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Enhancing soluble expression of cyclohexane carboxylate CoA ligase from Streptomyces nodosus subspecies asukaensis through nested deletions of the gene.

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Student: Amanda AMES
Supervisor: Mary Forrest

Asukamycin is a secondary metabolite produced by the bacteria Streptomyces nodosus ssp. asukaensis (Sno). Asukamycin has been shown to possess both strong anti-inflammatory and antitumor properties. The enzyme cyclohexane carboxylate CoA ligase (acyl CoA ligase) is required for the first step of biosynthesis of asukamycin and is of particular interest due to its broad range of substrate specificity. It is thought that by feeding the acyl CoA ligase different substrates, it may be possible to produce new bioactive compounds that could be used to treat human disease. In order to test this hypothesis, soluble acyl CoA ligase must first be isolated in a soluble form. However, previous studies have been unsuccessful in isolating soluble acyl CoA ligase. This study constructed nested deletions of the gene that encodes the acyl CoA ligase (labeled the mid1a gene) to enhance the solubility of the gene product. Fragments of the mid1a gene measuring 273, 543, 789, 1068, 1407 and 1686 nucleotides long were cloned separately into a pGS-21a::GFP vector and then transformed into Escherichia coli (E. coli). The expression of the 6 different sized acyl CoA ligases was induced through the addition of IPTG to media containing the E. coli transformants. Expression studies demonstrated that the most soluble acyl CoA ligase was produced by the E. coli that were transformed with the 1407 nucleotide length gene fragment (mid1a1407 gene). This mid1407 gene produces an acyl CoA ligase that lacks the last 93 amino acids from the carboxyl terminal. This study was the first to successfully produce a soluble form of the acyl CoA ligase. This was an important step towards isolating a functional form of this enzyme, and is significant because the acyl CoA ligase may be exploited in the future to generate novel clinically relevant compounds.

Stable isotope-labelling with aminosugars (SILAS): A quantitative approach to glycomics using infrared spectroscopy

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Student: Trevor ANDREWS
Supervisor: Wesley Zandberg

The most common post-translational modification of proteins is their chemical modification with carbohydrate polymers (herein called glycans), resulting in the formation of a glycoproteins. The biosynthesis of glycans is competitive and not templated directed and thus an otherwise pure glycoprotein may bear many different glycan structures. Although they exist as diverse mixtures, specific glycan structures have been shown to exhibit correlation and causation with many common human health issues. It has been well-documented that the relative concentration of different glycans in pathological or diseased states differ compared to healthy states. Therefore, the quantification of glycans present in diseased and healthy states is essential for enabling a glycomic approach to studying the biochemical basis for human health and disease. One strategy used to measure the relative concentrations of glycans by mass spectrometry, relies on the metabolic incorporation of a stable-isotope into the glycan samples. For example, one proof of concept in vivo study of glycan quantification called isotopic detection of aminosugars with glutamine (IDAWG), relies on the incorporation of 15N into glycans by the use of 15N-glutamine, the sole nitrogen donor for the three aminosugars commonly observed in mammalian glycans. Here, we describe the development of SILAS, stable isotope-labelling with aminosugars, for an improved approach to isotope labelling into glycans of cultured cells. Peracetylated N-acetyl-D-glucosamine (GlcNAc) containing a heavy isotope (13C) in carbon one (i.e. the carbonyl carbon) of its N-acetamido moiety was synthesized in order to incorporate a stable isotope into glycan samples. These peracetylated sugars are rapidly taken up into cells and are de-O-acetylated by esterases. In contrast with an IDAWG approach, these peracetylated derivatives are not subject to competitive label incorporation into proteins. One intriguing extension of the SILAS approach to metabolic glycan-labelling is that the heavy 13C isotope alters the infrared stretching frequency of the amide carbonyl group by about 40 cm-1; this suggests that the relative quantification of glycans in a mixture containing both 12C- and 13C-GlcNAc can be accomplished by infrared (IR) spectroscopy. Progress towards using IR spectroscopy for quantitative glycomic of cells labelled with 12C/13C-GlcNAc will be reported.

Synthesis of next generation molecular probes to study Cav1.2 proteins

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Student: Louise ARAUJO
Supervisor: Fred Menard

Neurodegenerative disease is a leading global disease burden with limited treatment and often no cure. Of the two types of cells in the brain, neurons and astrocytes, it is the astrocytes that are thought to play a key role in neurodegenerative disease. Astrocytes have protein channels that allow transport and exchange of molecules between them; one of the main protein channels in astrocytes are the calcium channels but their role in neurodegenerative disease is still unknown. Molecular imaging probes can be used as a means of observing the function of the calcium channels. The goal of this project was to use organic synthesis to create a molecular imaging probe that would target the Cav1.2 calcium protein channel. The probe made was modified from a previous version to increase selectivity for the Cav1.2 calcium channel. There are three components that make up the molecule: the Cav1.2 inhibitor, a fluorophore, and a linker. During this project the Cav1.2 inhibitor and linker were synthesized separately, attached together, and then attached to the fluorophore. The role of the inhibitor is binding to the Cav1.2 calcium channel and the linker attaches it to the fluorophore, which allows for the observation of the calcium channels in cells using fluorescence microscopy.

Expression patterns of the organic cation-like transporters orct & orct2 in larval Drosophila melanogaster renal tubules following acute and chronic exposure to tetraethylammonium.

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Student: Emily BERNIE
Supervisor: Mark Rheault

This study used the quantitative Polymerase Chain Reaction (qPCR) to examine the expression of two organic cation transporters in the Malpighian (renal) tubules of the fruit fly Drosophila melanogaster. The expression of the putative organic cation-like transporters orct and orct2 were measured in the Malpighian tubules after both acute and chronic dietary exposure of the prototypical type 1 organic cation (OC) tetraethyl ammonium (TEA) . Gene expression differences were measured between orct and orct2 at different concentrations and after different exposure periods. This suggests that the two transporters compensate for one another under short-term stress. Larval mortality was also studied for larva reared long-term (90+ generations) on various concentrations of TEA-enriched diets. Mortality was shown to decrease when long-term diets contained higher concentrations of TEA, suggesting that long-term exposure to TEA increases the ability of MT to transport and remove the toxin.

Mountain bluebirds breeding on reclaimed mine lands: assessment of land reclamation through offspring provisioning by parent birds.

