2018-2019 FMHS Summer Research Projects
**PROJECT AREA: ARTIFICIAL INTELLIGENCE, HEALTH INFORMATICS, AND ANALYTIC**

**PROJECT 1: PATIENT SAFETY IN THE AGE OF ARTIFICIAL INTELLIGENCE**

**SUPERVISOR:** A/Prof. Farah Magrabi

**PROJECT DESCRIPTION:**

In the next few years, a new generation of interactive software agents incorporating artificial intelligence (AI) will support both clinicians and consumers across a wide set of healthcare tasks. Alongside its many benefits AI can introduce new, often unforeseen, modes of failure that affect the safety and quality of care and lead to patient harm.

This project is centered around a brand new research program at the Centre for Health Informatics to investigate the safety risks of AI in healthcare. Students will have the opportunity to work a multidisciplinary team alongside computer scientists, engineers, health professionals and patients. They will participate in (a) identifying and evaluating the safety risks of clinical and consumer technologies; (b) design technical and social solutions to mitigate these risks (c) develop new methods and protocols for timely detection and response to emerging threats.

This project is suitable for students interested in medicine, health sciences, ethics, psychology, computer science, or other related disciplines.

For more information please contact A/Prof. Farah Magrabi (farah.magrabi@mq.edu.au).

**PROJECT 2: ARTIFICIAL INTELLIGENCE FOR PATIENTS AND CONSUMERS**

**SUPERVISOR:** Dr. Annie Lau

**PROJECT DESCRIPTION:**

Artificial Intelligence (AI) is an area of study that examines intelligence behaviour in machines, such as reasoning, planning, learning, perceiving and interacting to maximise its chance of achieving a goal. Current applications of AI include: self-driving cars, chess, and understanding human speech.

This project examines whether AI has a role for patients and consumers. Students will review current applications of AI in healthcare, and identify areas where AI can help address patients’ and consumers’ needs and the associated risks and benefits.

Students will work in a multidisciplinary team and have an opportunity to work with clinicians, patients, and researchers from Macquarie University.

For more information please contact Dr. Annie Lau (annie.lau@mq.edu.au).
PROJECT 3: CAN SOCIAL NETWORKS HELP US BECOME HEALTHIER?
SUPERVISOR: Dr. Annie Lau

PROJECT DESCRIPTION:
To accomplish a health goal, a lot of effort and time is required, regardless of whether it is for achieving an optimal level of fitness or managing illness. However, there is lack of research examining the ‘work’ involved in managing our health and illness, especially from a patient/consumer perspective.

This project examines the activities that patients and consumers do for their health and illness. Students will examine how these health activities fit into one’s routine, and provide suggestions on whether digital technology has a role to empower consumers, patients and their carers in their everyday settings.

Students will work in a multidisciplinary team and have an opportunity to work with clinicians, patients, and researchers from Macquarie University and University of Oxford

For more information please contact Dr. Annie Lau (annie.lau@mq.edu.au).

PROJECT 4: ROLE OF DIGITAL HEALTH IN PATIENT-CLINICIAN RELATIONSHIP
SUPERVISOR: Dr. Annie Lau

PROJECT DESCRIPTION:
We use technology everyday yet the use of technology for health is limited. Although digital health technologies (e.g. websites, wearables, mobile apps) are available, they are not used routinely in our encounters with healthcare professionals.

This project examines ways we can utilise digital technologies to enrich our relationship with healthcare professionals. Students will have an opportunity to work closely with healthcare professionals, consumers and patients to understand the tasks that digital technologies can assist in health, and examine ways we can incorporate digital technologies in our encounters with healthcare professionals.

This project is suitable for students interested in health sciences, psychology, health services, medicine, computer science, or other related disciplines.

For more information please contact Dr. Annie Lau (annie.lau@mq.edu.au).
PROJECT 5: SURGICAL INFORMATICS FOR PATIENTS AND CONSUMERS

SUPERVISOR: Dr. Annie Lau

PROJECT DESCRIPTION:

Surgical practice, unlike other health specialties, has its own unique needs. In particular, surgical patients have specific needs across different stages of surgical care (e.g. preoperative, intra-operative, and post-operative). Can advances in informatics (e.g. mobile apps) help support surgeons and their patients?

