College of Biological Science (CBS) Undergraduate Summer Research Assistantship

Below is a list of possible sponsors for the CBS Undergraduate Summer Research Assistantship. You may apply to more than one sponsor.

Department of Human Health and Nutritional Sciences
More information regarding each sponsor’s research and contact information can be found on the Department of Human Health and Nutritional Sciences website.

Stephen Brown, HHNS
The research in Dr Brown's Spine and Muscle Biomechanics lab is dedicated to developing the understanding of the mechanics and physiology of the lumbar spine and spine musculature. Specific focus is placed on function, injury, adaptation and rehabilitation of these tissues.

Philip Millar, HHNS
My research program is focused on neural control of the circulatory system in humans. We address both basic (e.g. reflex control mechanisms) and applied (e.g. responses to interventions like exercise) questions by directly recording muscle sympathetic nerve activity using a specialized technique called microneurography.

David Mutch, HHNS
Dr. Mutch's nutrigenomic research program explores the roles of dietary fatty acids on various health outcomes. In collaboration with Drs. Leri and Fernandes in the Department of Psychology, we are examining the molecular mechanisms underlying how omega-3 and omega-6 polyunsaturated fatty acids (PUFAs) contribute to emotional disorders. A CBS Undergraduate Summer Research Assistantship position is available in Dr. Mutch's lab for a motivated and hard-working student who will assist with studies examining if interactions between PUFA-derived inflammatory mediators and adipokines serves as a potential molecular mechanism through which dietary omega-3 and omega-6 fats affect emotional behaviour.

Geoff Power, HHNS
The goal of my research program is to understand and gain intimate knowledge regarding mechanisms associated with age-related alterations to muscle contractility across multiple scales of organization. We investigate the neural control of movement using various neuromuscular tools and techniques (e.g, brain, spinal cord, muscle stimulation, electromyography) and basic intrinsic muscle contractile properties at the cellular level. This work has significant relevance, including understanding the neural control of voluntary movement across the lifespan and generating new insight into the active and passive muscular contributions to force production / transmission of skeletal muscle. Utilizing the chronic adapted state of human senescence, we aim to identify mechanisms which regulate intrinsic contractile function and gain
invaluable insight into the adaptive capacity of skeletal muscle and what limits function in the context of normal adult aging.

**Department of Integrative Biology**
More information regarding each sponsor’s research and contact information can be found on the [Department of Integrative Biology](#) website.

**Sally Adamowiz, IB/BIO**
My students and I aim to understand the evolution and maintenance of biodiversity across varying spatial and time scales, with a focus on aquatic invertebrates. Focal study systems include arctic freshwater habitats, ancient lakes, and Canadian marine waters. We employ a variety of molecular methods, including phylogenetics and DNA barcoding, to investigate geographic patterns in the distribution of biodiversity, rates of diversification across the Tree of Life, and biological and environmental correlates of rates of molecular evolution.

**Teresa Crease, IB**
The long-term goal of Dr. Crease’s research is to understand the mechanisms by which ribosomal DNA evolves and to determine the impact of sequence changes on the structure and function of ribosomal RNA. Crustaceans in the genus Daphnia are used as a model system for this research. Dr. Crease also studies the population genetics and impact of transposons that specifically target ribosomal DNA.

**Moira Ferguson, IB**
Natural selection in Icelandic Arctic charr
We are investigating the processes underlying the early stages of ecological diversification, by focusing on natural populations of Arctic charr in Icelandic lake systems. Through measuring the phenotypic targets and the ecological causes of natural selection, we hope to better understand the mechanisms by which selection contributes to the creation and maintenance of polymorphisms within these populations. The successful candidate will work alongside a member of our lab in Iceland over the summer months and have the opportunity to collect fish and analyze data for a subcomponent of the larger project. Airfare and living costs in Iceland will be provided.

**Brian Husband, IB**
Research area: evolutionary biology, plant sexual systems, polyploid speciation
Research description: My lab explores the ecological and genetic attributes of plant populations and the evolution of traits that contribute to adaptation and speciation. Our primary focus is on plant reproductive systems, which include gamete quality and quantity, pollination, and mating patterns and their impact on genetic diversity, distribution and reproductive isolation. We use a variety of wild and cultivated species for this work, and apply our knowledge to problems in conservation, restoration, and interactions between agricultural and natural ecosystems.

**Fred Laberge, IB**
My lab is interested in evolution of the brain and how it relates to cognition in vertebrates. We study the cognitive abilities of amphibians using experimental psychology approaches such as conditioning or manipulations of motivation. Recently, we have also begun investigating how ecology shapes morphology of the brain and other organs in wild fish.

Hafiz Maherali, IB

Our research is focused on understanding the function, ecology and evolution of the symbiosis between plants and mycorrhizal fungi. In exchange for sugars from photosynthesis, mycorrhizal fungi provide plants with access to soil nutrients. This symbiosis is widespread, occurring in nearly 90% of plant species, and takes place in every plant community on earth, including agricultural and managed systems. However, we know relatively little about why and how the symbiosis evolved, and why and how it is maintained in the present day. Potential projects will include evaluating the stability of the symbiosis in different environmental contexts, particularly under varying soil resources, and in the presence or absence of other symbionts that complement or compete with mycorrhizal fungi.