EME Foyer

Student: Matias BOFARULL ODDO
Supervisor: Erin O'Brien/Ian Walker

Standard approaches to evaluate land rehabilitation do not examine the life-histories and behavioural changes of individual animals, but rather population-wide effects (i.e. census and species presence). However, these responses may not be sensitive to rapid shifts in environmental quality. The sheer existence of a population is no indication of habitat health by itself, as census data may mask the presence of an “ecological trap”. In this scenario, specific environmental cues give animals the impression of a good quality habitat, but once individuals colonise that habitat, they are unable to survive or reproduce due to unpredictable ecological deficiencies or risks. These characteristics are inherent to many human-modified terrestrial systems. Food is the most important factor that determines reproductive success of animals, and it is also the most variable regarding quality and availability across habitats. For

example, variation in prey availability may alter the behaviour of parent birds that forage to provide food for their young. These behaviours are in turn quantifiable, and may indicate site differences that are due to human activity, and which may still exhibit unsustainable properties that hinder ecological health. In this study, we assessed nestling provisioning behaviour of adult mountain bluebirds (Sialia currucoides) breeding in nest boxes on reclaimed mine tailings and waste rock areas over two years at Highland Valley Copper (HVC) in central British Columbia. For comparison, we also examined birds breeding on a reference area (REF) approximately 20 km from the mine site, which has no history of mining activity but is otherwise similar in environmental conditions. A food supplementation experiment was included to assess behavioural plasticity if more food (i.e. waxworms and mealworms) was present in otherwise equal conditions. To examine provisioning behaviour, we used video recordings of parent birds delivering food to their young during the nesting period. Videos were manually screened for provisioning rates (i.e. prey delivered per hour), prey size (i.e. relative biomass), and prey identification, which fell under three visually distinct categories: terrestrial adults (i.e. insects such as butterflies, beetles and crickets), terrestrial larvae (i.e. caterpillars and grubs), and aquatic adults (i.e. damselflies and dragonflies). We detected simultaneous effects of study year, site, and supplementation experiment on prey biomass and provisioning rates of foraging mountain bluebirds. Parents breeding on HVC delivered larger prey items in 2013 compared to 2012. 2012 was a poorer year for bluebirds in the study area, as shown by a companion study that examined reproductive success and nestling phenotypic quality over the same years. Behavioural shifts between years in response to food supplementation were observed on the REF area that differed in direction; while no such responses were seen on HVC. This suggests that breeding birds on the mine site were consistently resource limited and so not able to respond to supplemental food resources like their REF counterparts. Bluebirds breeding on HVC delivered a larger proportion of adult aquatic invertebrates (damselflies, dragonflies) to their young, whereas birds on the REF site tended to deliver more terrestrial larvae. This is noteworthy, as mountain bluebirds have never been documented to rely on aquatic arthropod prey to any extent, at any stage of the nesting period, and so this behaviour on the HVC site is very unusual. Furthermore, a significant inverse relationship was discovered between provisioning rates and prey biomass, indicating a trade-off between the frequency of prey delivery and the size of prey delivered to the nest by parent bluebirds. These results suggest that behavioural traits such as offspring provisioning in passerine species that typically rely on terrestrial insects as a food source may be sensitive indicators of habitat quality, and the human impact on complex ecosystems they inhabit. Indeed, industrial reliance on census data alone may limit our ability to identify “ecological traps” in human-modified terrestrial systems; therefore hindering efforts towards effective environmental rehabilitation.

ENHANCE: Design and Rationale of a Randomized Controlled Trial for Promoting Happiness.

EME Foyer

Student: Courtney CHRUSCH
Supervisor: Lesley Lutes

Happiness is defined as a fundamental human goal, that many agree is crucial to overall functioning and is linked to several factors including improved physical health, emotional health, and longevity. While there has been an explosion in recent years of interventions to help people achieve higher levels of happiness, few studies have examined interventions using a non-university population with a multi-faceted treatment, looking at its impact on both self-report and objective outcomes. The present study is a 2-arm randomized clinical trial that encompasses multiple constructs to boost happiness, ENHANCE: Enduring Happiness and Continued Self-Enhancement. Community-based participants will be randomly assigned to either: 1) The enhance group-based treatment, or 2) a wait-list control group for a period of 6 months. The treatment group will meet with Ph.D. student clinicians weekly in the first 12 weeks, followed by monthly groups and monthly individual phone-based check-ins for another 3 months. The primary outcome, well-being, will be evaluated through The Scale of Positive and Negative Experience, the Satisfaction with Life Scale, and the Meaning in Life Questionnaire measured at baseline, three months, and six months. Secondary outcomes will include a cognitive assessment of well-being, peer reports of well-being, social functioning, and physical health. The study will include N=60 individuals ranging from 25-years-old to 65-years-old. Participants will be screened for major psychological disorders, such as severe anxiety and depression, and will be referred for appropriate services. The present study seeks to determine if ENHANCE will result in greater overall happiness, well-being, and physical health outcomes compared to a wait-list control group. We expect participants in the program to report increase in their levels of happiness at the end of the 12-week program compared to those in the wait-list control group. Following completion of the six-month testing, participants in the wait-list control group will receive the ENHANCE group-based treatment program. Baseline characteristics of the participants in the present study will be presented.

Psychological Disturbance and Performance on measures of Memory, Attention and Executive Functioning

EME Foyer

Student: Jeneya CLARK
Supervisor: Maya Libben

The influence of psychological disturbance on performance with neuropsychological tests has been a focus in several studies. The current study looks to replicate and extend the findings of a previous study (Ross, Putnam, Gass, Bailey, Adams, 2003) that found that MMPI-2 indices of psychological disturbance affected the performance of patients with head injury on neuropsychological tests of attention and memory. In the current study we examined the relationship between MMPI-2 measures of psychological disturbance and measures of attention, memory, and executive functioning in a sample of traumatic brain injury patients previously referred for evaluation. The Wechsler Adult Intelligence Scale- Fourth Edition (WAIS-IV) (Wechsler, 2008), The Weschsler Memory Scale Fourth Edition (WMS-IV; Wechsler 2009), The Consonant Trigrams (Brown, 1958; Peterson and Peterson, 1959; Stuss, Stethem, and Poirier, 1987), The Color Trails Test (D'Elia, Satz, Uchiyama and White, 1996), The Selective Reminding Task (Buschke, 1973), The Wisconsin Card Sorting Test (WCST; Heaton, 1980), and The Rey-O Complex Figure Test (Osterrieth, 1944) were all used to evaluate performance. In the present study it is hypothesized that that scores on the MMPI-2 will present a negative relationship with performance on measures of attention, memory and executive functioning in the sample of TBI patients.

Synthetic Routes to Active Chromium Complexes for Radical Generation

EME Foyer

Student: Giuseppe CRESCENZO
Supervisor: Kevin Smith

Metal catalysts have been known to form carbon-carbon bonds between two substrates that typically would not react with one another, known as cross-coupling. Recent studies by the Weix group have shown cross-electrophile coupling of organic halides with the use of nickel organometallic species. They have proposed a radical-chain mechanism for this process. The interception of metal-generated carbon-based radicals by the nickel catalyst greatly increases the rate of the critical C-C bond-forming step, allowing for enhanced reactivity and selectivity. Previous work by the Smith group has shown that chromium complexes can generate these desired carbon-based radicals from non-activated alkyl halides. The rate of radical generation is dependent on the size and electron-donation capacity of the ligands bound to the chromium. Chromium complexes with small and electron-donating chelating ligands were of interest to optimize radical generation; synthetic routes to these reactive chromium complexes were investigated. Protonolysis routes to these reactive chromium complexes were further investigated to allow more effective screening of reactivity with alkyl halides and activated esters to generate carbon-based radicals.

Utilizing IBeacon technology to provide indoor location information to mobile devices.

EME Foyer

Student: Jake DAVIES
Supervisor: Abdallah Mohammed

Indoor location is a widely discussed but mostly unsolved problem in the world today. There are many technologies that can be used, such as WIFI, Bluetooth or Sonar, but there is no de-facto standard in this space. Indoor navigation can be applied to many areas of society, from helping the blind navigate locations they depend on for everyday life, to helping people who are unfamiliar with a new location find the things they are looking for. We have explored the possibility of using iBeacon technology (A bluetooth device designed for bluetooth proximity detection on mobile devices) for indoor navigation when combined with the various sensors

inside mobile devices. Two main methods have been explored, one being trilateration and the other being proximity based movement approximation. Thorough tests of both methods as well as the accuracy of the IBeacon technology will be displayed. Early analysis suggests that the trilateration method is not a viable method for positioning due to the vulnerabilities to inaccuracies that trilateration algorithms possess, but the proximity based movement detection is a more promising solution.

