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# UBC 2022 Multidisciplinary Undergraduate Research Conference: Inspire Change

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## Abstract

The Multidisciplinary Undergraduate Research Conference (MURC) is a conference for undergraduate students at the University of British Columbia (UBC) to showcase their research in front of their fellow UBC students, family, and friends. Researchers may choose one of three formats to showcase their research: oral presentation, poster, or virtual presentation. Presentations are categorized into four multidisciplinary themes: Health and Wellness; Individual, Community and Society; Sustainability and Conservation; and Innovation and Technology. Presentations were evaluated by UBC graduate students and faculty to provide students with feedback on their projects and presentation skills. MURC 2022 was the 19th iteration of the conference and the first ever hybrid (both in-person and virtual) undergraduate research conference held at UBC. The theme for MURC 2022 was *Inspire Change*. This theme seeks to approach research in a manner that inspires new generations to see that change as an agent of positivity and growth. The in-person components of the conference were held at the UBC Vancouver campus, with poster sessions in the Marine Drive Ballroom and oral presentations in the various lecture rooms in the West Mall Swing Space Building. Virtual presentations were held using the Zoom Meetings videoconferencing software.

**Keywords:** undergraduate; health; wellness; individual; community; society; sustainability; conservation; innovation; technology

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**MURC 2022 Abstracts**

**Health and Wellness**

**A correlation study between ADHD-related genes**

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Scholars in neuroscience have identified a number of genetic risk factors for the onset of Attention-deficit/hyperactivity disorder (ADHD). However, most studies have only looked at how a single gene relates to the phenotype and do not examine the role of the interaction between different genes. My study aims to examine how different genes interact to influence the onset and expression of ADHD by utilizing the online genetic databases Gene Expression Omnibus (GEO), Genemania, Gene card, string and Mala cards as a source of gene expression data related to ADHD. I hypothesize different genes that correlate with specific symptoms interact and influence ADHD through a chain-like structure. I argue the gene data would reveal that while these genes do not directly influence the expression of each other, there exists a possible correlation that the genes' related symptoms and bodily functions influence one's physical structure, forming a "chain" that ties genes together. I believe this "gene--function--gene" showed correlations between ADHD-related genes, which influence the expression of the phenotype. The results of this study could provide future scholars with a unique perspective of the interworking of genes correlated with ADHD.

**A proposed study to investigate the effects of early life gastrointestinal bacterial infection on brain function**

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Gram-negative bacterial infection in the gut causes local inflammation through LPS (macromolecular lipopolysaccharides) which can possibly impact brain function, especially microglial dysfunction. This has recently been demonstrated to contribute to several neurodegenerative and neurodevelopmental disorders' pathogenesis. While SCFAs (byproducts of healthy gut microbes) are known to play an anti-inflammatory role, whether gut microbes communicate with the brain through LPS and SCFAs, causing microglia alteration, is currently unclear. We hypothesize that bacterial infection in the gut leads to decreased levels of SCFA producing microbes and causes microglia activation which can be reversed by the introduction of SCFAs. We will use *in vitro* techniques with several SCFAs and LPS on microglia development in culture by viewing changes in surface marker expression using flow cytometry. Mice (4 weeks old) will be infected with *C. rodentium* and after a week at peak infection, colon and brain samples will be dissected and analyzed using immunohistochemistry to view changes in microglia surface marker expression. 16s RNA sequencing will be used to analyze the gut microbiome before and after infection. We expect to see decreased levels of SCFA producing bacteria in the gut and microglia activation in the brain after infection, both being reversed with SCFA reintroduction. These results may support the connection between the gut microbiota impacting brain function and how disturbances to the microbiota may negatively affect the brain and behavior. Future research may lead to mechanisms such as introducing SCFA producing microbes early on to prevent severe neurological consequences later in life associated with microglial activation.

**Analyzing machine learning models to classify triple-negative and non-triple-negative breast cancer**

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Breast cancer, one of the most lethal cancers in women, has different subtypes that are differentiated by molecular markers. Triple-negative breast cancer (TNBC) is a subtype that has a worse prognosis when compared to other subtypes. Current diagnosis methods for breast cancer subtyping can be misinterpreted, so a more accurate method is needed. Differential gene expression analysis, a method to quantify gene expression flux, can be used to discover potential markers that differentiate breast cancer subtypes. In this study, we classified TNBC and non-TNBC using several machine learning models. Publicly available RNA sequencing data sets were taken from GEO (Gene Expression Omnibus) and were used to identify differentially expressed RNA sequences so gene expression levels could be determined. Data from multiple GEO datasets were combined and normalized. LIMMA was then used to identify differentially expressed genes so that TNBC samples could be differentiated from non-TNBC samples. Next, we used different machine learning models, including K-Nearest Neighbour, Support Vector Machines, Decision Tree, and Naive Bayes to classify TNBC and non-TNBC samples. Finally, we analysed the different machine learning models and determined their accuracy. We calculated the false positivity rate, false negative rate, and F1 score, which represents the harmonic mean of precision and recall, for each model. Results show that K-Nearest Neighbour has the highest accuracy rate and F1 score when compared to the other three models and was therefore the most successful in correctly differentiating between TNBC and non-TNBC.

**Anti-neuroinflammatory effects of dietary guar gum on experimental autoimmune encephalomyelitis**

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Multiple sclerosis (MS) is an autoimmune disease characterized by infiltration of lymphocytes into the central nervous system (CNS) that causes chronic demyelination that leads to impaired motor and sensory functions, and the rates of MS in Canada are among the highest in the world. In addition to therapeutics, many people living with MS modifies their diet in an attempt to manage disease symptoms. However, there is limited clinical data supporting the efficacy of dietary modification so far. However, increased understanding of diet-microbiota-immune interactions could lead to better interventions. Here, we used a mouse model of MS (experimental autoimmune encephalitis, EAE) to directly test the neuro-immunomodulatory role of dietary fibres. We gave C57BL/6 mice a 2-week pre-treatment with control (5% cellulose standard chow or fibre-free), and fibre rich (30% pectin or 30% guar gum) (n=4-5 per group) prior to EAE induction and monitored the physical symptoms on a 16-point scale for 25 days. Guar gum, a soluble, highly fermentable fibre diet, lowered EAE incidence and delayed disease onset. Histological analysis demonstrated reduced leukocyte infiltration into the CNS compared to the other high-fibre and control diets. Overall, guar gum ameliorated EAE by limiting neuroinflammation compared to other fibre and control diets. Altogether, guar gum is a novel dietary factor for future studies of supplementation in models of MS.

## Application of random forest in predicting breast cancer progression

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Breast cancer is a leading cause of cancer-related deaths among Canadian women. Statistically, about one in five new breast cancers is the ductal carcinoma in situ (DCIS) case. DCIS is a pre-cancerous condition where the cells inside the breast ducts become cancerous without spreading into surrounding tissue areas. Although DCIS is commonly considered benign, its close relationship to invasive breast cancer requires careful evaluation and consideration for treatment options. Traditionally, the standard care for DCIS diagnosis is to receive the lumpectomy or mastectomy surgery. However, there is no effective way to distinguish which DCIS cases will progress to invasive cancer, indicating that many patients are undergoing an unnecessary surgical procedure. Previous studies have looked at may-be-associate factors but have not identified a reliable method to predict which DCIS cells will upgrade. This study thus plays the role of a preliminary study of this challenge. Twenty-one breast cancer patients' biopsies were obtained, all have DCIS components, and a final sample of 715,329 DCIS cells was extracted from these biopsies. By training a random forest (RF) powered binary classifier, we confirmed that there exist such statistical differences between the DCIS cells in proximity to invasive cancer cells and ones that do not. Specifically, we obtained an overall accuracy of 94% (with 92% specificity and 97% sensitivity). The interpretation of the morphometric features from this model is likely to become handy for constructing more predictive models.

## Characterizing islet cells of the human pancreas

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Pancreatic human islets are composed of multiple cell types that detect and respond to changing blood glucose levels by secreting hormones. In these cells, calcium signaling is critical for normal function, including gene expression. In order to study the effects of calcium signaling in human islets, we previously used single cell RNA sequencing to identify all calcium-regulated genes in islet cell types. From this dataset, we found the gene PCDH7 specifically marks insulin-secreting beta cells with enhanced function and the most calcium-regulated genes. To validate this finding, immunostaining was used to show that PCDH7 protein is in the same beta cells as NPAS4, a known calcium-regulated protein. qPCR was also used to confirm calcium-regulated gene expression in human islets. The study of differences in gene expression in islet cell subtypes may help provide insights on the biology of healthy islets, to better understand what happens when they malfunction.

## Characterizing the secretion of inflammatory mediators by microglia in response to multiple stimuli

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The central nervous system is composed of neurons, which receive and send electrical and chemical signals, and glia, which are non-neuronal cells that support the functions of neurons. Microglia are a subset of glial cells which act as the immune cells of the brain and can alter their gene expression and secretory profile of inflammatory mediators when they are stimulated by specific signalling compounds. Historically, activated microglia have been categorized as either anti-inflammatory or pro-inflammatory. However, recent evidence suggests that there may be as many as six distinct pro-inflammatory states, each characterized by a unique secretory profile, known as the secretome. All currently available studies have utilized variable experimental conditions, such as different concentrations of stimuli and distinctive microglia cell types, making it impossible to quantitatively compare the levels of neurotoxins secreted by activated microglia. To address this knowledge gap, I stimulated BV-2 murine microglia with eight different stimuli which mimic infection or have a regulatory function in the immune system. The stimuli included adenosine triphosphate, interferon gamma, interferon beta, lipopolysaccharide, N-formylmethionyl-leucyl-phenylalanine, phorbol 12-myristate 13-acetate, polyinosinic-polycytidylic acid, and zymosan A. Subsequently, I measured the secretion of a panel of inflammatory mediators including nitric oxide, tumor necrosis factor, L-glutamate and interferon-gamma-induced protein 10. Ultimately, this project will advance our understanding of release mechanisms of inflammatory mediators by microglia. This knowledge advances the research of neurodegenerative diseases, such as Alzheimer's disease, which are characterized by overactivated microglia and is essential for developing new therapeutic strategies.

**Comparing genomic landscapes of carcinomas and sarcomas**

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Carcinomas are a category of cancer where growth begins in tissues covering internal organs while sarcomas are a category of cancer where growth begins in tissues like bone or muscle. Despite certain risk factors or genetic syndromes associated with both categories of cancers, the exact cause is often unknown. Researchers have analyzed genomic alterations in different types of sarcomas and carcinomas. Broadly, they identified recurrent types of mutations, driver genes, markers for disease progression, and potential targets for therapy. However, there is little research that compares the genomic characteristics of carcinomas and sarcomas, along with how these characteristics differ among patient demographics, including age, sex, and race. Given that carcinomas and sarcomas will differ, we hypothesize that there will be significant differences in the tissue type that the cancer develops in, and we expect to find significant differences in genomic characteristics among different patient demographics. Our group will be utilizing The Cancer Genome Atlas (TCGA) database in order to analyze available DNA and RNA datasets. Specifically, we will be making comparisons regarding mutations between carcinomas and sarcomas and will be looking at how mutation characteristics differ across patient characteristics. The analysis will be performed using the R coding software to determine statistically significant comparisons for mutational differences and each clinical characteristic. By analyzing the mutational differences between carcinomas and sarcomas across patient characteristics, we hope that our work provides a greater understanding of how both types of cancers form, leading to improved treatments methods and therapeutic outcomes.

**Developing an online resource for safe active recreation for families of children with autism spectrum disorder**

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Physical activity for children with neurodevelopmental disabilities (NDD) is important for their physical, psychological, and social development. For children with autism spectrum disorder (ASD), participation in recreational activity also contributes to social inclusion and quality of life. However, children with ASD and their families often experience barriers to recreation participation due to factors such as parental safety concerns and a lack of educational resources. In this study, we are designing a web-based parent resource to increase safety awareness in a number of recreational settings. We are utilizing data collected through an online survey to incorporate parent preferences regarding priority recreation, sport and safety topics, and ideas for website design and features. A literature review of peer-reviewed academic sources and reputable grey literature is currently being completed on the topics of swimming and water safety, hiking and camping. Topic-specific website pages will be designed with information on safety risks, suggestions for preventive strategies, and additional resources. The literature review findings will be used to create informative web pages for swimming and water safety, hiking and camping. This project aims to encourage active recreation for families with ASD by providing information that will reduce the risk of harm during these activities, boost excitement and provide access to resources and support. The survey will inform us of topics that interest parents and their preferences for safety information surrounding active recreation for their children. This research will help to address these concerns and encourage healthy recreation participation for families.

