**Faculty of Science**

**Itinerary** **Zoom**

**September 23, 2021**

4:00 pm ***Opening Remarks and Introduction of first presenter by Dr. Lael Parrott***

4:10 pm **Christy Richards**, Biology (Dr. Andis Klegeris) URA

Evaluating the therapeutic potential of Camptothecin and its analogues as treatment for neurodegenerative diseases

Currently, neurodegenerative diseases lack effective treatments. Neurodegeneration is characterized by inflammation and neuronal death, which can result from the over activation of microglia, the immune cells of the brain. Camptothecin (CPT) is an anti-cancer drug with well-established toxicity; however, emerging evidence suggests that, at non-toxic concentrations, CPT may downregulate microglia-mediated neuronal death. Our experiments measured neuron and microglia survival and release of inflammatory molecules in the presence of CPT and its analogues. In addition, we demonstrated that CPT and two of its analogues inhibit pro-inflammatory microglial functions and promote neuronal survival, identifying these drugs as potential novel therapeutics for neurodegenerative diseases.

4:20 pm **Seamus McRae**, Biology (Dr. Andis Klegeris) URA

DNA-binding proteins as mediators of neurodegeneration

Dying cells release DNA-binding proteins called histones into the extracellular space. These proteins damage various cell types and elicit inflammatory responses outside the nervous system; however, their effects in the brain are poorly understood. Using cellular models of human neurons and microglia, the immune cells of the brain, I observed that histones were directly toxic to neuronal cells, and that microglia-like cells could modify this toxicity. These microglia-mediated effects depended on the presence of other pro-inflammatory factors. My findings highlight histones as mediators of neurodegeneration, making them potential contributors to ischemic stroke, Alzheimer’s disease, and traumatic brain injury.

4:30 pm **Anna Bernath**, Biology (Dr. Andis Klegeris) NSERC-USRA

Characterizing the secretion of toxins by microglia in response to multiple stimuli

Microglia are the immune cells of the brain. Available evidence indicates that activating microglia with various stimuli leads to the release of distinct subsets of neurotoxins; however, current studies utilize different microglia cell types and diverse experimental conditions making it impossible to directly compare results between studies. To address this knowledge gap, I stimulated microglia with eight different stimuli then measured the secretion of toxins including nitric oxide, tumor necrosis factor and interferon-gamma-induced protein 10. Progressing the understanding of microglial release of toxins could advance the research of neurodegenerative diseases, such as Alzheimer’s disease, which are characterized by over activated microglia.

4:40 pm **Erica Packard**, Biology (Dr. Melanie Jones) NSERC-USRA

Wildfire severity shifts the functional community of towards saprotrophic dominance within one-year

Climate change is resulting in unpredictable outcomes for forest regeneration following wildfires. Pyrophilous (fire-loving) fungi may play an important role early in regeneration, but little is known about the ecology of these fungi. The soil fungal community of six different fire severity levels following the 2020 Mt. Christie wildfire were observed using next-generation sequencing. Wildfire severity and sampling date affected both alpha diversity and fungal community composition. In general, ectomycorrhizal fungi were negatively correlated with increasing wildfire severity. My results suggest that the fungal community changes rapidly within the first year but that shifts in the functional community persist longer.

4:50 pm **Owen Partrick**, Biology (Dr. Michael Deyholos) NSERC-USRA

Discovery of novel antimicrobials in ferns

There is a growing need for novel antibiotics due to the increasing threat of antibiotic resistance. Anti-microbial peptides (AMPs) have been identified almost ubiquitously amongst plants and animals, however AMPs from ferns have largely been unexplored. This study aimed to elucidate the antimicrobial effects of protein and ethanol extracts from a selection of ferns. Protein and ethanol extracts were generated and tested against fungal and bacterial pathogens using quantitative and qualitative assays. Results for both ethanol and protein isolates were inconclusive and lacked reproducibility; however, extracts from some ferns showed promising antimicrobial activity. Overall, this area requires much further study.

5:00 pm **Selina Spence,** Biology (Dr. Miranda Hart) URA

Spread of bio fertilizer into natural landscapes

Arbuscular mycorrhizal fungi (AMF) are used as bio fertilizers worldwide. Whether these bio fertilizers can disperse from crops to natural ecosystems is unclear. Exotic plants may facilitate AMF dispersal; thus, we compared the differences in AMF root colonization of 15 exotic plant species to 15 native plant species to test whether AMF preferred exotic plants over native plants. We hypothesize that AMF prefers exotic plants over native plants, suggesting that AMF could be assisted by exotic plants to disperse underground. This may negatively impact ecosystem functioning. Understanding AMF dispersal is crucial for understanding their ecological threat and for developing bio fertilizer management plans.