Transcending education: First hand accounts of how university can add meaning to your life

EME Foyer

Student: Benjamin DUNN

Supervisor: Mark Holder

Jonathan Haidt (2006) described meaning in life as one of the ten greatest psychological ideas of all time. Although researchers differ in their definitions of “meaning in life”, there is consensus that meaning in life encompasses three main aspects: 1) a feeling that one's life and one's self have order and coherence, 2) a belief that one's life fits into a larger framework in a purposeful and significant way, and 3) a feeling of transcendence (i.e., being connected to something larger than one's self and to the world beyond the present moment). High meaning in life is associated with numerous positive benefits including higher levels of emotional well-being, optimism, life satisfaction, and self-esteem, along with increased longevity and greater academic achievement (see review, Shin & Steger, 2016). The development and fostering of a stable sense of meaning in life is, thus, critically important. Indeed, Frankl (1956) proposed that searching for meaning in life is a fundamental part of being human. The search for, and establishment of, meaning in life may be particularly important and pronounced in undergraduate university students (Astin et al, 2005; Pryor et al., 2013). However, little research has explored the cultivation of meaning in life in this population. The pursuit of a university education is not only a pathway to obtaining a “good job”, it occurs during a critical time when young adults are actively pursuing an understanding of who they are and what their place is in the world. Shin and Steger (2016) suggested that a university education could be, therefore, a pathway to discovering meaning in one's life. We expanded on this suggestion and proposed that the experience of pursing a university education may itself be a source of meaning in life. In the current study, over a seven-day period, undergraduates reflected on why pursuing a university education was meaningful to them. In accordance with Shin & Steger's (2014) recommendations for the development of a meaning-oriented positive psychology intervention, participants were also asked to think about how being a university student fit with their sense of who they are and with their particular character strengths. Participants were asked to jot down notes throughout the week as they reflected on these meaning questions. At the end of the seven-day study period, participants entered these reflections on the study's website. Findings from the current study suggest that the pursuit of a university education is, in and of itself, meaningful to students. Each participant identified many ways through which they found meaning in being a university student. All qualitative responses were coded and analyzed for recurrent themes. Common themes included: goal achievement, self-development, sense of identity, self-transcendence, and challenge. These results, coupled with previous findings that identify perceived college support for meaning searching as a predictor of presence of meaning in life (Shin & Steger, 2016), suggest that universities play an important role in the cultivation of their students' meaning in life.

Growth and survival of lodgepole pine (Pinus contorta) in a sandwich culture system is affected by membrane type

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Student: Kyle FITZPATRICK

Supervisor: Melanie Jones

Nitrogen-limited ecosystems, including most temperate coniferous forests, rely on nutrient transfer between fungi and plants in ectomycorrhizal symbioses. To understand nutrient movement in ectomycorrhizae, a lab-based approach is often used, yet it is a challenge to develop and maintain the symbiosis in an artificial environment. In my initial experiment exploring nitrogen movement in ectomycorrhizas, both plants (Pinus contorta) and fungi (Suillus tomentosus) became nutrient stressed and died. To determine the cause of these problems and to allow for future lab-based experiments, I tested the effects of several components of the cellophane-sandwich, Petrie-plate culture system on P. contorta seedlings. In a fully factorial experiment, seedlings were placed on

one of two types of cellophane membrane or directly on solid modified Melin Norkrans media. The roots of half of the plants were covered with a second layer of cellophane; then a cover of black plastic was wrapped around half of the microcosms to reduce root exposure to light (three lower cellophane treatments X two layering treatments X two light treatments X five replicate plates = 60 seedlings). Preliminary results indicate that plants grown on low cost membranes died sooner than those on lab-grade membranes, which, in turn, were nutrient stressed compared to plants grown directly on the media. This suggests that the lab-grade cellophane was more permeable to water and nutrients. The effect of a top membrane over the root zone was positive across treatments. It kept the roots in contact with the media, improving nutrient accesss. Plants with roots covered in black plastic grew slower than uncovered plants. In future, sandwich culture system studies of ectomycorrhizae should employ a lab-grade cellophane and cover the roots with a membrane. Finally, black plastic around the root zone is not beneficial to the plant but may still be used to enhance fungal growth.

How nothing can lead to something

EME Foyer

Student: Matteo GERWIN

Supervisor: Mark Holder/Brian O'Connor

Flotation Restricted Environmental Stimulation Therapy (float-REST) involves floating in salt water with very limited sensory input. This form of therapy has grown in popularity with a range of benefits from lowering blood pressure and weight loss, to a decrease of stress and anxiety. A community sample of 118 volunteers participated in a study to assess the efficacy of float-REST on self-reports of mindfulness, spirituality, life satisfaction, state anxiety and affect. Personality was also assessed. The surveys were completed either immediately before or after participants' float sessions. Results suggest that the positive effects of float-REST on well-being can, in part, be attributed to an increase in mindfulness and spirituality (still to be validated). Though initial findings suggest that float-REST shows promise in promoting well-being, additional research is needed to confirm these findings and to determine both the components of float-REST which contribute to well-being and what additional components of well-being may be influenced by this procedure.

Properties at Surface-Molecule Interfaces: A Computation Approach

EME Foyer

Student: Josh GIBBS

Supervisor: Gino DiLabio

Surface-molecule interactions have become an important area of research in regard to the development of molecular-sized devices. With the current rate of size reduction taking place in the electronics industry, these systems are of great interest to offer a substitute to current silicon-based technology. Therefore, the ability to accurately model the chemistry at these interfaces then becomes indispensable. However, while the development of these systems is required in order to build advanced molecular devices on surface boundaries, the methods for modeling them remain unclear. There is currently a poor understanding of the interaction between individual molecules bound to carbon surfaces. Popular 'molecular' modeling programs make use of non-periodic representations of bulk systems, which leads to the inability to describe the conduction band of such systems. Additional challenges include the fact that many Density Functional Theory (DFT) methods available within these programs lack the ability to accurately predict the energy levels associated with molecular orbitals. Ideally, a periodic approach to these calculations may offer solutions to these issues in developing the electronic structure for such systems, however many DFT methods implemented in periodic DFT programs predict energy levels that are very far from correct in both the absolute and the relative sense. Similarly, DFT-based methods that are implemented into 'molecular' codes have the ability to predict energy levels consistent with experimental results, but suffer from aforementioned issues. Furthermore, many interfaces, including the conducting carbon substrate in which we have

interest, have poorly defined structures, making the prediction of a representative electronic structure a "best guess". It is because of this that a detailed analysis of the methods for modeling these systems has been done which has shown a way in accurately representing conducting carbon surfaces. In addition to this, multiple DFT methods have been evaluated in order to determine which is the most suitable in for analyzing these systems with the hopes that these techniques can be further utilized in the development of molecular-sized technologies.