**Differences in adolescent boys' and girls' perceptions and motivators behind their eating practices**

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Adolescent boys' and girls' eating practices diverge. Boys often report eating more energy-dense foods like fast foods whereas girls report skipping more meals or consuming more produce. Adult literature suggests that differences in food-related decisions and motivations could be, in part, due to gender norms on body shape, concern for health or future household roles (e.g., mothers leading food-related decisions). It is unclear to what extent gender norms impact adolescents' eating practices. Therefore, this systematic review aims to evaluate differences in boys' and girls' motivation and eating practices. Following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines (PRISMA), four electronic databases will be searched (i.e., Medline Ovid, EMBASE, Web of Science and CINHAL). Qualitative studies

exploring adolescents' motivation behind eating will be eligible. Studies must include adolescents (13-17 years) living without a diagnosed psychological disorder, pregnancy, professional diagnosis of an eating disorder or severe dietary restriction. Studies must also include qualitative analysis of adolescents' perspectives, motivation, views of their eating practices, and present separate results for boys and girls. Eligible studies will undergo data extraction and quality appraisal. Eligible studies will undergo deductive thematic synthesis of themes across studies. Findings will be discussed based on socio-demographic factors and by gender. Understanding how gender norms contribute to differences in eating practices will help inform dietary interventions. By considering gender, interventions can be targeted to address areas of gender-specific improvement, potentially benefiting intervention relevance and likelihood of uptake.

### Effect of testosterone on behavioural flexibility in male rats

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Behavioural flexibility, a complex executive function, is the ability to change behaviour in response to changes in the environment in order to achieve specific goals. The mesocorticolimbic system, including the ventral tegmental area, nucleus accumbens, and medial prefrontal cortex, regulates behavioural flexibility via dopamine signaling. In addition, we have shown that testosterone is produced locally within the mesocorticolimbic system. In rodents, behavioural flexibility can be measured using a set-shifting paradigm that requires animals to switch from a visual-cue rule to a side rule, or vice versa, for reward. Total errors and perseverative errors (errors where a rat responds to the previously correct rule) made during the rule shift are then analyzed. Using this task, we have previously shown that systemic testosterone treatment impairs set shifting, and inhibition of systemic testosterone synthesis via abiraterone acetate (a testosterone synthesis inhibitor) improves set shifting when shifting from the visual-cue to side rule. In our current study, we are investigating the role of neurally-produced testosterone in set-shifting. Adult male Long-Evans rats were gonadectomized to eliminate systemic but not neurally-produced testosterone and subsequently received either abiraterone acetate or control treatment during set-shift training and testing. Data collection and analysis on their cue-to-side or side-to-cue rule shift performance are still ongoing. These data will provide novel insight on the role of locally-produced testosterone on behavioural flexibility in male rats.

### Effects of androgens on behavioural flexibility and tyrosine hydroxylase expression

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Behavioural flexibility is the ability to adjust or adapt strategies when environmental contingencies change, and it is regulated by dopamine (DA) signalling in the mesocorticolimbic system of the brain. DA synthesis is rate-limited by the enzyme tyrosine hydroxylase (TH), the expression of which is sensitive to the presence of androgens, notably testosterone. The effects of testosterone on TH therefore have downstream effects on behavioural flexibility. Strategy set-shifting paradigms using operant chambers can be used to measure behavioural flexibility. This is done by monitoring the relative ease (or difficulty) with which animals learn new reward-reinforced strategies. In this study, we utilized a 2x2 experimental design using a drug treatment and strategy order as factors. Male rats were randomly assigned to (a) the drug abiraterone acetate (ABI), an androgen synthesis inhibitor, or a vehicle and (b) one of two set-shifting protocols. In one protocol, the animals were required to learn a visual-cue rule (i.e. press the lever corresponding to the position of a stimulus light) on the first day and then learn a response discrimination rule (i.e. press the lever opposite your preferred side) on the second day. For the other protocol, the rule order was switched. Preliminary evidence suggests no significant effects of ABI treatment on behavioural flexibility but a significant effect of strategy order was observed. Animals required to learn the visual-cue rule on the second day, irrespective of treatment, exhibited significantly greater difficulty switching between strategies. The effects of testosterone on TH expression are currently being explored through qPCR.

## Epigenetic regulation of gene expression by dietary polyphenols in liver cancer

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High incidence and lack of effective long-term treatment often result in the leading mortality rate in liver cancer. Emerging research has shown that aberrant changes in the DNA methylation landscape can be an important hallmark of liver cancer development and progression. Moreover, stilbenoid polyphenols, such as pterostilbene (PTS) from blueberries and resveratrol (RSV) from grapes, have been shown to exert anti-cancer effects through epigenetic regulation of gene expression, specifically via remodeling DNA methylation. The purpose of the study is to identify potential oncogenes and tumor-suppressor genes that are differentially methylated and expressed upon exposure to dietary polyphenols in vitro and in vivo models of liver cancer. To meet this goal, we used genome-wide DNA methylation data that were previously established in the lab through Illumina 450K methylation microarrays in human SkHep1 liver cancer cells treated with polyphenols. These methylation data were compiled with our transcriptomics data that were generated via RNA sequencing of liver tissues from a rat model of liver cancer. We identified 13 genes that were both hypermethylated and downregulated, and 10 genes that were both hypomethylated and upregulated upon exposure to dietary polyphenols. Functions, biological processes, and signaling pathways of the identified genes were determined using bioinformatics tools, such as Gene Cards, Gene Ontology, Protein Atlas, and DAVID knowledge base. As the result, we confirmed that all 13 hypermethylated and downregulated genes are strongly associated with oncogenic function, while all 10 hypomethylated and downregulated genes are strongly associated with tumor-suppressor function. As the experiment was conducted in a liver cancer model, we further analyzed the target genes and revealed that 3 out of 13 genes are specifically related to liver cancer, while 1 out of 10 genes is specifically related to liver cancer. The finding identified potential candidate genes that are epigenetically targeted by dietary polyphenols which accompany polyphenol-mediated anticancer effects. Further mechanistic studies need to be conducted to explain the role of polyphenol-mediated epigenetic changes in their anticancer action.

## Evaluation of CD8 as a predictive biomarker of benefits from added avelumab immunotherapy treatment in early-stage ovarian cancer

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Tumor-infiltrating lymphocytes (TILs), such as killer T-cells, are crucial for immune defense against cancers such as ovarian carcinomas. CD8 is a protein expressed on the surface of killer T-cells and used for their identification. Presence of CD8 + TILs in patients' tumors are associated with better survival rates among multiple cancers, including breast, cervical, and ovarian. Immunotherapy is a relatively new treatment, enhancing the body's immune response to cancer. However, some patients experience adverse side effects to immunotherapy. Some biomarkers can predict extra benefits of immunotherapy for patients possessing them prior to treatment; thus, they are valuable to identify. The value of CD8 as a predictive biomarker for immunotherapy treatments has not been well-documented in ovarian cancer. We hypothesize that the presence of CD8+ TILs may be a predictive biomarker for a positive response to immunotherapy treatment in ovarian cancer. We will retrospectively evaluate CD8+ TIL presence by staining tissue samples from a completed randomized phase III clinical trial on early-stage ovarian cancer. Trial patients are randomly assigned to either chemotherapy or chemotherapy with added immunotherapy treatment groups. We expect to observe that in the added immunotherapy cohort, the presence of CD8+TILs will be associated with better survival rates. This study's results can provide valuable insight into which patients will most benefit from immunotherapy, aiding doctors in determining treatment courses. Additionally, using CD8 as a biomarker for predicting extra benefits from immunotherapy could factor into insurance considerations and increase the chances that ovarian cancer patients receive benefits for life-saving treatments.

**Examining the efficacy of a virtual multi-disciplinary 10-week family based behavioural lifestyle intervention in children and adolescents**

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The Shapedown BC program (Canada) has undergone drastic restructuring to make it accessible on a virtual platform (using Zoom) since the disruption of services caused by the Covid-19 pandemic. As online formats are new and practical methods of delivering interventions, it is crucial to determine how they compare to in-person interventions. The aim of this study is to evaluate the efficacy of a virtual multidisciplinary 10-week family-based behavioural lifestyle intervention for children and adolescents (ages ten to 17 years old) living with obesity on improved weight outcomes (decreased BMI z-scores) when compared to an in-person behavioural lifestyle intervention. Secondary aims will be to investigate the differences in pre- and post-diet quality (vegetable and sugary drink consumption), in rates of attendance and attrition (virtual and in-person), and pre and post metabolic profile (ALT- liver enzymes, fasting glucose, triglycerides, total cholesterol, HDL, and LDL). In this chart review study, we anticipate 32-40 participants from four, 10-week virtual interventions conducted between September 2021 to March 2022, which we will match and compare with participants from in-person interventions conducted in September to March between 2016 to 2019. Participants will be matched by age, sex, and BMI Z-score at baseline. An e-survey measuring sociodemographic and diet quality is administered at intake and again at post-intervention (10 weeks). Anthropometric measurements and bloodwork (to assess metabolic markers) are collected during an in-person clinical visit at intake, then again at post-intervention. Attendance is collected throughout the intervention. We expect to see that virtual interventions have no change in BMI z-score and similar outcomes when compared to the in-person intervention. Results from this study will provide insight into the efficacy of a virtual multidisciplinary family-based behavioural lifestyle intervention and may contribute to the design of future virtual weight management programs for preventing childhood and adolescent obesity.

**Exploring the effects of ambient near-infrared radiation on cognitive performance and heart-rate variability**

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Human exposure to near-infrared (NIR) radiation is decreasing as people are spending more time indoors where NIR has been removed from lighting sources as an energy-saving measure. However, NIR is now known to be biologically active, and is being investigated for its potential benefits to human health and well-being. Although studies have reported improved cognitive performance following NIR administration via laser or light-emitting diode (LED) directly to the head, no research has yet examined cognitive performance during exposure to ambient NIR radiation. This repeated-measures study will test the hypothesis that increased NIR in ambient lighting improves cognitive performance and heart rate variability (HRV), a physiological indicator of cognitive performance, in healthy undergraduate students. Participants will be asked to perform cognitive tasks assessing attention, perception, short-term and working memory, and executive function on paper during exposure to two counterbalanced lighting conditions: standard LED office lighting (with no NIR radiation) and the same LED lighting with NIR radiation. All tasks will be completed under controlled conditions at a single 3-hour laboratory session while the participant is seated in a custom-built booth designed to resemble a typical workspace. HRV will be measured throughout the procedure by electrocardiogram (ECG). It is expected that NIR radiation exposure will lead to improved performance on the cognitive tasks, reflected also by increased resting HRV and decreased HRV reactivity, which have previously been associated with improved cognitive performance. The results of this study will help determine ideal lighting conditions for indoor workspaces to benefit individuals working in them.

**Glial fibrillary acidic protein as a diagnostic blood biomarker for traumatic brain injury**

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Traumatic Brain Injury (TBI) has a notable impact on society, causing individual disturbances in daily life functioning, leading to significant societal, financial, and medical complications. Therefore, diagnostic biomarkers, molecules detected in the blood, are needed to diagnose the condition in its early stages effectively. Glial fibrillary acidic protein (GFAP) is a protein expressed by different brain cells such as astrocytes, and it has been related to various neurological disorders. The objective of this study was to evaluate whether blood levels of GFAP can serve as a biomarker for TBI. Blood samples were collected from 100 Canadian army veterans with history of head trauma within past three-months to assess plasma levels of GFAP. TBI was verified using computed tomography (CT) scan, an x-ray machine that moves around the brain, capturing different points of view and producing a 2D image. The injury severity was determined using the Glasgow outcome score (GOS). The controlled group included 100 veterans without a diagnosis of TBI. It was found that TBI group had higher plasma GFAP levels (1500pg/ml vs 500pg/ml, $p<0.05$ student's T-test) compared with controls. GFAP levels were higher in patients with a GOS 3 (severe disability) than patients with a score of 5 (good recovery). The study identified that GFAP is elevated in TBI patients, and it can be used to stratify TBI patients from control subjects. Moreover, the amount of GFAP could also indicate the severity of the TBI. Future studies will be needed to characterize the specificity and sensitivity of these blood tests and the association of GFAP with single and polytrauma.

