Inquiry at UST:
A Poster Session with the Results of Faculty/Student Collaboration at the University of St. Thomas

Abstracts

Vol. 23
May 13, 2014
Introduction

The abstracts published here summarize some of the most compelling research and creative inquiry carried out in recent months across many disciplines by undergraduate students at the University of St. Thomas. In all cases, the student researchers have worked in close collaboration with faculty mentors who have contributed their time and talent to help our students dig more deeply into topics of the students’ choosing and design.

Funded by the University of St. Thomas through undergraduate research programs administered by the Grants and Research Office, this poster session allows some of our most dedicated scholars an opportunity to share their work with larger audiences and receive the critical scrutiny of their peers, professors, and the general public.

We hope that you enjoy this event and invite you to engage our scholars in ways that will both challenge them and encourage them to continue their journey of the mind.

David Steele, Ph.D.
Director, URCS Program

Vanča Schrunk, Ph.D.
Coordinator, Inquiry at UST

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Lucia Pawlowski, Ph.D., English
May 2014

As president of the University of St. Thomas, I am both pleased and proud to introduce the twenty-third annual poster session devoted to the collaborative projects of our students and faculty, sponsored by the Grants and Research Office.

One of the most effective ways for students to learn is through collaborative inquiry, in which students and faculty work together on research that can have real-world consequences. Active learning of this kind solidly demonstrates our mission as a Catholic university grounded in the liberal arts tradition. We strive to provide a high degree of personal attention in a challenging campus environment that is engaged with the complexities of our urban community and the world beyond.

Collaborative inquiry offers our students the opportunity to experience firsthand their professors’ approaches to research questions in a variety of disciplines. It also gives our faculty an excellent opportunity to understand how students think, helping them to develop new ways of examining research problems. Collaborative inquiry enables our students and faculty to experience their disciplines in action, deepening students’ academic experience while simultaneously increasing career competency.

I heartily endorse this effort, and I hope you enjoy this presentation so aptly demonstrating the importance of collaborative inquiry at St. Thomas.

Sincerely,

Julie H. Sullivan, Ph.D.
President
The *Green Research at UST* badge, sponsored by the UST Office of Mission, identifies research projects that exemplify the UST strategic priority 4 under Catholic Identity:

The University of St. Thomas will cultivate an ethic of environmental stewardship, and will integrate principles of environmental sustainability across the curriculum and in co-curricular activities in order to educate students to appreciate their roles and obtain tools for leadership and innovation in care for God’s Creation.
Rocio Andrade Vera

RELATIONSHIP BETWEEN YOGA BASED EXERCISES ON SELF-OBJECTIFICATION AND CONNECTEDNESS TO NATURE
Faculty Mentor: Dr. Uta Wolfe

Recent studies have discovered that despite the physical benefits of exercise, the type of exercise an individual engages in can be linked to self-objectification. This self-objectification can ultimately lead to negative impacts on an individual’s emotional well-being. The proposed study not only looks at the connection between self-objectification and the type of exercise an individual practices but, explores whether the type of exercise an individual engages in has an impact on the relationship they have with nature. Studies have shown that societal expectations on beauty can isolate women from their natural body and thus impact the connection they have with nature. Practices like yoga focus on the balance of an individual’s mind and body while other cardio-based exercises do not. We continued a study that looked at whether practicing yoga had an effect on self-objectification and connectedness to nature as opposed to practicing cardio-based exercises. We surveyed University of St. Thomas students who took part-time fitness courses at the AARC and students who took full time credit fitness courses. We conducted self-objectification and connectedness to nature surveys on the first week of classes and will continue to conduct post-surveys on the last week of classes. A comparison of these surveys will be made in order to determine whether the type of fitness class an individual participates in has an effect on their self-objectification and connectedness to nature score.