Synthesis of a New Amine-Reactive Fluorophore for the Capillary Electrophoresis Analysis of Glycans

EME Foyer

Student: Samuel GRIFFIN

Supervisor: Wesley Zandberg

Chemical compounds containing an amine functional group are found in virtually every biological system. However, one of the major classes of biological compounds, carbohydrates, contains few naturally occurring amine compounds relative to the other major classes. An understanding of the important roles played by carbohydrates, also called glycans, in both healthy and diseased states requires improved techniques and methods capable of analytically separating and quantifying these molecules. Capillary electrophoresis (CE) is one such technique, and has been used extensively to carry out high-resolution separations of glycans that have been derivatized with the fluorophore 8-aminopyrene-1,3,6-trisulfonic acid (APTS). The Zandberg group has recently developed a glycan sample-preparation method in which glycans are obtained with a single, non-natural amine group. To extend the utility of this method into a larger glyco-analytical strategy, a way to be able to analyze glycans with amine functional groups by CE is desirable. This work focuses on the synthesis of an APTS analogue specifically designed for the labelling of amine-functionalized glycans that is applicable to CE. The new fluorophore, termed N-substituted aldehyde-APTS (NAAPTS), was synthesized from 8-aminopyrene in three steps and was characterized by NMR spectroscopy and CE. Purification of these aromatic sulfonates was the greatest obstacle in reaching the goals of the project. NAAPTS inverts the reductive amination chemistry traditionally used to label glycans with APTS and therefore is predicated to be able to be linked to glycans under milder reaction conditions with a much lower fluorophore to analyte ratio. This is important as it will minimize both analyte (glycan) degradation during fluorescence labelling and interference from excess fluorophore during subsequent CE analysis. Recent progress towards labelling model glycan samples using NAAPTS will be reported.

Investigating bee-to-bee communication with diffusion based models.

EME Foyer

Student: Kendas HANSEN

Supervisor: Rebecca Tyson

Wild and domestic bees play a vital role in the production of human foods as well as in sustaining ecosystems. In recent years there has been a great decline in both wild and domestic bee populations. Mathematical models are studied to gain a better understanding of how bees disperse on a landscape, and to gain insights into how landscapes can be arranged to better support wild bee foraging. Existing diffusion-based models for bee movement have used simple movement terms, yet realistic bee movement is more complex. In particular, bee communication has not been included. We model bee-to-bee communication as a directed diffusion, and explore how this affects the bee population distribution on the landscape. It is not entirely clear exactly how the bee-to-bee communication translates into directed diffusion, and so we investigate three mathematical models, increasing in complexity, to explore this question in different theoretical landscapes. Our work provides a basis for future modeling efforts aimed at predicting which landscapes best support wild bee populations.

Exploring new methods for preparing O-linked glycans for analysis by capillary electrophoresis and chromatography

EME Foyer

Student: Andrew KENNEDY

Supervisor: Wesley Zandberg

In the absence of a general enzymatic method for cleaving serine/threonine (O)-linked glycans from glycoproteins, chemical deglycosylation methods must be used. These methods, the most common of which is reductive β-elimination, are suitable for the mass spectrometric analysis of glycans, but not for analytical separation techniques employing optical detectors. This is because the reductive nature of these deglycosylation strategies produces glycans that are unable to be further derivatized with chromophores or fluorophores by the commonly used reductive amination reactions. Another approach for chemically obtaining free reducing O-glycans is to perform ammonia-based β-elimination in the presence of ammonium carbonate. This method traps otherwise base-liable glycans as their glycosylamines, which are resistant to otherwise degradative "peeling" reactions; these glycosylamines are rapidly hydrolyzed to their free reducing sugars at neutral pH. We have discovered that it is possible to combine traditional glycan reductive β-elimination with ammonia-catalyzed elimination thereby installing a single primary amino group into the O-glycans. This stable amino functional group is rarely observed in glycans. A practical result of this new form of sample preparation is that the amine-reactive fluorophores developed for the field of proteomics may now be extended to glycomic analysis. The reductive ammonia-catalyzed glycan elimination technique has been successfully tested with a wide variety of model glycoprotein substrates containing both N-linked and O-linked glycans. Initial experiments have been optimized using 3-(4-carboxybenzoyl)-2-quinolinecarboxaldehyde (CBQCA) as an amine-reactive fluorophore permitting the subsequent analysis of labelled glycans by both capillary electrophoresis (CE) and ultra-high-performance liquid chromatography (uHPLC). In addition, starch ladder standard was labelled with amine-reactive fluorophores Pacific Blue succinimidyl ester and N-hydroxysuccinimide-activated (NHS) fluorescein with subsequent analysis by uHPLC and CE respectively.

Synthesis of a Suflonium Ion Based Lysine Alkylation Linker

EME Foyer

Student: Jeff KERKOVIUS

Supervisor: Fred Menard

One of the key factors in understanding the mechanisms of heart and neurodegenerative disease is to learn the role of calcium channels in these illnesses. Such studies require a labeling probe that can enable real time visualization of the channels in action. The ideal labeling probe has a channel ligand connected to a linker that can covalently deliver a fluorescent tag followed by ejection of the ligand. This method will allow for selective labeling of proteins in vivo without alteration of their function. To meet this need, we have synthesized a sulfonium ion linker and tested its reactivity with various amines under several conditions. The linker will be appended to thapsigargin and a coumarin dye called pacific blue for use in labeling SERCA proteins.

Characterization Of The Bifunctional Enzyme Ornithine Decarboxylase Arginase from The Organism Fuso Nucleatum

EME Foyer

Student: Neven KNEZEVIC

Supervisor: Kirsten Wolthers

Fusobacterium nulceatum is a common oral bacterium that is indirectly implicated in periodontal disease by providing an anaerobic environment within dental plaque for pathogenic bacteria such as Porphyromonas gingivalis to thrive. Fusobacterium nucleatum contains a unique bifunctional enzyme called ornithine decarboxylase arginase (ODA). The enzyme produces the polyamine, putracine essential for the formation of the biofilm associated with dental plaque. Characterization of ODA is an important first step towards design of a successful inhibitor for the treatment of periodontal disease. The gene for ODA was successfully amplified from

F. nulceatum genomic DNA using the polymerase chain reaction. The coding sequence was subsequently cloned into an E. coli expression vector for expression in the E. coli strain, Rossetta(DE3) pLysS. The recombinant enzyme was purified by affinity chromatography. The arginase active site catalyzes the hydrolysis of arginine to form ornithine and urea. Ornithine decarboxylase converts ornithine to putrescine and carbon dioxide. UV-visible spectroscopic assays confirmed that L-ornithine but not D-ornithine can bind to the ornithine decarboxylase active site. Ornithine decarboxylase catalytic site activity was explored by performing steady-state kinetic coupled assay. Unfortunately, background levels of CO2 present in buffer prevented accurate determination of catalytic turnover. However, a coupled assay was able to measure catalytic activity of the arginase active site.