5:10 pm **Maya Bandy**, Biology (Dr. Deanna Gibson) URA

Examining the influence of glyphosate on the gut-brain axis

The abundantly used pesticide, glyphosate (Roundup®), has been detected in food items across Canada. Research indicates that glyphosate may alter the gut bacteriome and behaviour through the microbiota-gut-brain axis. These studies yielded conflicting results due to supra-physiologically high doses. We examined pre-natal glyphosate exposure across three generations and direct exposure over one generation of mice using diet-appropriate dosage. Reduced locomotor activity was observed three generations following pre-natal glyphosate exposure, but there were no behavioural differences following direct exposure. This work demonstrates that a physiologically relevant dose of glyphosate may impact the gut-brain axis, emphasizing the susceptibility of the pre-natal window.

5:20 pm **Allison Leam,** Chemistry (Dr. Isaac Li) URA

Visualizing tensile forces in cell adhesion by DNA-based molecular probes

In cell adhesion, cells communicate using mechanical signalling where tiny forces are used to push or pull on their surroundings. This study aims to quantitatively measure the mechanical signaling that directs the events and behaviours of cell adhesion. Cells were adhered on a DNA surface that fluorescently probes mechanical events, creating a visible map of cells’ force transductions. Preliminary observations showed that cells apply greater adhering forces next to neighbouring cells, exhibiting potential tissue-forming behaviour. Characterizing these forces could have major implications as cell adhesion remains poorly understood but plays a role in innumerable biological processes and diseases.

5:30 pm **Dyuti Raghu**, Chemistry (Dr. Isaac Li) IURA

Conformational dynamics of DNA Hairpins using Optical Tweezers

DNA hairpins serve as useful models to study the formation of secondary structures. They can also be employed in the construction of force sensors and tethers. DNA hairpins of varying stem length, loop length, and GC content were constructed using molecular biology techniques. Optical tweezers were employed to study the conformational dynamics of DNA hairpins in response to nanomechanical forces to construct the force-extension curve of each hairpin. The studies conducted in this project will lay the foundation for many subsequent projects in the fields of biophysics and mechanobiology, as well as serving as proof of concept for multi-stage tethers.

5:40 pm **Micah Yang**, Chemistry (Dr. Isaac Li) NSERC-USRA

DNA rupture kinetics for Tension Gauge Tether design

Cells communicate internally and with each other electrically, chemically, and mechanically. Of these, mechanical signalling is the least studied due to the technical difficulty of measuring the pico-newton scale forces involved. Short DNA fragments rupture predictably when pulled by specific forces, making them useful as bio safe force probes for use in cells. Using Acoustic Force Spectroscopy, we aim to form a kinetic model of DNA rupture with changing length, cytosine-guanine content, and the location of force application. This model will allow for the design of more tools to measure internal and external cellular forces.

5:50 pm **Emily Knudson-Goerner**, Chemistry (Dr. Wesley Zandberg) NSERC-USRA

Sialic Acid characterization of chicken intestinal mucin

Necrotic enteritis (NE) is the leading cause of economic losses in poultry production and is the result of *Clostridium perfringens* colonization in the gastrointestinal tract. Changes in sialic acid composition are related to *C. perfringens* activity. Accordingly, sialic acid profiles of small and large intestinal tissues in healthy chickens were characterized by high performance liquid chromatography-quadrupole time-of-flight mass spectrometry (HPLC-QTOF-MS). The quantitative data revealed varying levels of Neu5Ac compounds throughout duodenum, jejunum, ileum, and colon tissues. Additionally, significant biological variation was observed between individual chickens. The analyzed profiles reveal immunological implications upon comparison to *C. perfringens* infected tissue.

6:00 pm **Durvan Zandamela,** Chemistry (Dr. Wesley Zandberg) IURA

Structural elucidation of lichen exopolysaccharide by CE-LC-MS

We aim to characterize a lichen exopolysaccharide which is hypothesized to resemble the capsular polysaccharide (GXM) of the opportunistic pathogen *Cryptococcus neoformans*. If putative GXM is found in lichens, their natural consumers may harbour GXM-degrading enzymes with therapeutic potential. We have detected all GXM monomers in lichen extracts of five species by Capillary Electrophoresis (CE). Current efforts are in replicating and improving the polysaccharide extraction protocol for further analysis by CE with absolute quantitation including more lichen specimens, as well as introducing sample clean-up steps to enable analysis of GXM oligomers by Liquid Chromatography – Mass Spectrometry (LC-MS).