Elizabeth Annoni

POLARIMETRIC IMAGING WITH BIOMEDICAL APPLICATIONS
Faculty Mentor: Dr. Adam Green

Polarimetry is the process of shining light of various polarization states at a target and measuring the extent to which the target alters the polarization. This technique reveals information about the composition of the target that is inaccessible by other types of optical measurements. One application of polarimetric imaging is medical diagnostics. This non-invasive imaging modality can help detect diseases in the early stages. The idea is to image human tissues using polarized light of different wavelengths that can penetrate to different depths, allowing for analysis of surface or subsurface lesions. Normal and abnormal tissues can be distinguished due to the different ways in which they scatter polarized light. For this project, I created a simple, inexpensive polarimeter using a filter wheel containing circularly polarizing film set to analyze all linear and circular polarization states. By choosing special orientation angles of the film, I optimized the signal-to-noise ratio of my measurements. I wrote Mathematica codes to ensure that my optimization scheme was correct. I also wrote LabVIEW codes to automate the data analysis. The simple nature of my polarimeter makes it accessible to undergraduate students and yet broadly applicable in a research setting. I have analyzed standard polarization elements and stress patterns in Plexiglas to calibrate my apparatus. I then used the polarimeter for reflection and transmission imaging tests of raw chicken breast as a simulation of human tissues. My goal is to quantify the tissue’s polarization properties of birefringence, dichroism, and depolarization. I also hope to detect simulated tumors beneath the tissue’s surface. Preliminary results are promising.
Elizabeth Annoni, Sarah Hammad, Nicole Lopez, and Madeline Shogren

COMPARATIVE METHODS FOR THE CLASSIFICATION OF KNOTS IN OPEN CHAINS
Faculty Mentor: Dr. Eric Rawdon

The recent discovery of knotting behavior in proteins has stimulated discussion about how to classify knots in open chains. Topologically speaking, all open arcs are equivalent to a straight line. However, there may still be entanglement present in the open chain that intuitively resembles a knot. The goal of this project is to compare methods for classifying that entanglement. Methods 1 and 2 are from a previous project and close knots using points on a sphere and random arcs respectively. An additional method is being developed to close equilateral open chains using equilateral arcs. This process expands the closures to include arcs that are 1/2, 1, 2, and 3 times the length of the missing edges in the open chain. This process requires the trims to be translated and rotated in order to concatenate the trim and closure forming a closed knot. This project develops efficient processes for all methods and compares them to determine the most precise method for classifying an open knot.

Ryan C. Augustin

FEATURES OF THE RAP1A AND RAP1B CORE PROMOTERS: RECOMBINANT APPROACHES TO TESTING REGULATORY ELEMENT FUNCTION IN EXPRESSION CONTROL
Faculty Mentor: Dr. Jennifer L. Cruise

The RAP1 genes, closely related to the RAS oncogenes, have been shown to have numerous functions, yet little is known about the expression regulation of these genes in human cells. Our lab has constructed plasmids containing putative promoter regions of human RAP1A and RAP1B, driving a gene for green fluorescent protein (GFP). We have transiently transfected these plasmids into a wide-range of human cell types, and analyzed GFP expression via fluorescence microscopy, qRT-PCR, and western blotting. By comparing the efficacy of each putative core promoter segment, some distinct regulatory regions have been revealed. Additionally, comparing promoter-driven expression to the actual native expression of the RAP1B genes in specific cell types has suggested an important regulatory role for enhancer elements not included in the core promoter regions. Various sub-cloning techniques have been employed to add putative regulatory regions to existing GFP core promoter plasmids. These should allow us to further characterize the expression control of the RAP1 genes, and to understand the cell-type differences observed in native RAP1 expression.