This project involves understanding the needs of patients across different stages of surgical care, and identifying areas where informatics can help address their needs. Students will have an opportunity to work with surgeons, nurses, other surgical team members, and patients in this project. They will participate in designing and evaluating mobile apps for patients in areas such as orthopedics, cancer or vascular surgery.

This project is suitable for students interested in surgery, medicine, psychotherapy, health sciences, psychology, computer science, or other related disciplines.

For more information please contact Dr. Annie Lau (annie.lau@mq.edu.au).

PROJECT 6: DIGITAL TECHNOLOGIES FOR BEHAVIOUR CHANGE AND LIFESTYLE MODIFICATION

SUPERVISOR: Dr. Liliana Laranjo

PROJECT DESCRIPTION:

Growth in use of consumer mobile technologies, social media, and artificial intelligence offers new possibilities in behaviour change. Lifestyle behaviours, such as unhealthy diets and physical inactivity, are global contributors to the growing incidence of cardiovascular disease, type 2 diabetes, and obesity.

This project involves multiple components to which students may contribute, according to their preference:

- Exploring the use of mobile health technologies (e.g. mobile applications, fitness trackers) and online social networks (e.g. Facebook) in the prevention and self-management of chronic diseases;
- Evaluating the use of mobile social networking interventions for physical activity promotion and weight management;
- Exploring the use of artificial intelligence conversational agents (e.g. Apple’s Siri, Amazon Alexa) for health purposes;
- Exploring the perspectives of consumers/patients and General Practitioners on the importance of promoting lifestyle behaviour change, effective strategies for that purpose, and the potential role of digital technologies;
- Co-designing an intervention to promote lifestyle behaviour change.

Students will work in a multidisciplinary team and will be able to work with other students, clinicians, consumers/patients, and researchers from Macquarie University. There will be the opportunity for students to co-author publications depending on their intellectual contribution to the project.

For more information please contact Dr. Liliana Laranjo (liliana.laranjo@mq.edu.au).
**PROJECT AREA: BIOMECHANICS & MUSCULOSKELETAL**

**PROJECT 1: ANATOMICAL MODELLING OF KNEES**

**SUPERVISOR:** A/Prof Richard Appleyad and Dr Danè Turner

**PROJECT DESCRIPTION:**

Computer modelling of human bones and joints help to answer biomechanical questions related to the stresses and strains of the structure, through use of finite element analysis, and also to answer kinematic questions, for example through use of fluoroscopic analysis. In both cases, accurate anatomical models of the structures need to be developed.

This project will require the student to create three-dimensional bone geometries from medical images. The lower limb is either CT or MRI scanned and using dedicated segmentation software, these medical image stacks will be segmented and further processed to create 3D anatomical models.

For more information please contact Dr. Danè Turner (daneh.turner@mq.edu.au).

**PROJECT 2: FLUOROSCOPY OF THE KNEE JOINT**

**SUPERVISOR:** A/Prof Richard Appleyad and Dr Danè Turner

**PROJECT DESCRIPTION:**

Fluoroscopy is an effective way of determining the in-vivo motions of the knee joint. Already developed anatomical models are used to match up with the cine-fluoro images in order to calculate the motion of the joint. This is particularly useful to compare biomechanics of a patient before and after surgery.

For this project the student will use custom-written software to position the already created anatomical models over each of the fluoroscopic images in order to calculate the position and orientation of the joint over a number of time frames, depending on the activity (eg. Stair climbing).

This project is best suited to a Mechanical or Software Engineering student.

For more information please contact Dr. Danè Turner (daneh.turner@mq.edu.au).
PROJECT 3: BIOMECHANICS/ GAIT ANALYSIS AND BIOMECHANICAL MODELLING

SUPERVISOR: A/Prof Richard Appleyad and Dr Danè Turner

PROJECT DESCRIPTION:

Gait analysis is commonly used to better understand the biomechanics of the musculoskeletal system. Optical markers are placed on specific sites of the body and patients are asked to undergo different physical movements. Cameras collect three-dimensional motion of the markers, which provide information regarding the person’s kinematics. This study has two main components, which may or may not be undertaken by the same student:

Gait data collection and analysis: On the day of testing, the laboratory will be set up, with cameras positioned 3D space optimised and calibrated. Study participants will have markers placed, questionnaires filled out and measurements made. 3D gait data will be collected and notes taken during testing. This data will be processed using the Nexus program.

