UNIVERSITY OF SASKATCHEWAN

2016 USRA Poster Competition

August 18th, 2016

Undergraduate researchers at the University of Saskatchewan have dedicated summer 2016 to faculty-supervised research.

The USRA Poster Competition ensures students have a chance to write and submit an abstract and poster – widely used methods for sharing research. Presenting a poster to a wide audience enables students to communicate their research with others, to receive feedback, and to network in ways which facilitate thinking beyond the scope of one current project and continue the process of discovery.

More than 70 successful student-involved investigations from over 16 academic units represent the fascinating range of research underway at the U of S. We hope you enjoy the variety and quality of research endeavours outlined here and presented on August 18th at the third annual USRA Summer Social and Poster Competition.

Abstracts are arranged alphabetically by the first letter of the students' last names.

5'UTR HCV Targeting siRNAs Pressured the Evolution of Escape Mutant Viruses that use siRNAs to Promote Viral Replication

Halim M. Adams; Joyce Wilson (Supervisor)
Microbiology & Immunology

The Hepatitis C virus is a liver virus that effects a staggering 2-3% of the world's population with an estimated of 700,000 individuals dying annually. Unfortunately, there remains no effective vaccine. Our lab is interested in understanding HCV's perplexing dependence on a liver specific microRNA known as miR-122. HCV needs miR-122 to anneal to two positions on the 5'untranslated region (5'UTR) to promote efficient virus replication. This role is unusual for a miRNA since they normally suppress expression of messenger RNAs. The mechanism behind miR-122 augmentation of HCV is not fully understood. My research has focused on characterizing the replicative fitness of HCV having point mutations within or near the miR-122 binding sites, a region highly conserved between different virus genotypes and thus thought to be essential. These point mutant viruses were selected and isolated using siRNA knockdown pressure that targeted the 5'UTR. To test the replicative fitness of each mutant virus I electroporated mutant genomic RNA, with or without the siRNA, into cells and measured their growth at various time points. Many mutants' growth phenotypes were poor as expected. However, some were almost as fit as wild type virus and suggested that this region could accommodate a wide variety of point mutations. The mutant viruses had a varied ability to resist siRNA knockdown, and fascinatingly, in some cases the siRNAs increased the mutants' replication. We hypothesize that the point mutations that block siRNA cleavage allow siRNA binding to promote HCV replication using the same mechanism as miR-122.

Effects of International Immersion Experiences on Undergraduate Nursing Students' Level of Cultural Competency

Razieh Alizadeh; Louise Racine (Supervisor)
Nursing

Background: Each day Canada and Saskatchewan become more culturally and linguistically diverse with the influx of non-Western immigrants and refugees. These newcomers often present acute physical and mental health care needs. Undergraduate nursing and other health professional students contribute to the delivery of health care through their clinical placements. Although the inclusion of cultural competency and cultural safety in professional standards of practice, providing culturally and linguistically congruent health care remains a major challenge among health professions. An integrative review is necessary to answer the following research questions. Research Questions: Are undergraduate nursing students adequately prepared to embark on international immersion experiences? How can we effectively measure undergraduate nursing students' level of cultural competency? Methodology: An integrative review was performed using "cultural competency" and "nursing students" as keywords. The following databases were searched: CINAHL and the University of Saskatchewan Library Database. A sample of 42 articles were selected based upon inclusion criteria. Data Analysis: thematic analysis was used to classify the main ideas. Preliminary Findings: Cultural competency is a process and an outcome necessary for the delivery of linguistically and culturally competent healthcare. Cultural safety is seen as process of decolonization where Otherness must not be objectified but understood in a holistic view of the clients.

Spectroscopic analysis of environmental soil samples: influence of sample preparation method

Ian Andvaag; Derek Peak (Supervisor)
Soil Science

Many spectroscopic techniques exist for imaging, but none are entirely satisfactory for imaging the soil rhizosphere due to radiation-induced sample damage, poor detection sensitivities or low resolution. We investigated the suitability of three sample preparation methods at CLS soft and hard X-ray microprobe beamlines to generate element maps of rhizosphere soils. The images with the best contrast were obtained when loose roots mounted to an Al sample holder were irradiated with soft X-rays. Hydraulically pressed pellets did not acceptably maintain root-soil interactions, and are not recommended for imaging.

Development of Web Groupware Toolkit for Synchronous Collaboration

Gaurav Arora; Carl Gutwin (Supervisor)
Computer Science

Groupware toolkits assist in the development of collaborative applications, which can otherwise be lengthy, error prone and time consuming. These toolkits are currently not accessible as web-based applications and can not be used to develop web based applications. The purpose of this research was to develop a synchronous web-based groupware toolkit that can help developers in developing collaborative web applications efficiently. We used easyrtc (a javaScript library created using webRTC) to develop a web groupware toolkit, which automatically manages the creation, inter-connection and re-connection between clients. It also provides methods for management of rooms (spaces in which multiple clients are automatically connected with each other). Developers can select from different types of communications between different clients, which can be reliable/unreliable or ordered/unordered. We have used the toolkit to develop two simple web applications – RTDrawing and RTChess. RTDrawing is collaborative synchronous drawing application, whereas RTChess is a fast-paced, multiplayer, distributed chess game reinvented for group play.

Processing Fluency as a Predictor of Analytic Thinking

Courtney Ballantyne; Valerie Thompson (Supervisor)
Psychology

Dual Processing Theory (DPT) of reasoning suggests that people make judgements in two ways: a fast, automatic, and intuitive way, and a slower, controlled, and analytic way. Research has been aimed at getting individuals to overcome this automatic reasoning and think in a more analytic manner. It has been proposed that when an intuitive answer is generated, it is accompanied by a Feeling of Rightness (FOR). This FOR is produced by experiences that are associated with solving the problem, such as how easily an answer comes to mind, and is independent of whether the answer is correct. To manipulate how easily an answer comes to mind, we gave participants reasoning problems that were represented either more or less easily, but did not differ in actual difficulty. Participants were asked to give two answers to the problem: a quick, intuitive answer, and thoughtful, deliberate answer. After each response participants were asked to rate how confident they were in their answers as a measure of their FOR. Reaction times were longer for less easily represented problems and had lower FORs than more easily represented problems, but were not associated with greater response accuracy. These results suggest that when a problem is processed less easily it can aid in engaging deeper thinking about the problem but does not make it more likely that the answer will be correct.

On eigenvalue problems arising from nonlinear oscillators

Madeline Berezowski; Artur Sowa (Supervisor)
Mathematics & Statistics

Memristance is one of the electric properties of matter unique to the nano-to-micro scale. It is ubiquitous in materials ranging from engineered nano-lattices to brain neurons. This research analyses several nonlinear eigenvalue problems that describe the dynamics of memristive nano-electronic resonators. Solutions in the form of Dirichlet series and Fourier series were searched for, and ultimately characterized via recurrence relations on the respective series coefficients as well as closed-form formulas for their respective eigenvalues. These theoretical results are applicable to numerical simulation and computer-aided design of memristive circuits, enabling further explorations in nano-science and nano-engineering.

Murderers, Burglars, and Boodlers: An history study of extradition

Tyla Betke; Benjamin Hoy (Supervisor)
History

“Murderers, Burglars, and Boodlers” is an historical research project of extradition between the United States and Great Britain from 1842 to 1890. Extradition, the process through which one county transfers an individual suspected of a crime back to the country in which the crime was committed, was an especially complex international process in the 19th century as it involved very different legal and political systems and a porous USA-Canada border. This project compiled all of the data on extraditions between the United States and Great Britain from each country’s official reports on extradition and created an easily navigable, comprehensive database. This database was then used along with historical

newspapers to understand how the American and British governments recorded and carried out cases of extradition, to determine which crimes were of most importance to each government, and to measure the reach of federal power across borders. The results show that both countries kept poor records of extradition, that there was a racial component to policing cross-border crime, and that governments cared most about murder and financial crimes. This research also found that governments often relied on irregular forms of justice and that the official treaty of extradition was not always followed. The database from this project can now be used with software such as Historical Geographic Information System (HGIS) and additional primary documents to answer a variety of other historical questions such as how international policing has changed over time and how posts of federal power impacted the frequency of extradition cases.

Meniscal Mayhem: Designing a Material Testing Chamber for Knee Cartilage

Josef Beug; Emily McWalter (Supervisor)
Mechanical Engineering

Osteoarthritis is a degenerative joint disease that can cause failure of the knee meniscus, limiting its ability to transfer forces through the knee. Biomarkers, such as quantitative MRI (qMRI), may be useful in improving our understanding meniscal degeneration and developing treatments. The purpose of this project was to design and construct an apparatus to carry out mechanical testing of meniscus samples in confined compression for the validation of qMRI-based biomarkers. The apparatus must facilitate the confinement and testing of 4mm diameter and 2mm thick meniscus plugs, bathe samples in phosphate buffered saline, and operate with an available material testing system (Bx1-EZ010.A1K-000, Zwick USA, Kennesaw, GA). Furthermore, an appropriate load cell with an operating range of 0N-5N, the expected force values, was required. Following these criteria several alternative designs were created. The final design consisted of a confining chamber on stilts submerged in fluid (Fig-1). For creating cartilage plugs with accurate dimensions, 4mm biopsy punches were acquired and a sample cutting device was designed and constructed. A load cell was chosen to fit the operating range (Xforce-P 10N, Zwick USA, Kennesaw, GA). A prototype of the final design was 3D printed (Fig-2). The design will be machined using 316L stainless steel for corrosion resistance and rigidity to eliminate apparatus compression. The designed chamber facilitates the mechanical testing of meniscal samples. This allows for study and validation of qMRI biomarkers of meniscal degeneration. Such biomarkers would be valuable for diagnosing, understanding, and treating osteoarthritis.

"Stop and slow down": a pilot project of meditation and mindfulness techniques during a first nursing clinical experience

Sarah Bocking, Jennifer Ong, & Vivian Murungi; Lorraine Holtslander (Supervisor)
Nursing

Clinical placements educate student nurses in demanding in-hospital environments. A student's initial clinical experience presents both anticipated and unexpected new stressors and a novice student's coping skills for stress are often underdeveloped. Previous attempts to build resilience in nurses and students have successfully used meditation and mindfulness techniques. However, there is a paucity of Canadian research on the qualitative experience of nursing students using meditation and mindfulness techniques during clinical placements. This pilot study provided 4 in-person and 4 online teaching sessions of meditation and mindfulness techniques to U of S student nurses prior to their first in-hospital clinical placement. Information about the study participant's clinical and stress experience was collected by semi-structured interview, transcribed, thematically coded and analyzed using an interpretive description method. The study participant reported experiencing unanticipated situations of novel stressors during the clinical. To cope, the participant used techniques learned during the teaching sessions and adapted them as needed during her clinical placement. Four main themes emerged from the analysis including: making sense of her environment, making sense of her role, finding time to "slow down", and her inner-world. The insights gained from this pilot study have resulted in modifications and enhancements to the original interventions in preparation for another wave of recruitment of 2nd year U of S nursing students.

It's Better in Leather: Examining the British Shoe & Leather Trades of the 19th Century Using HGIS and Other Quantitative Methods

Danika Bonham; Geoffrey Cunfer (Supervisor)
History

During the late nineteenth-century, the British shoe and leather industries were faced with increasing competition from foreign markets. As a result, shoe and leather businesses across Britain changed locations, professions, and products in order to remain profitable and relevant to consumers. The periodicals published for the British shoe and leather industries during the late nineteenth-century illustrate an ever-changing market, and provide insight into how individuals involved in all aspects of the trade conducted their daily business. This project examined the changes to the locations, professions, and materials advertised during the years of 1877 and 1881. By utilising Historic GIS to visually represent the locations of each business, alongside data that identified any changes in the professions or materials advertised, 1877 and 1881 are comparatively analysed. The results of this project indicate that between the two years, noticeable changes were undertaken by those involved in the British shoe and leather trades. The locations of advertised businesses shifted inland, with a greater number appearing in London. Similarly, the professions and materials advertised also underwent change as different products and new companies entered the market. It is, therefore, necessary to further study the periodicals of the British shoe and leather trades within the context of the late nineteenth-century, to better understand domestic response to the changes in the international leather trades during the late nineteenth-century.