**How is volunteering associated with reduced mortality? Exploring underlying pathways in a longitudinal cohort study of older US adults**

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Volunteering is consistently associated with positive health and well-being outcomes in older adults, including reductions in mortality risk. The association between volunteering and mortality has been extensively documented, yet research on the mechanisms explaining this association is limited. We hypothesize that five potentially modifiable mediators (increased: physical activity, optimism, and purpose in life, and decreased: loneliness and depression) may underlie the volunteering-mortality association. We used prospective data from 9,962 participants in the Health and Retirement Study (2006-2018), a national, diverse, and longitudinal cohort of U.S. adults aged >50 to assess multiple potential mechanisms (mediators) underlying the association between volunteering and reduced mortality risk. We evaluated associations between volunteering at baseline (2008/2010), 5 candidate mediators at wave 2 (2010/2012), and mortality between waves 3 and 4 (2010-2016 for Cohort A, 2012-2018 for Cohort B). After adjusting for demographic confounders in the pre-baseline wave (2006/2008), we observed evidence of mediation through increased physical activity (6.35%, the proportion of the volunteering-mortality association mediated by physical activity; P = 0.03) and optimism (7.47%; P ≤ 0.001), as well as through reductions in loneliness (6.28%; P ≤ 0.001). However, there was less evidence of mediation through increased purpose in life (6.26%; P = 0.06) and decreased depression (3.66%; P = 0.202). These results inform basic science, interventions, and policies by identifying potential mechanisms, which might become modifiable features of the volunteering experience, to promote longevity in our rapidly aging population.

**Identifying pathways to increased volunteering in older adults: A lagged exposure-wide approach**

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Informal helping is a form of civic engagement defined as unpaid volunteering that is not coordinated by an organization and directed toward helping people outside of one's household (e.g., babysitting, cooking meals, etc.). Growing evidence documents associations between informal helping and improved health and well-being outcomes. However, less is known about factors that lead to increased informal helping in older adults. Using data from a subsample of participants (N=13,771) in the Health and Retirement Study (HRS)—a diverse, longitudinal, and nationally representative sample of older U.S. adults—we evaluated a large range of potentially modifiable candidate predictors of informal helping. Through a lagged exposure-wide (hypothesis-generating, data-driven) approach, we assessed if changes in 61 predictors spanning physical-, behavioral-, and psychosocial factors (over a 4-year follow-up between $t_0$;2006/2008 and $t_1$;2010/2012) were associated with informal helping four years later ($t_2$;2014/2016). After adjusting for a rich set of covariates, several candidate predictors were associated with increased informal helping four years later. For example, participants who engaged in frequent physical activity ($\geq$1x/week) had a 33% increased likelihood of engaging in informal helping, and those with physical functioning limitations had a 25% decreased likelihood of engaging in informal helping (95% CI: 0.66, 0.86 four years later). However, other factors showed little evidence of associations with subsequent informal helping. With further research, our findings suggest that several potentially modifiable factors may be intervened upon to increase informal helping, which may benefit society at both the individual- and population-levels (societal benefits of more informal helping).

**Improving rates of attrition in mHealth applications use among college students with comorbid depression and anxiety: A research study**

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Mental health smartphone applications can decrease symptoms of anxiety and depression, but user engagement is an obstacle to receiving the full benefits of mHealth apps. Features like gamification, peer support and personalization may help prevent users from dropping out prematurely. Our mixed methods study aims at testing a beta smartphone application. Our objective is to evaluate; a) engagement with the app overall and with specific features, namely personalization, gamification, and peer support, and b) impact of app use on depression and anxiety symptoms. Participants will be undergraduate college students with clinically diagnosed comorbid depression and anxiety (N= 50) aged 18-60 years. Participants will complete the DASS-21 (Depression, Anxiety, and Stress Scale) self-report questionnaire before and after using the app for a month. Usage metrics will be collected including the number of logins per week and time spent on the application. One-on-one qualitative interviews will be conducted with participants who had reduced engagement (n=10), and participants who used the app regularly (n=10). Currently, our research is in its early stages of development with the beta version of the application developed. Participant recruitment and data collection is scheduled to begin shortly. This study will help us explore the feasibility and efficacy of an app for depression and anxiety in college students. With the popularity of non-evidence based mHealth applications on the market, findings from this study will help us make mHealth applications more evidence-based, widespread, and accessible.

## Inter-organelle communication: An insight into ER-mitochondria contacts (MERCs)

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The Hubble space telescope has provided us with glimpses into connections between us Earthlings and the cosmos, and this relationship is mirrored in our cells, especially between cellular organelles through membrane contact sites. These are cellular regions where 2 or more organelles are in close proximity, at a minimum distance of 10nm, to execute comprehensive functions. This is what my research focuses on: membrane contact sites between the mitochondria and endoplasmic reticulum (ER), also known as MERCs. These sites occur along the entire ER distribution of the cell, are highly dynamic, regulate mitochondrial merging/division, and calcium exchange in cell death. My research encapsulates the proteins responsible for establishing these contacts and are called mitofusins. They are transmembrane GTPases that can tether the mitochondria to the ER for the regulation of mitochondrial health. Detection of these proteins at the sites is accomplished through super resolution microscopy, which allows for higher resolutions by defying the diffraction limit of light. Previous research has utilized limited resolution to exhibit these sites, and with super resolution technologies, I am able to localize these mitofusins to a nanoscale level and determine whether they regulate the mitochondrial-ER contact sites (MERCs). We must also understand the implications of these contacts in diseased states such as Parkinson's, where these sites are defective due to decreased tether points, or in cancer cells which involve contact dysregulation leading to proliferation. With more insight into their regulation, we hope to add to the growing field around therapeutics targeted at membrane contact sites.

## Investigating the extracellular ligands for Dystroglycan protein involved in wrapping glia formation in *Drosophila melanogaster*

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Glia cells are integral to the nervous system as they help protect the nerves, provide nutrients for axonal growth, and regulate neural activities. One type of glial cells are the non-myelinating Schwann cells that wrap around small axons of the human nervous system. The non-myelinating Schwann cells help create insulating barriers around the axons that are critical for proper functioning of the nerves, but the developmental processes of non-myelinating Schwann cells are still not well understood. In *Drosophila melanogaster,* the wrapping glia is morphologically similar to the non-myelinating Schwann cells in vertebrates. It was found that Dystroglycan, an important protein for muscle contraction, is also expressed in the wrapping glia. Suppression of the Dystroglycan gene expression using RNAi-mediated knockdown results in morphological defects and the loss of axon ensheathment, but the ligands of Dystroglycan are unknown. It is known that Dystroglycan interacts with proteins that contain the Laminin G (LamG) domain. Here, I investigated the involvement of two LamG proteins: Multiplexin and SP2353. I detected the presence of Multiplexin in the wrapping glia and observed similar morphological defects when Multiplexin is knocked down compared to the Dystroglycan knock-down, suggesting that Multiplexin may be one of the extracellular ligands of Dystroglycan involved in wrapping glia formation. The same morphological defects were not observed in SP2353 knock-down, suggesting that SP2353 may not interact with Dystroglycan for wrapping glia formation. With this work, I hope to provide more insights on the developmental processes of non-myelinating Schwann cells and potential etiology of peripheral neuropathies.

## Investigating the impacts of glutamate receptor modification in Alzheimer's disease

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Alzheimer's disease (AD) is known to cause a decrease in memory and cognitive functions and has been associated with an excess concentration of glutamate in the nervous system that over-stimulates metabotropic glutamate receptors (mGluRs) on cerebral cells, causing neuronal cell death. Over-excitation can be reduced by inhibiting mGluRs, but the effect of modifying the mGluRs on AD pathology is unknown. To address this, RNA-editing of the mGluRs will be completed to reduce its production and stop overexcitation. We hypothesize that reducing the expression of mGluRs will decrease the pathological markers of AD. This is tested by dsRNA-dependent adenosine deaminase which edits RNA using recombinant viral vectors

to modify mRNA and change the protein product. The effect of modifying mGluRs in an AD mouse model will be assessed by tracking AD pathological changes in the brain through biomarker status, positron emission tomography (PET), and cognitive functions. Markers of AD such as Amyloid-β (Aβ) would be assessed within the cerebrospinal fluid (CSF) using mass spectrometry. The PET ligand selected for imaging was [18]F- florbetapir which detects Aβ aggregation. We expect mice with modified mGluR expression to have increased Aβ CSF concentration and decreased Aβ aggregation compared to the mice without the modification. The Morris Water Maze and Spontaneous Object Recognition test would assess changes in cognitive functioning with the expectation that mice with the receptor modification would perform better compared to mice with the unmodified receptor. Decreasing AD pathology would improve the quality of life of AD patients and help develop potential preventative measures.

**Lasting impact: Examining the association between quality of the therapeutic relationship and distress following psychotherapy termination for men and the mediating role of existential isolation**

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The therapeutic alliance has emerged as one of the most important components of successful treatment outcomes, regardless of the specific form of therapy. Research has now turned its attention to better understanding how the alliance contributes to patient improvement. Humanistic/existential theory contends that a strong therapy relationship can help reduce a patient's sense of existential isolation (i.e., a sense of not feeling understood by others). Research suggests that existential isolation might be especially problematic for men, potentially increasing their risk for suicidality. An additional consideration is whether the impact of the alliance extends beyond treatment termination, which few studies have addressed. The present study investigated existential isolation as a mediator of the association between strength of the therapy relationship and psychological distress and suicidality among men. The study focused specifically on men who had previously been in therapy, investigating the potential lasting impact of the alliance following termination of therapy. A total of 204 Canadian men who had previously attended psychotherapy (but were not currently in therapy) participated in a cross-sectional survey, completing measures of quality of their most recent therapy relationship, existential isolation, depression and anxiety symptoms, and suicidality. Regression with mediation analysis was conducted. Both mediation models emerged as significant, indicating a significant indirect effect for quality of the therapy relationship on symptoms of anxiety/depression and suicidality through existential isolation. The findings revealed that a good therapy relationship lessens existential isolation and in turn reduces distress and suicidality for men beyond treatment termination.

**Neural pathways underlying *Drosophila* short term visual memory**

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Animals use sensory cues from the environment to form memories that inform their feeding behaviours. In *Drosophila melanogaster*, smell and taste can be paired with rewarding stimuli to form appetitive memories in their memory center called the mushroom body (MB). However, it is unclear how the mushroom body stores memories involving other sensory modalities such as vision. This study aims to elucidate the visual memory pathway and confirm whether the MB processes visual memories the same way as smell and taste. If neuron subpopulations involved in the MB's visual memory pathway are silenced, then flies should display impaired visual memory performance. To assess visual memory performance, I adapted a novel optogenetic assay to incorporate two-choice feeding and the pairing of a sucrose reward with the visual cue of light. Flies trained using this pairing exhibited subsequent preferential triggering of the light in absence of the reward. I am in the process of assaying visually impaired flies to explore whether the preferential triggering demonstrated was from an association with the visual cue and not extraneous stimuli such as heat. At the same time, silencing the MB301B and MB043B neuron subpopulations with the GAL4/UAS system did not impair learning, hinting that they are not involved with sweet taste-associated visual memory. These results reveal the potential of this assay to expand our model of *Drosophila*'s visual memory formation and taste processing.

**Perioperative multimodal analgesia including intravenous lidocaine infusion for pain management following idiopathic scoliosis correction surgery in children: Challenges of implementing a clinical double blind randomized controlled trial**

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Posterior spinal instrumentation and fusion (PSIF) is a common surgical correction for adolescent idiopathic scoliosis. A variety of medications, clinically referred to as preventative multimodal analgesia, minimizes the significant postoperative pain associated with PSIF. Reduction in the need for intravenous opioids is key, as dose-dependent side effects delay recovery and increase length of hospital stay. Intravenous lidocaine has been shown to reduce discomfort and opioid consumption after major surgery in adults, including spinal procedures. It is postulated that adding intravenous lidocaine to a standard multimodal analgesia regime will improve comfort and reduce morphine utilization in adolescents undergoing PSIF. A double-blind randomized control trial (RCT) is currently in progress to establish the efficacy of perioperative intravenous lidocaine therapy (P-IVLT) for managing opioid consumption and postoperative pain in adolescents undergoing PSIF. All patients receive standard multimodal analgesia. Additionally, the intervention group receive 48 hrs of blinded P-IVLT compared to blinded saline in the control group. The primary outcome measure is the difference in morphine consumption between groups. Thus far, 22 adolescent patients have been recruited to this study. Data collection is ongoing and still blinded. There have been significant challenges associated with implementing this clinical trial including, overcoming Health Canada regulations regarding pediatric off-label drug use, establishing a morphine titration protocol; developing a scripted consent process to minimize nocebo risks, and navigating pandemic-related restrictions on recruitment. The learning experiences associated with implementing this clinical study are important and pertinent for future RCTs investigating analgesia regimes for other major pediatric surgeries.