Overexpression of lavandulyl diphosphate synthase in Chrysanthemum cinerariifolium | EME Foyer

Student: Ashley LEMKE

Supervisor: Soheil Mahmoud

Plants produce regular and irregular monoterpenes, a group of 10 carbon biochemical compounds that impart aroma, flavour and biological activity to the tissues they occur in, and are common constituents of essential oils. Chrysanthemum cinerariifolium (Pyrethrum) plants produce large quantities of pyrethrins, which are a group of irregular monoterpenes with potent insecticidal activity. In contrast, most lavender species accumulate large quantities of regular monoterpenes and small amounts of irregular monoterpenes including lavandulol and lavandulyl acetate. Recently, Dr. Soheil Mahmoud's lab cloned a lavandulyl diphosphate synthase (LPPS) gene from Grosso lavender (Lavandula x intermedia) plants. This gene is responsible for the production of lavandulyl diphosphate, the precursor to irregular monoterpenes, in lavenders. Given that the LPPS gene is strongly expressed, it is unclear why lavenders produce small amounts of lavandulol and lavaldulyl acetate. We hypothesized that an inhibitory element restricts the activity of the LPPS enzyme in lavenders, therefore limiting production of irregular monoterpenes. To test this hypothesis, we set to overexpress LPPS in Chrysanthemum cinerariifolium, which is known to produce large amounts of irregular monoterpenes, using an Agrobacterium-based transformation procedure. It is anticipated that transformed plants will accumulate high amounts of lavandulyl diphosphate, lavandulol and lavandulyl acetate. Regeneration conditions for C. cinerariifolium were established, the LPPS cDNA was inserted into a plant expression vector (pGA:LPPS), the construct was transformed into Agrobacterium, and plant tissue was infected with bacterial cells. The successful transformants will be selected next on media supplemented with appropriate antibiotics and further screened for the expression of the LPPS gene. The results of this work will help us understand regulation of monoterpene synthesis in plants. They will also help develop technologies for mass production of industrially important plant biochemical compounds.

Growth of Suillus tomentosus on four different media substrates in two light conditions | EME Foyer

Student: Cameron LONGFELLOW

Supervisor: Melanie Jones

Ectomycorrhizal fungi are becoming increasingly appreciated in global nutrient cycles. Suillus tomentosus (Kauffman) is a pine-associated ectomycorrhizal fungus that is ubiquitous in the Northern hemisphere. In laboratory-based experiments, fungi may be grown on cellophane layered over solid growth media to allow for efficient sampling of the hyphae. In a previous experiment, S. tomentosus failed to grow and colonize roots in a petri-plate based microcosm when we tried to use a low-cost cellophane. The goal of my current experiment was to elucidate the cause of this lack of growth. The growth of S. tomentosus was tested on four growth substrates placed on a solid ¼ Modified Melin-Norkrans media: low-cost cellophane, lab-grade cellophane, charcoal enhanced filter paper, and nothing (fungus placed directly on media); and in two light conditions: dark (wrapped in tin foil), and light (not covered). Preliminary results indicate that the presence of light slowed growth substantially. Additionally, the low-cost cellophane inhibited

growth, suggesting that the two brands differed in composition. The fungus was able to grow on lab-grade cellophane and charcoal filter paper. The lab-grade cellophane also allowed for easy hyphal extraction; however, charcoal paper did not and the hyphae grew directly into the media below. If hyphal extraction is necessary, I suggest that lab-grade cellophane be used and the plates be placed in the dark.

Perfectionism CBM Increases Anxiety and Eating Disorder Traits

EME Foyer

Student: Caleb MAKORTOFF

Supervisor: Maya Libben

Research has found that the onset and maintenance of mental illnesses, such as anxiety or depression, is related to biased processing of negative information. Cognitive Bias Modification (CBM) is a technique that alters these cognitive biases, to either model pathology in healthy participants, or shift attention to less negative information. In the present study, a variant of the CBM task, that uses ambiguous scenarios, was employed with the aim of encouraging perfectionistic ideals in female university students (n = 130). We predicted that an increase in perfectionism would be associated with an increase is anxiety and eating disorder (ED) traits among female participants. Results indicated that, although anxiety and ED traits were elevated following the CBM manipulation, perfectionistic ideals decreased. We posit that repeated perfectionistic reinforcement, in the form of ambiguous scenarios that highlighted failure to attain perfection, led participants to abandon endorsement of perfectionism. Further study is planned to investigate if a more positive manipulation will have similar effects.

Analysis of N-glycans in ripening cherry fruit

EME Foyer

Student: Carson MCKAY

Supervisor: Wesley Zandberg

Cherry fruit are an economically important crop to the Okanagan Valley. Specifically, late season cultivars are very popular in Asian markets when American producers have sold out of product. Cherry fruit are different from many other tree fruits in that they must ripen completely on the tree and be sold soon after due to their poor shelf life. Previous research has revealed that shelf life was significantly improved in tomato fruit when N-glycan processing enzymes were inhibited by RNA interference techniques; this suggests that further research on the impact of protein N-linked glycosylation on fruit ripening may provide a unique means to enhance the marketability of locally produced crops This project, in collaboration with the Pacific Agri-food Research Center (PARC), involved the extraction of glycoprotein fractions from cherry fruit obtained at different stages of ripening. These glycoproteins were subjected to chemical deglycosylation and the resulting glycans were labelled with highly fluorescent 8-aminopyrene-1,3,6-trisulfonate to permit their sensitive detection after separation by capillary electrophoresis (CE). Using CE analysis the relative abundances of specific glycan structures at different stages of cherry fruit ripening could be determined. The results from this research is intended to lead to the study of inhibiting similar enzymes in cherry fruit to enable further control over the ripening process and to extend shelf life.

SYNTHEIC DESIGN AND INVESTIGATION OF INTRAMOLECULAR DIELS-ALDER REACTIONS | EME Foyer

Student: Yousif MURAD

Supervisor: Ed Neeland

The Diels-Alder reaction was discovered in 1928 and is currently used for the generation of six membered ring systems with stereogenic centers. This reaction has paved the way for the synthesis of many complex molecules, especially those of a natural origin as described by Corey's "grand old synthesis". The use of the Diels-Alder reaction in pharmaceuticals is less widely employed but still critical in the generation of 6 membered ring moieties including new medicinal drugs. The Diels-Alder reaction still occupies a prominent position in organic synthesis today and the aim of this project is to investigate intramolecular Diels-Alder reactions in furan systems using both homomolecular and heteromolecular atomic arrangements. The main synthesis proposed in this project will aim to achieve the formation of a multi cyclic molecular system from the Diels-Alder substrate synthesized in a reaction that only requires the use of toluene as a solvent and heat. This is directed at the synthesis of a unique chemical skeleton not easily made using other reactions. Such a synthesis can be considered very green and economical when integrated into larger scale projects as it can avoid the use of many harsh chemicals and can reduce the number of synthetic steps required.

The Biosynthesis Pathway of β-N-methylamino-L-alanine(BMAA) | EME Foyer

Student: Amy NGUYEN

Supervisor: Susan Murch

β-N-methylamino-L-alanine (BMAA) is a natural, non-protein amino acid produced by cyanobacteria that has been linked with several neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS). Due to the exposure of BMAA being a possible risk factor for progressive neurodegenerative diseases, the study of BMAA is essential. In my study, the biosynthesis pathway of BMAA in cyanobacteria was investigated using 13C- labeled glutamic acid and 13C- alanine as the possible precursor. Cyanobacteria cultures were exposed for set time intervals using a set up similar to Calvin's lollipop experiment. The samples were analyzed using Waters Acquity I-class UPLC and Waters Xevo TQ-S triple quadrupole Mass spectrometer using standardized validated analytical methods (Glover et al., 2015). The exposure of 13C-Alanine to the cyanobacteria cultures did not show any production of 13C-BMAA indicating that this was not a precursor of BMAA. The results from the feeding of BMAA to the cyanobacteria cultures indicate that BMAA is metabolized in the presence of arginine. The results from this study will contribute to the knowledge of the biosynthesis pathway of BMAA, which could lead to possible prevention of its production and therefore reduce its exposure to the food web and also decrease the risk of neurodegenerative diseases that are linked to BMAA.