Nitrogen fixation rates along the Qu'Appelle Valley

Lisa Boyer; Helen Baulch (Supervisor)
School of Environment & Sustainability

Nitrogen (N), a component required for both plant and animal growth, is largely in a form inaccessible by most organisms, N2 gas. Specialized algae have the capacity to anaerobically transform N2 into a biologically-available form through nitrogen fixation (N-fix), increasing ecosystem productivity. As N-fix is energy expensive, these algae will only fix N2 when bioavailable nitrogen is locally unavailable. Heterocysts, specialized structures, are formed by most N-fixing algae to create an anaerobic environment. In these structures, the oxygen-inhibited enzyme, nitrogenase, is generated to reduce N2 to ammonium. This study seeks to understand the variation of N-fix rates in lakes upstream and downstream of Regina's wastewater treatment plant (WWTP). Through existing taxonomic data, we know that N-fix occurs in one of these lakes due to the presence of several N-fixing species with active heterocysts. We propose that N-fix rates will decrease in lakes downstream of the wastewater treatment plant as a result of N inputs from effluent. In order to understand if this is the case, an ongoing comparative study using both the 15N-tracer and the acetylene reduction assay (ARA) methods will be used to measure N-fix rates in Buffalo Pound and three lakes downstream of the WWTP to understand post-WWTP N-fix rates. This study will provide valuable insights to the significance of N-fix on the nitrogen cycle of the Qu'Appelle Valley.

Using Cell Communication to Promote the Formation of Bone

Connor T. A. Brenna; Brian Eames (Supervisor)
Anatomy & Cell Biology

During endochondral ossification, formation of bone in the perichondrium (a fibrous layer surrounding cartilage) can be mediated through intercellular signalling molecules. Here, we hypothesize that signalling by the growth factor family Bone morphogenetic protein (Bmp) promotes perichondral bone formation. To test this hypothesis, we used two lines of transgenic zebrafish, loss-of-function (hsp70l:dnBmpr1a) and gain-of-function (hsp70l:GAL4; UAS:bmp4), to experimentally decrease or increase Bmp signalling, respectively, in response to heat shock treatment. To demonstrate that heat shock treatments altered Bmp signalling, we used transgenic fish containing a Bmp response element (BRE) driving GFP. Our results suggest that loss-of-function fish displayed a decrease in Bmp signalling following heat shock, compared to controls. Next, skeletal histology was performed, and levels of perichondral bone formation among experimental and control groups were quantitated using microscopy and a numerical scoring system. Trends in the data favor our hypothesis. Zebrafish with increased or decreased Bmp signalling tend to have increased or decreased bone formation, respectively, relative to controls. In the future, we will increase the numbers of fish analyzed by skeletal

histology in order to increase statistical significance. Also, we will use the BRE fish to demonstrate increases in Bmp signalling in gain-of-function groups, localizing these changes to cells in the perichondrium using confocal microscopy.

Annual changes in clinically relevant cortical bone properties can be characterized in children using high resolution peripheral computed tomography

Amy T. Bunyamin; James Johnston (Supervisor)
Mechanical Engineering

Monitoring thin cortical bone at the long bone ends is important because cortical bone properties (e.g. thickness and porosity) are major determinants of bone strength and fracture risk in children and older adults1,2. High resolution peripheral CT (HR-pQCT) can be used to monitor cortical bone in older adults3 but its ability to capture changes in the growing long bone ends of children is unknown. When monitoring cortical bone development, knowing whether observed change is due to actual bone growth (beyond measurement error) is crucial but not yet studied in children. Our objectives were to define precision errors and least significant changes (LSCs) to test if observed 1-year changes in cortical bone properties were beyond LSC in children. We measured cortical properties (bone volume, thickness, porosity, pore volume, pore diameter) at the distal radius and tibia using HR-pQCT. To determine precision errors, we scanned 32 children (mean age:11.3,SD:1.6years) twice, one week apart. To assess annual change, we scanned another 20 children (10.9,1.6years) twice, one year apart. We calculated LSCs from precision errors (root-mean-squared coefficients-of-variation, CV%RMS)3. We defined annual bone change as the difference between baseline and 1-year follow-up using t-tests ($P<0.05$). We reported annual changes in cortical bone that exceeded LSC. Cortical bone volume increased (radius:10.1%, $P<0.001$; tibia:8.2%, $P<0.010$), thickness reduced (radius:-3.5%, $P<0.001$; tibia:-2.1%, $P<0.001$), and porosity decreased (radius:-26.9%, $P<0.001$; tibia:-13.2% ,$P<0.004$) over one-year. Findings indicate cortical bone consolidation at the long bone ends and that HR-pQCT can be used to monitor development of clinically important cortical bone properties in children.

Link Transition Probabilities After A Strand Exchange in an 'Equal---Length' Self---Avoiding Polygon Model

Marla Cheston; Michael Szafron (Supervisor)
Public Health

DNA within cells is compact and supercoiled, and hence can become knotted and linked with a high probability. This knotting and linking is problematic for many necessary cell processes, including replication. The main type of enzymes responsible for resolving DNA knots and links, and so responsible for the survival of the cell, are type II topoisomerases. Due to their crucial role in cell processes and survival, topoisomerases have become the target for many cancer and infectious disease treatments. Recently it has been found that when topoisomerase actions are inhibited, a second type of enzymes, recombinases, have the ability to unknot and unlink DNA in place of the inhibited topoisomerases, resulting in implications for drug treatments. Recombinases' efficiency at unknotting and unlinking DNA is not well studied; investigating this efficiency is the motivation for this work. To study the recombinase---DNA interaction and recombinases' efficiency at unknotting and unlinking, we used a self---avoiding polygon model on the simple cubic lattice. We simulated recombinases' action on DNA through strand exchanges on simulated self---avoiding polygons. Once a strand exchange has been performed, the resulting knot or link type is identified, providing estimates for link transition probabilities. These probabilities are then used to determine the probabilities associated with different unknotting and unlinking pathways for both variable and 'equal---length' polygons.

The *Borrelia burgdorferi* telomere resolvase, ResT, displays ATP-dependent DNA unwinding activity

McKayla R. Cozart & Madison A. Hart; Kerri Kobryn (Supervisor)
Microbiology & Immunology

Spirochetes of the genus Borrelia possess unusual genomes harbouring multiple linear and circular replicons. The linear replicons are terminated by covalently closed hairpin (hp) telomeres. Hairpin telomeres are formed from replicated intermediates by the telomere resolvase, ResT, in a phosphoryl transfer reaction with mechanistic similarities to those promoted by type 1B topoisomerases and tyrosine recombinases. There is growing evidence that ResT is multifunctional. Upon ResT depletion DNA replication unexpectedly ceases. Additionally, ResT possesses RecO-like biochemical activities being able to promote single-strand annealing on both naked ssDNA and ssDNA complexed with Borrelia's

single-stranded DNA binding protein. These observations suggest that ResT plays additional roles in DNA replication and recombination. We report here that ResT possesses DNA-dependent ATPase activity that promotes DNA unwinding that proceeds with a 3'-5' polarity bias. The ATPase activity is preferentially stimulated by single-strand DNA (ssDNA). We show that the balance between the annealing and unwinding activities of ResT is influenced by substrate structure and ATP concentration. Furthermore, we have identified and characterized mutations in invariant residues in ResT that have hyper- and hypoactive properties for the ATPase and/or unwinding activities that do not greatly affect hp telomere formation by the enzyme. Examination of mutations in the telomere resolvase active site suggest that the ATPase active site is distinct from that used by ResT to cleave and transfer DNA bonds.

Fe@FexOy Nanoparticle Synthesis and Hydrogenation Catalysis

Michael-Roy Durr; Robert Scott (Supervisor)
Chemistry

Hydrogenation, a ubiquitous reaction, is seen throughout all fields of chemistry. Traditionally, Pd, Pt, and other transition metals have been used as catalysts for this reaction. The aforementioned metals, being quite costly, have lead researchers to search for new catalysts. Fe@FexOy (core@shell) nanoparticles have been previously shown to be a suitable replacement for the traditional catalysts: iron is extremely abundant and therefore relatively cheap, and iron is potentially magnetically recoverable. Hence, we have synthesised Fe@FexOy nanoparticles and tested their catalytic ability in the hydrogenation of three different substrates: norbornene, octene, and cyclohexene. The hydrogenation reaction took place over 20 hours, under 400psi of hydrogen, and at 80°C. Our nanoparticles were synthesised following two different techniques: a reduction in "conventional alcohol" (methanol, ethanol) solvents and another in ionic liquid solvents. The two different methods allowed for varying nanoparticle size and further exploration of Fe@FexOy nanoparticles' catalytic ability. Using TEM we measured the size of the nanoparticles. Making use of GC and NMR analysis, the catalytic power of Fe@FexOy nanoparticles was determined. Early results show that both types of nanoparticles can effectively catalyze the conversion of norbornene to norbornane, however, only the Fe@FexOy nanoparticles synthesised in ionic liquid are effective as catalysts for the hydrogenation of octene.

Novel multi-axial, MRI-compatible loading rig to simulate daily activities: A design overview

Álvaro Espinosa; Emily McWalter (Supervisor)
Engineering

Quantitative magnetic resonance imaging (qMRI) is a non-invasive technique that can assess cartilage biochemical content. It is a promising biomarker because it can measure differences in macromolecular distribution between healthy and diseased tissues, but we need to understand more about how this distribution changes under load. Thus, my goal was to design a MRI-compatible device that applies physiologic loads to human cadaver knees at different flexion angles. I was tasked to design a high precision loading rig (key deliverables include blueprints and a 3D model) to simultaneously flex and compress the knee during qMRI experiments. This device must keep the knee joint capsule intact (to avoid tissue degradation) and fit in < [154x154x256]mm^3. While most research groups compress the knee in only one direction, it has been determined that forces act in many, so multiaxial loading was a key objective. Physiological loads are difficult to deliver within a MRI scanner: specimens lack the rest of the human body's biological context, muscle load decreases throughout constant viscoelastic deformation, and almost any metal part distorts magnetic fields degrading image quality. Following standard engineering design principles, 10 design alternatives were created and ranked according to predetermined criteria. The most promising designs apply muscle tension and axial compression, and distribute them such that a torque is generated at the joint (Fig 1) using a pneumatic air bladder, thereby applying near physiologic loading conditions without complex controls systems. Therefore, the final device will improve our understanding of functional deficiencies in diseased cartilage!

Seasonal Thermal Patterns in Lake Diefenbaker

Ruizhe (Rachel) Fan; Jeffrey Hudson
Biology

Lake Diefenbaker is a reservoir in the South Saskatchewan River watershed. Purposes: source drinking water, flood control, irrigation, recreation and aquaculture. However, a comprehensive water quality analyses has not been

completed on the system for 30 years. Temperature within lakes and reservoirs affect water column mixing, stratification, oxygen solubility, water quality, and abundance and distribution of organisms. Therefore, the water column profiles of temperature were measured throughout the reservoir during the ice-free periods from 2011 to 2015. Considerable effort was expended to accurately plot spatial patterns in temperature in 2015 (e.g., kriging and other interpolation methods). Thermal stratification started in the reservoir at late May after spring turnover. Fall turnover was completed by late October. The greatest temperature gradient was approximately 1.01°C/cm. The period of greatest stratification occurred in July of 2015. Future research will compare the thermal stratification patterns between high flow years (2011—2013) with low flow years (2014—2015).

