March 2019 STEMpowerment Internship Program Descriptions

Das Laboratory

http://www.sickkids.ca/AboutSickKids/Directory/People/D/Sunit-Das-Profile.html

Students at the Das Laboratory will have the chance to explore two projects. The first project is focused on the role of the mismatch repair mechanism of DNA repair and deficiencies in this mechanism in relation to response to immunotherapy in glioblastoma. The second project focuses on the idea of minimal residual disease (MRD) in glioblastoma. MRD is a population of cells that are known to cause a relapse in cancer due to being below the threshold for detection during initial treatment. Our goal is to develop a cerebral organoid using patient-derived glioma stem cells in which gliobastoma MRD can be more easily studied due to a relatively small cell scale.

Khosrow Laboratory

http://www.sickkids.ca/Research/Adeli-Lab/index.html

Our laboratory is investigating the role of the intestine in metabolic health and development of diseases such as obesity and type 2 diabetes (I.e. Insulin resistant states). Specifically, we study key gut hormones secreted by the small intestine in response to dietary fat and carbohydrate ingestion. These hormones such as glucagon-like peptides have been found to regulate dietary fat absorption and production of lipid particles in the intestine called, chylomicrons. Our main objective is to elucidate the molecular, cellular, and physiological mechanisms mediating the control of dietary fat absorption by gut hormones and the interaction of these hormones with enteric neurons and the central nervous system. Nutrient sensing mechanisms that are triggered by dietary fat and carbohydrate and the ensuing gut-brain neuroendocrine network that controls nutrient absorption and metabolism are being studied using both cell culture models as well as animal models of insulin resistance such as the fructose-fed hamster model.

Branch Laboratory

http://www.lmp.facmed.utoronto.ca/research/faculty-research-database/branch-donald

Red blood cells (RBCs) when they are coated by certain proteins such as antibodies can be eaten by certain white blood cells called monocyte-macrophages. This process is called RBC-opsonization-mediated phagocytosis. We have developed an in vitro assay to measure phagocytosis of opsonized RBCs. The student will learn the background (immunology) of monocyte-macrophage phagocytosis and be trained to perform our phagocytosis assay using different RBCs coated with different proteins.

Girardin Laboratory

http://www.lmp.utoronto.ca/research/faculty-research-database/girardin-stephen

Students in the Girardin laboratory will have the chance to explore one of two projects. The first project involves analyzing the response of intestinal epithelial cells to a bacterial metabolite named succinate. In particular, the student will be familiarized with techniques to analyze heterogeneous cell populations in the intestine using flow cytometry and confocal microscopy. The goal of the project is to identify how various sub-populations of intestinal epithelial cells differentiate and grow after stimulation with the

metabolite succinate. The second project involves analyzing how epithelial cells respond to infection by a bacterial pathogen named Shigella flexneri. In particular, the student will discover how infected cells induce a specific transcriptional program in response to the pathogen by turning on the transcription factor known as TFEB. The project will involve protein biochemistry (western blotting) and confocal microscopy.

Dabdoub Laboratory

https://sunnybrook.ca/research/team/member.asp?m=513&page=172

Hearing is one of our five precious senses. Healthy hearing enables us to stay connected to the world around us. It helps us to communicate and socialize with our family and friends. When our hearing declines, it affects both our physical and social wellbeing. It is estimated that over 5% of the world population, including over 3 million Canadians, are suffering from disabling hearing loss. One of the leading causes of hearing deficiency is degeneration of primary auditory neurons that transfer auditory signal from sensory hair cells in the inner ear to the brain. To help individuals who suffer from this condition we use a neuronal reprogramming approach. We are investigating genes that will induce primary auditory neurons from glial cells that normally surround and maintain the neurons. We analyse the induced neurons in terms of morphology, expression of neuronal markers as wells as comparing their transcriptome to the endogenous neurons. The result of our research could propose gene therapy and neuronal reprogramming as a novel approach for treatment of hearing loss.

Johnson Laboratory

https://www.utm.utoronto.ca/infant-child-centre/child-language-and-speech-studies-lab

The cognitive machinery needed to produce and comprehend human language is remarkably complex, and yet typically children demonstrate mastery of many key elements of language by 3 to 4 years of age. In fact, infants comprehension of language as early as 6 months of age, and some evidence for language-specific knowledge is evident by birth! In Johnson's Child Language and Speech Studies (C.L.A.S.S.) Lab, we study how auditory, visual, linguistics, and social experiences sculpt the initial emergence of children's communication abilities. We also study how the acquisition of language affects other domains of cognition, such as talker recognition and the development of peer preferences. A unique aspect of many studies is their focus on child development in linguistically and culturally diverse settings, like the GTA. Interns in our lab will shadow researchers as they run experiments, interact with families taking part in studies, analyze data, and present their research findings.