**Pharmaceutical research: Health equity requires gender equity**

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Physiological differences between men and women affect drug reactivity through pharmacokinetics (the movement and fate of drugs in the body) and pharmacodynamics (the effect of the drug on the body). For example, pharmacokinetic variations can be seen in alcohol metabolism. Compared to men, women have slower activity of the gastrointestinal enzymes responsible for alcohol degradation, leading to higher blood alcohol levels following the same level of consumption. In addition, women are 50 to 75 percent more likely to report adverse side effects, which demonstrates the existence of important pharmacodynamic differences between the sexes. These significant differences compel us to advocate for the equitable participation of women in clinical research. However, according to a meta-analysis, 80% of research still only includes male subjects. My research emphasizes the importance of considering the physiological differences and provides theories regarding the lack of female participation in research; such as addressing the complexities of hormonal fluctuations in women as an added variable in research. I will continue by discussing some specific drugs that, when prescribed according to the manufacturer's instructions, have potentially disastrous repercussions. For instance, women require a higher dose of general anesthesia than males, despite pharmaceutical companies' recommendations for a lower dose based on body weight measurements. My hypothesis is that medical professionals' dosing regimens and experiences lead them to an individual conclusion to modify the recommended dose for their female patients. These adjustments are rarely communicated back to the pharmaceutical companies, and in most cases, the patient's health relies on the individual physician's variable experience with the drug.

## Physical activity and memory functions: Are there differences between the sexes?

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Physical activity has been linked to multiple physical health benefits. Additionally, recent research has *also* demonstrated the positive effects of physical activity on cognition, specifically memory. However, few studies have focused on sex differences and the relationship between physical activity and episodic memory. This study aims to fill that gap in research by focusing on how moderate to vigorous leisure time physical activity predicts future episodic memory performance in middle-aged to older adults, and if this relationship is moderated by sex. Data was gathered and analyzed from the Midlife in the United States (MIDUS) study. At two time points nine years apart (MIDUS 2 and MIDUS 3), participants were asked how frequently they engaged in vigorous and moderate leisure time physical activity and completed the Brief Test of Adult Cognition by Telephone (BTACT) to assess episodic memory. A regression model found that increased exercise frequency predicted higher memory performance nine years later. As hypothesized, moderate physical activity had a positive relationship with episodic memory while vigorous physical activity did not yield a significant relationship, when moderated by sex. While this is true for females, the same relationship with moderate physical activity was not found in males. These results suggest the relationship between moderate to vigorous exercise and later episodic memory may differ by sex; however, the mechanism through which the relationship occurs has yet to be explored.

## Predicting discharge status in a post-rehabilitation stroke population using a cognitive model, stroke characteristics and the FIM

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Stroke is a leading cause of death and disability worldwide; the lasting impacts can affect individuals in their daily functioning. A portion of stroke survivors enter inpatient rehabilitation after primary care with variations in stroke type, lesion location, social support, and cognitive status. These factors can determine a patient's discharge status which represents discharge location (i.e., care facility or home) and level of care needed. The current study is assessing the predictive value of neuropsychological measures, stroke demographics, and the functional independence measure (FIM) in relation to patients' discharge status post-stroke rehabilitation. This study will also replicate findings from Leitner, Miller & Libben's (2018) research which found that neuropsychological measures outperform a baseline model in predicting functional outcome, represented by the Mayo-Portland measure. Based on the literature, it is expected that a blended model consisting of neuropsychological measures (assessing the domains of visuo-spatial construction, memory, and executive function), stroke demographics (stroke type, lesion location, and marital status) and the FIM will most reliably predict discharge status in a stroke population. Data files from a previous study at Kelowna General Hospital's Rehabilitation center will be used, with an estimated sample of 20-30 patients. Demographic information, discharge summaries and performances on measures will be assessed. Once data is sorted and models are quantified, a hierarchical multiple regression will be conducted. We speculate that this research will aid health-care settings by isolating which factors can prove most informative in assessing rehabilitative success in a stroke population.

## RACK1 reduction improves motor function and lifespan in an *in vivo* TDP-43 ALS model

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Amyotrophic lateral sclerosis (ALS) is an incurable, adult-onset neurodegenerative disease characterized by the progressive death of motor neurons, leading to loss of motor control, paralysis, and a reduced lifespan. Up to 97% of ALS cases display clearance of a protein called TAR DNA binding protein 43 kDa (TDP-43) from the nucleus of motor neurons, as well as its abnormal aggregation in the cytoplasm. Cytoplasmic TDP-43 aggregates reduce levels of protein translation through interactions with another protein called Receptor for Activated C Kinase 1 (RACK1). Recent work in the Cashman laboratory has found that reducing RACK1 protein levels (RACK1 knockdown) in cell lines solves these problems by clearing TDP-43 aggregates from the cytoplasm, increasing TDP-43 levels in the nucleus, and restoring protein translation. Based on these

observations, we hypothesized that RACK1 knockdown improves TDP-43-associated ALS symptoms in a living model such as *Drosophila melanogaster* (fruit fly). We expressed human TDP-43 (hTDP-43) in motor neurons of flies, with and without RACK1 knockdown. Climbing ability (indicating motor neuron function) and lifespan were used as measures of disease severity. Flies expressing hTDP-43 showed impaired climbing ability and shorter lifespans compared to controls. RACK1 knockdown in hTDP-43-expressing flies led to significantly better climbing ability and lifespan. These results confirm previous observations from cell-based experiments regarding the involvement of RACK1 in the mechanism of TDP-43 pathology seen in ALS. Our work supports the potential of RACK1 modulation as a therapeutic approach in treating TDP-43-associated ALS.

**Regulation of microRNA expression in scleroderma and idiopathic pulmonary fibrosis: A research study**
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Scleroderma (SSc) is an autoimmune disorder that involves the thickening and tightening of the skin, connective tissue, and internal organs. SSc patients are susceptible to developing interstitial lung disease (ILD), leading to decreased lung tissue function. In addition to normal controls, this study includes cases with idiopathic pulmonary fibrosis (IPF), which is a form of ILD not associated with other diseases. Lung involvement of SSc will be studied by observing how disease progression and pathogenesis differ between patients living with SSc and ILD compared to healthy controls and controls with IPF. Targets of disease pathogenesis have been identified through microRNA sequencing, such as the DICER enzyme, which works closely with the protein DGCR8 and the enzyme DROSHA in the RNA interference pathway. DICER, DROSHA, and DGCR8 are hypothesized to contribute to ILD progression. Human peripheral blood mononuclear cells were isolated and subsequently lysed with subcellular fractionation buffer. Western blotting was done on protein lysates to analyze the resulting cytosolic and nucleic fractions for DICER, DROSHA, and DGCR8 protein expression. The statistical analysis method used was a non-parametric Kruskal-Wallis analysis with a Bonferroni corrected p-value of 0.05/3. Variability of disease progression within the groups likely leads to variable enzyme and protein levels within the same disease status. This work is exploratory, and currently, there is no significant difference between the groups for DGCR8, DROSHA, or DICER protein expression normalized to GAPDH. Work in progress pertains to normalization of DGCR8 and DROSHA to the nuclear housekeeping protein Beta 2 Microglobulin.

**Seeking novel therapies using CDK4/6 inhibitors in low grade serous ovarian carcinomas**
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Low-grade serous ovarian carcinoma (LGSOC) is a rare cancer that is diagnosed in advanced stages. LGSOC is known to be relatively resistant to conventional chemotherapy resulting in high tumor relapse and mortality rates. A recent drug, trametinib, has shown activity in the treatment of this disease. Despite the fact that this is now the most effective treatment for relapsed disease, development of drug resistance can also occur. Thus, for patients with LGSOC, more effective treatment options are urgently needed. LGSOC tumors are known to have other gene abnormalities that affect cell division. A new drug, palbociclib, can help to treat them. Using research models developed from LGSOC tumors from patients with advanced/recurrent disease, our goal is to evaluate trametinib and palbociclib treatments, alone or in combination, with the hope to find better treatments for these patients. We evaluated drug effects in several LGSOC cell line models using cell counting experiments, to see how these drugs inhibit their growth. We then compared cell line responses to their gene abnormalities to seek for predictive markers of sensitivity. Based on our results, we found that palbociclib reduces cell proliferation in all LGSOC cell line models. However, the inhibitory effects of palbociclib and trametinib combination were not as strong as with trametinib treatment alone. Combination of palbociclib with other novel drug treatments remains to be studied.

## Short-term organ culture of rat seminiferous tubules

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In humans, it has been estimated that each testis releases up to 85 million sperm per day; hence, junction turnover is essential to male fertility, and we suspect that calcium is a major regulator. The Vogl lab has previously shown that calcium regulatory machinery is present in the endoplasmic reticulum at junctions and at the 'tubulobulbar complexes' (TBCs) that are associated with internalizing the junctions during sperm release. The purpose of this study is to determine if it is possible to establish a short-term organ culture system of rat seminiferous tubules, which would eventually enable us to study if Calcium functions to regulate junction turnover *in vitro*. Seminiferous tubules were isolated from adult male Sprague-Dawley rat testes and cultured for three days in one of Fetal Bovine Serum (FBS), Knockout Serum Replacement (KSR), or AlbuMAX II medium supplemented with FSH and Testosterone. Results were verified using light and electron microscopy. Although there were some evidence showing that the basal junctions were more preserved than the apical junctions, seminiferous tubules failed to preserve morphological integrity in general, regardless of the media type. Degeneration of subcellular structures, dedifferentiation of germ cells, and the accumulation of lipid droplets were observed. Therefore, it can be concluded that short-term organ culture will not be an ideal system for evaluating Calcium function in the seminiferous epithelium. Alternatively, future experiments could use *in vivo* approaches via genetically-encoded Calcium indicators to study the role of Calcium in spermatogenesis.

## Skin microbiome and metabolome and its effects on health

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Skin health is an important factor in overall wellbeing. Microbes residing on the skin have been increasingly implicated in affecting its health, in part, by changing the metabolites found on the skin. Skin cells can be affected by a variety of molecules including lipids, vitamins, and even microbe-derived metabolites. Cutaneous lipids work with the immune system and act as potent antimicrobials. Vitamins play a large role in maintaining the homeostasis of our skin microbiome and health of our skin. Vitamins can protect our skin by affecting the gene expression of certain enzymes which in turn promote the development of cells within the epithelium. Thus, learning more about the interaction between the skin and its microbes through the lens of the molecules they exchange can lead to exciting new discoveries that can facilitate improving skin health and developing new treatments against infections.

## Social-net: Objective and automated assessment of chronic social isolation-induced behaviour deficits using machine learning

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The continued lockdown and self-quarantine measures during the COVID-19 pandemic have drastically and chronically restricted our in-person and proximal social interactions. How this prolonged social isolation will impact human health and behavior remains unclear; a more detailed analysis of behavioral dynamics to extract richer representations of social behavior is required. Computer vision has seen exponential growth and could be applied to behavior analysis leading to automated clustering of social behaviors and potentially uncovering new pathological behavioral patterns. Thus in this study, we use computer vision and machine learning to investigate the social behaviours of mice after seven weeks of chronic social isolation compared to that of the group-housed mice. We developed a pipeline to automate the classification of distinct social behaviours in the socially isolated and group-housed mice using a combination of unsupervised and supervised machine learning approaches. Specifically, we first use convolutional autoencoders to produce a low-dimensional continuous

representation of behaviour videos. We then use an autoregressive hidden Markov model (ARHMM) to segment videos into discrete behaviour states. Another unsupervised machine learning method (TW-FINCH) was implemented to group semantically and temporally consistent video frames. The resulting video clips were then observed and evaluated by a group of raters and finally created a ground truth dataset with consensus behaviour class labels. Finally, an end-to-end transformer model was trained to predict behaviour classes from social interaction videos. We find that this method can significantly improve the speed and precision of behavioural clustering, which lays the groundwork for characterizing behavioural abnormalities induced by social isolation. Our classification pipeline can be translated into human behaviour analysis to evaluate and treat psychiatric disorders and the behavioural impacts amidst pandemic-induced isolation.