Hippocampal Neurodegeneration: Role of Adenosine A1R stimulation and Microglia Activation
Olivia Friesen; Francisco Cayabyab (Supervisor)
Physiology

After central nervous system (CNS) damage, microglia become activated and migrate to the damaged site to aid in neuron repair. This does not always occur, however, as microglia can become hyper-activated and release excessive inflammatory factors, leading to inflammation and neuronal death. Little is known about what initiates microglial hyper-activation (dubbed microgliosis). After showing that prolonged adenosine A1 receptor (A1R) stimulation contributes to neuronal death following stroke (Chen et. al, 2014), we hypothesized that microglial A1R stimulation elicits microgliosis. We tested this hypothesis with an in vivo, A1Rmediated stroke-like condition where we injected rats intraperitoneally with synthetic A1R agonist, N6-cyclopentyladenosine (CPA), to simulate the post-stroke adenosine flood. To counteract the action of CPA, we used treatments of CPA plus A1R antagonist, DPCPX, or CPA plus microglia inhibitor, minocycline. Confocal imaging of hippocampal slices revealed substantial neuronal loss in CPA-treated rats compared with control, while co-treatments with either DPCPX or minocycline prevented neuronal loss. Imaging also revealed a significant upregulation of microglia and microglial A1R in hippocampal slices of CPA-treated rats as compared to the other treatment groups. These results implicate A1R stimulation in the initiation of microgliosis, and subsequent neuronal death. Testing with a Y-maze spatial learning paradigm revealed cognitive deficits in CPA-treated rats, which was abrogated by DPCPX or minocycline. Together, these results suggest that an A1R-mediated microglia activation contributes to hippocampal neuronal loss and spatial memory deficits, and highlight that novel treatments aimed at reducing microglia hyper-activation can be effective adjuncts to prevent further brain damage after stroke.

Early Life Stage Toxicity of Selenium in Zebrafish (Danio rerio) Embryos
Ella P. Fulmes; David Janz (Supervisor)
Toxicology Centre

Zebrafish (Danio rerio) are a model organism in research, and previous studies have reported effects of selenomethionine (SeMet) on their development using methods such as maternal transfer and embryo microinjection. The objectives of this study were to determine if early life stage toxicities become present when recently fertilized zebrafish eggs are directly exposed to increasing concentrations of SeMet (5, 25, or 125 ug/L), and establish a dose-response relationship with this data. Adult zebrafish were bred, and eggs were collected soon after fertilization. 50 eggs were placed in petri dishes containing increasing SeMet concentrations or an egg water control for 6 days post-fertilization. Hatchability and mortality data were collected, and deformity analysis was also performed. Direct exposure to increasing doses of SeMet resulted in reduced hatchability of zebrafish eggs and increased mortality of embryos. Future research will focus on the uptake potential of SeMet and it's concentration within larvae.

Pilot Studies for Designing Off-Loading Knee Braces
Timothy Gadzella; Allan Dolovich & JD Johnston (Supervisors)
Engineering

Disease and injury of the knee are the leading causes of disability around the world. A new type of treatment which involves off-loading the knee offers potential for treating knee injuries and debilitating diseases such as osteoarthritis. This treatment adjusts the knee to be in tension such that when walking (where a compressive load is applied to the knee), the joint load is zero. The current treatment though requires surgical intervention, exposing the patient to the risks of infection and further injury. We desire to off-load the knee with an external brace and eliminate or

reduce these risks. However, current external braces do not support load—they redirect it (e.g., braces which apply laterally directed loads to correct bow-leggedness). The purpose of the proposed research is to study the ability of braces to support loads. Two studies are proposed: one to study the upper (thigh) segment of a knee brace (with load directed superiorly), and another to study the lower (calve) segment of the brace (with load directed inferiorly). Both studies will be conducted using simple mechanisms to apply load to custom-fabricated brace segments using volunteer participants. Pressure sensors will be used to analyze the response of the body to the applied load. At each load increment, the participants will be asked to rate their pain and discomfort on discrete, 11-point scales from zero to ten. This pilot study will provide a basis for the design of next-generation knee braces for treating osteoarthritis and other knee instabilities.

CLIC3 knockdown represses tumorigenic properties in CREB3L1-deficient breast cancer cells

Farah Goubran; Deborah Anderson (Supervisor)
Medicine

Breast cancer is the most prevalent cancer in Canada affecting 1 in 9 women. Metastatic breast cancers are the most aggressive form of this disease with a 22% 5-year survival rate after diagnosis. Our laboratory recently described a stress-activated transcription factor, called CREB3L1 (cAMP-responsive element-binding protein 3-like protein), which acts as a metastasis suppressor in breast cancer. A loss of CREB3L1, which is observed in 53% of high-grade metastatic human breast tumors, allows for the expression of various cancer progression genes. CLIC3 (chloride intracellular channel 3) is one of the cancer progression genes that have been identified and is upregulated in CREB3L1-deficient cells. Our aim was to identify the effect of CLIC3 knockdown on tumorigenic and migratory properties in CREB3L1-deficient human breast cancer cell lines. To knockdown expression of the endogenous CLIC3 protein, an shRNA directed at CLIC3 was transduced via a lentiviral system into HCC1806 and T47D paired metastatic breast cancer cell lines (± HA-CREB3L1), as well as a non-tumorigenic breast cell line (MCF10A). Real time PCR and Western blots were performed to verify CLIC3 knockdown at both the mRNA and protein level. MTT assay results demonstrated that knockdown of CLIC3 does not affect cell proliferation in the control cell line. Preliminary results characterizing the HCC1806 CLIC3 knockdowns suggest that the loss of CLIC3 expression has no effect on cell proliferation but represses cell migration and anchorage-independent growth. In conclusion, this experiment provides evidence that CLIC3 is an important mediator of breast cancer progression.

Inhibitory mechanisms of human LINE1 retrotransposition by cytidine deaminase APOBEC3s

Mariam Goubran; Linda Chelico (Supervisor)
Microbiology & Immunology

Retrotransposons are genetic elements that can replicate themselves through an RNA intermediate and insert their genetic information in the host cell's genome. Retroelement insertions are involved in the development of some human diseases so their excessive replication needs to be suppressed. The APOBEC3 (A3) enzyme family of cytidine deaminases was found to block the replication of LINE-1 (L1), the most abundant retrotransposon in the human genome, but whether this inhibition involves deamination remains controversial. During L1 integration, A3s act on transiently exposed single-stranded cDNA to produce uracils which are excised by uracil DNA glycosylase (UDG) thus generating abasic sites leading to cDNA degradation. We hypothesized that the addition of uracil DNA glycosylase inhibitor (UGI) would inhibit UDG, preventing the degradation of L1 cDNA, thus allowing the recovery of the A3s-catalyzed deamination signature. Using a cell-based assay, we confirmed that A3A effectively inhibits L1 retrotransposition, whereas A3G doesn’t seem to restrict L1 and A3H has a moderate effect. Addition of UGI alleviated A3A-mediated inhibition of L1 by 2-fold but UGI did not significantly mitigate L1 restrictions by A3G and A3H. We further analyzed the editing potencies of A3 enzymes on a 588-bp transposed neo gene. In the presence of UGI, a 5-fold increase in G to A mutation frequency was observed for A3A but no significant changes were observed for A3G and A3H. Altogether, these findings suggest that A3A restriction of L1 is deamination-dependent, whereas A3H likely uses a less effective mechanism that does not involve deamination, and A3G is ineffective.

Digital Document Navigation Using Space-Filling Thumbnails

Nickolas Gough; Carl Gutwin (Supervisor)
Computer Science

The standard method of navigation through digital documents is scrolling, whether that be through use of the mouse-wheel, scrollbar, or scrolling through a pane of thumbnails, all of which are limited in performance. A basic PDF viewer that imitated the standard methods of scrolling was implemented and the SFT interface, a window in which all the pages of the document are laid out as thumbnails, was added for comparison. Pariticipants used the viewer for a period of a few weeks and completed search tasks for documents of four different lengths under three conditions. One condition, "Thumbnails," limited navigation to only the SFT interface; another, "Scrolling," limited the navigation to only scrolling the document; and the last condition, "Scrolling + Thumbnails," limited navigation to scrolling the document or a pane of thumbnails. Current feedback suggests the SFT interface is preferred when the length of the document is approximately 100 pages or less. SFT is also preferred when the document contains many images that can act as visual landmarks for navigation. Feedback also suggests that searching for pages is faster using the SFT interface than scrolling when the document size is small because each page is laid out within a single window all seen by the user. Scrolling is limited in its ability to efficiently navigate digital documents and generally does not allow for visual images within documents to act as visual landmarks.

Acute Cardiac Toxicity of Benzo(a)pyrene

Logan Hahn; Lynn Weber (Supervisor)
Veterinary Biomedical Sciences

Benzo(a)pyrene (BaP), a polycyclic aromatic hydrocarbon (PAH), is a ubiquitous environmental contaminant that is strongly correlated with various cancers and developmental defects in numerous fish species. BaP is found in coal tar and produced primarily from anthropogenic sources such as automobile exhaust fumes, although it is produced from natural activities like forest fires. While the chronic health effects of this contaminant are well documented, acute toxicity is less substantiated. We hypothesized that aqueous exposure to BaP would cause acute cardiac effects in fish. In order to investigate this hypothesis, adult zebrafish (Danio rerio) were aqueously exposed to BaP at a concentration of 162 μg/L in glass beakers. The zebrafish were exposed to the PAH for 48 hours with a renewal of beaker water and contaminant occurring at 24 hours. Directly following the exposure, the zebrafish were placed in clean water for 72 hours with daily water changes conducted to keep ammonia levels in the beaker suitable. Subsequent ultrasounds (n=10 for BaP treatment, n=11 for control treatment) were performed to compare cardiac performance of BaP-exposed fish to dimethylsulfoxide (DMSO) controls. Ultrasound recordings were analyzed to obtain heart rate, ejection fraction, stroke volume and cardiac output. ANOVA tests revealed that there was no statistical difference between treatment groups in any of the aforementioned cardiac parameters. These findings suggest that BaP introduced at this concentration and exposure route may not induce acute cardiac toxicity in zebrafish.

The History of the BC Hospital Association Convention, 1918-1931

Megan Hewson; Helen Vandenberg (Supervisor)
Nursing

In 1918, hospital administrators and workers across British Columbia gathered in Vancouver for the first annual British Columbia Hospitals' Association (BCHA) conference. The primary goal of this newly formed association was to serve as a means of intercommunication and co-operation between hospitals across BC. In this study, we examine over a decade of conference proceedings of the BCHA (1918-1931) to understand the role of this organization in the operation and development of hospitals after World War I, until the beginning of the Great Depression. During the first half of the twentieth century, hospital care in Canada transformed and began to replace care that had previously been provided in the home. During the 1920s, hospital administrators envisioned a new era of hospital development, one characterized by a public perspective of hospitals as fundamental to the health and well-being of communities. In this poster, we argue that the BCHA played a central role in promoting hospital standardization, including the ideals of hospital efficiency, and consistency of equipment and procedures. The BCHA was a strong supporter of enhanced and uniform nursing education to improve hospital care. Most importantly, the BCHA was one of the first organizations in Western Canada to consistently support the movement towards a more stable and reliable system of public hospital funding. Members of the

BCHA envisioned a bright future for BC hospitals, but they would also need to significantly boost public support for their vision if they were to achieve these goals.

Salmonella Population Divergence as an Essential Part of the Transmission Process

Dakoda J. Herman; Aaron White (Supervisor)
Medicine

The main purpose of this study was to determine if *Salmonella* Typhimurium divergence into virulent, single cells and resistant, multicellular forms can be observed during passage through the gastrointestinal tract of the host. The formation of specialized cell types may ensure efficient transmission of *Salmonella* prior to the pathogen's exit into the environment, with single cells being able to infect new hosts immediately and multicellular "biofilms" being able to survive long-term until an opportunity for infection arises. To investigate divergence inside the host, we used a mouse infection model to mimic human gastroenteritis and tracked the expression of key *Salmonella* virulence and environmental persistence genes during infection. Mice were infected with a green fluorescent protein reporter strain of *Salmonella* Typhimurium controlled by the promoter for a well-characterized protein component of biofilms. Western blots of mouse gastrointestinal tract were performed to detect SipC, a protein essential to *Salmonella* virulence and pathogenesis, and CsgD, the central regulator of *Salmonella* biofilm formation. The results of this study demonstrate that the expression of essential biofilm and virulence genes can be detected in the gastrointestinal tract. We provide evidence in support of our hypothesis that *Salmonella* Typhimurium responds to environmental cues in the mammalian intestine to stimulate the formation of specialized cell types. The discovery of Salmonella differentiation within the host environment has implications for the study of *Salmonella* transmission and vaccine development, with the ultimate goal to reduce the prevalence of *Salmonella* infections worldwide.