Detection of BMAA in the Okanagan Aquatic Food Chain | EME Foyer

Student: Viktor NNABUIHE

Supervisor: Karen Perry

Nitrogen fixing and non-nitrogen-fixing cyanobacteria exist ubiquitously in freshwater ecosystems and produce toxins such as saxitoxins, anatoxins and β-methylamino-L-alanine (BMAA). BMAA is a non-proteinogenic amino acid linked to neurodegenerative diseases including Amyotrophic Lateral Sclerosis (ALS), also known as Lou Gehrig's disease. This disease causes the progressive loss of motor neurons in the brain and spinal cord by selectively injuring motor neurons via AMPA/kainite receptor activation (Metcalf et al., 2008). In 2002, Cox and Sacks proposed a mechanism for the biomagnification of BMAA at various trophic levels. Further studies have confirmed the hypothesis that biomagnification of BMAA at various trophic levels in the environment can lead to high concentrations of human exposure through organisms such as the flying fox and the wild pig (Cox et al., 2003; Banack et al., 2006;

Banack et al., 2009). BMAA is water-soluble and it has yet to be investigated in Okanagan Lakes. The study described herein investigates whether BMAA is present in different trophic levels of the Okanagan Lakes. Specifically, the trophic levels of Kalamalka Lake, Wood Lake, and Okanagan Lake that this study explores include particulates, cyanobacteria, zooplankton, and various fishes that are native to the Okanagan area. Four samples of lake water were collected every two weeks from each location during the summer months. Nutrient analyzes were performed by UVis to determine the Ammonium (NH4+), Nitrite (NO2), Nitrate (NO3), Phosphorus (P) concentrations. Cyanobacteria samples were grown from each collection date in Blue-Green Medium (BG11 and BG11 Nitrogen Free). All samples from the particulate, cyanobacteria grown in both media, zooplankton, and fish were analyzed using the UPLC to compare the presence of BMAA, and its different isomers N-(2-aminoethyl) glycine (AEG) and 2,4-diaminobutyric acid DAB. Preliminary analysis of results suggests that BMAA is indeed present in different trophic levels of the various Okanagan Lakes. On average, the highest concentration of BMAA found corresponded with increased temperature of the lakes. Furthermore, the other isomers of BMAA, AEG and DAB were found in higher concentrations than BMAA in all the samples analyzed. Given the detection of BMAA in the Okanagan Lakes, the findings presented here lay a foundation for more quantitative work. By qualifying BMAA concentrations in different trophic levels in the various Okanagan Lakes, it is hoped that an important understanding of the bioaccumulation of this neurotoxin in the Okanagan area can be gained.

Effect of Wolbachia infection on the morphology and development of Diplolepis variabilis galls

EME Foyer

Student: Kalenna OLYNYK

Supervisor: Robert Lalonde

Parasites can influence population structure and host biology via genetic manipulation. The endosymbiotic bacterium Wolbachia can act as a reproductive parasite, causing female wasps (Diplolepis) to produce more female offspring than males. Members of the Diplolepis genus form galls on the plant Rosa woodsii and are a host to a large number of inquilines and parasites, including Wolbachia. Previous studies have found that some D. variabilis individuals in a population have been infected with Wolbachia however not have been infected. This suggests that there may be some variation in D. varaibilis traits which Wolbachia can influence. This study evaluates the correlation between Wolbachia infection, gall morphology and the rate of gall development. I collected galls from two sites in the Okanagan where Wolbachia has been previously found to infect some but not all gall wasps. Galls were collected and D. variabilis larvae were removed. The DNA from the larvae was then extracted and analyzed for Wolbachia infection using gel electrophoresis. The DNA will be sequenced to evaluate relatedness among and within populations.

Lesion Localization and Performance on the California Verbal Learning Test-II Following Stroke

EME Foyer

Student: Ashleigh PARKER

Supervisor: Maya Libben

Previous research has found that stroke patients with unilateral right hemisphere damage (RHD) score significantly below the normative mean on a test of verbal memory, the California Verbal Learning Test (CVLT). This study aims to: (1) replicate the previous findings using the second edition of the test, the CVLT-II, and (2) determine if performance on the CVLT-II differs by stroke lesion location. Participants (N = 37) were hospital inpatients (mean age = 66.16, SD = 12.13) who completed the CVLT-II during a neuropsychological evaluation 10.72 days (SD=13.97) following stroke. Raw scores were converted to T-scores by referencing normative data. Independent samples t-tests were used to determine significant differences on CVLT-II performance based on stroke lesion location: right vs. left hemisphere damage (RHD vs. LHD) and anterior vs. posterior lesions (AL vs. PL). All stroke patients exhibited deficits on the total recall portion of the CVLT-II. On examination of T-scores (M = 50, SD = 10), those with LHD or PL performed more than 1 SD below the mean, while those with RHD or AL performed within 1SD below the mean. However, t-tests indicate no significant differences on CVLT-II performance between RHD (M = 44.96, SD = 14.19) and LHD (M = 39.55, SD = 14.41), t(35)1.06, p = 0.298; or between AL (M = 44.27, SD = 14.24) and PL (M = 38.80, SD = 13.19), t(34), p = 0.300. Previous findings of RHD stroke patients performing close to 2 SD below the mean on the CVLT were not replicated using the CVLT-II. This may be due to the

improved normative database of the CVLT-II. No significant differences on CVLT-II performance were found between those with RHD and LHD or between those with AL and PL. Results suggest that the CVLT-II is not challenging enough to discriminate verbal memory performance based on stroke lesion location. Future research should be directed towards determining if other commonly used verbal learning tests are sensitive enough to discriminate verbal memory performance in stroke patients.

Characterization of Adenosylcobalamin- and PLP-dependent Lysine 5,6-aminomutase from Fusobacterium nucleatum

EME Foyer

Student: Alix PETIT

Supervisor: Kirsten Wolthers

Enzymes that employ radical-based chemistry are able to catalyze a broad array of energetically demanding reactions, including the cleavage of unactivated C-H and C-N bonds. An example of an enzyme that uses radical-based chemistry is lysine 5,6-aminomutase (LAM), which functions in the catabolism of lysine by several anaerobic bacteria. The enzyme uses two cofactors, adenosylcobalamin and pyridoxal-L-phosphate. The former cofactor initiates radical chemistry by cleavage of its Co-C bond. The goal of the research is to determine the substrate scope of LAM, by determining if it acts on different isomers of lysine. Recombinant form of LAM and 3,5-diaminohexanoate dehydrogenase (DAHDH), were cloned from the genomic DNA of Fusobacterium nucleatum, a gram-negative commensal anaerobic organism found in the oral cavities of humans. Both enzymes were expressed in E. coli and purified using affinity chromatography. DAHDH catalyzes the oxidative deamination of 3,5-diaminohexanoate (product of LAM turnover), by transferring reducing equivalents to NADP+, producing NADPH. Thus, DAHDH was used in conjugation with LAM to indirectly measure 3,5-diaminohexanoate by monitoring the production of NADPH at 340 nm. No significant activity was found for either D or L-lysine as substrates using this coupled assay. However, thin layer chromatography (TLC) experiments showed the presence of product after the addition of D-lysine, but not L-lysine. UV-visible spectroscopic assays of LAM showed the formation of external aldimine, and the homolysis of the Co-C bond of AdoCbl upon the addition of D-lysine indicating that the substrate binds to the PLP cofactor and induces homolysis of the Co-C bond. The spectral data also showed formation of cob(III)alamin, which is a characteristic of suicide inactivation. The accumulation of these results indicate that LAM is specific for D-lysine over L-lysine, and further studies using LAM's native substrate, L-B-lysine need to be studied.