Biomechanical modelling and analysis: The processed Nexus data will then be further processed to scale the model, calculate the joint angles and joint moments as well as the muscle forces.

This project is best suited to a Mechanical or Software Engineering student.

For more information please contact Dr. Danè Turner (daneh.turner@mq.edu.au).

PROJECT 4: ASSESSING OXYGEN CONSUMPTION DURING EXERCISE

SUPERVISOR: Dr Tim Doyle and Dr Joel Fuller

PROJECT DESCRIPTION:

FMHS have recently acquired a new, portable metabolic gas analyser for measuring oxygen consumption and other respiratory measurements during physical activity. Importantly for metabolic measurements, in particular, VO2max measurements i.e., the maximum amount of oxygen a person can utilise, different protocols can illicit different measurements. For that reason a standardised and repeatable protocol must be developed to ensure high quality of data. This project will help to develop a standardised protocol while either running on a treadmill and/or cycling on an exercise bike in a young, healthy population. Students will learn about the theory behind VO2 measurements, the practical considerations while undertaking VO2 testing, and specific skills to run VO2 tests.

For more information please contact Dr. Tim Doyle (tim.doyle@mq.edu.au).
PROJECT AREA: CANCER

PROJECT 1: ONCOGENIC SIGNALLING PATHWAYS IN GLIOBLASTOMA

SUPERVISOR: Dr Andreia Pinho

PROJECT DESCRIPTION:

Glioblastoma multiforme (GBM), the most frequent and aggressive primary tumour affecting the central nervous system, has a dismal prognosis, presenting a median overall survival of less than 15 months. Therefore, there is an urgent need for the development of novel therapeutic approaches involving molecularly targeted agents.

Building on our previous experience in melanoma, where the recent development of precision therapies has contributed to a dramatic improvement in patient survival rates, this project aims to analyse the relative contribution of oncogenic signalling pathways in promoting cell proliferation and survival in different molecular subtypes of GBM.

For more information please contact Dr. Andreia Pinho (andreia.pinho@mq.edu.au).

PROJECT 2: EFFECTS OF TUMOUR-ASSOCIATED FIBROBLASTS ON T CELL MEDIATED ANTI-TUMOUR RESPONSE

SUPERVISOR: Dr Esther Lim

PROJECT DESCRIPTION:

The tumour microenvironment plays an important role in regulating cancer development. Fibroblasts, cells that produce extracellular matrix and collagen, form a key component of the tumour microenvironment, and are often reprogrammed into tumour-associated fibroblasts (TAFs) to support cancer progression. This project aims to investigate the effects of TAFs on melanoma cell behaviour and response to T cell-mediated killing. Melanoma cells will be cultured alone or in combination with TAFs, before assessing cell proliferation and T cell-mediated killing, the latter in a co-culture assay.

For more information please contact Dr. Esther Lim (esther.lim@mq.edu.au).
PROJECT AREA: CARDIOVASCULAR AND RESPIRATORY

PROJECT 1: EXPLORING NOVEL DEVICES FOR BLOOD PRESSURE MEASUREMENT
SUPERVISOR: Prof Alberto Avolio, Dr Mark Butlin, Dr Isabella Tan

PROJECT DESCRIPTION:
Blood pressure measurement is less convenient in everyday life because it requires a cuff to be placed on the arm. Yet blood pressure measurement in everyday life is very important as it may catch rising blood pressure to tackle problems before they occur. A number of devices propose methods of measuring blood pressure without a cuff. This study investigates those devices and explores the accuracy of blood pressure measurement in various scenarios including acute blood pressure changes induced in a controlled environment, and variability of blood pressure in daily life. Work may include participation in studies to measure and induce changes in blood pressure, observation and assistance in patient consults in the clinical work space, and analysis of data to draw conclusions from the studies.

For more information please contact Dr. Mark Butlin (mark.butlin@mq.edu.au).