## Suitability of a post-operative bariatric nutrition teaching tool

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Bariatric surgery is an effective treatment for people living with severe obesity, however meeting dietary post-operative requirements is challenging. This study evaluated the suitability of a nutrition-based education tool named, "Protein Cards," which focuses on protein-rich recipes to support individuals who have undergone bariatric surgery. The tool is based on the post-operative diet stages (full fluid, purée, soft, and regular) to cater to the gastrointestinal tract alterations. An online survey (23 questions) was developed using an adapted version of the Suitability Assessment of Materials (SAM) with the addition of two questions focusing on the tool's utilization based on a scale of 0-100. Participants were asked to rate the tool on six areas of suitability and readability as: "Not Suitable", "Adequate", or "Superior," and provide optional comments. The survey was distributed via email and posted on the Obesity Canada blog to reach Canadian bariatric patients (adolescents and adults), dietitians, healthcare providers, and the general public. Of the 1,836 surveys collected between September 2020 and May 2021, 679 were included in the analysis (11% were from dietitians to provide expert critique). The total SAM score (72.9%) fell into the "superior" evaluation range (70-100%). Overall, participants were 63% likely to use the tool during the post-operative regular diet stage. The Protein Cards are considered a superior education tool for providing protein-rich food suggestions to be consumed after bariatric surgery. Future work will involve testing the revised tool's effectiveness in clinical practice with adolescent and adult patients to increase adherence to post-operative protein requirements.

## The association of severe mental illness disorders with cervical cancer screening frequencies in British Columbia

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Cervical cancer is the fourth most common female cancer in the world. In Canada, each year, over 1300 women are diagnosed with cervical cancer with 30% of cases being fatal. Many factors prevent women from receiving cervical cancer screening, potentially including mental illness. However, there's little research done to assess the influence of mental illness on the frequency of cervical cancer screening. We hypothesize that women who are not diagnosed with severe mental illness disorders have a greater likelihood of being up to date for cervical cancer screening. Approximately 1000 BC women eligible for cervical screening will be recruited by email to participate in the study. We would assess patient knowledge, attitudes, and history toward cervical screening and their mental health history through self-assessment questionnaires based on items from the Canadian Community Health Survey (CCHS). Patient severe mental health diagnosis and cervical screening history will be provided through BC's administrative health data. Both datasets will be used to conduct a linear regression model. We expect that women diagnosed with severe mental illness will receive cervical screenings less frequently. Furthermore, we expect that women with severe mental illnesses are more likely to have scheduled screenings if they frequently communicate with their primary care provider. This study explores the possible relationship between severe mental illnesses in women and cervical cancer screening frequencies. We hope these results will develop methods which increase the frequency of cervical cancer screenings among high-risk women.

### The development of an evidence-informed knowledge translation tool to facilitate resistance training prescription delivery for people with rheumatoid arthritis

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Rheumatoid arthritis (RA) is a chronic autoimmune disease characterized by the inflammation and swelling of the joint synovium. Individuals with RA often experience symptoms of joint pain, stiffness, increased prevalence of systemic comorbidities, and diminished day-to-day physical function. Resistance training (RT) has been shown to be an integral component of RA symptom treatment. Despite its known benefits, safety, and internationally-supported guidelines, only 1 to 14% of people with RA routinely partake in RT. Low participation rates are likely due to disease-specific barriers that people with RA experience (e.g., recall of exercise technique, encountering flares in disease activity, fear of exercise). A scoping review by Wu et al. summarized RT prescription recommendations that addressed such RA-specific participation factors. To now facilitate the uptake of these RT prescriptions, we describe the development of an evidence-informed knowledge translation (KT) tool that will support RT delivery amongst healthcare practitioners for their patients with RA. The creation of this KT tool will consist of 3 phases: Content Development, Prototyping and Usability Testing, and Dissemination. Within Phase 1, we will assemble a KT working group comprised of patients and clinician stakeholders to engage in shared decision making of the KT tool's content, format, and design. Within Phase 2, three versions of a KT tool prototype will be made following multiple rounds of usability testing that include semi-structured interviews and survey questionnaires. Within Phase 3, the KT tool will have been finalized and then disseminated through existing practitioner networks.

### The effect of a combination therapy of protease inhibitors (ritonavir and atazanavir) on the viral load and insulin resistance of patients living with HIV: A research study

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Human Immunodeficiency Virus (HIV) is an infectious agent that attacks the immune system and can be fatal without treatment. Protease inhibitors (PIs) are an effective type of HIV treatment that blocks the viral life cycle by inhibiting HIV protease enzymes. However, PIs can have off-target effects, such as interfering with glucose transport proteins. This often increases the risk for the development of insulin resistance and Type II Diabetes Mellitus (T2DM). Previous research has shown that the PIs ritonavir and atazanavir are often used in combination for treating HIV. Ritonavir is very effective in treating HIV, but has been linked to insulin resistance. In contrast, Atazanavir's modified chemical structure reduces its impact on insulin sensitivity, but weakens its ability to inhibit the HIV protease. There is currently limited research on the metabolic effect of combining these two PIs. Therefore, our research investigates a combined treatment of ritonavir and atazanavir through the use of a randomized control trial. Participants will be randomly assigned to three groups: Ritonavir group, Atazanavir group, and Combination group. The HIV viral load of all patients will be monitored using PCR. Oral glucose tolerance tests will be used to measure changes in insulin sensitivity over time. We hypothesize that this combination therapy will be most successful in decreasing the viral load in HIV positive patients without decreasing insulin sensitivity. The results of this study can provide new insight into the development of HIV treatments and potentially enrich the quality of life for people with HIV.

### The effect of structural enrichment in male mice: A systematic review

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Aggression between male mice housed in laboratories is a persistent animal welfare concern without a clear solution. Environmental enrichment, such as shelters or tunnels, is often used to improve laboratory animal welfare, but effects on animal behaviour can vary. The provision of structural enrichment has been shown to both increase and decrease aggression among male mice in different studies, but it is unclear what contributes to these different outcomes or what the overall effect

of enrichment is on mouse aggression. Conflicting findings have led to a lack of consensus on how best to provide environmental enrichment to male mice in laboratories. To address this, we are conducting a systematic review of the literature using the PubMed and Web of Science databases to investigate the effect of structural enrichment on aggression in male laboratory mice. We defined structural enrichment as anything providing shelter within the cage, excluding mazes and running wheels. The titles and abstracts of 265 articles were screened by two reviewers according to our predetermined inclusion and exclusion criteria. After full-text screening, 13 articles met our inclusion criteria. Data extraction is ongoing, but we expect to find that aggression outcomes will vary depending on the specific type and quantity of enrichment provided, as suggested by the conflicting results of studies. The findings of this review will help establish an understanding of male mouse aggression and effective laboratory environmental enrichment strategies.

**The effects of gene expression regulation on memory dysfunction in temporal lobe epilepsy: A research study**

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Recent studies have shown that patients living with temporal lobe epilepsy (TLE) show irregular expressions of particular genes. A subset of these affected genes have also been associated with memory decline, one of many comorbidities of temporal lobe epilepsy. We hypothesize that genes that play a role in both memory and seizure regulation in the temporal lobe will show differential expression that results in memory dysfunction. In our study, we will analyze the expression of various genes, which are implicated to play a role in both memory decline and epilepsy using published single-cell RNA sequencing data of TLE patients. We will, for instance, look at the transcription of the MAPT gene within the data sets, as it has been shown to influence plasticity. Specifically, the MAPT shows higher expression in females and has been associated with an increased risk of neurodegenerative diseases. We expect to see results that showcase how genes like BDNF, MAPT and SAMD3 facilitate and inhibit memory formation in TLE patients. We expect to observe that the analyzed data sets will show a positive or negative correlation between the gene expression of specific genes and disease progression in TLE patients. Gaining a deeper understanding of genes implicated in memory dysfunction as well as in TLE and investigating the gene expression regulation of those genes may be beneficial in drug targeting and thus, make more effective therapeutic strategies.

**The machine learning approach to breast cancer subtype classification**

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Breast cancer is the second leading cause of cancer deaths among Canadian women. The probability of a woman getting breast cancer in their lifetime in Canada is 12.5%, and the probability that a woman dies from this disease is 2.9%. This fatal disease occurs when normal breast cells grow and divide uncontrollably. This disease has five main subtypes: Luminar A, Luminar B, Triple-negative, HER2-enriched and Normal-like. Our objective is to use machine learning approaches to classify breast cancer subtypes and identify the genes that play significant roles in classification. In this work, we used multiple machine learning algorithms: random forest, logistic regression, support vector machines and an ensemble of these models to classify these subtypes. The random forest model gave the best result with 86.5% accuracy. The top 10 most important genes in the classification model were observed to be associated with cell cycle pathways, and three of them are known to be associated with breast cancer. Breast cancer involves a variety of subtypes with different morphologies and clinical significance, and determining the subtype is essential for improving treatment options. We made a machine learning model that could help speed up the process of molecular subtype identification, which was a manifestation of how machine learning can impact healthcare.

**Tissue clearing as a method to investigate brain injury**

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About 50 million people have Traumatic Brain Injury (TBI) each year with a mortality rate of 30% - 40% and it is estimated that more than half of the world's population will have a TBI in their lifetime. Diagnosis and treatment of TBI is challenging owing to the diversity and severity of injury. Various neuroimaging methods including MRI and CT scans are used but these methods do not offer cellular resolution for preclinical studies. Therefore, the goal of this research is to see if tissue clearance may be used to examine TBI in the mouse brain. The effectiveness of tissue clearing procedures based on organic or hydrogel systems was investigated. Tissues from mice that had a TBI and controls (n=6) were utilized to test two commercially available tissue clearing methods (3 brains per clearing method). A light sheet microscope was used to observe cleared tissues, and 3D pictures of neurons were acquired. ARIVIS software was used to conduct the analysis. Statistical analysis was carried out using Graphpad for comparison of the number of damaged neurons between sham and TBI group. T-test was used for single comparison and ANOVA was used for multiple comparisons. Among the two methods tested, the hydrogel-based method, called CLARITY, resulted in best signal preservation and low background noise. The 3D rendering provided high resolution details of neurons as well as broken axons within different areas of the brain which helped in building of a comprehensive brain map. The output from the maps correlated with the experimental group. In conclusion, this study identified that CLARITY can be used for studying TBI in mice because this method provided better signal and less noise. The tissue was intact and not fragile. Further research will explore the role of tissue-clearing technologies in generating impartial system-level pictures of injured brains.

**Understanding cortical activation during gait adaptation in advanced Parkinson's disease**

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Parkinson's disease (PD) is a neurodegenerative disorder characterized by abnormal protein aggregation within groups of neurons, resulting in cell dysfunction and eventually cell death. Symptoms of PD include a variety of motor and non-motor features and can vary in degree of severity. A common feature of individuals with advanced PD is freezing of gait, which is often associated with falls. There is a lack of knowledge within the literature regarding cortical activation during gait adaptation in people with advanced PD. We aim to determine if cortical activation during gait adaptation is altered in people with advanced PD compared to age-matched controls. To induce gait adaptation, we used a split-belt treadmill walking paradigm. Treadmill belts were split with a 2:1 speed ratio during the adaptation condition. Functional near-infrared spectroscopy (fNIRS), which measures the hemodynamic response in the cortex, was employed to infer cortical activity as participants adapt to the split-belt walking paradigm. Cortical activation in individuals with PD was compared to controls to determine whether or not there is a difference amongst the groups. We observed that participants with PD did not fully adapt during the split-belt condition. Additionally, activation in the prefrontal cortex of PD participants was found to be elevated compared to controls. These results will develop a fundamental understanding of cortical activation during gait adaptation in people with advanced PD. This understanding will help researchers develop novel therapies and tools to improve the quality of life of individuals with advanced PD.

## Individual, Community, and Society

### Assessing the relationship between infants' attachment styles and their social and moral judgements

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Previous research suggests that preverbal infants evaluate others' prosocial and antisocial behaviours. Following puppet shows in which a protagonist unsuccessfully attempts to reach a goal and is helped by a "good guy" or thwarted by a "bad guy", the majority of infants subsequently chose to engage with helpful characters (Holvoet et al., 2016, Margoni & Surian, 2018). But, how can the minority of infants' preference for the antisocial character be explained? Infants' attachment styles, or mental representations of their relationships with primary caregivers, are proposed to shape infants' interpretations of social interactions (Johnson et al., 2010). Thus, attachment style may provide insight into the individual variability seen in infants' sociomoral evaluations. Here, we assess whether infants' attachment classification is associated with their preferences for helpful versus unhelpful agents. As part of an ongoing longitudinal project, 6-month-olds ($n = 39$; $M_{age} = 6.25$ months; $SD = 0.69$) watched a puppet show in which a protagonist is helped/hindered while playing with a ball and were then asked to "choose" between (reach for) the helpful or unhelpful character (Hamlin et al., 2007). At 12 months old, the same infants ($M_{age} = 13.37$ months; $SD = 0.94$) completed the Strange Situation Task, in which they were separated from their caregiver (Ainsworth et al., 1978). Upon reunion, infants' attachment behaviours were coded and used to classify attachment style (secure/insecure). A Fisher's exact test indicated that infants' attachment style is not associated with their preferences for prosocial versus antisocial others ($p = .73$).