Elucidation of the role of Glu338 in mediating cobalt-carbon bond homolysis and hydrogen atom abstraction in ornithine 4,5-aminomutase

EME Foyer

Student: Shaqil RAHEMTULLA

Supervisor: Gino DiLabio/Kirsten Wolthers

Proteins are macromolecules that are abundant in biological systems and play an important role in a number of different bodily processes. An example of protein is an enzyme; enzymes are large molecules that catalyze some really cool, high-energy, chemical reactions, some of which are essential to our survival. In particular, the reactivity of enzymes that use highly reactive radical species during catalysis is remarkable as they are able to break and re-form strong C-C, C-N, and C-H bonds in inert substrates. The ability to catalyze energetically demanding reactions with incredible accuracy and precision makes radical enzymes appealing for the use as biocatalysts for industry, pharmacy, and chemical synthesis in general. In order to harness the power of these enzymes, a detailed understanding of their mechanism of action is necessary. The radical enzyme investigated in this project is known as D-ornithine 4,5 aminomutase (OAM). OAM catalyzes conversion of D-ornithine to 2,4-diaminopentanoate via a 1,2 amino shift. Recently published studies have highlighted the importance of a conserved glutamate (Glu338) residue that may play a significant role in a major step of catalysis in OAM. It has been found experimentally that replacing Glu338 with a Gln, Asp and Ala leads to a progressive decrease in catalytic turnover. The origin of this reduced catalytic turnover and the specific role of Glu338 was explored in this project through a combined computational and experimental approach. The computational work involved employment of quantum mechanical-based DFT methods to simulate a model of the substrate-bound OAM system along with variant enzyme-substrate complexes. The overall potential energy surface and energetics of the reaction mechanism were calculated for the variant enzymes and compared to the energetics of the wild type. By doing so, the role of Glu338 was explicitly determined by analyzing which energy barriers are affected

in the variant enzyme systems. The experimental work involved performing spectroscopic measurements on the primary kinetic isotope effects on kcat (Dkcat) and kcat/Km (Dkcat/Km) on the OAM variants. These measurements helped to elucidate whether or not Glu338 participates in catalysis by lowering the energy barrier for cobalt-carbon bond homolysis and H-atom abstraction. Overall, this work will provide insights in to the fundamental behavior of enzymes that use radicals to catalyze energetically challenging chemistry.

Investigating the Effects of Dietary Fatty Acids in Drosophila

EME Foyer

Student: Lisa RENAUD

Supervisor: Sanjoy Ghosh

Western diets are high in caloric intake and typically contain large amounts of polyunsaturated fatty acids. Fatty acids are categorized depending on the number of double bounds. Monounsaturated fatty acids (MUFA) contain one double bound while polyunsaturated fatty acids (PUFA) contain multiple double bonds. Saturated fatty acids (SFA) have no double bonds. The types of fatty acids and subsequent ratios of fat in our diets have implications on human health. Fatty acid accumulation can lead to chronic diseases such as obesity and insulin resistance by production of oxidative stress precursors reactive oxygen species (ROS). ROS damages important cell constituents including protein and DNA. The link between chronic disease and increased fat consumption has been investigated however the effects of different fatty acids have not been elucidated. It is difficult to determine whether detrimental effects in humans are the result of parent or downstream fatty acids. Drosophila melanogaster circumvent this problem of downstream conversion because they do not produce longer chain fatty acids and therefore are an excellent model for studying the fatty acid metabolism pathway. This study explores the connection between various fatty acids and damage to fat body (equivalent of vertebrate liver) DNA within Drosophila. Flies were fed a particular oil or control diet and then incubated for 12 hours in 85% oxygen at 25°C. Next, the fat bodies were isolated and genetic material was extracted for quantitative polymerase chain reaction (qPCR). Gene expression amplification was conducted on various genes, including superoxide dismutase and insulin-like peptides, with differences shown between the oil fed and control diet groups.

Developing analytical techniques for evaluating diet-induced changes in gastrointestinal sialic acids

EME Foyer

Student: Leona SHUM

Supervisor: Wesley Zandberg

Sialic acids are a family of anionic, nine carbon sugars, that are key components of glycans, and have been implicated in numerous processes affecting human health and disease. The terminal position of sialic acids on glycoconjugates poises them to play critical roles in glycan recognition by glycosidases and lectins of both immune or pathogen origin. The most abundant sialic acid found in nature is 5-N-acetylneuraminic acid (Neu5Ac). Sialic acids bearing an N-glycolyl (5-N-glycolylneuraminic acid; Neu5Gc) or hydroxyl (2-keto-3-deoxy-D-glycero-D-galactonononic acid; KDN) substituent are also commonly observed. Neu5Gc and KDN elevations have been observed in different human cancers and it has been proposed that Neu5Gc accumulation, which is diet-derived in humans, may contribute to the inflammation associated with gastrointestinal (GI) diseases. A major source of chemical diversity among sialic acids is the acetylation of specific hydroxyl groups to form O-acetylated species. Sialic acids are a major component of the mucus protecting the GI tract. The highest levels of O-acetylated sialic acids in the human body are observed in the GI tract; these are thought to prevent the adhesion of some pathogenic bacteria to the GI mucus. The GI inflammation occurring during autoimmune disorders, such as Crohn's disease (CD) or ulcerative colitis (UC), has been correlated with large changes in mucus-borne sialic acid levels. However, little is known about how these disorders affect, or are exacerbated by, the levels of O-acetylated sialic acids. Recent studies in mouse models of CD and UC have revealed that mucus-borne sialic acids regulate the species of bacteria that

colonize the GI tract, impacting host susceptibility to these diseases. Diet is suspected to alter the levels of O-acetylated species present in the GI tract and may therefore impact the risk of developing GI-associated autoimmune disorders. To determine if diet affects O-acetylated sialic acids present on GI mucus, new methods for their chemical analysis have been developed. The preliminary data reveals significant diet-induced changes to the levels of these sialic acids; recent progress will be presented.

The effect of neurosteroids on adult neurogenesis in the goldfish, Carrasius auratus.

EME Foyer

Student: Shane SIMON

Supervisor: Bruce Mathieson

Neurogenesis, the synthesis of new neurons from neural stem cells, is widespread throughout all vertebrates, including mammals. Teleost fish, a general taxonomical classification encompassing goldfish, undergo adult neurogenesis at a rate approximately one to two orders of magnitude higher than that of mammals (Zupanc, 2008). Therefore, optimizing their role to study a manipulation of neurogenesis. Endogenous neurosteroids are thought to influence rates of adult neurogenesis significantly. We are studying a specific, multistep biochemical pathway that yields allopregnanolone, a neurosteroid. Four experimental groups were included in this study, and each were administered different drug injections: finasteride*, indomethacin**, exogenous allopregnanolone (neurosteroid), or a vehicle control. Through BrdU labeling, coupled with immunocytochemistry, cells undergoing neurogenesis in the cerebellum were visualized with confocal microscopy and quantified. Our preliminary results indicate that exogenous allopregnanolone decreases the amount of BrdU labeled cells, and inhibiting allopregnanolone synthesis via indomethacin or finasteride increases the amount of BrdU labeled cells. Thus allopregnanolone decreases neurogenesis in the goldfish brain. This study has proven the importance of neurosteroid influence on neurogenesis; however, future research is needed to identify the mechanism that underlies this process. (*): Inhibits the final step in allopregnanolone synthesis (**): Inhibits the first step in allopregnanolone synthesis

Development of a Traceless Affinity Labelling Technique

EME Foyer

Student: Laura SOUKEROFF

Supervisor: Fred Menard

An important challenge in chemical biology is to label and monitor proteins in their native environment without the use of genetic modification. A general strategy that has been developed is traceless affinity labelling. The method uses a site directed tag release mechanism to selectively bind a fluorescent probe to a protein. The tag-release linker consists of a ligand, linker chain, and a fluorescent probe. In physiological conditions, the ligand will bind to a protein, bring the probe within proximity of a lysine residue on the surface of the protein and chemoselectively react. The ligand will then be cleaved off from the probe and restore the functional, labelled protein. To demonstrate this strategy two molecular models were synthesized and their rate of trans-acylation with free lysine in a buffered water solution was tested and monitored by proton NMR spectroscopy.

