health and well-being in a biomedical science course.

**Main Supervisor**: Dr Chantal Hoppe  
chantal.hoppe@monash.edu  
99059096

**Location**: Dept Anatomy & Developmental Biology 10 Chancellors Walk

**Background**: Educators involved in the Biomedical Science (BMS) course have reported an increase in challenging student behaviour, conceivably heightened by a dramatic increase in student numbers and competition. However, as yet, we do not understand the unique milieu behind the lapses in professional behaviour one of which may include adverse student well-being. Incidents of lapses in professionalism, described elsewhere (Mak-van der Vossen 2017), are difficult to action, however in support of student development, we have in 2019 piloted a code of professional practice to provide the student with a framework on which to base their behaviour, in line with our expectations. In this study, we will investigate the BMS cohort alongside their well-being, tailoring relevant professionalism programs to accommodate them. This project will help to streamline processes around course design and development ensuring they are responsive to rapidly changing contexts, helping develop graduates who are responsible and effective global citizens, demonstrating ethical values.

**Project aims**: to gather and evaluate data on i) student understanding of professionalism, ii) perceptions of relevance of professionalism to current status as BMS student iii) responses to case-based scenarios/other activities of unprofessionalism and iv) background data on student health and well-being. Data will be evaluated and inform on current practice. A potential second or alternate Honours project could be to build student-staff partnerships to inform professionalism activities via bringing on students as partners in their development, roll out and evaluation.

**Techniques**: Evaluation tools and surveys, quantitative and qualitative analysis; human ethics, development of educational resources, facilitation/teaching experience
### Project Title

Supporting International students in their transition to University: establishing teaching practices that incorporate student diversity.

### Background:
Supporting International students in their transition to university, learning experience and academic performance is an important task in any inclusive environment, yet we lack significant data and academic support for these groups in the Biomedical Sciences. This project will gather data on International students and together with students as partners, create and facilitate relevant activities to support students in their transition to University. The student that is suited to this project will be committed to improving the learning experience for all students, in an inclusive environment where diversity is celebrated, and part of everyday teaching practices.

**Project aims:** to gather and evaluate data on i) International student perceptions of University ii) geographical and cultural background iii) student perceptions on how they study, cope, socialise and other factors important for health and well-being or that contribute to a positive learning experience iv) The honours student will then develop timely and supportive activities or resources (with students as partners or from data retrieved) for International students. Time-permitting, student experience regarding University transition will be evaluated.

**Techniques:** Evaluation tools and surveys, quantitative and qualitative analysis; human ethics, development of educational resources, facilitation/teaching experience
The Impact of the Anatomic Handover on Monash Medical Students

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<tr>
<th>Project Title</th>
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<tbody>
<tr>
<td>Main Supervisor</td>
<td>Michelle Lazarus  <a href="mailto:Michelle.lazarus@monash.edu">Michelle.lazarus@monash.edu</a>  990 50732</td>
</tr>
<tr>
<td>Location</td>
<td>Clayton Campus, 10 Chancellors Walk, Level 1</td>
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**Background:** Communication between physicians about patient care impacts patient outcomes however, this skillset is often reported as sub-par in the hospital. We have developed a method for introducing an essential clinical communication method for patient handovers (when a doctor is leaving their shift and must communicate the patients’ status and needs to the oncoming caregiver) known as the anatomic SBAR, and have previously assessed this in another institution.

**Project aim/s:**

*Aim 1:* Identify the impact of the Anatomic SBAR on Monash Students

*Aim 2:* Evaluate the impact of the Anatomic SBAR on students’ performance in standardized patient exams

*Aim 3:* Evaluate the impact of the Anatomic SBAR on student outcome (exam performance).

**Techniques to be utilised:** This project will utilize both quantitative and qualitative techniques. Both of these approaches are essential for anyone interested in clinical medicine or a career focused around education. Skills will be gained in the scientific method, by designing surveys and focus group discussions to test the role of the communication on student learning and professional development. Additionally, you will be engaging in video analysis and gain skills in identifying non-verbal communication.
<table>
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<tr>
<th>Outline of project</th>
<th>The Impact of Twitter on Developing Communities of Practice and Engagement</th>
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<tr>
<td>Project Title</td>
<td>The Impact of Twitter on Developing Communities of Practice and Engagement</td>
</tr>
<tr>
<td>Main Supervisor</td>
<td>Michelle Lazarus  <a href="mailto:Michelle.lazarus@monash.edu">Michelle.lazarus@monash.edu</a>  990 50732</td>
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<tr>
<td>Location</td>
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**Background:** The use of social media, and the impact of its role in education is hotly debated. While there are often calls for educators to engage in using social media, there are few recommendations on the ways to engage this platform. In addition, the relevant social media platforms (from the students’ perspective) is regularly changing. The aims of this project are to evaluate a novel use of Twitter on the followers; specifically we will be identifying the impact of the @AskAnatomist site on its twitter followers and identifying the role that similar uses of social media may have within the broader community.

**Project aim/s:**

**Aim 1:** Identify the role the @AskAnatomist has on the community (both general and anatomical) in terms of impact, potential collaborations, and increasing others’ exposure

**Aim 2:** Identify the themes associated with the @AskAnatomist hashtag (#AnatQ) to determine whether there are: areas of controversy, areas for further research, and/or areas most likely to illicit discussion.

**Aim 3:** Make recommendations for others wanting to engage an audience in topics related to STEM education on twitter, based on findings from Aim 1 and 2.

**Techniques to be utilised:** This project will utilize both quantitative and qualitative techniques. Both of these approaches are essential for anyone interested in clinical medicine or a career focused around education. Skills will be gained in the scientific method, by designing surveys and experiments to test the role of the @AskAnatomist twitter feed in the community. Additionally, analysis of tweets to identify themes associated with the weekly tweetchat will be undertaken.