PROJECT 2: NON-CONTACT BLOOD PRESSURE MEASUREMENT
SUPERVISOR: Prof Alberto Avolio, Dr Mark Butlin, Ms Fatemeh Shirbani

PROJECT DESCRIPTION:
The pulsation of blood is visible by analysing a video of the face and therefore we can measure heart rate without any contact with the patient. This study takes this a step further by investigating whether blood pressure can also be measured purely by video of the skin. Pilot studies within the group have shown potential in this area and this summer project will investigate the effect of varying degree of light on the pulse signals being measured, and the ability to measure blood pressure from those signals. The study may involve non-invasive biological measurements in volunteers, analysis of the signals acquired, and drawing summaries from the data.

For more information please contact Dr. Mark Butlin (mark.butlin@mq.edu.au).

PROJECT 3: EFFECT OF ARTIFICIAL REALITY ON BLOOD PRESSURE
SUPERVISOR: Dr Edward Barin, Prof Alberto Avolio and Dr Mark Butlin

PROJECT DESCRIPTION:
Visual immersion in an artificial reality that pictures a cool calm place has been shown to reduce perception of pain in people experiencing high levels of pain. This study will study the effect of visual immersion in an artificial reality of a calm setting on blood pressure. Blood pressure, heart rate, and arterial stiffness will be measured before, during, and following immersion in the artificial reality. Analysis of changes in these variables and in heart rate variability and baroreceptor activity will show the effect of the artificial reality and possible mechanisms behind any changes. If results are positive, the device could be used to assist in treatment of acute hypertensive events.

For more information please contact Dr. Mark Butlin (mark.butlin@mq.edu.au).
PROJECT 4: MEDICAL IMAGE ANALYSIS
SUPERVISOR: Prof. Itsu Sen

PROJECT DESCRIPTION:
A series of medical image segmentation software technologies have been developed. This project is to apply those medical-image segmentation software to reconstruct the vessels of brain arteriovenous malformations (AVM).

The project aims to identify the factors influence the haemodynamic changes in the feeding arteries after treatment of AVMs.

For more information please contact Prof. Istu Sen (itsu.sen@mq.edu.au).

PROJECT 5: ARTIFICIAL HEART (BLOOD PUMP) RESEARCH AND DEVELOPMENT
SUPERVISOR: Prof. Itsu Sen

PROJECT DESCRIPTION:
The project aims to introduce computational hemodynamic technology to improve blood pump suspension technology. The project is to cooperate with Australian local industry to research and develop a new generation artificial heart.

For more information please contact Prof. Istu Sen (itsu.sen@mq.edu.au).

PROJECT 6: BIOREACTOR PROJECT
SUPERVISOR: Prof. Itsu Sen

PROJECT DESCRIPTION:
The project is to use tissue-engineering bioreactor to grow living tissues and organs from cells. The use of engineered tissues instead of testing on animals or in over-simplified conventional cell cultures will improve research quality by providing access to more realistic tissue models and accelerate experimental outcomes by bypassing ethical and research management problems.

For more information please contact Prof. Istu Sen (itsu.sen@mq.edu.au).
PROJECT AREA: CLINICAL SCIENCES

PROJECT 1: BACTERIAL ATTACHMENT TO MEDICAL IMPLANTS AND THE HOST RESPONSE

SUPERVISOR: A/Professor Karen Vickery, Dr Helen Hu and Maria Mempin

PROJECT DESCRIPTION:
Capsular contraction (contraction around breast implants resulting in implant failure) is the most common complication in breast augmentation surgery. An association exists between bacterial contamination leading to subsequent biofilm formation on breast implants and an increased host immune response that results in capsular contraction and possibly development of cancer.

Aim 1: To assess the ability of bacteria to attach to breast implants of different textures in vitro.
Implants will be incubated in broth containing bacteria for set periods of time. Following exposure, the bacteria contaminating implants will be enumerated by plate culture following sonication of the implant in TSB.

Aim 2: To assess the response of cancer cells to bacterial antigens in cell culture.
Biofilm will be grown on pieces of breast implants and co-cultured with lymphocytes and cancer cells isolated from patients. The proliferative response of the cells will be measured.

For more information please contact Dr. Helen Hu (helen.hu@mq.edu.au).