6:10 pm **Jasper Pankratz**, Chemistry (Dr. Robert Godin) URA

Soluble 2D Nanosheets as Versatile Precursors to Photocatalysts with Different Morphologies

Carbon nitride is an organic polymer capable of storing solar energy within the chemical bonds of hydrogen gas. Before carbon nitride can become commercially available, there must be improvements on its photocatalytic efficiency. This project aims to understand how carbon nitride’s shape will affect its performance. We developed a new approach to modifying the polymer’s shape without changing its chemical environment. Three morphologies were prepared, and their optical and chemical properties were evaluated to reveal important information about their photocatalytic properties. This knowledge will help us begin making rational modifications to the morphology to prepare better photo catalysts for sustainable energy.

6:20 pm **Evan Keenan**, Chemistry (Dr. Robert Godin) NSERC-USRA

Covalent attachment of carbon nitrides on solid substrates

Carbon nitride (CN) is an organic polymer that possesses promising properties for use in photocatalytic water-splitting and degradation of organic pollutants [1][2]. Unfortunately, the efficiency of these reaction is low and requires improvements to unlock CN’s full potential as a photocatalyst. Therefore, developing a deeper understanding of the properties of CN and the mechanism of hydrogen production is crucial. CN’s insolubility and inhomogeneity in solution make its properties difficult to study. For this reason, we are looking at a method to bind carbon nitride to a glass surface without modifications to the physical and electronic structure of carbon nitride. Two methods are currently being explored. The first method uses the reductive amination of dialdehydes as cross-linking agents between CN and amino-silanized slides, and the second uses the nucleophilic acyl substitution to cross-link CN and the amino-silanized slides.

6:30 pm **Brooke Kwan**, Chemistry (Dr. Thuy Dang) URA

One step at a time: Identification of genes encoding camptothecin-producing enzymes

Camptothecin is a high-value anticancer compound produced by *Camptotheca acuminata*. However, the enzymes involved in its biosynthesis are not well-elucidated. Ten candidate genes suspected of involvement in camptothecin biosynthesis were identified by *in silico* orthogroup analysis, cloned into a maintenance strain, and expressed in *Escherichia coli*. The resultant proteins may be later characterized using tandem mass spectrometry and other tools, facilitating later pathway reconstitution and large-scale production of camptothecin.

6:40 pm **Matthew McConnachie**, Chemistry (Dr. Thuy Dang) NSERC-USRA

Combinatorial biochemistry for alkaloid pathway elucidation

Camptothecin (CPT) and its derivatives are potent inhibitors of DNA topoisomerase I activity and are used clinically for the treatment of lung cervix, ovarian and colon cancers. The synthesis of CPT derivatives requires the chemical “decoration” of the CPT backbone. Current synthetic methods of decoration require heavy metal catalysis which is both expensive and creates hazardous wastes. This research aims to use newly discovered and previously characterized enzymes to develop green methods to synthesize CPT derivatives. Molecular cloning and biochemical techniques were used to successfully clone and express candidate genes and identify their enzymatic activity on CPT and its derivatives.

6:50 pm **Bryce Dyck**, CMPS (Dr. Rebecca Tyson) NSERC-USRA

P-tipping in the forest tent caterpillar host-parasitoid system

It is understood that species with low and declining populations are at risk of extinction, but is there a risk to healthy populations? P-Tipping, a climate change induced extinction event, occurs during a specific phase of continuous time population models and causes a crash from healthy population levels to extinction. We are interested in whether this phenomenon occurs in discrete models as well, such as the Forest Tent Caterpillar (FTC) host-parasitoid system. We have developed a model which displays P-Tipping behaviour, and data from simulations of the system are being analyzed to determine the phase and frequency of tipping.

7:00 pm **Vivien Nagy**, CMPS (Dr. Rebecca Tyson) URA

Observing the Spread of AMF with the Presence of Weeds

The mutualistic relationship between Arbuscular Mycorrhizal Fungi (AMF) and crop plants has led the agriculture industry to use AMF as a low carbon footprint fertilizer. We are interested in determining if weed plants are beneficial to the spread and growth of AMF. We developed a mathematical model for the spread of AMF in the presence of weed plants and examined this through varying the degree to which the weed plant is a good mutualist. My results indicate that AMF spread rate and total crop plant biomass both increase when a mutualistic weed plant is present.