Using Buttons for Controlling Input Modes in Software for Hand-held Touchscreen Devices

Carl Hofmeister; Carl Gutwin (Supervisor)
Computer Science

Due to the limited screen size of smart phones, software such as drawing applications can be hindered by menu systems that waste space. We attempt to solve this problem by using physical buttons attached to the side of the phone to change modes of an application depending on the combination of buttons pressed. This allows the fingers on the hand holding the phone to be on the buttons at all times for rapid selection of modes, and removes the need for users to navigate through menus. We wanted to see how well users could memorize the combinations by testing how quickly they could execute the correct combination, and how many mistakes they made in the process. To test this, we ran participants through tasks that displayed a command on the screen and participants would then press the button combination corresponding to that command. We based these tasks around software for drawing, text manipulation, and application launchers. The drawing application maps the buttons to colors, the text manipulation application maps the buttons to text styles such as bold, italic, etc, and the application launcher maps the buttons to names of phone applications such as email, calendar, contacts, etc. We are just begining to run participants through the study now, but pilot results show that users can learn the button combinations quite quickly.

Lysine-Functionalized Nanodiamonds as Gene Delivery Vectors in Melanoma Cells

QingYun (Nancy) Hua; Ildiko Badea (Supervisor)
Pharmacy & Nutrition

This study investigates the potential for lysine-functionalized nanodiamonds (lys-NDs) to serve as nanocarriers for melanoma gene therapy. Alwani et al demonstrated that lys-NDs are biocompatible, the lysine on the surface were capable of binding genetic materials and promoting diamoplex (genetic material + lys-NDs) internalization in a model cell system. However, no studies tested the gene delivery capabilities of lys-ND in cellular models of melanoma. Thus, this study explores Lys-NDs' usefulness in melanoma gene therapy. Biocompatibility of the Lys-ND with melanoma cell line RPMI 7951 was evaluated by MTT assay. Side scattering (SSC) vs forward scattering (FSC) analyses in flow cytometry were performed to visualize the changes in internal complexity of cells as a result of Lys-ND uptake. By creating diamoplex with siRNAs conjugated with FITC fluorescent labels, lys-ND's ability to facilitate siRNA uptake was assessed using flow cytometry. Lastly, the mechanisms of diamoplex uptake were investigated using specific endocytosis inhibitors by flow cytometry. The Lys-NDs showed minimal toxicity in the model melanoma cell line, even at

concentrations exceeding greatly the therapeutic range. The amount of lys-ND uptake by RPMI was positively correlated with lys-ND concentrations. Flow cytometry showed 65% and 90% upward shift in side scattering (measure of internal complexity) for cells treated with 100µg/ml and 250µg/ml lys-ND, respectively, which were accompanied by minimal variations in forward scattering (measure of cell size). This suggested successful lys-ND internalization by RPMI cells without excessive cell death. A positive shift in measured fluorescence after treatment with diamoplex confirmed that lys-ND facilitated cellular uptake of genetic materials.

Synthesis of b-Glucocerebrosidase Inhibitors for applications in diagnosing Parkinson's Disease and Gaucher's Disease

Zachary Huschi; David Palmer (Supervisor)
Chemistry

β-glucocerebrosidase (GCase) is a glycosidase enzyme responsible for the metabolism and breakdown of glucosylceramide. While homozygous mutations in the gene encoding the GCase enzyme have been known to cause the lysosomal storage disorder known as Gauchers disease, it has been discovered that a deficiency in GCase could be a potential marker of Parkinson's disease. Previously, the Phenix group has shown that N-alkylated aziridine cyclitols, with the conduritol b geometry, are effective and irreversible inhibitors of GCase. Expanding on this work, we have created additional inhibitors, focusing on inhibitors that are amenable to radiolabelling with Fluorine-18. Additionally, we have explored the use of various protection groups that will allow the desired transformations to take place within the time frame allowed when working with radioactive fluorine. It is our hope to test these inhibitors in live cells in the future, and proceed to animal models with the most promising inhibitors found in order to see if we can observe the GCase concentrations in live subjects.

Working Relationships: Translating Knowledge for Chronic Care Management in First Nation Communities

Shelby Lang & Sydney Lerat; Lynn Jansen (Supervisor)
Nursing

A pilot project was conducted with a rural First Nations Health organization to review the applicability of a theoretical model of Social Interaction Knowledge Translation (KT) '*Translating Knowledge Through Relating'* (Jansen et al., 2013). The model was reviewed to inform KT for traditional and western approaches for community-based health promotion and chronic care management. The Model suggests that KT is facilitated by social interactions within working relationships amongst interdisciplinary teams, individuals, families and communities. Five key relational themes of the model were: Living with the Problem, Developing Comfort, Nurturing Mutuality, Building Confidence, and Managing In-Home Care. These themes were interlinked with five additional KT themes: Building Experiential Knowledge, Easing into a Working Relationship, Facilitating Knowledge Exchange, Fine Tuning Knowledge, and Putting it all Together. The Principal Investigator and undergraduate research assistant student dialogued with employees of the First Nations Health organization to review the model and it's applicability to KT with First Nations individuals, families and communities. Coding techniques were used to analyze the data obtained. The four key findings were: provide consistent approaches to develop relationships; maintain continuity of relationships, allocate adequate time for developing relationships; and attend to the traditional knowledge of individuals, family and communities to inform KT or 'learning approaches with others' for health promotion and chronic care management. The project findings may assist First Nations organizations and interdisciplinary healthcare teams with practical approaches to primary care initiatives. Further research is planned to implement KT strategies within a First Nations healthcare setting.

Velocity of SuperDARN HF Echoes and ExB Plasma Drift

Donovan Lavoie; Sasha Koustov (Supervisor)
Physics & Engineering Physics

The University of Saskatchewan has been involved in the Super Dual Auroral Radar Network (SuperDARN) project, consisting of high frequency (HF) radars continuously receiving return echoes from the high-latitude ionosphere. Doppler velocity information from these echoes is used to produce global plasma flow maps, which help to identify and forecast space weather that can affect ground and space infrastructure. The radars assume that the echoes' Doppler velocity is the bulk plasma's electric and magnetic (ExB) drift in the line-of-sight direction. Limited assessments of this

assumption were done and they showed occasional violations, but progress has been impeded by the lack of independent ExB drift data. For several years, a powerful, US led, incoherent scatter radar (Resolute Incoherent Scatter Radar, RISR) has been operating at Resolute Bay (around 75 deg geographic latitude). In this study we consider velocity data from the Rankin Inlet and Inuvik SuperDARN radars and compare it with RISR measured ExB drift vectors. We show statistically that the radars agree reasonably most of the time. We identify periods when the SuperDARN radars underestimate the ExB drift by about 10%, in line with previously reported results (for observations over Greenland and Northern Europe), as well as periods where they overestimate the ExB drift by about 20%. This unreported effect suggests that SuperDARN radar beams may occasionally experience significant lateral deviation from their assumed directions. We support this conclusion by analysing one such anomalous event in detail. The implications of this overestimation effect on SuperDARN radar operation are discussed.

Kinome Array Analysis: Location Bias and Target Calibration

Conor Lazarou; Tony Kusalik (Supervisor)
Computer Science

Kinome microarrays, a tool for high---throughput measurement of protein kinase activity, are increasingly becoming a popular method of assessing intra---cellular communication. Kinome microarrays consist of many short polypeptide phosphorylation targets affixed to a slide, which, after exposure to cell lysate and adenosine triphosphate, are dyed and measured for evidence of phosphorylation. Because they are a relatively new technology, the supporting technical infrastructure does not yet have established standards and many of the tools biochemists have to rely on are repurposed, ill---suited DNA microarray procedures. DNA microarrays have probes numbering in the hundreds of thousands and target several housekeeping genes with known expression levels for calibration purposes, while kinome microarrays consist of only a few thousand peptides and do not have targets with known phosphorylation levels. These factors confound intra and inter---array comparisons. In the data---rich DNA microarrays, omitting low--- quality data can solve issues such as location bias, whereas biased data must be salvaged in the relatively data---poor kinome microarrays. With these shortcomings in mind, we assessed the extent to which background scaling can reduce intensity variance and the effects of location bias, and the extent to which pre---phosphorylated calibration probes can be used to normalize intensity. We found that background scaling reduces variance and mitigates location bias, but is less effective than the background subtraction method commonly employed in DNA microarrays. We also found that calibration probes are highly effective at extracting biologically meaningful data.

Shear Cylindrical Waves in the Framework of Finite Fiber-reinfored Hyper- and Viscoelasticity: Applications to Blood Vessel Models

Caylin M. Lee; Alexei Cheviakov (Supervisor)
Mathematics & Statistics

An adequate description of elastic fiber-reinforced materials plays an important role in the understanding of the properties of man-made materials and biological tissues, such as human skin and blood vessels, etc. Such a description is also required to design new materials. The mathematical frame-work of incompressible hyper- and viscoelasticity is one of the common ways to approach such modelling tasks. The general three-dimensional partial differential equations of motion of elastic solids are nonlinear wave equations involving four independent variables (three in space and one in time). These equations are usually too complicated to be solved with analytical methods, and are typically studied numerically in different settings. In order to better understand the physical properties revealed by the mathematical models, we consider reduced forms of the equations, describing specific motions and wave types of interest. As a special reduction of interest, we derive and study equations for the radial shear waves describing finite z-displacements of a cylindrically symmetric solid reinforced with two sets of helical fibers. This provides a model of the media and adventitia layers of an artery in its interaction with blood flow. For the Mooney-Rivlin hyperelastic model with standard quadratic fiber reinforcement term in the strain energy function, we show that the equations of motion for the shear waves are linear. For the viscoelasticity setting, an additional damping nonlinear term appears. In both cases, we set up and solve Dirichlet and Neumann boundary value problems describing radially varying vertical oscillations of the arterial walls.

Engineering allosteric control in N-acetylneuraminate lyase by synthesis of a chimeric protein

Claire Liu; David Palmer (Supervisor)
Chemistry

Allosteric control of protein function plays a pivotal role in conferring tight regulation to key metabolic pathways in living organisms. In recent years, with increasing availability of molecular details regarding enzyme structure and regulation, the allosteric site has been an area of great interest to researchers as a potential drug target and site for mutagenesis. This project demonstrates a method of introducing allosteric regulation into a previously nonallosteric enzyme, thus engineering new control mechanisms to the reaction pathway in question. Using site directed mutagenesis, a N-acetylneuraminate lyase (NAL) – Dihydrodipicolinate synthase (DHDPS) chimeric enzyme was synthesized by substituting the gene sequence coding for the allosteric region of DHDPS into the analogous region of the structurally similar NAL, thus allowing regulation of NAL by DHDPS allostery. Preliminary kinetics assays performed on the chimera show no activity, suggesting potential protein misfolding. In order to elucidate the secondary structure of the chimera, circular dichroism (CD) is currently being performed to compare the chimera to wildtype structure. This will provide a reference point of how to further optimize stability in the chimera. Once refined, this procedure would have numerous applications in the context of bioengineering.

Variation in telia production of Puccinia striiformis f. sp. tritici in western Canada

Kun Lou; H. Randy Kutcher (Supervisor)
Agriculture & Bioresources

Stripe rust of wheat, caused by Puccinia striiformis f. sp. tritici (Pst), is a well-known fungal disease that occurs world-wide. It causes yield and quality reduction every year when conditions are favourable. This pathogen is a biotrophic, macrocyclic, heteroecious fungus. It primarily attacks wheat to reproduce asexually, while also parasitizing susceptible Berberis spp. as an alternate host to complete its sexual cycle. On wheat, Pst produces urediospores and teliospores as part of the life cycle. Basidiospores are produced after germination of the teliospores, which infect Berberis spp. to produce pycniospores and aeciospores to complete sexual phase. During the evolutionary process some sex-related structures in the sexually derived clonal population are expected to degenerate due to lack of fitness. Telia production, amount and size, is a sex-related trait in Pst and ability of some recombinant Pst populations to produce more telia per unit leaf area over time was reported. Therefore, the ability to produce telia becomes an indication of sexually recombinant populations, i.e. low telia production is expected in clonal Pst populations, whereas high telia production is a phenotypic trait in sexual populations. A study of Pst from western Canada reported signs of recombination in the population. Thus, the objective of this study was to assess a number of Pst isolates from western Canada for variability in telia production. Preliminary results indicated variation in telia production among seven isolates. Our goal is to evaluate 25 isolates for telia production.