Andrew McAdam, IB

We are studying the ecology and evolution of red squirrels in the Yukon near Kluane National Park. This is a long-term study that follows the survival and reproduction of marked individuals throughout their lifetime. Fieldwork will involve live-trapping and handling of animals, radio-telemetry, behavioural observation, and climbing trees to find young in nests. Interested applicants should contact Andrew McAdam for more details.

Amy Newman, IB

The early-life environment can influence development, behaviour, health and fitness; in particular, early-life stress can have profound and long-lasting impacts throughout an organism's life-span. In the Newman Lab, we study proximate and ultimate questions around stress ecophysiology. We combine field studies and laboratory analyses to examine the persistent effects of early life stress on physiology, behaviour and fitness and we work on a variety of wild animal model systems including birds and small mammals. We are looking for a student to assist in field research and data collection; experience handling birds is an asset, although not a necessity. More information on our research is available on the Newman Lab website.

Alex Smith, IB

In this lab, we work to better understand the contemporary distribution of hyperdiverse, and often cryptic, species of insects across major ecological gradients in tropical and temperate environments. Our research is built upon projects designed to explore the causes and consequences of biodiversity across elevational, latitudinal and disturbance gradients and builds on long-term collections using phylogenetic, functional and physiological measures. I am committed to teaching, and learning from, diverse individuals and scientists, participating in outreach, improving how we communicate science, and publishing accessible research and data.

Pat Wright, IB
We are interested in understanding the diversity of strategies that amphibious fish use to cope with life out of water. We study the mangrove rivulus (Kryptolebias marmoratus) that survive up to 84 days in air. The aim of this laboratory project is to link plasticity in physiological traits with performance on land to understand the characteristics that are most important in tolerance to prolonged air exposure. This project is ideal for supporting an honours research project over the F16 – W17 semester.

Department of Molecular and Cellular Biology
More information regarding each sponsor’s research and contact information can be found on the Department of Molecular and Cellular Biology website.

Emma Allen-Vercoe, MCB
The human gut microbiome is a central component of health, and understanding how these important microbial passengers help to maintain well-being is currently an area of research focus. One of the most pertinent questions is how the gut microbial ecosystem, which is compositionally unique and tightly associated with an individual throughout life, is maintained. In the A-V lab, we are interested to define the role of a particular family of bacteria, the Lachnospiraceae, as a central component of the human gut microbiota that may be protective against a range of diseases including infections, as well as more chronic conditions including certain cancers. Working alongside a graduate student, this project will focus on using integrated 'omics' methods to understand the contributions of Lachnospiraceae bacteria to ecosystem robustness and function.

Andrew Bendall, MCB
Vertebrate Dlx genes are expressed in a variety of embryonic tissues where they promote cell lineage-specific differentiation and suppress cell division. Conversely, a variety of human cancers show elevated expression of Dlx genes and Dlx genes have been shown to have growth promoting effects in some tumourigenic cell types. We seek to understand the mechanisms of action of Dlx genes with respect to cell division during development in order to understand how their functions are altered in cancer cells.

Anthony Clarke, MCB
Studies in the Clarke laboratory pertain to the metabolism of the bacterial cell wall polymer peptidoglycan with the aim of finding new targets for antibacterial therapy. On-going projects designed to investigate this area of bacterial physiology include the characterization of the autolysins (enzymes involved in the lysis of peptidoglycan during its biosynthesis and turnover), and studies on the O-acetylation and de-O-acetylation of peptidoglycan. Depending upon technical experience, the successful applicant will participate in our investigations on the structure and function relationship of peptidoglycan O-acetyltransferase, O-acetyl peptidoglycan esterase and/or lytic transglycosylases.

Marc Coppolino, MCB
Tumour cell invasion through extracellular matrix (ECM) is required for cancers to spread, and is dependent upon partial degradation of ECM components by matrix metalloproteinases (MMPs) secreted by tumour cells. A semester project is proposed to examine how the transport and targeted release of MMPs are regulated during invasion of ECM by breast cancer cells. The project will involve
experimentation using cultured tumour cell lines, expression of GFP-tagged proteins, and cell-based assays to assess cell invasion.

John Dawson, MCB
We study the proteins involved in cardiomyopathy: diseases of the heart muscle itself. We think that altered interactions between actin and myosin proteins in heart muscle cause hypertrophic cardiomyopathy. By combining biochemistry and biophysics with the physiology and genetics of model organisms, we will determine the cause of cardiomyopathy from molecules to organs and animals. Ultimately, we want to understand what causes cardiomyopathy so we can correct it and improve lives.