PROJECT 2: UNRAVELLING THE MOLECULAR AND CELLULAR CONSEQUENCES OF POLYCYSTIC KIDNEY DISEASE MUTATIONS

SUPERVISOR: Prof. Jacqueline Phillips

PROJECT DESCRIPTION:
Polycystic kidney disease is a genetic condition that causes enlarged kidneys and ultimately loss of renal function. While many of the genetic mutations that can cause PKD have been identified, the molecular pathways that are disrupted and how this causes cellular damage and proliferation are unclear. This project will be working in a kidney cell tissue culture based system to examine proteins and pathways that are altered in response to PKD mutations and conditions that mimic the uraemic state associated with chronic kidney disease. The project will involve exposure to and training in western blots, RT-PCR and assays.

For more information please contact Prof. Jacqueline Phillips (jacqueline.phillips@mq.edu.au).
PROJECT 1: USING CONVERSATION ANALYSIS TO EXPLORE CLINICAL COMMUNICATION

SUPERVISOR: Dr Sarah White

PROJECT DESCRIPTION:

To support research and teaching in clinical communication in the Faculty of Medicine and Health Sciences, a library of clinical interactions is being developed. In this project, the student will contribute to ongoing research into how clinicians communicate. This will include work such as: recording clinical interactions, transcribing and coding the videos within the library, creating clips for research and teaching, preparing literature reviews, and participating in data analysis sessions. Methods of analysis include conversation analysis, other forms of interaction analysis, and coding (e.g. RIAS). Students interested in this project will be studying linguistics and/or anthropology and/or sociology and have an interest in qualitative interaction analysis.

For more information please contact Dr. Sarah White (sarah.white@mq.edu.au).
**PROJECT area: MOTOR NEURON DISEASE**

**PROJECT 1: IDENTIFICATION OF NOVEL THERAPIES FOR MOTOR NEURON DISEASE**

SUPERVISOR: A/Prof Julie Atkin and Dr Hamideh Shahheydari

**PROJECT DESCRIPTION:**

Motor neuron disease (MND) is a devastating, rapidly progressive disease caused by the death of motor neurons. A major hallmark observed in MND is the accumulation of misfolded proteins, which form aggregates in the cytoplasm of degenerating motor neurons. Recent evidence, however, suggests that dysfunction to the Endoplasmic Reticulum (ER), resulting in ER stress, is increasingly implicated in ALS pathogenesis. Protein Disulphide Isomerase (PDI) is an ER chaperone upregulated during bouts of ER stress. Our laboratory has previously demonstrated that PDI overexpression is protective against diverse forms of well-studied MND causing proteins, in neuronal cell culture. Moreover, previous studies have identified that PDI’s disulphide interchange activity is fundamental for its protective function. Ultimately, there is a need for more effective therapeutics in MND, thus, peptides mimicking the identified protective properties of PDI has been developed and the aim of this study is to analyse these peptides for their protective effect in MND cell models. In this project, candidates will have the opportunity to learn advanced biochemical and cell biology techniques including mammalian cell culture, DNA transfection, SDS-PAGE and western blotting, immunocytochemistry and fluorescence microscopy. Taken together, the findings from this project will hopefully lead to the advancement of an effective treatment in the near future for MND.

For more information please contact A/Prof. Julie Atkin (julie.atkin@mq.edu.au).

**PROJECT 2: INVESTIGATING THE REGULATORY AND FUNCTIONAL ROLES OF CYCLIN F IN THE DEVELOPMENT OF MOTOR NEURONE DISEASE (MND)**

SUPERVISOR: Dr. Albert Lee

**PROJECT DESCRIPTION:**

This project will investigate the cellular and functional roles of a new motor neurone disease (MND) gene discovered by researchers at the Macquarie University Centre for Motor Neurone Disease (MND) Research. Mutations in this new MND gene, CCNF, which encodes the protein Cyclin F, is involved in maintaining cellular health by tagging unwanted proteins (ubiquitylation) for breakdown and recycling within the cell. Mutant versions of Cyclin F, found in some MND patients, are defective in that they lack the necessary features needed to regulate proper function, which ultimately leads to impaired ubiquitylation and accumulation of proteins. This project will systemically investigate the regulatory and functional role of post-translational modifications (such as phosphorylation, O-GlcNAc and ubiquitylation) of Cyclin F focusing on those that have been mapped to MND mutations, and determine whether upstream kinases can be modulated to promote survival responses in MND cell models. Moreover, this project will investigate the role Cyclin F on its nuclear and cytoplasmic translocation and degradation and will examine:

Aim 1: Whether phosphorylation plays a role in nuclear/cytoplasmic shuttling through dephosphorylation treatments and artificial cyclin F constructs.