Alleviation of Uncertainty in Wind Power Generation through a Novel Prediction Model

Le-Ping Mao; CY Chung (Supervisor)
Engineering

Wind energy is the most developed and the fastest growing form of renewable energy. This source of energy has an immense potential to reduce the dependence on traditional resources such as oil, gas and coal, without causing any harmful effects on the environment. SaskPower, our collaborator and the major electricity provider in Saskatchewan, is committed to reducing carbon emissions for a more environmentally sustainable future by expansions of wind farms in the province. With the ever growing increase in wind power integration, more precise wind power forecasting techniques are needed to alleviate the unprecedented challenges resulting from the uncertainty in wind power generation. Therefore, a novel wind power prediction model is proposed. This research first presents an effective way to obtain the required historical data of wind power by using image processing techniques to convert graphical data from online databases into accurate discrete data points, which are suitably utilized in the forecasting simulation. After the data acquisition process, a prediction model based on autoregressive moving average modelling (ARMA) is proposed to forecast wind power. ARMA is a linear model and cannot perform well on wind power time series (TS) which is non-linear and non-stationary. For this reason, the wavelet decomposition (WD) has been employed as a preprocessing stage for prediction. The outcome

of this research will help not only tackle the obstacle of wind power uncertainty, but also accomplish SaskPower's target to achieve a 50 percent renewable electricity generation in Saskatchewan by 2030.

Defining Empowerment and Supporting Engagement: Saskatchewan Patients and the eHealth Citizen Health Information Portal

Juan Martinez; Tracie Risling (Supervisor)
Nursing

Despite increasing engagement in the pursuit and promotion of patient centered care, questions remain about how to accomplish the meaningful systematic changes many individuals and healthcare organizations are working to achieve. Recently, some Saskatchewan residents had an opportunity to engage with their healthcare data through an eHealth Saskatchewan pilot project, the Citizen Health Information Portal or CHIP. The vision of eHealth Saskatchewan, Empowering Patients, Enabling Care, delivers a powerful message to provincial residents about their importance in the delivery of eHealth solutions. A strong commitment to patient empowerment is a crucial foundation in leading these kinds of transformations, however the concept of patient empowerment within the eHealth setting requires further explanation. Although 'power' in healthcare has historically been thought of as being wielded by healthcare providers, by better understanding how Saskatchewan residents currently define and reclaim this key element in their healthcare journeys, there is opportunity to further tailor eHealth solutions to maximize engagement and positive health outcomes. This poster features results from a scoping review on eHealth solutions and patient empowerment. Results from the scoping review were employed as a data source in phase one of a sequential exploratory mixed methods study on patient empowerment and use of the CHIP in Saskatchewan. The review results were integrated with qualitative interview data from study participants and will support the development of a quantitative survey tool to further study empowerment and the use of eHealth technologies.

Building Northern Capacity through Aboriginal Entrepreneurship

Brittany Michael & Koleban Paziuk; Lee Swanson (Supervisor)
Edwards School of Business

The *Building Northern Capacity through Aboriginal Entrepreneurship: A Canadian and Scandinavian Comparative Study* research project commenced in 2014 when University of Saskatchewan researchers from the Edwards School of Business and the International Centre for Northern Governance and Development began studying northern Saskatchewan's entrepreneurial ecosystem. The initial project goal was to explore the ways entrepreneurship contributed to social and economic capacity building in small northern Saskatchewan communities, and how this related to local concepts of 'the good life', well-being and prosperity. The project used a *community-based participatory action research* approach, which provided community members with the opportunity to provide meaningful input into the research process. This approach, where research is done *with* and *for* communities, allows communities to benefit directly from the research outcomes. From May to September, 2016, two undergraduate research assistants used a qualitative analysis program called NVivo to code transcripts from Photovoice interviews and other primary data collected during an earlier project phase. They then used NVivo to organize the almost 9,000 data elements into themes to be further analyzed and categorized to provide answers to the project's research questions. The major emergent themes included how the traditional northern Saskatchewan economy blends with the modern economy; what community members want for their communities for the future; what opportunities exist there for economic development; and what barriers exist to hinder new business start-ups and existing business growth.

The contentious issue of palliative care delivery in the correctional setting: A case study using findings from a scoping review

Vivian Murungi; Lorraine Holtslander (Supervisor)
Nursing

Palliative care in corrections is a challenge in the provision of family-centered end-of-life care as more prisoners are dying while incarcerated. Achieving community palliative standards for end-of-life care in prison has proven to be a challenge for a multitude of reasons. Given the tensions that exist between custody and caring within prison settings and the realities of prison palliative care, it is important to contextualize how end-of-life care is incorporated into the prison

system. The aim of this hypothetical case study is to explore the practical and ethical dilemmas associated with the provision of palliative care in the correctional setting using a family-focused approach. Findings from a scoping review were used to develop the case study; the main themes derived from the findings were categorized into a model termed IRIS (Individual, Relational, Institutional, and Socio-cultural). The key themes included in the IRIS model will be used as the backbone for the case study. Implications from this study present the opportunity for reflection and discussion on the moral and ethical considerations that take place at the shifting interface of the health care system and the criminal justice system.

Response of the Cr isotope proxy to environmental changes 450 million years ago: ocean oxygenation recorded in carbonates

Matthew D. Nadeau; Chris Holmden (Supervisor)
Geological Sciences

Chromium offers a redox sensitive isotopic proxy with potential for tracing past oxygen levels in the oceans. This potential is explored in a pelagic succession of marine carbonate sediment deposited during the Hirnantian glaciation. Reduction of Cr(VI) causes light isotopes of Cr to preferentially partition into Cr(III). Because Cr(VI) is the thermodynamically favored species in oxygenated seawater, and Cr(III) is relatively insoluble under the same conditions, decreased removal of Cr(III) during time of increased ocean oxidation should cause negative shifts in seawater δ^{53}Cr values. Seawater δ^{53}Cr values can be recorded due to the ability of chromite to be incorporated into the crystal structure of carbonate during precipitation. Results show that there is a negative shift in δ^{53}Cr values between 0.4‰ and 1.2‰ during the time interval of increased ocean oxidation relative to times of ocean anoxia. The data shows that the excursion event for δ^{53}Cr lasts longer then for TON and δ^{15}N. This can be attributed to a lag affect associated with the re-equilibration of Cr in the oceans. Cr has a much longer residence time then Nitrogen, 4000-90000 years compared to 2000-3000 years respectively. Therefore it takes a greater amount of time to reach equilibrium. This study provides a proof of concept that Cr-isotopic compositions of carbonate rocks can provide important insight and constraints to ocean oxidation states.

Contribution of oxidative stress to cortical demyelination in multiple sclerosis

Laura Neuburger; Helen Nichol (Supervisor)
Medicine

Multiple sclerosis (MS) is a chronic inflammatory demyelinating disease affecting the central nervous system (CNS). Historically, MS has been considered a disease primarily affecting CNS white matter. However, while white matter lesions have been able to explain part of the clinical deficits seen in MS patients, cognitive impairment and seizures are better explained by pathology affecting the grey matter. This study investigates the role of oxidative stress in the pathogenesis of cortical demyelinating lesions. We analyzed autopsy tissue from 12 MS patients (11 with chronic MS; 1 with acute MS) and 4 controls. We identified cortical lesions in 10 MS cases (9 with chronic MS; 1 with acute MS) using immunohistochemistry for myelin proteolipid protein. We assessed the state of oligodendrocytes (immature vs. mature) with immunohistochemistry for myelin associated glycoprotein (MAG), 2',3'-cyclic nucleotide 3'-phosphodiesterase (CNPase), and Nogo. Oxidative/nitrosative stress was assessed with immunohistochemistry for 8-Hydroxyguanosine (8-Hdg), a DNA oxidation marker, and inducible nitric oxide synthase (iNOS/NOS II), a marker for reactive nitrogen species generation, as well as with Fourier transformed infrared imaging (FTIR). iNOS was expressed in oligodendrocytes in the demyelinated cortex of all 9 chronic MS cases, but not in the acute case or normal cortex. DNA damage was not present, but FTIR showed accumulation of aggregated protein and oxidized lipids in cortical lesions. Oligodendrocytes were immunonegative for MAG, CNPase, and Nogo in the demyelinated and normal cortex, consistent with them being in a mature state. Oxidative/nitrosative stress plays a major role in the pathogenesis of chronic cortical demyelination.

Retrieval-Induced Forgetting by Verification and Production of Arithmetic Facts

Josh Neudorf; Jamie Campbell (Supervisor)
Psychology

Whether arithmetic verification (8 + 9 = 16 true or false?) requires memory fact retrieval, or is based on the familiarity of the equation, has not been clearly established. The Retrieve-Compare Model proposes a two stage process: first retrieve the correct answer and then compare it with the presented answer. Alternatively, the Resonance Model emphasizes the role of familiarity in reaching a true or false answer decision, in which case no fact retrieval is needed.

Here we use retrieval-induced forgetting (RIF), a signature of retrieval use, as an index to determine whether memory retrieval is involved in arithmetic verification. Seventy-two adults received blocks of multiplication practice either in a production format (2 × 5 = ?) or in a verification format (2 × 5 = 15 true or false?) and then were tested on corresponding addition problems (2 + 5 = ?) and control problems. The results showed RIF (i.e., slower answer production for addition problems whose multiplication counterparts had been practiced) in both the verification practice and the production practice groups. Given that RIF occurs as a consequence of memory fact retrieval, the current results support the Retrieve-Compare model of arithmetic verification. However, the RIF effect was more robust for production than for verification. This difference in RIF following production and verification practice suggests that participants used a mixture of fact retrieval and familiarity-based recognition to solve verification equations.

Properties of High pressure-high temperature Jadeite by Quantum Molecular Dynamics Simulations

Hoang Anh Tu (Lavie) Nguyen; John S. Tse (Supervisor)
Physics & Engineering Physics

Interest in silicate melts/glasses is considerable due to their diverse technological applications and their widespread occurrences in Nature where they play important roles in the evolution of Earth and other planets. Sodium aluminum silicate melts such as those of the jadeite ($NaAlSi_2O_6$) composition are particularly important in understanding the recycling of subducted oceanic crust into Earth's mantle. Previous studies of $NaAlSi_2O_6$ melts have reported the anomalous behaviour of pressure-dependent viscosity relative to common silicate melts. However, the origin of this anomalous behavior remains uncertain. Using First-Principles Molecular Dynamics calculations, we have investigated the structures and viscosities of the jadeite melts under different temperature and pressure conditions appropriate to the Earth's mantle. Simulations were performed at temperatures between 300K to 3000K and pressure ~10 GPa to ~31 GPa. Our calculations show that the anomalous behaviour of viscosity is related to the change of the Al-O coordination numbers as a function of temperature and pressure. In particular, the Al-O coordination numbers increase from 4 to a mixture of 5 and 6 over the pressure range from 10 GPa to 31 GPa.

Anisotropic Gold Nanoparticles: Electrodeposition and Characterization

Theo I. Olumorin; Ian Burgess (Supervisor)
Chemistry

Research on gold (Au) nanoparticles has shown various unique properties that can be harnessed for practical applications. The objective of this research is to electrochemically generate anisotropic Au nanoparticles, and highlight their use in potential sensor-based applications. Since the properties of these nanostructures are highly dependent on their shape and size, control of growth conditions is highly desirable. The approach employed here is to reduce gold (III) precursor ($KAuCl_4$) to an oxidation state of zero by applying a reductive potential to an optically transparent electrode. Structural differences are observed as a result of exploiting factors such as the potential applied, time of electrodeposition, and concentration of Au (III) as well as the stabilizing agent MOP (4-Methoxypyridine).