Gerlai Laboratory

http://sites.utoronto.ca/GerlaiLab/

Students at the Gerlai laboratory will have the chance to explore a project examining the effects of embryonic alcohol exposure in zebrafish. This mimics the human condition of fetal alcohol spectrum disorder. Students will shadow us and observe/work in a zebrafish facility. Activities will most likely include observing behavioral testing, husbandry, and analysis of zebrafish behaviour. We will provide a broad overview of how we perform our studies and allow students to follow us each step of the way (from study design to data analysis).

Kay Laboratory

http://pound.med.utoronto.ca/

Pediatric Medulloblastoma (MB) is the most common childhood brain cancer and accounts for 15-20% of childhood brain tumours. Treatments for these cancers usually include removal of the tumour by invasive surgery followed by chemotherapy and radiotherapy, often resulting in long lasting health problems for patients. Recently, much progress has been made in classifying the genetic and molecular basis of these tumours, enabling their categorization into at least four groups (WNT, SHH, Group 3 and Group 4). These discoveries have focused research into MB and opened up possibilities for the development of targeted and personalised therapies.

The Ddx3x protein is frequently mutated in childhood MB and abundantly produced in MB tumours regardless of mutational status. The underlying goal of my research is to understand the effects of disease-causing mutations on the structure and dynamics of Ddx3x in both solution and phase-separated environments and to elucidate at atomic resolution the interactions between Ddx3x and its binding partners. This research will provide a basis to enable the targeted development of therapeutics against Ddx3x with the goal of providing more effective treatments for MB in the future.

Monks Laboratory

https://www.utm.utoronto.ca/psychology/faculty-staff/monks-ashley

Students at the Monks Lab will explore the differences between males and females, especially how they communicate their social status. Together, we will investigate how male and female mice differ in their production of pheromones (chemicals used for communication). We will also look at how different levels of testosterone and its receptor (the Androgen receptor) interact to increase or decrease the amounts of pheromones produced. We will do this by performing a variety of protocols that are commonly used in biological research, which will allow us to compare the quantities and types of these pheromones. This will involve learning theoretical background information on protein characteristics and sexual differences in behavior, experimental planning, pipetting techniques to collect and prepare samples, executing experimental protocols, and analyzing data to make inferences about interesting differences between the ways males and females communicate.

McMillen Laboratory

https://www.utm.utoronto.ca/mcmillen-lab/

Synthetic biology is a new and rapidly growing branch of science in an effort to implement engineering at the cellular level. It aims at the (re-)design and fabrication of biological components and systems that do not already exist in the natural world. It represents a maturation of genetic engineering and biotechnology with the potential to reshape medicine, industry and agriculture. At the McMillen Synthetic Biology and Cellular Control laboratory, we mainly work on microbial synthetic biology in conjunction with systems biology and mathematical modeling, investigating ways to create novel solutions to real-world problems. We pursue several parallel tracks; one project of our main focus is on sensing and responding to inflammatory bowel diseases (IBD) using engineered microbes. The result of our research could someday help patients with IBD to alleviate some of the symptoms and combat the diseases from within before it worsens.

Westwood Laboratory

https://www.utm.utoronto.ca/biology/people/westwood-j-tim

During heat shock (hs) in Drosophila and almost all other organisms, a set of genes known as the hs genes have upregulated transcription. Heat shock factor (HSF) is the transcription factor that regulates hs gene transcription by binding to the promoters and/or other DNA elements leading to the recruitment and stimulation of RNA polymerase II. Drosophila that are missing HSF protein or function arrest during embryogenesis. This result suggests that HSF has a role in normal development even under non-stress conditions. More specifically, HSF may be regulating the transcription of genes that are required for progression through development.

Objectives: The objective of the study is to determine the stage(s) in embryogenesis when HSF is active.

Methodologies: The project will involve the following techniques: collecting Green (and/or Red) Fluorescent Protein reporter embryos; staining and microscopic examination of embryos to identify the stage(s) HSF is active during embryogenesis.