Hiwot Ayebu

WASTEWATER EFFLUENTS AS SOURCE OF CONTAMINATION WITH NEUROENDOCRINE CHEMICALS
Faculty Mentor: Dr. Dalma Martinovic-Weigelt

Pharmaceuticals pass through wastewater treatment plants and are now commonly found in aquatic environments due to ineffective wastewater treatment strategies. Over the last five years, a new generation of tools capable of quantifying neuroendocrine activity of complex mixtures has been developed and implemented in the field. This is important because regulation of endocrine function in fish involves neurotransmitters and these mixtures can drastically affect aquatic organisms by disrupting the normal functioning of their neurotransmitters. This study investigated effects of the single chemicals (atrazine) and effluents on monoamine–oxidase (MAO) associated signaling and pathways. MAO
is of special interest due to the fact that in fish it catabolizes dopamine, which inhibits luteinizing hormone release and suppresses reproduction. For fish assay, total protein was extracted from goldfish brains, and incubated with either whole WRP effluent samples (n=5) or solid-phase extracted WRP effluents in 1% methanol (n=5) from the greater Chicago area. A MAO-Glo assay (Manufacturer name, State, country) was used to detect MAO activity. The WRP effluent samples were found to suppress fish MAO activity. The observed interference with MAO could impact reproductive success of exposed fish and warrants further investigation.

Christopher D. Baldwin and Joseph M. Spitzer

ANALYZING KNOTTING IN FOLDED PROTEINS
Faculty Mentor: Dr. Eric J. Rawdon

Only in the past 20 years have researchers discovered knotting in proteins. Still much is to be understood about their significance. The latest research suggests that knotting in protein chains is critical to their cellular function. We continue work to discover knots in the latest proteins deposited into the Research Collaboratory for Structural Bioinformatics (RCSB) protein data bank with the hopes of understanding why some proteins contain knots and slipknots. We provide background on how to classify knotting in open chains (like proteins) and show the results of our latest search for knotted proteins.

Priscila Barron Sanchez

COMPROMISING LAW: A PILOT STUDY OF ATTORNEYS’ ATTITUDES ON IMMIGRATION LEGISLATION
Faculty Mentor: Dr. Meg Wilkes Karraker

This study examines attorneys’ political preferences between liberal and conservative, the correlation of political preferences with their legal specializations, and their political preferences’ effects on their attitudes towards immigration and its legislation. This paper poses the hypothesis that immigration attorneys are more liberal than their non-immigration specializing counterparts. The random sample used consists of three immigration and three non-immigration attorneys drawn from a University of St. Thomas provided online database of alumni practicing law in the Twin Cities-Metro Area of Minnesota. The study conducted uses mixed methods consisting of individual face-to-face interviews and online surveys. A Likert-type scale was used to measure attorneys’ attitudes towards immigration and government. Semi-structured questions allow for elaboration of opinion.

Marissa Beckers

TIDAL DEBRIS IN INTERACTING GALAXY PAIRS
Faculty Mentor: Dr. Elizabeth Wehner

Studying galaxies can be quite amazing, especially with the help of a powerful telescope. Over spring break, we took a trip to the sunny state of Arizona where we used the WIYN 0.9 meter telescope at Kitt Peak National Observatory to collect images and data of distant galaxies. The main component for receiving images from the telescope is an imaging camera called the Half Degree Imager (HDI). Setting the telescope to follow guide stars throughout the night allowed us to take longer exposures in order to obtain clearer images of distant objects in space.

We looked at various objects in space including a pair of galaxies that are currently in the process of colliding with one another. By analyzing multiple sets of galaxies in different phases of collision, we can pinpoint interaction patterns
that will help explain some of the physics behind the behavior of interacting galaxies. Here we discuss our observations and data collection. This summer, I will be taking a closer look at the collected data from Kitt Peak and studying the behavior of these galaxies from a physics standpoint.

Megan Beetch

MITOCHONDRIAL FUNCTIONALITY ASSAYS TO INVESTIGATE EFFECTS OF MUTATION ACCUMULATION ON LINEAGES OF A FRESHWATER SNAIL
Faculty Mentor: Dr. Jennifer Cruise

Increased mutation burden in the mitochondrial genomes of asexual lineages of Potamopyrgus antipodarum may at least partly explain the success of sexual forms, despite evolutionary costs (Neiman, 2010). Our previous experiments found lineage-specific differences in mitochondrial charge gradient strengths, indicating a genetic basis for the observed variation. To explore this hypothesis, we performed additional assays to examine other aspects of mitochondrial physiology.