The influence of the miRNA suppression protein family, GW182/TRNC6A-C on miR-122-stimulated Hepatitis C Virus Replication

Michael Palmer; Joyce Wilson (Supervisor)
Microbiology & Immunology

Micro RNAs (miRNA) are small double stranded RNAs that supress protein expression from messenger RNA. miRNAs suppress mRNAs by associating with essential proteins Argonaute and TNRC6 and annealing to mRNAs having similar sequences. miR-122, a liver specific miRNA anneals to sequences in the Hepatitis C virus (HCV) RNA genome, but strangely enhances viral replication. Argonaute is essential for miR-122 promotion of HCV, but a role for GW182/TNRC6 is as yet unknown. To study the role of TNRC6 in HCV replication we have used an siRNA knockdown approach. First we assessed if knockdown of the three TNRC6 isoforms, A, B or C, individually or in combinations affected HCV replication. We hypothesized that if TNRC6 is required for miR-122 promotion of HCV replication then knockdown will inhibit HCV replication. Initial results indicate that TNRC6 has little effect on HCV replication, and knockdown might even increase HCV replication efficiency. Knockdown of isoform A of GW182 was confirmed via quantitative polymerase chain reaction (qPCR), however the other isoforms remain to be verified. To determine if the

influences of TNRC6 knockdown is linked with miR-122, we tested the impact of knockdown on miR-122-independent HCV replication. To assess miR-122-independent HCV replication we used HCV RNAs having mutations within the miR-122 binding sites that abolish miRNA binding. Knockdown of TNRC6 also had no effect on HCV replication. Thus, initial results indicate that TNRC6 is not required for HCV replication nor for miR-122 to promote HCV, and might even suppress HCV to a small extent.

Validation of a rodent multisensory integration and oddity task for use in neuroscience and psychiatric research
Madeline Parker; John Howland (Supervisor)
Physiology

A growing body of literature demonstrates that deficits in multisensory integration and preference for novelty are common cognitive comorbidities associated with psychiatric and neurological disorders. However, behavioral tasks used to assess rodent models of these illnesses generally do not evaluate both multisensory integration and preference for novelty directly. By requiring a rodent to use a combination of two senses to identify a novel object, the multisensory integration and oddity task (MSIOT) has the potential to test both types of cognition simultaneously. Therefore, we sought to validate the MSIOT for use in male Long Evans rats. The task is composed of six tests, which explicitly examine novelty seeking behavior across three sensory modalities: touch, vision, and olfaction. Subjects were presented with five objects simultaneously; using either a combination of two senses or a single sense, they were required to identify the odd object. Preference for said object was demonstrated regardless of the sensory modality, or combination of modalities, employed. Further, with the exception of the visual-tactile test, performance on the multisensory tests did not differ significantly when compared to the corresponding unisensory versions. Together, these data suggest that the MSIOT provides a valid assessment of multisensory integration and preference for novelty in male Long Evans.

Awkward Silences: Investigating Relational Closeness Using Auditory Analysis
Tushita Patel; Regan Mandryk (Supervisor)
Computer Science

In research, it can be hard to evaluate study participants' thought process and emotional experience during studies. It would be beneficial for researchers to have a tool that computationally extracts information such as vehemence, warmth, engagement and other features from recorded audio conversations of the participants. This research project is an attempt to obtain information about people's behavioural and emotional experience in one-to-one conversations using three types of metrics - signal metrics: using just the signals in a recorded audio, semantic metrics: transcribing the conversations and lexically calculating the effectiveness of the conversation, and emotional speech: using the auditory features such as pitch, modulation and pace to infer emotions of the speaker. To evaluate our approach, we ran the set of metrics on multiple conversations. We found strong correlations between our computationally derived metrics and participants' subjective evaluations of their conversations (e.g. Affections, Composure). Our findings suggest that this tool can prove to be quite valuable for research purposes that require determining the emotions of the study participants, especially in the area of social sciences. Moreover, the extraction of such information in this project can be significantly useful in areas such as speech pathology, quality management in customer service, and mental health.

A Systematic Study of the Physio-chemical Properties of β-cyclodextrin-divinyl sulfone Copolymers
Marissa Pirlot; Lee Wilson (Supervisor)
Chemistry

Various β-cyclodextrin (β-CD) copolymers were synthesized in aqueous media via crosslinking with divinyl sulfone (DVS) at various cross linking ratios. The resulting copolymers were characterized using diffuse reflectance infrared Fourier transform (DRIFT),13C nuclear magnetic resonance (NMR), thermogravimetric analysis (TGA) and phenophthalein (phth) dye to probe accessible β-CD sites. The aforementioned techniques reveal differences in the physico-chemical properties of the synthesized copolymers. This systematic study builds on previous work on exploring new physico-chemical properties forβ-CD-based polymers.

Prairie Habitat Garden: A diverse learning place

Sofia Quijada; Janet McVittie (Supervisor)
Education

The Prairie Habitat Garden is an educational site, teaching about Saskatchewan's First Peoples, native prairies, and providing a learning space for early learners. Thus, this home for diverse flora and fauna invites the public to engage in a unique experiential learning opportunity. It serves not only to teach but to demonstrate how various plant, bird, mammal, insect (and the occasional reptile) species coexist in uniquely important relationships with one another. The importance of sustainably preserving prairie habitat can be observed through a new lens of appreciation for the beauty, resilience and strength of the prairies. We commemorate Saskatchewan's First Peoples: through collaboration, we have ceremonially installed essential features that are representative of Indigenous worldviews and Indigenous knowledge in the garden. The Prairie Habitat Garden is located on the west side of the education building on the University of Saskatchewan Campus, which exists on Treaty 6 Territory. This poster will present features that have been designed into the garden, in our attempts to help people think about: What is nature? Are we a part of nature? Why is it important to build relationships with the natural world? In what ways can we learn from Indigenous worldviews? In what ways might early learners learn their roles in nature and about Indigenous world views through being in the garden?

Learning Communities and Peer Mentorship in the College of Education: The Value of Student Support Services in Professional Schools of Education

Serena Reimer; Dawn Wallin (Supervisor)
Education

Students enter post-secondary education with the ambition to pursue their passion, grow their knowledge, and in many cases, develop a sense of professionalism. Once students enter a professional College, School, or Faculty, they are met with a host of unique challenges that, without proper student supports, may result in attrition. Thus, professional schools are looking for better ways to keep their students engaged and committed to their programs through to completion. In this paper, I present some of the issues that students entering post-secondary professional schools face. Next, I examine student service supports such as learning communities, peer mentorship programs, and academic advising strategies employed for the purpose of increasing retention both here at the University of Saskatchewan and beyond. I discuss programs that other Universities within Canada's U15 have implemented to improve student support services and improve retention rates within their institutions, and I focus specifically on what Faculties and Colleges of Education in Canada have done to address student needs. Ending the paper, I will make a recommendation based on the discussed research, and suggest some next steps that the College of Education at the U of S might take in the future to mitigate student attrition as the College moves toward increased Direct Entry Admissions.

Energy-Minimizing Arrangements of Repelling Particles on the Sphere: Coulombic and Narrow Escape Potentials

Wesley Ridgway; Alexei Cheviakov (Supervisor)
Mathematics & Statistics

Multiple applications in material science, solid state physics, and cell biology involve ordered arrangements of particles on the surface of a sphere. Basic examples include trap arrangements in the Narrow Escape (NE) problem for a Brownian particle in biophysics, and the study of surface defects in spherical crystals. In many situations, the ordered arrangements minimize some pairwise potential. Local and global minimization presents a difficult computational problem. Some putative global minima for Coulombic, logarithmic and NE potentials have been found in the literature using numerical algorithms but less is known of local minima. The goal of our work is the study of spherical N-particle configurations corresponding to local and global energy minima for N particles confined to the unit sphere surface. The method is based on systematic construction of optimal configurations for N+1 particles from locally and globally optimal N-particle designs, and a new fast local optimization routine developed in C++. The preliminary computations ($N<115$) have already led to new results. For the Coulombic energy, the algorithm yielded the known globally optimal, as well as previously unknown locally optimal configurations. For the Narrow Escape potential, many new putative global and local minima were discovered. It remains the topic of future work to study this problem for more particles and for other important classes of pairwise potentials, and study and compare the topologies of the optimal arrangements.

Impact of Decreased Nutrient Availability on Human Genome Structure and Function

Miriam Robak; Christopher Eskiw (Supervisor)
Food & Bioproduct Sciences

It has long been noted that caloric restriction (decreased nutrient availability without causing malnutrition) leads to increased lifespan in model organisms such as yeast to non-human primates. While this is important and has implications for human longevity, how this impacts function (gene expression) and organization (folding) of our genetic material, our genome, is unclear. To understand the impact of decreased nutrient availability on genome function and organization, normal human 2DD and immortalized NB1 fibroblasts were grown in the absence of glucose and pyruvate, or the essential amino acids leucine and arginine. We observed a significant decrease in cell proliferation rates following nutrient depletion without evidence of cell death; a surprising observation considering the lack of essential building blocks. Additionally, we observed a reduction in the rates of DNA synthesis and decreased levels of the proliferative marker Ki67 in nutrient deprived cells. Furthermore, nutrient deprivation resulted in increased levels of the light chain 3 (LC3) II protein which demonstrates an increase in autophagy (self-eating), indicating a cellular response to nutrient deprivation by initiating cellular maintenance and repair cascades. Finally, we observed that nutrient deprivation caused chromosomes (individual segments of the genome) to re-organize within 2DD fibroblasts, indicating a shift in genome organization. Changes in genome organization are indicative of changes in genome function; therefore, nutrient deprivation is likely driving changes in genome organization as a mechanism to facilitate gene expression profiles promoting increased cellular health and longevity.

BatchSim: a general framework for parallel and probabilistic biomechanical simulations in ArtiSynth

Francois Roewer-Despres; Ian Stavness (Supervisor)
Computer Science

ArtiSynth, a 3D biomechanical modeling toolkit, provides a rich set of modeling and interactive simulation features [1]. Amongst others, upper airway and shoulder models have been successfully implemented in ArtiSynth [2, 3]. Physics-based simulations of these and other models have led to novel insight into the biomechanics of the human body, often by testing research hypotheses that are otherwise deemed too impractical or unethical to verify. However, generalizing these research findings prompts investigation beyond a few heuristic test cases, as larger datasets are required for generalizable results. While some researchers have written model-specific scripts to automate certain simulation tasks, this approach wastes time and is error-prone, as scripts must be rewritten for each new model. Further, such scripts are typically inefficient, performing simulations sequentially, not in parallel. This suggests a general tool for automating "batches" of simulations is needed. We present BatchSim, a robust, multipurpose framework for automating simulation tasks in ArtiSynth. BatchSim seamlessly integrates into existing model workflows, and offers general extensibility where model-specific simulation behaviour is required. In addition, the framework is specifically designed to reuse components and to perform simulations in parallel, resulting in faster data gathering as compared to the existing script-based system. Beyond automation, BatchSim's deterministic, probabilistic, and hybrid simulation methods facilitate uncertainty and sensitivity analyses, as well as Monte Carlo simulations. Already, ArtiSynth users have productively used BatchSim to run thousands of simulations on several models, resulting in vast quantities of new biomechanical simulation data on, for example, the upper airway and shoulder.

CO_2 Adsorption on PEI Impregnated Activated Carbon

Dylan Scheibelhoffer; Ajay Dalai (Supervisor)
Engineering

Biochar was used to produce steam activated carbon with the intention of creating micro-pores capable of adsorbing CO_2 from industrial flue gas. Steam to carbon ratios of 0.8, 1.2 and 1.6 were used during the activation process. BET analysis showed the total surface area to be 888 cm_3/g, 949 cm_3/g and 1106 cm_3/g for 0.8, 1.2 and 1.6 steam to carbon ratios, respectively. A similar pore size distribution was noted among the samples, consequently, biochar was activated at a steam to carbon ratio of 1.2 and temperatures of 620^0C and 770^0C to determine the effect of activation temperature on the CO_2 adsorption capacity of the samples. CO_2 adsorption capacity was measured in a fixed-bed reactor under adsorption conditions of 15% CO_2 in N_2 at 70^0C. The activated carbon samples were impregnated with PEI (Polyethylenimine) in order to increase the number of nitrogen containing functional groups on the surface of the carbon,

increasing their CO_2 adsorption potential at increased temperatures. Carbon activated at 770^0C had a 49% greater adsorption capacity than that of samples activated at 620^0C. Steam activation at higher temperatures produced a lower product yield with a higher micro-pore volume. Activated carbon with a steam to carbon ratio of 1.2 impregnated with 20 wt% PEI in water at 100 ^{0}C had the optimal CO_2 adsorption potential. The CO_2 adsorption capacity was increased by 51% compared with untreated activated carbon. Surface chemistry analysis and BET results will be discussed in further detail on the research poster.