Cloning of Transcription Factors Responsible for the Regulation of Expression of the Linalool Synthase Gene in Lavenders.

EME Foyer

Student: Felisha TRUONG

Supervisor: Soheil Mahmoud

Lavenders (Lavandula) have been used traditionally for their essential oils (EO), which serve many uses in cooking and cosmetics, and have significant implications today in medicine for their antiseptic and anti-inflammatory properties. Linalool is a therapeutically relevant biochemical constituent of lavender EO, and the proportion of linalool in the EO is amongst the top criteria for EO that is

considered of "high quality". Numerous research efforts have been made to increase linalool production in lavenders, but with limited success. Linalool production is controlled in part through transcriptional regulation of linalool synthase (LinS), the enzyme responsible for linalool biosynthesis. We hypothesized that lavender plants express transcription factors (TF) that can modulate the expression of the LinS gene. Through analysis of a Lavandula transcriptomics database created by Mahmoud lab, we have identified 17 candidate TF genes that potentially regulate LinS expression. Four of the candidate genes were amplified by polymerase chain reaction (PCR), cloned into bacterial expression vectors (pET41b+), and expressed in E. coli Rosetta cells in order to produce recombinant proteins. A mobility shift assay will next be conducted with the recombinant proteins to verify their binding to the LinS promoter. Binding of TF proteins to the LinS promoter likely indicates regulation of LinS expression, and will be further studied in the future. The results from this study will allow further studies on TF regulation of other critical EO genes in lavenders.

The effects of targeted RNAi gene knockdown on the expression of organic cation transporters in the Malpighian tubules of Drosophila melanogaster

EME Foyer

Student: Molly-Rae WALKER

Supervisor: Mark Rheault

The ability of insects to develop tolerance to pesticides is a growing problem worldwide. As tolerance increases, the concentration and volume of pesticides sprayed on food crops escalates. This can be detrimental to our environment; therefore, research is constantly under way to develop effective and environmentally friendly insect control measures. Previous research has demonstrated that two organic cation transporters, (ORCT and ORCT2), in the renal system of insects, provide a mechanism for pesticide tolerance. To date, only the collective function of these two transporters has been reported. The goal of this thesis was to study gene knockdown of organic cation transporters in the renal tubules of fruit flies, in order to determine the individual contributions made by each transporter. This poster outlines the methods used for gene knockdown in fruit flies, how our data was collected, and the results that were obtained throughout the study.

Sub-Reach Characterization of Alderson Creek to Determine Microhabitats Within a Small Riparian System

EME Foyer

Student: Justine WALKER

Supervisor: Bernard Bauer

Alderson Creek is one of British Columbia's many small stream systems which exhibit unique micro-habitat characteristics at a sub-reach scale. Micro-habitats naturally occur as gradients along creek systems, and are represented by a spatial change in stream conditions. Previously, riparian stream systems have been assessed as one homogenous reach, which results in an over-simplification of a diversely complex system. The principal focus of this research was to employ in situ monitoring methods to carry out biotic and abiotic stream characterization of Alderson Creek at a sub-reach scale, in order to identify the significant habitat boundaries within the system. Through original data collection, the analysis of hypothesized sub-reaches within Alderson Creek were assessed based on biologic, chemical, and riparian vegetation parameters to identify the significance of environmental gradients indicative of microhabitat variation. The 1.5km stream reach was allocated into five sub-reach sections and sampling ensued at 23 benchmark sampling stations from June to December, 2015. A series of macro-invertebrate artificial substrates were deployed at 5 corresponding segments of the creek to monitor the colonization and relative abundance of species Ephemeroptera, Plecoptera and Trichoptera. Statistical analysis of the data indicates Alderson Creek to have a unique combination of habitat character along the stream gradient, represented by a range of biotic and abiotic factors. Spatial and temporal patterns of pH, specific conductivity and temperature conditions, in association with the micro-invertebrate assemblages showed suggestive evidence of internal habitat boundaries. This study proposes that sub-reach characterization of small riparian systems can produce a high resolution correlation to micro-habitat boundary identification.

How might we improve the accuracy of reconstructions of historical environmental conditions?

EME Foyer

Student: Taylor WEIXL

Supervisor: Jason Pither

Biological indicators can be used to infer environmental change over hundreds or thousands of years in the past. This practice requires (i) a calibration dataset that uses contemporary environmental data to characterize indicator species' current environmental preferences and tolerances, and (ii) a transfer function – a model that matches calibrated taxa to fossil community assemblages, and infers historical environmental conditions based on the composition of those assemblages. There are many characteristics of calibration datasets that are thought to influence model accuracy, such as gradient length and the diversity of indicator taxa. However, because in practice these characteristics tend to co-vary strongly, their independent and interactive effects are challenging to quantify. We acquired 9 diatom calibration datasets previously used to reconstruct historical lake pH conditions, encompassing 675 unique taxa and 980 lakes. We used resampling techniques to generate thousands of pseudo-calibration datasets whose attributes (e.g. gradient length, species richness) varied. Using each dataset, we conducted standard reconstructions and recorded a measure of model reliability. Our novel analyses revealed some counter-intuitive results, including that longer gradients yield poorer predictive models. We discuss the important implications these findings have for global change research.

Individual Differences and the Acceptance of Forced Sex

EME Foyer

Student: Iman ZAHIRFAR

Supervisor: Jan Cioe

Sexual assault is a widespread phenomenon. The most common and damaging form of sexual assault is rape, which approximately 1 in 17 Canadian women experience at some point in their lives (Rape Victims Support Network, 2014). The present study replicates and extends research by Giarrusso and colleagues (1979) by examining the individual differences present in those who find forced sex in certain circumstances acceptable. Participants completed a questionnaire about various situations that provided cues or signals that either a male or female wanted to have sex, how a male and a female might behave when they are alone together, and under which circumstances it was OK for a guy to hold a girl down and force her to have sexual intercourse. Individual difference questionnaires, including psychopathy, personality traits, and ambivalent sexism, were also completed. The findings will demonstrate the difference across time in prevalence rates of those who deem forced sex to be acceptable by comparing the rates from the Giarrusso and colleagues' (1979) study to our sample. The findings will further reveal the degrees of ambivalent sexism, psychopathy, and specific personality traits associated with those who found forced sex acceptable. This study will add to the growing body of literature documenting the importance of individual differences in explaining rape against women.