In MTT-reduction assays of isolated snail mitochondria, electrons from the electron transport chain (ETC) reduce MTT, (3-(4,5-dimethylthizol-2-yl) diphenyltetrazolium bromide), quantified as A$_{570}$/ug mitochondrial protein, showing us how well the ETC is functioning. Pyruvate from glycolysis appears in the cytoplasm. In snail preps with poorer-functioning mitochondria, if pyruvate transport is held constant, we expected pyruvate to be converted to lactate and to build up in the cytoplasm, rather than entering into the citric acid cycle in the mitochondria. We used an enzymatic assay to measure lactate/ug cytoplasmic protein.

MTT reduction appears less sensitive than our measures of charge gradient strength, but the measures appear significantly correlated. Lactate results have not been so clear-cut. Sexual lineages hint at a negative correlation with both previous assays, but not across all lineage groups. Investigation of other energy storage forms is planned.

Joshua Bohl

ANALYZING THE VOLCKER RULE’S IMPACT ON COMMERCIAL BANKS
Faculty Mentor: Dr. Dale Thompson

A principal goal of the Dodd-Frank Act is to limit risk to prevent the recurrence of financial crises, like the one in 2007-2009. One part of this Act is the Volcker Rule. The Volcker Rule prohibits banks from engaging in proprietary trading, or banks using their own money to make a profit based on short-term price movements. As a result of the Volcker Rule, banks will face higher compliance costs stemming from more regulatory reporting and documentation. Because of this extra regulatory burden, there may be a decrease in competition in the marketplace as some larger banks are buying, or merging with, smaller banks. With the Dodd-Frank Act, Congress wants to eliminate the perception that banks are “too big to fail,” but one of its unintended consequences may be that banks are actually becoming bigger in size at the expense of smaller banks that are “too small to succeed.”
Jessica A. Bremseth

A COMPUTATIONAL MODEL OF THE COMPOSTING PROCESS
Faculty Mentor: Dr. Paul R. Ohmann

There has been a great deal of interest in composting as a means of recycling resources. In order to best understand composting, it is helpful to build computer models of the process. Over the last 30+ years, many models have been developed that simulate composting, with varying assumptions and results. Our particular computational model will incorporate the major physical, chemical, and biological processes along with experimental measurements appropriate for urban composting. We then hope to use what we have learned to optimize composting in urban environments, such as in our local Twin Cities community.

Katie Christophersen

SMOOTHING THE TRANSITION TO ADULTHOOD: CREATING ONGOING SUPPORTIVE RELATIONSHIPS AMONG FOSTER YOUTH
Faculty Mentor: Dr. Ande Nesmith

This project assesses the utility and effectiveness of a foster care model designed to improve youth transitions to adulthood. The model engages the youth’s social network, helps youth to develop supportive, ongoing relationships with adults, and is heavily focused on youth empowerment. A three-year evaluation of 88 foster youth revealed that youth exposed to the model felt they had more power over their lives, had a wider variety of supportive adults in their lives, and could better regulate their emotions than those in a comparison group.

Nick Cipoletti and T. J. Firkus

NITRATE ALTER STEROIDOGENESIS IN FATHEAD MINNOWS (PIMEPHALES PROMELAS)
Faculty Mentor: Dr. Dalma Martinovic-Weigelt