Benthic Denitrification in Wascana Creek and the Qu'Appelle River

Beauregard Schlageter; Helen Baulch (Supervisor)
School of Environment & Sustainability

Denitrification is a biological process where nitrate is reduced under anaerobic conditions to produced nitrogen gas. This can be positive by removing excess nitrogen from an ecosystem. However, one of the intermediary products of denitrification is nitrous oxide (N2O) which is a potent greenhouse gas. The City of Regina's wastewater treatment plant is undergoing upgrades to enhance removal of many contaminants including nutrients such as nitrate. This research assessed the rate of denitrification at five sites along the Wascana Creek and Qu'Appelle River system including sites affected by the wastewater treatment plant effluent and two unaffected sites. The goal of this research was to better understand how nitrate concentration in the waste water treatment plant effluent affects in-situ denitrification and to determine how nitrous oxide concentrations relate to denitrification rates. Preliminary results show that denitrification rates are nitrate limited at all sites except the site immediately downstream of the wastewater treatment plant. Denitrification rates are directly proportional to the nitrate concentration in the stream, and dissolved nitrous oxide concentration is directly proportional to the rate of denitrification. Decreased nitrate concentrations in the waste water effluent may reduce nitrogen removal (through denitrification) in Wascana Creek and the Qu'Appelle River and therefore reduce nitrous oxide emissions from the system. Ongoing work will determine how denitrification rates and nitrous oxide emissions are affected by the completion of Regina's wastewater treatment plant upgrade.

Differential tolerance of low pH and lactic acid may contribute to determining distribution and abundance of Gardnerella vaginalis subgroups in the vaginal microbiome

Erica B. Seebach; Janet Hill (Supervisor)
Veterinary Microbiology

Gardnerella vaginalis is a hallmark species of bacterial vaginosis (BV), a common dysbiosis during which the vaginal microbiota shifts from a Lactobacillus-dominated community to an overgrowth of anaerobic bacteria. BV is associated with an increased risk of preterm birth and increased transmission of sexually transmitted infections. We have demonstrated that Gardnerella consists of four distinct subgroups that differ in their distribution among women and potentially in their ability to survive in the vaginal environment. Our goal was to assess the distribution of subgroups of Gardnerella in an existing collection of 558 microbiome profiles and to determine the ability of isolates from each subgroup to survive in conditions emulating a healthy vagina (100 mM lactic acid, pH < 5). 75/558 profiles contained > 50% Gardnerella and in 64/75 cases, at least 75% of the Gardnerella detected belonged to one subgroup. A selection of Gardnerella isolates from each subgroup were exposed to pH 3.9, 4.5, and 6.8 with and without lactic acid. Preliminary results of exposures suggest that all isolates survive in pH 4.5 and 6.8 (with no lactic acid) but not in pH 3.9 with 100 mM lactic acid, while differences in isolate viability in other conditions were observed. Differences within the microbiome profiles and isolate pH and lactic acid tolerance may indicate the subgroups are in competition with each other or could have different abilities to persist in the vaginal environment. Elucidation of factors influencing Gardnerella abundance will have implications for women's health, especially recurrent BV.

A Novel Platform for the Assessment of Working Memory Capacity in Rodents

Alex Senger; John Howland (Supervisor)
Physiology

Working memory (WM) is the cognitive capacity to hold multiple items in active attention for short-term use or manipulation. A primary feature of WM is that, unlike long-term memory, it has a very limited capacity, the size of which can be linked to intelligence, and can be affected by various psychiatric disorders. Although many measures of WM

capacity exist for human and non-human primate subjects, the only assessment of WM capacity in rats is the Odour Span Task (OST). In the typical version of OST, rats are trained to dig into a bowls of scented sand to receive food rewards. On each subsequent trial, an additional bowl with a unique scent is added to the table, and the rat must choose the novel scented bowl to continue receiving rewards, which becomes increasingly difficult as the number of odours to choose from accumulates over the trial, thus forming a test of olfactory WM capacity. Unfortunately for the experimenter, the task is extremely labour intensive, introduces human errors and data analysis is slow, causing certain types of experiments involving this task to be extremely impractical to carry out. We have constructed the Rat Olfactory Automated Span Task (ROAST) - an 18 odour automated version of the OST - to help manage the inefficiencies of the experiment. This version of the task uses an arduino microcontroller to present rats with a 2-choice decision between a novel odour and a previously presented sample odour (each delivered to one of two nose poke holes via compressed air), in exchange for a sucrose pellet dispensed inside the chamber.

Do gaze shifts disrupt object motion tracking?

Daria Taskina; Steven Prime (Supervisor)
Psychology

During typical rapid eye movements we make in our daily life, called saccades, our visual processing of the world is suppressed. For instance, previous studies show subjects are poor at detecting sudden jumps of a moving object occurring during saccades compared to when they maintain eye fixation. Here, we investigated the extent to which subjects can detect a displacement of a moving object during a saccade by varying the size of the displacement. We also investigate potential differences in displacement detection between orthogonal saccades versus parallel ones relative to the moving object. In our main experiment, the participants (N=5) made orthogonal and parallel saccades relative to the moving object. In some trials, the moving object could jump either forward or backward in its path during the saccade. Participants made a two-alternative forced choice about the direction of the displacement (forward or backward). Participants also performed a similar control experiment designed to distinguish two separate effects: direction congruency of the saccade and the moving object and the object displacement's proximity to the fovea. Preliminary results for the main experiment have shown a potential advantage for orthogonal versus parallel saccades in detecting object displacement. The results have also indicated a promising advantage for smaller rather than larger displacement. In the control experiment, participants performed better when the saccade direction was in the opposite direction of the moving object bringing the object closer to fovea and vice versa. We continue to test more participants to clarify our results and their significance.

Nonlinear Dynamics of Viscous fluids with Gas Bubbles

Ryan Thiessen; Alexei Cheviakov (Supervisor)
Mathematics & Statistics

The description of motion of viscous fluids containing gas bubbles is an integral part of modelling certain stages of industrial and geological processes, including magma flows in the volcanic magma chamber, conduit, and horizontal subaerial lava flow fields. We construct a mathematical model of a bubbly flow, based on the Naiver-Stokes equations of viscous fluid dynamics, the Rayleigh-Plesset equation describing the evolution of spherical bubbles, and the heat transfer between the bubble surface and liquid prescribed by Nakoryakov-Pokusaev equation with the Newton's law of cooling heat transfer term. A physical non-dimensionalization of the model is performed; the dimensionless parameter values are estimated for some geological flows. The presented model is Galilean-invariant. This allows for the use of the Su-Gardner algorithm to derive partial differential equation describing slow oscillations of gas bubble sizes in an appropriate moving frame of reference, in the long-wavelength and slow-time approximation. In different cases, we show that the bubble dynamics, in the asymptotic limit of small perturbations to an equilibrium flow, at different time and length scales, is described by one of the two famous equations of mathematical physics: the Korteweg-de Vries equation and the Burgers equation. Classes of typical solutions of these equations, and their physical meaning for the considered applications.

General Relativistic Radiative Transfer in Curved Space-Time: Application to Black Hole Emissions

Ashley M. Stock: Gordon Sarty (Supervisor)
Psychology

General relativity has been a successful theory in physics, as its predictions have so far passed various very stringent experimental and observational tests. The recent discovery of gravitational waves from coalescing black holes (both gravitational waves and black holes are key predictions of general relativity) by LIGO implies that gravitational wave sources are means for investigation of the Universe. These sources are expected to produce electromagnetic radiation (photons) and high-energy particles. However, the properties of the photons and the particles would be affected by a strong gravity intrinsic to the source. To understand the physics of the gravitational wave sources deeper, it is important to learn how particles (with or without mass) behave in a strong gravity, as observed/inferred by a distant observer. As a first step we investigate the dynamics of photons in the vicinity of a massive black hole. We consider a Lagrangian formulation in a fully relativistic setting to determine the photon trajectories, which are essentially null geodesics in the space-time. We solve the geodesic equations numerically using a fourth order Runge Kutta method for initial conditions specified by energy, angular momentum, position, and velocity. Our calculations have shown that the photons' motion is significantly affected by general relativistic effects, such as lensing, time dilation and frame dragging near the black hole's event horizon. We also use general relativistic radiative transfer equation (coded in a ray tracing algorithm) to generate images for photons emitted from a Keplerian disk (i.e. in a free fall) around a black hole, showing the effects of relativistic shifts and intensity boost/suppression.

Intrinsic Dimensionality and Cross-correlation of Human Behavioural Activity Data

Flaviu Vadan; Kevin Stanley (Supervisor)
Computer Science

The past decade is characterized by significant technological advances that provide us with efficient ways of organizing and collecting data. The technological advances that we have witnessed allowed the emergence of human behavioural data collection and analysis – study that allows us to better understand human spatial mobility. All the data collection that occurs via human spatial behaviour research has to be processed but not all the data contains relevant information. Such a research problem can be addressed by looking at the number of dimensions of the analyzed data and studying its spatial complexity. In this study we perform a dimensionality analysis on several human behavioural mobility databases in order to determine the intrinsic dimensionality of the datasets. We bring forward a method for measuring the spatial complexity of data and its variables' orthogonality by employing the definition of the Minkowski-Bouligand dimension to analyze the data. The analysis of 7-dimensional datasets indicate dimensions of between 1.41 and 1.92, for different databases. The resulting dimensions of the datasets indicate that the analyzed databases contain data points that are highly correlated, therefore indicating a high degree of human behavioural predictability and low information entropy. The dimensionality measures of the analyzed databases aid in the creation of models used for human behavioural prediction models.

The effect of in ovo administration of the mycotoxin deoxynivalenol (don) on the broiler chicken embryo

Emilie Viczko; Natacha Hogan (Supervisor)
Agriculture & Bioresources

As the most commonly detected mycotoxin in cereal grains of Western Canada, deoxynivalenol is a prevalent contaminant of livestock feed. However, due to a variety of external influences and inconsistencies among studies, providing an encompassing assessment of DON toxicity to broilers *in vivo* has been difficult. The present study was performed in order to provide a base of comparison for effects of DON toxicity by utilizing the isolation of an *in ovo* model to assess changes in growth, hatch quality, and morphology and histology of the liver, spleen, and small intestine. A total of 200 Ross 308 broiler eggs were divided and assigned to one of seven treatments: control (CON, n=20), vehicle control (VEH, n=20), DON 0.04 (n=20), DON 0.2 (n=20), DON 1 (n=20), DON 5 (n=20) and DON 10 (n=10). CON eggs were left completely untreated. VEH eggs were administered 2 µL corn oil/g egg weight. The remaining treatment groups were administered 2µL corn oil-DON solution/g egg weight. The amount of DON in solution corresponded to the treatment group (i.e. DON 0.04 = 0.04 µg DON/g egg weight, etc.). No significant differences were seen in body weight, yolk sac-free body weight, body length or hatch quality. Weights of the liver, spleen, duodenum, jejunum and ileum were

unaffected by treatment. Histology of the same organs and organ segments revealed no abnormalities corresponding to DON exposure. Future research should focus on more sensitive assays to evaluate effects of DON at the cellular and molecular level.