### Examining attachment styles in hookup culture: A research study

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Based off the theory of attachment, people are going to love someone the way they themselves have experienced love. Much has been written about hookup culture on university campuses and the impacts that it has on mental and emotional health, but not much is done on whether it impacts or is a product of attachment styles. This study intends to examine college student's experiences of hookups through an analysis of college students' attachment styles, their participation with hookups, their levels of satisfaction and guilt, and their self-esteem. Individuals will be interviewed about their experiences after completing a brief survey to determine their attachment style. By looking at the correlation between the three variables, this research will expand the current scholarly focus on societal factors that diminish a secure attachment style, while highlighting the sociological processes behind the cultural development of college dating culture. Twenty adult college students currently residing in British Columbia were asked to complete a preliminary survey to assess their attachment style and were then invited to an hour long semi-structured interview to learn about their experiences with hookups, including their romantic experiences and participation in hook up culture. It was found that those individuals with a secure attachment style were the only subgroup that did not regret a previous casual hookup experience. It was also found that fearful-avoidant individuals maintained significantly lower self-esteem levels than secure individuals. The implications of these results, as well as various other trends in the data, are discussed alongside the potential societal norms that contribute pressure many participants expressed they felt from peers and social standards to participate in hookup culture. This shows potential to foster fearful avoidance and worsen individuals' attachment traumas.

### From visionaries to victims: Representations of older Asian adults in Canadian news media during COVID-19: A research study

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Media coverage over the course of the COVID-19 pandemic has often reflected and reinforced ageist perceptions of older adults as weak and burdensome and racist perceptions of the Asian community as vectors of virus and disease. Extensive research reveals that exposure to negative stereotypes has a detrimental impact on both physical and mental health. Together, the manifestations of societal ageism and racism in the media raises concerns about the representation of older Asian adults during the pandemic. Drawing on intersectionality theory, this study explores the portrayals of older Asian adults in Canadian news media during COVID-19. The sample consisted of 133 articles that either included or focused on older Asian adults

published in *The Globe and Mail* (n = 46)*, Vancouver Sun* (n = 54), and *Richmond News* (n = 33) published between March 1st, 2020 to August 31st, 2021. A content and a thematic analysis revealed that the voices and perspectives of older Asian adults were largely absent in the news media. When older Asian adults were represented, they tended to be depicted among a binary of being either victims or visionaries. These findings suggest that media attention is only directed towards older Asian adults when they are praised for their successes or pitied for their vulnerabilities, with little nuance in between. In light of these findings, I discuss my research in relation to the stereotype embodiment theory, which outlines the ways in which stereotypes may have detrimental impacts on the cognitive, emotional, and physiological well-being of older adults.

**Navigating Gold Mountain with Subtle Asian Networking: Exploring Asian diasporic workers'
use of online ethnic networks**
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Asian immigrant ethnic networks have served as necessary defenses to the long history of economic discrimination in Western countries. Today, systemic racism, along with cultural barriers, continues to create obstacles to Asian diasporas' career success. Whereas business research has focused on the forms of and effects of racism on Asian-Americans, this study addresses the need for research about the community and its resiliency. Furthermore, considering how the rise of social media and globalization allows for a greater spread of knowledge and resources, this research gives insight into how and why modern-day Asian diasporic workers use their ethnic networks by analyzing conversations from two prominent pan-ethnic Asian diasporic Facebook groups, Subtle Asian Traits and RYSE – Professional Asian Networking. By incorporating topic modelling with methodology and frameworks from related social media network research, these conversations are coded into themes and then further analyzed in the context of historical and sociological understandings of anti-Asian discrimination. The findings show that these online ethnic networks allow for the sharing of network resources, culturally informed career advice and support, job opportunities, discourse on navigating racism and capitalism, and inspirational content. This resource exchange combats discrimination unique to Asian diasporas, like the model minority myth and the bamboo ceiling, while breaking down systemic network and knowledge barriers. These networks are also used to negotiate career pressures enforced by offline Asian immigrant communities and other experiences unique to Asian-Americans. The community voice of this qualitative research provides the foundation for future business research that centers Asian diasporic resiliency.

**The female heroine's rebellious spirit towards feudal Chinese society in modern Chinese Wuxia martial arts novels --
A literary analysis of <The Story of Swordsman From Shushan>, <the bride with white hair>, <Crouching Tiger
Hidden Dragon>, <Fox Volant of the Snowy Mountain>**
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In feudal Chinese society, women were stripped of fundamental rights and were forced to live at the bottom of the social order. However, the female heroines in modern Chinese Wuxia martial arts novels dare to break the patriarchal social boundaries and bravely seek the right of personal liberty, open expression, and freedom of marriage. The reason that these female heroines possess such rebellious spirits even took place in the novels is that the authors of modern Chinese Wuxia martial arts novels were under the influence of gradually increasing feminism movement, development of the female-protection laws and the changing social demand of women in the 20th century China. It is these social factors that influenced the modern Chinese Wuxia martial arts novel authors and the people around them, allowing them to use the rebellious female heroines as vessels to showcase the ideology of breaking patriarchal social boundaries, seeking gender equality, and the feminist spirit of self-development and self-fulfilment for women.

**Wandering in the digital age: How do mood and cognition impact out-of-home mobility in young adults?**
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An important link between movement and cognition has been established in gerontology, showing that older adults' out-of-home mobility patterns are correlated with their executive functioning. In other words, one's ability to move around their community is dependent on their cognitive abilities. While past literature focuses on the relationship between older adults'

cognitive decline and their shrinking movement spaces, there is a lack of research on young adults' mood and cognition in relation to mobility patterns. Addressing these topics in younger adults may be instrumental to understanding their wellbeing. Out-of-home mobility patterns serve as an external point of view of brain function, defined by how individuals travel on a daily basis. Studying cognition through this mobility lens provides an alternative conception of cognitive and mental health, separate from the internal perspective of the brain. In this study, young adults will have their daily mobility patterns tracked via Google Maps for two weeks, particularly noting distances traveled and locations visited. The PROMIS Cognitive Function 6a and Mood Zoom questionnaires will be administered as daily measures of cognition and mood, respectively. Pre- and post- test data will be collected on similar constructs. We expect that younger adults with more negative moods (e.g. anxiety/depression), and dampened cognitive function will have less out-of-home mobility relative to those with greater mood and cognitive function. Comprehending movement paths' role in mental health creates room for digitally-based solutions. Instead of doing self-report in the doctor's office, mental health data can be collected in real-time using smartphones to optimize timing for mental health interventions.

## Sustainability and Conservation

### Arboriculture and wildlife: Supporting wildlife in the urban landscape

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As global populations become increasingly urban and land is converted to urban space, human-wildlife interactions are expected to increase in frequency. Urbanization causes habitat fragmentation and loss, impacting wildlife populations and distribution. While direct control of faunal species is hard to achieve, botanical diversity and density is often a direct result of human action, which in theory could yield beneficial effects on urban wildlife, underscoring canopy cover and habitat availability's importance to urban wildlife conservation. The creation and preservation of wildlife snags can be beneficial to urban wildlife. This presentation discusses aspects of the suitability of dead trees ("snags") for habitat through both natural/preserved and created snags. Factors in the successional process of snag development is discussed, addressing multidisciplinary literature to describe key points for arborists applying snag-creation techniques. Despite literature on wildlife habitat creation and preservation, there exists a knowledge gap surrounding arborists' willingness to preserve wildlife snags in the urban environment during tree care operations. This presentation discusses the results of a 2021 online, international survey that examined arborists' perception of wildlife and arboriculture, focusing on what arborists consider when deciding to retain wildlife snags, including risk tolerance, liability, and wildlife snag features. The presentation also discusses how current best management practices address wildlife snags and beneficial wildlife tree features, including during tree risk assessments and pruning. The presentation includes information from the survey on arborists' support for wildlife best management practices, standards, and legislation which have the potential to increase the successful implementation of conservation efforts.

### Arrival dates of transient killer whale matri-groups in the Salish Sea

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West coast transient (WCT) killer whales travel in small matri-groups consisting of an adult female, her non-dispersed offspring, and other identified unrelated individuals. They prey on other marine mammals, primarily seals and sea lions in BC waters. WCTs frequently travel throughout their range from the Gulf of Alaska to Californian coastal waters. Though encounters with WCTs in BC waters have been historically infrequent, their presence has increased since the 1970s. Why WCTs travel and whether matri-groups have specific movement patterns are unknown. The WCT population has been deemed threatened since 2003. Understanding the reasons behind WCT distribution could help identify environmental factors key to their survival and inform future conservation practices. Whale watching organizations have reported observations that WCT matri-groups return to the Salish Sea at similar dates from year to year. Therefore, we hypothesize that WCTs arrive in response to seasonal environmental changes. We analyzed arrival Julian dates for ten matri-groups in the Salish Sea from 2016-2020 using data collected by whale watching agencies, researchers, and the public. The standard deviations of arrival dates were high for most matri-groups, indicating that arrival dates vary widely between the years. Inconsistent with our

hypothesis, mean arrival dates show no evidence of uniform seasonal movement across matri-groups. However, six groups gradually arrived earlier during 2016-2018, the cause for this remaining unidentified. Further studies are warranted to compare WCT arrival dates with harbour seal pupping season and Steller sea lion migration dates to investigate whether their movement was associated with prey availability.

**Climate (in)justice and the other: Dissecting the politics of representation of climate displaced people in the Bay of Bengal**

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The ongoing devastation of the climate crisis disproportionately threatens the survival of low-lying countries in the Global South such as Bangladesh, despite it contributing only 0.3% to global emissions. Scholarship has been largely lacking in a critical engagement with the reductive and harmful conceptualizations of climate displaced peoples in larger discourses of global knowledge production. Grounded in the unjust realities of the climate crisis, our research examines narrative processes and their sociopolitical implications by excavating the politics of narrative construction and storytelling underlying the representation of climate displaced people across the Bay of Bengal. In this exploratory study, we pathologize and dissect the dynamics of racial capitalism through engagement with pertinent literature and analyses of three documentary films depicting the plights of climate displaced people in Bangladesh and surrounding regions in the Bay. Drawing on critical border studies and climate justice frameworks, we qualitatively analyze three documentaries produced by countries defined as "major developed economies." We manually code these films using NVivo, highlighting patterns of colonial dynamics, Othering, and the treatment of agency. We identify continuing themes of emotional exploitation, securitization, infantilization, and the glorification of resilience in the representation of climate displaced people in this region. Our analysis finds that storytelling and representation have significant, enduring political impacts, and these documentaries operate as a microcosm of broader global power dynamics, with the narratives they espouse serving to abdicate the responsibility of racial capitalism for the destruction posed by the climate crisis.

**Feasibility of using mine tailings to sequester carbon dioxide in Canada's nickel and diamond mines**

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Canada's climate plan aims to keep total carbon dioxide ($CO_2$) emissions below 588 megatonnes by 2030. This study maps the effectiveness of mine tailings to sequester $CO_2$ at Canadian nickel and diamond mines. Mine tailings are the by-products of ore extractions and must be managed to minimise environmental harm. Diamonds and nickel are mined from ultramafic ore deposits which contain key magnesium silicate and hydroxide minerals such as olivine, brucite, and serpentine. In carbon mineralization, $CO_2$ reacts with these minerals to form a stable magnesium carbonate material, where it can be stored in-situ for thousands of years. The extraction process increases the reactive surface by a millionfold which can significantly speed up the sequestering process. Small scale laboratory findings show that mines in Canada are passively capturing $CO_2$ on the order of kilotons per year. These rates could be accelerated through providing $CO_2$ in higher concentrations such as those found in diesel exhaust fumes from power generation at off-grid mine sites. Tailing storage facilities have a sufficient scale to potentially capture all $CO_2$ within the flue gas generated by the mine's energy demand. Geophysical surveying reports that British Columbia alone hosts enough ultramafic material to sequester 5300 gigatonnes of $CO_2$. In this study, we focus on the percentage of ultramafic material exposed for carbon mineralization and map locations of mines with the prospect of sequestering $CO_2$ through testing mine waste samples across Canada. The results will quantify the reduction of atmospheric $CO_2$ emissions from mining processes.