Nitrates (NO$_3^-$) have been shown to function as endocrine disruptors in fish, but mechanisms of disruption are poorly elucidated. Mammalian studies indicate that nitrite and nitrate are metabolized to nitric oxide, which binds heme in cytochrome P450 enzymes, thereby impacting steroidogenesis. This project examined whether short term exposure to waterborne nitrates can alter expression of genes involved in steroidogenesis and estrogen signaling, the process essential for reproduction in fathead minnows (Pimephales promelas), by examining changes to ER(estrogen receptor), CYP19(aromatase), 3-HSD(3-hydroxysteroid dehydrogenase), CYP11a, and StAR(steroidogenic acute regulatory protein). Male and female minnows were exposed to environmentally relevant concentrations of nitrate (5 mg/L and 25 mg/L sodium nitrate) for 96 hours, after which fish were euthanized using 0.1g MS-222 and liver samples collected. Total RNA was extracted from livers (TRI method) and 1-step RT PCR (real time polymerase chain reaction) was used to evaluate mRNA for above genes. Delta CT method was used to quantify relative changes among control and treated fish. CYP11a was down-regulated, but not significant, and CYP19 was up-regulated in males (One sample t-test, p < 0.05). In females both CYP11a and StAR were up-regulated, however not significantly (One sample t-test, p < 0.05). CYP11a is responsible for the synthesis of cholesterol and other steroids, CYP19 is involved in the final steps of converting androgens to estrogens, and StAR is responsible for cholesterol transfer. These changes in steroidogenic enzymes could lead to/reflect changes in sex steroid concentrations as well as potential alterations to sex steroid based processes, such as reproduction.
Cassie Clark

RATE OF PETROLEUM HYDROCARBON BIODEGRADATION IN ANOXIC WETLAND SEDIMENT WITH THE ADDITION OF COMMON CO-CONTAMINANTS

Faculty Mentor: Dr. Jennifer McGuire

Our long-term research goal is to evaluate the biodegradation rates of crude oil constituents, specifically BTEX compounds (benzene, toluene, ethylbenzene and xylene). Given the widespread use of ethanol as fuel and nitrogen as fertilizer, it is essential to understand the effects of combined BTEX-ethanol and BTEX-ethanol-nitrate releases on the biodegradation rates of crude oil. *In-situ* experiments conducted in 2012 indicated that ethanol acts as a solvent to BTEX, increasing its mobility and stimulating the microbial population, but the length of the experiment was not enough to fully assess this potential. These microcosm studies were designed to assess the impact of ethanol and nitrate as co-contaminants on the biodegradation of BTEX compounds over a six-month period. Specifically, these tests were designed to evaluate: *is the rate of biodegradation of crude oil in wetland sediments enhanced or reduced by the addition of ethanol or nitrate as co-contaminants?* Deep and shallow wetland sediments collected from the National Crude Oil Spill Research site in Bemidji, MN were homogenized in an anaerobic atmosphere and placed into 10 glass vessels. Water taken from the contaminated aquifer was augmented with 500µg/L BTEX, ethanol (1000 µg/L) and/or nitrate (100mg/L) in various combinations. Changes in the rate of CO₂ and CH₄ generation were measured hourly for six months to identify activity patterns between tests. Analysis of respiration rates showed that the presence of both ethanol and nitrate had a positive impact on the rate, but the dominant control was sediment depth. In experiments with shallow sediment, CO₂ generation rates were consistently 40-60% higher than those with deep sediments, likely due to the shallow sediments having approximately 50% more organic matter. The combined presence of ethanol and nitrate enhanced BTEX attenuation rates most effectively, producing increased rates of 0.25µL/hour in shallow and 0.15µL/hour in deep sediments.

Garen David

THE “GO-GO G-OHH” PROJECT: THE PROCESSING AND FABRICATION OF GRAPHENE AND GRAPHENE OXIDE AS AN ENABLING CAPABILITY

Faculty Mentor: Dr. Greg Mowry

Graphene is a two-dimensional mesh of carbon atoms in a one-atom thick hexagonal honeycomb pattern. This arrangement of carbon atoms exhibits properties that have the potential to revolutionize the landscape of energy production, electronics manufacturing, chemical processing, and many other disciplines.