Embryonic Localization and Functional Implications of the Shugoshin homolog in C. *elegans*

Brandon Waddell; Carlos Egydio de Carvalho (Supervisor)
Biology

Cilia are used by many organisms to sense their environment. Chemical ligands or physical stimulus are detected by the cilia, which then transmit signals to the organism about the location of food, toxic substances, heat or cold, etc. These signals are conveyed to the nerve center of the organism via neurons. Improper innervation or loss of neuronal connection can result in a loss of ciliary signalling. Cilia dysfunction has been implicated in a number of human diseases as most, if not all, human cells are ciliated. We have uncovered a putative protein SGO-1, a homolog of the Shugoshin protein family, that has implicated functions in the anchorage of neurons to their target cilia or organ. In other animal systems, the Shugoshin family functions during meiosis to protect the cohesion between sister chromatids at the centromere. However, C. *elegans* does not have discrete centromeres and loss of function of SGO-1 does not lead to lethality. Our preliminary findings indicate that SGO-1 localizes to the sensory depression of developing embryos during the time of ciliogenesis and sensory organ formation. We therefore examined the localization of known sensory neuron proteins as well as the effect of the loss of these proteins. We found that SGO-1 is expressed in close proximity to the dendritic tips of sensory neurons, and may even migrate alongside these neurons early on in embryogenesis. Loss of neuronal protein signals abolished SGO-1 signal. Here we suggest a new function of the Shugoshin homolog in C. *elegans*.

Creating an Urban Agriculture Action Plan

Lindsey Wagner; Wanda Martin (Supervisor)
Nursing

Loss of connection between people and their food systems affects physical, mental, and emotional wellbeing. The rising rate of chronic disease and mental illness requires public health interventions that differ from the traditional approach of directly delivering programs and services. Saskatchewan, Canada, is a major producer of the globe's wheat and pulse supply, yet this farming rich province only produces 7% of the local demand for fruits and vegetables. The purpose of this study is to reconnect people with a community food system through discussions on developing an urban agriculture action plan for the Saskatoon Food Council. We are using concept mapping and participatory diagramming along with individual interviews to map a strategy for supporting urban agriculture within the province's largest city. Reconnecting people with food production provides a means to increase fruit and vegetable intake, promote physical activity, and improve social relationships. We are also examining the economic aspects of home and community gardening to explore the feasibility of promoting urban agriculture as a means to supplement income or reduce home food costs. Upon completion of the study, the next steps will be implementation and evaluation of this action plan.

The Role of Troglitazone and Azacytidine in Altering the Gene Expression of Doxorubicin Resistance Breast Cancer Cells through Methylation

Matthew Waldner; Anthony Kusalik (Supervisor)
Computer Science

Resistance to doxorubicin in cancer cells has been linked to alterations of methylation levels in tumor suppressor genes and oncogenes. Azacytidine is a hypomethylation agent and troglitazone has been shown to reverse resistance to doxorubicin. By applying troglitazone and azacytidine to doxorubicin resistant MCF7 breast cancer cells, the correlation between alterations in methylation and gene expression levels can be examined to identify genes that influence doxorubicin resistance. Five treatments were prepared: a control MCF7 set (MCF7), a doxorubicin resistant set (DOX), DOX treated with azacytidine (AZA), DOX treated with troglitazone (TRG), and DOX treated with both troglitazone and azacytidine (BOTH). Sample methylation and gene expression levels were tested using the Illumina27K Platform and the Illumina HumanHT---12 BeadChip. Values for 4 comparisons (MCF7vsDOX, DOXvsAZA, DOXvsTRG, and DOXvsBOTH) were subjected to a minimum cutoff for both methylation and gene expression to identify significant gene

targets. Significant global methylation and a decrease in expression was only observed in MCF7vsDOX. Significant global demethylation and an increase in gene expression that passed the cutoff was observed in DOXvsAZA, DOXvsTRG, and DOXvsBOTH. DOXvsAZA and DOXvsBOTH also had significant sets of genes that had a decrease in methylation correlate with a decrease in expression. Troglitazone demonstrated hypomethylation properties previously undocumented and stronger than that of azacytidine. The results of the treatment with both troglitazone and azacytidine show that the mechanism of azacytidine likely overrides that of troglitazone. Three significant genes were identified that fit the criteria for being targets doxorubicin resistance.

Development of Radiolabeled Antibody-Targeted Gemini Nanoparticles for Melanoma

Kayla Wharton; Ildiko Badea (Supervisor)
Pharmacy & Nutrition

Melanoma is the most deadly form of skin cancer and about 6800 Canadians are diagnosed with it and 1150 die from the disease every year. The aim of our work is to develop radiolabeled antibody-targeted gemini nanoparticles which can be used to target melanoma. The radiolabel Indium-111 was conjugated to the gemini surfactant through a chelator, DOTA and the melanoma-specific antibody fragment through a spacer. Three different targeted radiolabelled formulations of gemini nanoparticles were prepared and physicochemical characteristics and stability were assessed. The targeted nanoparticles were added to a model of melanoma cells (RPMI), and cellular uptake and in vitro binding were assessed. The size of the optimal nanoparticles were 71-85nm and this remained in the acceptable range of 114-148nm after lyophilisation. Confocal microscopy showed successful internalization of the fluorescent dyed nanoparticles. The fab-binding study using the flowcytometer showed that the nanoparticles do bind to the receptors on the surface of the RPMI cells which could be blocked by free fab pre-treatment. The stability tests show that the radiolabelled nanoparticles are very stable and less than 5% of the Indium-111 dissociates from the nanoparticles over 168 hours. Radiometric measurements show that the targeted and non-targeted nanoparticles have similar binding rates of 33.8% and 34.2%, respectively. However, internalization of the targeted nanoparticles was higher at 13.6%, compared to 7.2% of the non-targeted nanoparticles. The radiolabeled nanoparticles show nuclear association of 5-10%. These findings demonstrate that the radiolabeled nanoparticles show promise for image-guided radiotherapy for melanoma.

How *meaning* Influences the Identification of *words* and *werds*: Semantic Priming of Lexical and Sublexical reading

Sarah Wingerak; Ron Borowsky (Supervisor)
Psychology

The Dual-Route Model of reading proposes there are two pathways in which orthography (i.e., print) is converted to phonology (i.e., sound): (1) a lexical route, whereby familiar exception words (e.g., pint) and regular words (e.g., nine) access their whole-word representations, and (2) a sublexical route, which is used to phonetically decode unfamiliar words and pseudohomophones (PHs; i.e., orthographically novel letter strings that sound like real words; e.g., pynt, nyne). Phonetic decoding is dysfunctional in cases of phonological dyslexia, and thus PH reading may serve as a diagnostic measure. Conversely, sight vocabulary is dysfunctional in cases of surface dyslexia, and thus exception word reading may serve as its diagnostic measure. Experiment 1 uses a naming task to compare naming reaction time (RT) and response duration (RD) of exception and regular words to their PH counterparts. Gould, Cummine, and Borowsky (2012) found a shorter RT and longer RD for exception compared to regular words. Experiment 1 replicated and extended these results, by showing a similar pattern of RT and RD for exception and regular words and their corresponding PHs. It is concluded the shorter RD of exception word naming is due to processing from the orthographical lexical system, and that phonetic decoding of PHs can also be influenced by this system. Ongoing experiments are further developing this paradigm (e.g., to see how semantic priming can influence regularity effects) in order to establish normal behavioral markers for reading processes.

Analysis of Historical Reinforcing Bar

Ryan Yakimoski; Lisa Feldman (Supervisor)
Engineering

Six reinforced concrete beam specimens will be tested under four point loading condition. The testing will evaluate the bond performance of each of the reinforcements used which include 19 mm plain round, 20 mm modern deformed bar and a 32 mm Ransome bar. All specimens will have the reinforcement cast in the bottom portion of the beam with a 50 mm cover as measured from the bottom and will have their ends bent at 180 degrees to avoid any pull out failure. Splice lengths of 1710, 1510 and 1210 mm will be used in conjunction with the plain reinforcement while splice lengths of 610, 510, 410 mm will be used in accordance with the modern deformed bar and a 410 mm lap splice for the Ransome bar. Lap splice lengths will simulate historical values as they range from too short of splice length to too long of lap splice which is not up to standard by today's code. Sandblasting was used to better replicate the surface roughness of the plain reinforcing bar which exists in historical concrete structures. As testing will not commence until mid to late August, results are still pending. However, previous study has suggested that all specimens should fail due to bond loss, the Ransome bar's bond performance shows similarities to that of the modern deformed bar and that plain bar is approximately 60% as effective in bond as Ransome and modern deformed bars (Feldman and Knight 2013).

Select Chemical Properties of Saskatchewan Grown Dwarf Sour Cherry

Eleanor E. Yates; Nicholas Low (Supervisor)
Food & Bioproduct Sciences

The breeding of dwarf sour cherries (P. x kerrasis) was initiated at the University of Saskatchewan in the 1970's. Recently, a series of cultivars of this fruit were produced through the U of S Fruit Program, one of the first being Carmine Jewel. As minimal information has been published on the chemical composition of dwarf sour cherries, the goal of this research project was to determine the chemical composition of this cultivar. Analyses were performed to determine: amino acid, ash, carbohydrate, fibre, lipid, moisture, organic acid, pH and protein content/composition. The total phenolic contents of aqueous, ethanol:formic acid:water and methanol:formic acid:water extracts were determined using the Folin---Ciocalteu assay. Free radical scavenging ability (i.e. antioxidant activity) of cultivar phenolics were determined using in vitro DPPH and ABTS assays. Extracts were analyzed using high performance liquid chromatography with photodiode array detection (HPLC---PDA) so as to relate cultivar phenolic structure with free radical scavenging ability. Literature information on the health promoting properties (e.g. anticancer; anti---inflammatory; antiaging) of phenolics has been reported, and as such, consumption of dwarf sour cherries may have a positive impact on human health.

The Mechanics of Fish Feed Pellets Using 80% Vegetable Based Proteins

Stephen Zettl; Duncan Cree (Supervisor)
Engineering

The purpose of this study is to understand the mechanical properties of economical vegetable ingredients in a fish feed pellet. A feed will be developed for Rainbow Trout or other Salmonids. The nutrient profile for Rainbow Trout (trout) was reviewed and the feed ingredients were selected and tailored to meet nutritional specifications. Due to a decline in ocean stocks of fish, fish feed producers are looking for more economical and viable feed formulation that use less fish meals and oils. Based on a literature review, the three best vegetable ingredients for the production of trout will be evaluated in different quantities (i.e. different recipes) to observe if any differences exist in the mechanics of the feed. The three vegetable ingredients are derived from camelina, soy and canola. These three ingredients make up 70 % of the feed in varying quantities along with 10% vegetable binder consisting of 7 % wheat gluten and 3 % guar gum. The wheat gluten and guar gum will improve digestibility of the lipids and proteins of the vegetable ingredients consumed by the carnivorous trout. In addition, each recipe will consist of 7.5 % fish meal, 5 % fish oil and 7.5 % vitamin premix. In this method each feed recipe will be competent for trout and the mechanics of the feed pellets can be studied based on different ratios of camelina, soy and canola in each recipe. The mechanics of the feed pellets to be studied are: hardness, durability, density, solubility, buoyancy and compression strength.

Distribution of vaginolysin genes and cytolytic activity in *Gardnerella vaginalis* isolates from the vaginal microbiome

Chelsea Ziegler; Janet Hill (Supervisor)
Veterinary Microbiology

Gardnerella vaginalis is among the most common bacteria found in the vaginal microbiome. While an increase in *G. vaginalis* is associated with a condition known as bacterial vaginosis (BV), which has adverse reproductive health effects, it can also be found colonizing healthy women. The enigmatic role of *Gardnerella* in the vaginal microbiome may be related to the observation that there are four distinct subgroups within the species that may differ in their pathogenicity. Our objective was to determine if the virulence factor, vaginolysin, is differentially distributed among the subgroups. Vaginolysin, a cholesterol-dependent cytolysin, is reported to cause complete lysis of human erythrocytes *in vitro.* The hemolytic activity of 112 *G. vaginalis* isolates obtained from clinical samples was assessed on agar plates supplemented with either human or sheep blood. Presence of the gene encoding vaginolysin was detected in the same set of isolates using a PCR assay. The results show that the vaginolysin gene is consistently present in our collection of *G. vaginalis* isolates. Despite this, not all isolates demonstrated cytolytic activity. These results were then amalgamated with the recently established subgroups of *Gardnerella*, and it was determined that gene presence and cytolytic activity had no observable pattern among the subgroups. Based on this observation, it is unlikely that differential vaginolysin expression is responsible for apparent differences in pathogenicity. However, the ubiquitous nature of the vaginolysin gene alongside the inconsistent hemolysis data provides an opportunity for further exploration.