Aim 2: E3 ligase activity using our customised ELISA and other biochemical techniques and determine to effect does mutated versions of cyclin F influence protein inclusion formation.
MND mutations to Cyclin F was discovered by researchers at our Centre. This project will contribute to our understanding of how disease-variant mutations in this protein causes MND. By providing insights into the post-translational modifications in cyclin F, we will be able to better characterise the regulatory elements of the protein that are responsible for its function, and how impairments can lead to perturbations and cellular death.

For more information please contact Dr. Albert Lee (albert.lee@mq.edu.au).

PROJECT 3: CHARACTERISING THE KYNURENE PATHWAY IN MODELS OF NEURODEGENERATIVE DISEASE.

SUPERVISOR: Dr. David Lovejoy and Dr. Ben Heng

PROJECT DESCRIPTION:
Dysregulation of the kynurenine pathway (KP) plays a role in the progression in neurodegenerative disease, like Alzheimer's disease. We have been examining how small-molecule inhibitors of the KP can re-balance the KP and slow disease progression. This project aims to explore these changes in animal tissues. Techniques to be used include immunohistochemistry, western blotting, microscopy and UHPLC.

For more information please contact Dr. David Lovejoy (david.lovejoy@mq.edu.au).

PROJECT 4: MAKING THE BRAIN AND SPINAL CORD 'TRANSPARENT' TO FACILITATE MOLECULAR STUDIES OF NEURODEGENERATIVE DISEASE PROGRESSION

SUPERVISOR: Dr. David Lovejoy, Dr. Mimi Sabaretnam and Dr Dmitri Perrin

PROJECT DESCRIPTION:
Our laboratory is interested in disease mechanisms in neurodegenerative disease and we have recently been keen to explore how making the brain and spinal cord transparent in mouse models of Alzheimer's and motor neuron diseases may enable us to better visualise the molecular events involved disease progression. The student will use CLARITY and CUBIC methods to make brains and spinal cord '3-dimensional' for advanced microscopy.

For more information please contact Dr. David Lovejoy (david.lovejoy@mq.edu.au).

PROJECT 5: DRUG DEVELOPMENT IN NEUROSCIENCE, TRANSITIONING A LEAD CANDIDATE TO AN ACTUAL DRUG

SUPERVISOR: Dr. David Lovejoy and Dr. Kelly Jacobs

PROJECT DESCRIPTION:
We recently completed a high-throughput screening (HTS) drug discovery project where we identified several promising leads that inhibit an enzyme involved in neurodegenerative disease progression. However, a lead candidate is not an actual drug and this project will involve various cell-based pharmacological assessments to progress our leads to drugs.

For more information please contact Dr. David Lovejoy (david.lovejoy@mq.edu.au).
PROJECT 6: GENETIC AND CELL BIOLOGY STUDIES OF MOTOR NEURON DISEASE

SUPERVISOR: Dr Shu Yang, Dr Kelly Williams, Dr Alison Hogan

PROJECT DESCRIPTION:

The motor neurons are nerves that extend from the brain to the spinal cord and muscles and provide the stimulus through which we move, breathe, eat and drink. Unlike other cells of the body, motor neurons are not replaced when they die. Motor neuron disease (MND, also known as amyotrophic lateral sclerosis, ALS) is a rapidly progressive disease that causes the death of motor neurons leading to paralysis and death. MND is a devastating illness with appalling prognosis. Median survival is around two years. There is a pressing need to develop more effective diagnostic tools and treatments for MND.

The only proven causes of MND are gene mutations that lead to motor neuron death. Current insights have been insufficient to develop effective treatments in humans, despite the promise shown in existing animal models. Identification of the genes that cause or predispose to MND will lead to the unravelling of the underlying molecular mechanisms as a prerequisite to effective disease diagnosis, treatment and prevention. But known MND genes only account for less than 10% of cases. Our research aims to use cutting edge genetics, genomics and bioinformatics to identify gene mutations that cause MND. We further investigate the effects of those mutations using cell biology techniques, such as immunohistochemistry/immunocytochemistry, transfection, confocal microscopy and flow cytometry. We have found mutations in several new disease genes among MND patients (published in Science and Nature Communications). Work is now underway to determine how these mutations lead to motor neuron death.