This research grant has given us the opportunity to attempt to develop and improve upon the existing methods of processing graphene. This grant also enabled experimentation on the fabrication process of graphene in the labs here at St. Thomas with initial preliminary studies on the properties of the materials we produce. The objective was not only to improve upon the current fabrication process of graphene, but also to produce graphene in a cost effective way. Graphene is currently available at a price of around $5000 for a sheet the size of a standard piece of printer paper, which limits the ability to experiment. Having the ability to fabricate our own graphene would enable us to research on its application in the areas of chemistry, sustainable energy and water purification. The main faculty advisor is Dr. Greg Mowry. We also collaborated with Dr. Tom Ippoliti of the Chemistry Department.
Evan A. Eklund

SUPRAMOLECULAR GUANINE-RICH QUADRUPLEXES AND THEIR TRANSFECTION INTO MAMMALIAN CELLS
Faculty Mentor: Dr. Thomas C. Marsh

Guanine-rich sequences in genomic DNA can adopt quadruple helical structures, known as G-DNA, that are associated with the maintenance of chromosomal stability. G-DNA forming sequences are located at the telomere as well as proximal to promoters of known oncogenes. The presence of G-DNA in these locations interferes with neoplastic transformation. The potential for G-DNA stabilization to serve as an anti-proliferative mechanism is of great interest. The worked described here utilizes a supramolecular G-DNA (G-wire) that is self-assembled from a guanine rich oligonucleotide (GRO) as a potential decoy molecule that would disrupt normal cell function. G-wires possess nanoscaffolding properties that allow for external modification and the creation of potential novel carrier molecules. Recently, the conditions for introducing G-wires into a mammalian cancer cell line have been identified. Current work is underway to quantify the cellular uptake, dispersion, and proliferative response of effected cells.

Taylor L. Fischer

REDUCTASE FUNCTION OF TRI1 REDUCES SENSITIVITY TO TRICLOSAN IN ESCHERICHIA COLI
Faculty Mentor: Dr. Justin J. Donato

A novel resistance gene named tri1 was recently discovered that confers reduced sensitivity to the antibacterial triclosan when expressed in Escherichia coli, but the molecular basis for this ability has not been determined. Based on its amino acid sequence, the Tri1 enzyme is hypothesized to be an enoyl-CoA reductase, likely capable of acting as an alternate step within fatty acid synthesis in place of FabI, the triclosan-sensitive enoyl-ACP reductase more commonly found in bacteria. After cloning, expression, and purification from E. coli, the ability of both wild-type and mutant Tri1 to act as the predicted reductase and reduce crotonoyl-CoA was tested in vitro. Wild-type Tri1 was able to reduce crotonoyl-CoA while the mutant lacked such ability. Tri1 was also tested in vivo by insertion into a fabI temperature sensitive mutant to determine whether Tri1 can functionally replace FabI within living cells. Upon testing, wild-type tri1 was able to rescue the temperature-sensitive strain while the mutant was not. Together, these studies suggest that Tri1’s ability to confer resistance is rooted in its function as an enoyl-CoA reductase, and furthermore, that Tri1 is capable of providing an alternate route through fatty acid synthesis.

Matthew Folstad and Daniel Kremer

INVESTIGATION OF NOVEL PINCER LIGANDS TO SENSITIZE LANTHANIDE (III) LUMINESCENCE
Faculty Mentor: Dr. Marites Guino-o

Lanthanide luminescence is known for its sharp and easily recognizable peaks in the visible and near-infrared ranges. Consequently, they are becoming increasingly popular for use in binding tags for studying proteins, polymer doping, and dyes. Our goal is to increase the quantum yield for lanthanide luminescence by synthesizing a novel pincer ligand that will sensitize the metal-centered luminescence, and stabilize the metal center. Herein, we report our preliminary results of the successful synthesis of Ln3+ complexes with a novel pincer ligand.
Danielle Francen

QUANTIFICATION OF FREE POLYMER ASSOCIATED WITH THE FORMATION OF POLYMER-DNA COMPLEXES
Faculty Mentor: Dr. Lisa Prevette