Mike Emes, MCB
As well as being the major carbohydrate staple in our diet, starch consumption (high carbohydrate load) is a significant contributor to Type2 Diabetes. Resistant starches (RS) are digested less easily as they pass through the small intestine, reducing the glycemic index and having the additional benefit of stimulating regeneration of the lining of the large bowel, reducing the incidence of colorectal cancer. This project is concerned with understanding the regulation of starch branching enzymes in plants, which contribute to the glucose-polymer architecture and affect its digestibility. A wide range of biochemical, molecular and cell biological approaches will be used including electrophoresis, pcr, recombinant protein production, transgenesis and confocal microscopy. For more information about our research please see my profile on the Departmental website.

Steffen Graether, MCB
Many plants are able to survive cold and drought by producing proteins that protect them from these stresses. Our lab is interested in understanding the sequence-function relationship of late embryogenesis abundant (LEA) proteins using bioinformatics to look for conserved sequence motifs. We have previously successfully used this approach to analyze dehydrins in plants using programs such as BLAST and MEME. Students will be guided through the project and do not need to be bioinformatics experts, but should be comfortable using computer scripts and have a basic understanding of protein biochemistry.

Nina Jones, MCB
Multicellular organisms rely on signal transduction cascades to control important biological responses such as cell growth, differentiation and survival. Understanding the biochemical basis of these protein-protein interactions is of key importance in defining how particular mutations can contribute to pathological conditions such as cancer. In this summer research project, the student will aid in determining the signalling pathways that are mediated by several phosphotyrosine adaptor proteins by identifying the molecular components and biological functions associated with these proteins. Techniques such as DNA cloning, PCR, bacterial and mammalian cell culture, protein purification, electrophoresis, immunohistochemistry and microscopy will be employed by the student.

Azad Kaushik, MCB
Opportunity is available for research on bovine immunoglobulin genetics using immunoinformatics. The student is required to have sound knowledge of at least immunology I (MICR3230) course level. Additional information is available at the Kaushik Laboratory website.

Jaideep Mathur, MCB
The Mathur lab works on fluorescent protein aided live imaging of intracellular interactions in plants. Students learn techniques in molecular, cell biology and genetics and apply them to understand fundamental aspects of plant development. The work entails creation of fluorescent protein fusions, transgenics plants, confocal laser scanning microscopy and may extend to transmission and scanning electron microscopy.

Rod Merrill, MCB
Bacteria rely on virulence factors to facilitate diseases in plants, animals, and man. A recent, new strategy to combat infection in immunocompromised patients (cancer, burn, and AIDS) is to neutralize these factors by small molecule therapy, thereby helping to disarm the offending microbe rather than threaten its survival. Cell-based strategies for identifying and testing inhibitory compounds against virulence factors have the advantage of not requiring purification of the target protein, testing of inhibition in a cellular context, and selecting for compounds that possess useful pharmacokinetic properties. We recently identified a suite of compounds that function as potent in vitro inhibitors of mART toxins and these provide protection of both yeast and mammalian cells against DT-group mART toxins. These exciting results provide proof-of-principle that an inhibitor designed against mART toxins may be important for reducing the virulence of bacterial pathogens. The summer student will work on this project alongside a postdoctoral researcher to develop new therapeutics for treating infections in immune-compromised patients.

Robert Mullen, MCB
Research efforts in the Mullen laboratory are focused primarily on understanding the cellular and molecular mechanisms underlying the formation of lipid droplets - cellular organelles that, in humans, are well known to be involved in the pathogenesis of various metabolic diseases, such as obesity and diabetes, while, in plants, have been attractive ‘targets’ for bioengineering strategies aimed at increasing the production of biofuels. Recently, we identified homologs in plants of two human genes, CGI-58 and SEIPIN, that are responsible for lipid storage disorders and showed that either the loss of CGI-58 or the over expression of SEIPIN in plants results in a massive accumulation of lipids in leaves. These findings suggest that the machinery for lipid droplet formation is evolutionarily conserved and our current efforts are aimed at extending these discoveries by taking advantage of a variety of cutting-edge cellular, biochemical, and molecular biology approaches to assess the involvement of other candidate lipid-disease-related genes in plants. Overall, we expect new models for storage lipid accumulation in plants to emerge from this work that will impact substantially the future strategies for bioenergy utilization.

Stephen Seah, MCB
Tuberculosis had surpassed HIV/AIDS as the No. 1 infectious killer in the world. The emergence and spread of multi-drug resistant strains of Mycobacterium tuberculosis, the causative agent of tuberculosis, are of particular concern, as treatment options are limited. M. tuberculosis can utilize host cholesterol for carbon and energy that contributes to their persistence in host immune cells. The research project
involves structure-function studies of steroid degradation enzymes in M. tuberculosis and related bacteria. The project may facilitate the development of new antibiotics against drug-resistant strains of M. tuberculosis by disrupting their cholesterol utilization pathway.

Chris Whitfield, MCB
Dr. Whitfield’s research group studies the processes involved in assembling the surfaces of pathogenic bacteria, particularly polysaccharide layers that protect the bacterium from components of the host’s innate and immune defence. Lab members investigate the structure and function on molecular machines that synthesize and export these polymers. In addition to being critical systems in microbial cell biology, they offer potential targets for new therapeutic approaches.