7:10 pm **Joan Brewer**, CMPS (Dr. Rebecca Feldman) URA

Multiple sclerosis: Investigating a program to help evaluate treatment options

Perivascular spaces (PVSs) are small structures within the brain. Their analysis may provide us with information to evaluate treatment options in those with multiple sclerosis (MS). A program (called PVS-SAS) has been designed to automatically segment (or mark) PVSs on MRI scans. This work sought to show that the number of PVSs found through automatic segmentation correlated with the number found through manual segmentation, the current accepted method. Correlation was 0.66. This strong correlation shows that PVS-SAS could facilitate the analysis of PVSs, and could thus be a valuable tool for evaluating MS treatment options.

7:20 pm **Emily Mellors**, CMPS (Dr. Rebecca Feldman) NSERC-USRA

Adaptive MRI coil development

Magnetic Resonant Imaging (MRI) systems consist of three powerful magnets. The magnetic fields produced by the magnets create an environment where signal can be elicited from a sample by exciting the MRI-visible nuclei with an electromagnetic field oscillating at the resonant radio frequency (RF). Often, there are local variations in the MRI fields which lead to image blurring, geometric distortions during image acquisition, and signal void artifacts. In this project, several different simulation software was evaluated for use in design and development of MRI systems, and a tabletop permanent magnet array was constructed and assessed for homogeneity.

7:30 pm **Livia Jonnatan**, CMPS (Dr. Khalad Hasan) IURA

Smartphone Usage Behavior among Rural and Urban People during the COVID-19 Pandemic

The COVID-19 pandemic has transformed people’s lifestyles. Many people are now working from home, shopping online, and gathering online, eventually increasing their digital device (e.g., smartphones) usage. However, this increased usage pattern may differ for people living in rural areas due to adequate digital infrastructure (e.g., internet access). We conduct an online survey investigating smartphone usage behavior among rural and urban people before and during the pandemic. Results reveal an increase *in* smartphone usage during the pandemic in rural and urban areas, though people in urban areas exhibit a significantly greater increase in their smartphone usage.

7:40 pm **Gillian Godden**, CMPS (Dr. Alex Hill) NSERC-USRA

Investigation of Dust Survival in the Interstellar Medium Using Magnetohydrodynamic Simulations

Interstellar dust plays a pivotal role in the evolution of galaxies, yet the processes behind dust evolution within the interstellar medium (ISM) are poorly understood. To investigate the origins of interstellar dust, I implemented a magneto hydrodynamic simulation of the turbulent ISM. I modified the simulation to include dust originating from asymptotic giant branch (AGB) stars in addition to dust originating from supernovae. Using this as the foundation, I will compare the distribution and development of dust originating from supernovae to dust originating from AGB stars in future research into the origin of dust within the ISM of Milky Way-like galaxies.

7:50 pm **Shawn Zhao**, CMPS (Dr. Jeffrey Andrews) NSERC-USRA

Investigation of the measurement error in Raman spectroscopy

Raman spectroscopy is a commonly used non-destructive analysis method to analyze the chemical structure of samples. This study aims to determine the normality of the measurement error in Raman spectroscopy. Specifically, it investigates how those normality test methods are widely used perform when testing a high-dimensional data set such as the Raman spectroscopy.

In the expected preparation, high-dimensional normal data was randomly generated and then used to test the performance of the Kolmogorov–Smirnov test, Shapiro test, and t-test. The result shows that the accuracy of those methods is over 85% when there are more than 750 observations. When using the real Raman data, a set of data will be sorted and cleaned to remove outliers, and 1021-dimensional data will be obtained. The data set is then tested, and the result for both methods suggested that the measurement error in Raman spectroscopy does not follow a normal distribution. Those results lead to a conclusion that the measurement error in Raman spectroscopy is likely to follow the normal distribution and the normality tests that are commonly used do not perform well when dealing with high-dimensional data set with a small number of observations.

8:00 pm **Muhammad Konain**, Management (Dr. Eric Li) IURA

Social Innovation in Healthcare Sector

“Social Innovation” is definitely one of the most popularly world in both academic and practitioner worlds. However, the definition of the term is polysemous. In this review article, we systematically unpack research studies on the use of social innovation in health. Through analyzing 56 recently published research articles between 2016 and 2021, we highlighted the roles of social innovation in improving health and health service delivery in different contexts. We conclude our paper with a set of practical recommendations and future research directions.