For more information please contact Dr. Shu Yang (shu.yang@mq.edu.au).

PROJECT 7: TESTING DISEASE TREATMENTS ON TRANSGENIC ZEBRAFISH AND CELL CULTURE MODELS OF NEURODEGENERATIVE DISEASE.

SUPERVISOR: Dr Angela Laird

PROJECT DESCRIPTION:

Background: We have developed transgenic zebrafish models of the neurodegenerative diseases motor neuron disease and spinocerebellar ataxia-3 (also known as Machado Joseph disease). In humans these diseases cause death of neurons throughout the brain and spinal cord, resulting in impaired movement control. Our zebrafish develop various signs of disease including motor dysfunction (decreased swimming speeds), abnormal motor neuron morphology, increased cell death and accumulation of aberrant protein fragments.

Aims: In this project we will test whether treating the transgenic motor neuron disease and spinocerebellar ataxia zebrafish with selected drugs can improve the swimming ability of the zebrafish and prevent related disease phenotypes. We will also perform testing of these potential therapeutics on our cell culture models of the diseases.

Methods: Training will be provided in transgenic zebrafish mating, zebrafish embryo collection, observation and imaging using a fluorescent microscope, drug treatment, behavioural testing and western blotting. For the cell culture studies, training will also be provided in cell culture techniques, drug treatments, immunostaining and microscopy.

The project will allow students to develop new skills and gain insight into the field of neurodegenerative disease research. The results of the project will contribute to a broader project that aims to identify treatments for these debilitating human diseases.

For more information please contact Dr. Angela Laird (angela.laird@mq.edu.au).
PROJECT AREA: NEUROBIOLOGY OF VITAL SYSTEMS

PROJECT 1: INVESTIGATION OF PREDATION-RELATED BEHAVIOUR AND AUTONOMIC OUTPUT.

SUPERVISOR: Dr. William Redmond and A/Prof. Simon McMullan

PROJECT DESCRIPTION:

The focus of this project will be to help devising and implementing a set-up to conduct 32-channels silicone probe recordings for awake, behaving rodents. Our aim is to investigate the circuit linking the sensory regions of the brain (focus on audio-visual) with the brainstem (where autonomic control occurs). To do so, we present salient sensory stimulations such as the looming stimulus, an expending circle over the head of the animal which mimics the descent of a bird of prey, which causes a freeze-or-flight response in rodents and is accompanied by an important surge in blood pressure and heart rate. This project will permit the student to get involved with various cutting-edge technologies including multi-array electrophysiology, optogenetic, confocal microscopy and behavioural approaches. Data analysis techniques using Matlab and various Python packages will also be presented.

For more information please contact Dr. William Redmond (william.redmond@mq.edu.au).

PROJECT AREA: NEUROSURGERY

Syringomyelia is a condition characterised by the formation of a fluid-filled cyst in the spinal cord. As the cyst enlarges, it causes damage to the surrounding spinal tissue, leading to pain, muscle weakness and wasting, loss of reflexes, loss of sensitivity to pain and temperature and/or an additional decline in motor and sensory function. Outcomes from surgical treatments are often unsatisfactory, with clinical studies reporting that only ~50% of patients show improvement. A better understanding of the mechanisms involved in cyst development and enlargement are critical to improve current treatment modalities.

It is generally understood that syringomyelia is caused by obstructions or alterations in cerebrospinal fluid (CSF) flow. In patients with a spinal cord injury, inflammation or scarring at the site of trauma causes a blockage of the CSF-filled space surrounding the spinal cord, and a cyst develops at or just above or below the original injury. However, it is not known if this is due to an increase in inflow or an obstruction to the fluid outflow pathways. In fact, even in healthy spinal cord the pathways involved in both inflow and outflow are poorly understood.

Our research group is interested in identifying what drives fluid inflow and outflow and the pathways for CSF flow in the spinal cord. We use various imaging techniques (light, fluorescent or electron microscopy), nanotechnology, immunohistochemistry and animal models in our work.
PROJECT 1: ELECTRON MICROSCOPIC INVESTIGATION OF SPINAL CORD CYSTS

SUPERVISOR: Dr. Magdalena Lam

PROJECT DESCRIPTION:

This project will investigate the potential molecular processes responsible for tissue cavitation and cyst formation in rat models of syringomyelia. This will be investigated using electron microscopy, immunohistochemistry and immunogold staining of spinal cord sections.