**Interactive effects of salinity and temperature on *Evasterias troschelii***

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One of the most important "black boxes" in ecology is the impact of multiple, combined environmental stressors, which can affect organisms in complex ways. These interactions are rarely predictable from additive summation of individual stressor effects. With climate change, ocean warming is one of the most concerning shifts and will often co-occur with lower salinities. Changes in both salinity and temperature can independently impact feeding, growth, and survival of most organisms. However, the combined effects of these stressors are still poorly understood, particularly in *Evasterias troschelii*, the mottled sea star. *Evasterias* is a benthic predator that is now more abundant than our keystone sea star in Vancouver, yet little is known or published about their tolerances to pressing environmental stressors. We hypothesized that temperature and salinity will interact synergistically, decreasing *Evasterias* performance beyond the additive summation of the stressors. Adult samples were collected from the field and tested for righting time, crawling speed, feeding, and growth. Independent stressor experiments (salinity: 15, 20, 25, 30 ppt; temperature: 12, 16, 20°C) and a factorial interaction experiment (salinities: 15, 20, 25 ppt; temperatures 12, 18°C) were done. Performance was found to be more heavily impaired by low salinities than high temperatures and no significant interaction between salinity and temperature was found. This work will provide a novel understanding of the salinity and temperature tolerances of *Evasterias* and help us better understand ongoing ecological changes in systems dominated by multiple stressor effects.

**Investigating natural predators of *Amphorophora agathonica* Hottes as a viable method of population control**

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The North American large raspberry aphid (*Amphorophora agathonica* Hottes) is a primary vector of viruses to species within the Rubus genus. Viruses transmitted by the aphid include the Raspberry leaf mottle virus (RLMV) and the Raspberry latent virus (RpLV), both of which result in crumbling fruit symptoms and decreased market viability of red raspberries. Aphid control in commercial raspberry farms mostly relies on the application of synthetic insecticides; this research aims to assess whether biological control agents are a viable alternative. Currently, no research exists testing this hypothesis specifically for *A. agathonica*. We predict that an assemblage of biological control agents along with a conventional aphidicide (specific to aphids, with no expected non-target effects) in a controlled field environment will work as an effective deterrent for aphids. To test this hypothesis, isolated colonies of a parasitoid species (specifically from the *Aphidius spp.* genus) and a fungal pathogen (*Pandora neoaphidis*) will be introduced into an aphid-infected crop of raspberry plants, with different combinations of all conditions tested (the aphidicide, fungus, and wasp treatments) to see which has the greatest effect. We expect to observe a tangible difference in aphid populations in groups with the biological control agents present, and an even greater decrease with a combination of the biological control agents and an aphidicide. These results would provide current field researchers and growers with another method of preventing the propagation of the RLMV and RpLV viruses by targeting the vector of the virus itself.

**Microbial degradation of microplastics in wastewater treatment plants: A research study**

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The accumulation of plastic waste in our environment is one of the most everlasting changes to occur to our planet. Wastewater containing microplastics is a major contributor to plastic pollution when released into the environment from treatment plants. Research suggests that microorganisms can colonize these plastic surfaces and utilize microplastics as a source of Carbon. However, microbe-plastic interactions in wastewater treatment plants (WWTP) are poorly understood. This study will investigate the ability of microorganisms from WWTP activated sludge to degrade microplastics. Microcosms containing $^{13}C$-labeled polyethylene terephthalate (PET) will be inoculated in three different microcosms with sterile deionized water, microorganisms from WWTP activated sludge, and bacteria known to degrade PET. Metagenomic and $^{13}C$ data will be collected to determine the extent of microplastic degradation. We expect to see microbes incorporated with $^{13}C$ and $^{13}C$ $CO_2$ if PET is utilised as a carbon source. Also, we predict that the Proteobacteria phylum, particularly the *Enterobacter* and *Pseudomonas* genera, will have the greatest association with microbial degradation of microplastics. These findings could be applied collectively to identify more effective microorganisms for the degradation of microplastics in WWTP.

**Statistical air pollution exposure models to address community environmental health concerns**

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Communities are increasingly engaging in environmental health advocacy in areas like air pollution exposure, but often, minimal data are available to empower communities in their pursuits. Strathcona and the Downtown Eastside are adjacent neighborhoods in Vancouver, impacted by many sources of air pollution, including the Port of Vancouver, major roadways, railroads, and industrial activities. Chronic exposure to air pollutants, like $PM_{2.5}$, and $NO_2$, can cause serious health problems. However, personal air pollution exposure is difficult to estimate due to low spatial resolution of monitors. These estimates are needed to compare the distribution of exposure between different socio-demographic groups: previous research indicates that marginalized communities in Canada often bear disproportionate air pollution burdens. Here, we review statistical models, including land-use regression, kriging and machine learning methods, to evaluate candidate methodologies for estimating air pollutant exposure within the Strathcona and Downtown Eastside communities. We select studies to review through keyword searches in academic databases focusing on geospatial modeling within the context of air pollution. After comparing different modeling approaches, we apply selected methodologies to our case study region, using land use, roadway, and meteorological data, with high spatial resolution air pollution data collected using the SENSIT® RAMP sensor. Using this model, we simulate air pollution concentrations at high spatial resolution and estimate exposures for different socio-demographic groups. The results will inform public awareness of local air quality in the Strathcona and Downtown Eastside communities, identify groups that have disproportionately high exposures, and empower community leaders in crafting and implementing exposure-reduction measures.

**The impact of managed honeybees on native pollination services**

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While 75% of crops worldwide depend on pollinators to bear fruit, wild pollinator numbers are on the decline, pushing farmers to rely heavily on managed honeybees (*Apis mellifera*), which are now responsible for over $250 million annually in the B.C. agricultural market (Ministry of Agriculture; Ritchie). These trends have raised concerns over protecting food security without negatively impacting biodiversity and the essential regulating services wild pollinators provide in their natural habitats. Crop yields have been shown to increase with wild pollinator diversity, and introducing managed bees to natural ecosystems may diminish wild pollinator fitness by influencing their floral niche. Previous studies, however, have failed to determine whether the presence of managed honeybees interferes with wild pollinators' ability to pollinate crops. We address this by investigating if there is a relationship between honeybee abundance and wild pollinators' ability to pollinate blueberry flowers in British Columbia, Canada. We hypothesize that managed honeybees reduce pollination from wild pollinators via direct competition at the flower and by diminishing the pollen available to native species. In our proposed study,

1. Wild pollinators and honeybees will be collected with sterile tubes and frozen to measure abundance, diversity, and pollen composition. Pollen will be brushed off each species post-freeze.
2. To assess direct competition between managed and wild pollinators, visual surveys will be conducted to determine whether wild pollinator visits to flowers are interrupted.
3. To assess the available floral resources, vegetation surveys will be conducted at each site.

Our results will provide a basis towards understanding the plant-pollinator interactions paramount to supporting higher crop yields, the profitability of crops, and food security, as well as overall ecosystem sustainability.

**The impacts of a warming ocean on the migration of cetaceans and sharks**

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The impacts of climate change are suggested by recent studies to be altering the habitat range of individual marine species and on a larger scale, the composition of communities. Larger species such as whales and dolphins (further referred to as cetaceans) and other higher-trophic level predators, such as sharks, have reproductive and migratory behaviours that are particularly sensitive to environmental properties such as sea surface and deeper ocean temperatures. The rise in ocean temperatures is evidenced through field observations and model predictions to shrink the ideal thermal niche of these animals. In response, cetaceans and sharks are redirecting their migratory grounds north in an unusual alteration of behavioural patterns reflecting their search for suitable habitats. This study's methodology includes reviewing and comparing modelling studies and their use of environmental parameters to predict the effects of climate change on cetacean and shark migratory patterns (e.g. feeding and breeding grounds). We hypothesize that increasing sea surface temperatures will continue to alter local niches in these animals' habitats, thereby causing a shift in biomass to higher latitudes with cooler conditions with the potential to force many changes onto the marine ecosystems. Preliminary in approach, this study proposes additional future work that can be done on this research topic, including synthesizing model outputs and comparing against observational data for conservation and management use.

<u>**Innovation and Technology**</u>

**Bone marrow dosimetry for radiopharmaceutical therapy: Expanding the capabilities of the MOBY phantom**

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Radiopharmaceutical therapy (RPT) in nuclear medicine is often a key component of treatment regimes for cancer patients. All internal radionuclide therapies require an estimation of the absorbed radiation dose and related tissue damage to organs at risk such as the bone marrow. In the field of radiation dosimetry, such doses are typically estimated using pre-estimated so-called *S*-values, representing the absorbed dose in a target region per decay of the radionuclide in a source region. Simulation of organ- and radionuclide-specific *S*-values is most commonly performed with digital human or mouse phantoms, the latter of which are used as a first step to demonstrate safe application of the RPT in pre-clinical animal studies. Bone marrow *S*-values are not yet available and hence need to be simulated. In this study, we aim to simulate *S*-values for the bone marrow in mice, using the 4D Mouse Whole Body (MOBY) phantom. First, a combination of single-photon emission computed tomography (SPECT) and high-resolution computed tomography (CT) imaging will yield the distribution of bone marrow in mice, allowing for incorporation of the bone marrow into the MOBY phantom. Subsequently, radionuclide decay will be simulated in the updated phantom using Monte Carlo-based methods. Lastly, the resulting radiation dose to the target bone marrow from other source organs within the mouse phantom will be estimated. Thus, the corresponding *S*-values can be calculated for use in future pre-clinical studies of RPT in mice. This work will ultimately guide researchers in translating potential RPTs to the clinical setting.

**Construction of SIGEX duo-directional reporter plasmid pSPPH21**

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Substrate-induced gene expression (SIGEX) methods use gene reporter systems to screen metagenomic libraries and identify novel catabolic genes. Commonly, these gene reporter systems use plasmids that contain promoter-less fluorescent protein markers downstream of a restriction site that produces overhangs. In the SIGEX method, a DNA fragment from a metagenomic library can then be inserted into the restriction site for its expression and analysis. Due to the overhangs produced during the cloning process, the fragment of interest can only be inserted in a single orientation to be detected. To circumvent this limitation, a vector with two oppositely-oriented fluorescent protein markers and a blunt-end producing restriction site - instead of an overhang-producing one - can be engineered. In this study, we adapted a vector design from UBC iGEM to construct a duo-directional SIGEX plasmid reporter system (pSPPH21) containing green fluorescent protein (GFP) and red fluorescent protein (RFP) reporter genes. To build plasmid pSPPH21, a 766 base pair DNA fragment containing a NruI restriction site and an RFP gene was synthesized, digested, and cloned into the pSB1C3 vector containing a GFP gene and a chloramphenicol selection marker to construct the duo-directional reporter vector. The location of the NruI restriction site between the oppositely-oriented GFP and RFP genes allows for high efficacy cloning of inducible promoters from metagenomic libraries and for the identification of novel catabolic genes.

**Developing a method to measure free stress hormone levels in mouse serum**

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Glucocorticoids (GCs) are "stress" hormones that travel through the bloodstream and regulate a myriad of processes in the body. At normal state, the majority (~90%) of corticosterone and cortisol (main active GC in mice and humans, respectively) is bound to circulating corticosteroid-binding globulin, a powerful regulator of corticosterone activity and access to tissues. However, only unbound GCs are biologically active and can enter and act on tissues, such as the brain. Thus, it is vital to distinguish between unbound and bound corticosterone in study samples. Nonetheless, there is a profound lack of the

distinction between unbound and bound corticosterone/cortisol in literature, partly due to the lack of an easy and robust method to measure unbound GCs in serum. Here, we aim to develop an accurate and reliable method of separating unbound from bound corticosterone in mouse serum using ultrafiltration, a method to separate large (bound corticosterone) from small (unbound corticosterone) molecules with a porous filter. By coupling filtering with mass spectrometry, the current gold standard for steroid quantification, we aimed to measure unbound corticosterone concentrations in the filtered serum precisely. Currently, we are also testing other methods to accurately measure unbound corticosterone levels after ultrafiltration, such as through immunoassays. Altogether, we aim to show possible methods of filtering unbound from bound GCs, and the possible constraints of ultrafiltration. This novel ultrafiltration method may be key in revealing the role of bound and unbound GCs on neuroimmunity and brain disorders, relevant for the basic, translational, and clinical sciences.

## Developing guidance for ethically-sound Scholarship of Teaching and Learning (SoTL) research at the University of British Columbia (UBC)

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The UBC Faculty of Pharmaceutical Sciences' Pharmacy Education Research and Leadership (PERL) research theme is Canada's first pharmacy education research collaborative. One of PERL's goals is to advance the quality of pharmacy education through SoTL and quality assurance/improvement (QA/QI) studies. Drawing on national Tri-council guidelines, UBC's current guidance for ethical research involving humans delineates between research and QA/QI in biomedical contexts but provides little direction in academic contexts; a situation that often leads to ambivalence among SoTL researchers regarding the ethics process. To address this issue, this project's objective was to create user-friendly guidelines for ethically-sound SoTL and QA/QI research for PERL and the broader UBC community. Utilizing a scholarly approach, development of the guidelines involved: 1) establishing the connection between SoTL and QA/QI research in academic contexts; 2) a rigorous literature review of key ethical considerations for SoTL research, 3) a web search for current guidance on ethically-sound SoTL in Canadian Universities, and 4) collaboration with UBC's Institute for the SoTL and Office of Research Ethics, and Research Ethics BC. Incorporating QA/QI work into the didactic domain of SoTL research, the main ethical considerations for SoTL and QA/QI work were identified and summarized into a Decision-Making Tool that included students, audiences, and the dual role of the researcher/instructor. The study results will be published as a comprehensive screening tool that guides SoTL researchers through the research design/ethics review processes.

## Development of a UV-LED based air purification system: A research study

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Respiratory droplets of pathogens, such as SARS-CoV-2 in the current COVID-19 pandemic, spread not only from person to person via direct contact, but also indirectly via contaminated air. Ultraviolet (UV) radiation is known as the gold standard of disinfection technology, where the DNA of microorganism are damaged by high energy UV photons. The traditional method to produce UV radiation is using medium-pressure or low-pressure mercury lamps, which are bulky, energy demanding, and not environmentally friendly. An emerging method to produce UV rays is based on semiconductors like those used in ultraviolet light-emitting diodes (UV-LEDs). These new sources of radiation have a smaller footprint and instant on-off capability, which make them suitable to be used in many disinfection applications. The goal of this project was to develop a UV-LED based air purification device which can be utilized for the disinfection of various air settings, as one of the most common sources for virus transmission. To this end, the characteristics of a UV-LED were studied fundamentally, and the engineering considerations are discussed thoroughly. Moreover, a simulation of the air treatment device is presented in this work. The system developed in this work can be installed in many places to kill harmful pathogens, such as SARS-COV-2.

## Electrochemical growth of *Acidithiobacillus ferrooxidans* as a sustainable food source for space travel: A research study

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Food supplies during space travel have historically depended on shipment from Earth, despite the large body of research on food being grown onboard. However, this production needs to be done self-sufficiently using only resources available on the spacecraft. Apart from growing photosynthetic organisms, there are methods that can produce food "electrically ". Using

mainly electrical energy and CO2, a chemosynthetic edible protein can be grown. Single-cell-microorganisms have been extensively researched, showing the potential to be a complete food source for humans. A lot of types of bacteria, if grown and processed in the right conditions, have the potential to be edible and can be grown in bio-electrochemical cells. While they have never been researched as a food source, iron-oxidizing bacteria have been grown electrochemically with great efficiency. Additionally, iron is a safer chemical compared to alternatives like ammonia or hydrogen. Moreover, *Acidithiobacillus ferrooxidans* is one of the most studied chemosynthetic bacteria. We therefore ask ourselves if *Acidithiobacillus ferrooxidans can* be efficiently grown in a bio-electrochemical cell as a safe and sustainable food source for space travel. *A. ferooxidans* were grown on a carbon felt cathode in a reactor filled with an acidic solution of $FeCl_2$. A humidified mixture of gasses ($CO_2, N_2, O_2$) was bubbled through a glass frit at the bottom of the reactor, providing the necessary compound for bacterial growth. Based on our literature review, the biomass produced should be edible after processing. That process involves lysing the cell walls and reducing nucleic acid concentration to avoid the formation of uric acid excess in the body Finally, to test the safety of consuming the biomass produced, we plan on conducting a mice study.

### INTACT (RetINal Toxicity And HydroxyChloroquine Therapy): A pilot study using ophthalmologic image transfer to expand access to early retinopathy screening: A research study

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Hydroxychloroquine (HCQ) is a cornerstone medication widely-prescribed to patients with systemic lupus erythematosus and rheumatoid arthritis, significantly improving survival and quality-of-life. However, long-term HCQ therapy poses a risk for retinopathy, leading to irreversible blindness unless detected early. Current care standards recommend annual retinopathy monitoring in long-term users, using Spectral-Domain Optical Coherence Tomography (SD-OCT) retinal images. Inter-brand incompatibility means these images are typically reviewed on-site; however, the highly-centralized distribution of BC's few retinologists makes it challenging for many patients to access the level of specialized care that early detection necessitates. Instead, images are often read by the optometrist taking them. INTACT aims to improve accessibility to early retinopathy detection by trialing a first-of-its-kind system enabling retinal images from different SD-OCT machine brands to be anonymized, transferred to, and read on a secure unified platform – enabling specialists to remotely review them in real-time. Retinal images taken by in-clinic SD-OCT machines are uploaded to a cloud-hosted platform, and reviewed by pairs of experienced retinologists for indicators of retinopathy. In 2021, 4 retinology clinics BC-wide participated in pilot-testing this system preceding the full-scale INTACT study. Forty anonymized retinal images of patients and controls were uploaded to the platform and accessed via secure website by two retinologists on the research team, successfully demonstrating functionality and scalability, and retaining image utility. INTACT will scale up to 22 participating retinology clinics throughout BC, demonstrating accessibility improvements for early HCQ-induced retinopathy screening. Consequently, study results will improve patients' confidence and adherence to HCQ, enabling improved disease management.

### Modifying Arabidopsis thalania mucilage composition to alter drought tolerance: A research study

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The plant seed coat contains several layers that aid in embryo protection and germination. Some species exhibit a property where their seed coat epidermal cells produce mucilage, a specialized secondary cell wall made of complex polysaccharides. Due to its water-absorbent properties, mucilage may help seeds with germination under osmotic stress. However, mucilage composition and drought resistance vary across plants, so it is unknown which polysaccharide composition contributes to greater tolerance of drought stress. This study explores how Arabidopsis thaliana mucilage composition could be modified to alter its overall drought resistance. Three other plant species, *Artemisia sphaerocephala, Salvia hispanica,* and *Plantago* ovata will be examined and compared to *Arabidopsis thaliana*. To analyze germination percentages in drought-like conditions, seeds will be grown in polyethylene glycol which generates osmotic stress. Mucilage will be extracted followed by a monosaccharide and polysaccharide linkage analysis to determine structure using chromatography. Based on these results, *Arabidopsis thaliana* mucilage will be modified to align more closely with the mucilage composition of the more drought-tolerant species. These proposed modifications are expected to involve the alteration of expression of enzymes involved in the biosynthesis of these mucilage polysaccharides. Once transgenic *Arabidopsis thaliana* plants are generated

with altered mucilage, the exact changes to the mucilage structure and composition will be confirmed and their germination under osmotic stress will be examined. In this way, the effect of specific changes to mucilage structure in relation to germination under osmotic stress can be explored. A successful modification of *Arabidopsis thaliana* mucilage would be a critical breakthrough to enhance survival in drought conditions.

## Objective and automated assessment of motor deficit using 3D mesh models in human Parkinson patients

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Human motion analysis has been a common thread across modern and early medicine. While medicine continues to evolve, analysis of movement disorders, such as Parkinson's Disease (PD), remains to be based on clinical presentations and trained observers making live assessments. Objective and quantitative assessment of motor impairment is needed to optimize treatment decisions and evaluate new therapies. Currently, diagnostic imaging and fields such as cancer have benefited from machine learning. However, neurology, for the most part, has not yet embraced digital movement analysis that leads to automated clinical assessment. One reason being due to the limited size of labeled training datasets for machine learning models. This study developed a pipeline to automate the 3D analysis of motor deficits using state-of-the-art computer vision methods. We first set up several existing 3D Human Pose Models, including ROMP and VIBE, to predict 3D motion from 2D PD patient videos. We then imported 3D motion data to Blender, which was used as an interface to animate the SMPL 3D human body models to fit the patients in the 2D video. Through this process, we created a 3D Motion Library of PD patients. Our initial models mostly focused on gait abnormalities but will be optimized by implementing more accurate models, such as PIXIE. Our pipeline will serve as the groundwork for transferring 2D video data to 3D human body models to anonymize clinical video. This leads to the standardization of processing and robust analysis by either trained observers or algorithms that predict clinical scores.

## Simulating quantum error correction on Kitaev surface codes

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Quantum information presents a radical computational paradigm with many potential benefits over classical computation. Unfortunately, quantum information is prone to spontaneous degradation due to limitations in current quantum hardware. The performance of near-future quantum hardware therefore stands to be drastically improved by using fault-tolerant encodings of qubits that can restore information scrambled by noise processes in real time. One such error-correcting code with a convenient square-lattice geometry is the Kitaev surface code. The lattice geometry is particularly pragmatic because it requires only nearest-neighbor interactions between physical qubits, meaning it can be implemented on many existing quantum architectures. I design a numerical model in Python for simulating error correction on planar surface codes using the minimum-weight perfect matching algorithm, a polynomial-time classical algorithm that determines the best error-correcting operations using a probabilistic error model. I then investigate the performance of the planar code under an augmented error-correction procedure that models local error probabilities, specifically under a photonic implementation of the qubit lattice where measurement failure presents an additional source of local errors. Finally, I determine the maximum tolerance of this error correction procedure to errors due to both environmental noise and measurement failure.

**Technology and transcription factors: Using CADD to target interactions**

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Transcription factors (TFs) are essential pieces to gene regulation that, when mutated, aid the growth of cell related diseases. Scientists had accepted TF as undruggable with highly specific binding sites and short lifetimes impeding their ability to bind with drugs. Recently, however, research focusing on ligand binding sites (LBDs), protein-protein interactions (PPI), DNA interactions, and degradation have induced investigations into drugging the "undruggable" (3). In this project, we will be doing literature on relevant papers in the form of a poster. No firsthand data or research will be conducted. One such way to encourage drug-ability is targeting PPIs, formed by TFs, creating regulatory networks. Scientists can control specific transcriptional responses by targeting these interactions (2, 3). Targeting PPIs was thought impossible due to; diffuse surface area, lack of well-defined pockets, and redundancy mechanisms (1, 3). Scientists have overcome these problems, successfully targeting PPIs and inducing disease control. Additionally, scientists have impeded interactions with DNA sites by binding DBDs, using compounds that compete with TFs, or making DNA unrecognizable (7). One such way to identify these PPIs is by utilizing computer-aided drug discovery (CADD). CADD is fueled by comprehensive chemical databases, AI, neural learning networks, and advanced 3D graphics (4). CADD can investigate physical samples of TFs which are related to specific detrimental diseases, LBDs are visualized and predicted, and protein-DNA interactions measured. Such findings allow for the development of small molecule drugs that inhibit, degrade, or address disorders in TFs that contribute to severe diseases that were formerly considered untreatable.

**Using Benford's Law to assess biodiversity datasets**

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Recent advancements in the field of open science have led to an increase in the availability of biodiversity datasets. As a consequence, the demand for tools to evaluate the quality of these sources has risen as well. Often observed as a naturally occurring phenomenon, Benford's Law is a widely obeyed law with applications to data from a variety of fields, such as finance, economics, politics, and ecology. It predicts that for natural datasets, the frequency at which a randomly chosen leading digit appears demonstrates a decreasing probability as the digit increases from 1 to 9. In this study, we explored the potential of Benford's Law in examining the quality of biodiversity datasets. We predict a positive relationship between the quality of a biodiversity dataset and its level of coherence to Benford's Law will be observed. To test this idea, we downloaded available datasets from various sources, which are then processed using the "benford.analysis" R package. Datasets from professional and official sources include the Canadian fisheries landing data (Fisheries and Oceans Canada) and Breeding Bird Survey data (North American Breeding Bird Survey), whereas the gastropod occurrence data from Ocean Biodiversity Information System involved both scientist and citizen participation. Lastly, a dataset that has been proven to be falsified is also included for comparison. By categorizing these data results by their predicted level of accuracy and comparing their alignment with Benford's Law, we aim to determine the applicability of Benford's Law in the field of biodiversity as a preliminary assessment of accuracy. If proven useful, Benford's Law can eventually become an easy, yet very effective step during data curation to evaluate information and ensure reliable research outcomes.

**Conflicts of Interest**
The author(s) declare that they have no conflict of interests.

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