For more information please contact Dr. Magdalena Lam (magdalena.lam@mq.edu.au).

PROJECT 2: IS THERE A DURAL LYMPHATIC SYSTEM IN THE SPINAL CORD?

SUPERVISOR: Dr. Magdalena Lam

PROJECT DESCRIPTION:

Based on recent discovery of meningeal lymphatic vessels in the brain, this project will investigate the existence of lymphatic structures in the spinal cord. The methods used include cryosectioning, immunohistochemistry, fluorescence microscopy, immunogold staining and electron microscopy.

For more information please contact Dr. Magdalena Lam (magdalena.lam@mq.edu.au).

PROJECT 3: THE EFFECT OF AQUAPORIN MODULATION ON CELL SWELLING AND SPINAL CORD CYSTS.

SUPERVISOR: Dr. Magdalena Lam

PROJECT DESCRIPTION:

This project will investigate the role of transmembrane water channels (aquaporins) in the regulation of water content in the central nervous system and/or investigate aquaporins as a potential therapeutic target for syringomyelia patients. This project uses cellular and/or animal models (including tissue culture, immunohistochemistry, fluorescence microscopy, electrophysiology).

For more information please contact Dr. Magdalena Lam (magdalena.lam@mq.edu.au).

PROJECT 4: WHAT DRIVES FLUID FLOW IN THE SPINAL CORD?

SUPERVISOR: Dr. Sarah Hemley

PROJECT DESCRIPTION:

This project will determine the effect of cardiac and respiratory parameters on CSF flow into and out of the spinal cord in healthy rats using a fluorescent CSF tracer.

For more information please contact Dr. Sarah Hemley (sarah.hemley@mq.edu.au).
PROJECT AREA: PATIENT SAFETY, QUALITY OF CARE AND HEALTHCARE SYSTEMS

PROJECT 1: EXPLORING THE CULTURE OF HEALTH CARE

SUPERVISOR: Dr Janet Long, Dr Kate Churruca, Dr Louise Ellis

PROJECT DESCRIPTION:
A recent systematic review found a correlation between organisational and workplace cultures of hospitals and patient outcomes in over 90% of studies. In other words, better hospital cultures mean better patient care, yet the concept of “culture” in hospitals is not clear, nor are the dimensions of culture well understood. Work is currently being undertaken at four large hospitals in Sydney to look at various aspects of hospital culture and physical context to explore new and potentially alterable variables relevant to patient outcomes. As part of this ongoing work we would like to invite applications for a Summer Research Position to assist in collecting and analysing supplementary data. The program has some flexibility (depending on the skills of the applicant and their areas of particular interest) but data collection is likely to be in the form of interviews or focus groups with staff at the hospitals followed by transcription and analysis of the data.

For more information please contact Dr. Janet Long (janet.long@mq.edu.au).

PROJECT AREA: PHARMACOLOGY

PROJECT 1: CAN TERPENES AND TERPENOIDS FROM CANNABIS MODULATE T-TYPE CALCIUM CHANNELS?

SUPERVISOR:

PROJECT DESCRIPTION:
T-type calcium channels are low-voltage activated channels important for physiological functions in the heart and brain, particularly rhythmic activity. There are three T-Type calcium channels: CaV3.1, Cav3.2 and Cav3.3 (1), and they are important potential targets for analgesics and anti-epileptics. In our lab, we have investigated the effect of phytocannabinoids (naturally in the plant) and synthetic cannabinoids in these channels and found they have a modulatory effect (2). Terpenes and terpenoids are natural components of all plants and their potential to modulate T-type calcium channel has been previously shown for lavender and rosemary extracts (3). Therefore, in this project we hypothesise that terpenes and terpenoids available in cannabis can modulate T-type calcium channels leading to a synergistic effect with unique phytocannabinoids. In this project, you will learn tissue culture, how to measure calcium mobilisation in cells and data analyses (Prism Graphpad).

For more information please contact Dr. Marina Santiago (marina.junqueirasantiago@mq.edu.au).