Gene therapy requires the delivery of foreign DNA to cells. Cell penetrating compounds (CPCs), such as Tat peptide, polyethyleneimine (PEI), and polyamidoamine (PAMAM) dendrimer, are polycations that have been shown to facilitate DNA delivery through the formation of polymer-DNA complexes defined by specific +/- charge ratios. At each charge ratio (+/- 10, 5, and 1) a different amount of “free” polymer is present. Using the 2,4,6-trinitrobenzencesulfonic acid (TNBS) assay for amine concentration, free polymer present after complexation and separation by ultrafiltration was quantified. It was found that both Tat peptide and PAMAM dendrimer follow expected trends of complex stoichiometry being approximately 1:1. Due to the long, linear structure of PEI, a new separation method, size exclusion chromatography, was used to determine the amount of free PEI present after formation of the PEI-DNA complexes. It was found that the TNBS assay is not an appropriate way to quantify secondary amines associated with PEI. Further studies will utilize Copper (II) ions to create a cuprammonium complex with the secondary amines of PEI which will be quantified using UV-spectrophotometry at 285 nm.

Julia Frebault and Ryan Merry

PROTEIN CHANGES ASSOCIATED WITH WINTER RECOVERY IN WHITE PINE AND WHITE SPRUCE
Faculty Mentor: Dr. Amy Verhoeven

During the wintertime, low temperatures cause a seasonal interruption in photosynthesis, but there is continued intake of light energy. To cope with the excess light as a result of halted photosynthesis, evergreens, such as pine and spruce trees, dissipate light among the energy-harvesting photosystems. Proteins comprising the photosystems (PSI and PSII) are thought to change in abundance to accomplish energy dissipation for photoprotection. Protein levels must be later restored for recovery from winter stress to resume photosynthesis. This study measures changes in abundance of photosynthetic proteins as a result of recovery from high light winter conditions in pine and spruce trees. To determine how quickly and in what quantity proteins return to recovered condition, Western Blot protein analysis was performed on pine and spruce tissue samples through recovery from sub-zero winter conditions. While this study is not complete, variations in recovery of different photosynthetic proteins have been noted. Photosynthetic efficiency (Fv/Fm) measurements indicated a quicker recovery by spruce species in comparison to a slower recovery by pine trees. No significant correlation between Fv/Fm data and protein abundance changes have been observed, but clear increases in abundance of PSII core protein D1 and light harvesting protein Lhcb1 have been observed, while other light harvesting proteins are maintained at high levels, suggesting differing roles in light dissipation processes. Experimental replicates and comparison to early winter recovery data are in this study’s future to better understand recovery kinetics.
AGGRESSIVE ENCOUNTERS OF A RECENTLY FORMED BACHELOR GROUP OF CAPTIVE WESTERN LOWLAND GORILLAS
Faculty Mentor: Dr. Sarah Hankerson

Recent pressure from conservation activists has resulted in zoos creating all male gorilla “bachelor” group, a social state which is not seen in the wild. Animal behaviorists have raised concerns about aggression among males while establishing dominance hierarchies and the long-term stability of the male-male relationships. Our research included observation of a bachelor group of Western Lowland Gorillas at the Como Zoo in St. Paul, Minnesota, composed of three adult males. During our 34 hours of observation, we documented 83 aggressive encounters, a rate of 2.4 per hour. These events averaged 13.19 seconds each and were largely comprised of displacement events. A displacement event can be defined as the approach of one individual causing another individual to shift position away with no direct behavioral interaction. Only two of the aggressive events were followed by reconciliation. The male gorilla’s recent move outdoors did not show a difference in the number of aggressive encounters, a rate of 2.3 per hour. However, only 3 hours of observation was taken outdoors due to the weather conditions. Our results show the bachelor group at the Como Zoo to be relatively stable and non-aggressive. These findings indicate the viability of preserving long-term genetic diversity in the captive gorilla population through the establishment of bachelor groups in zoos.

VALIDATION OF A MATHEMATICAL MODEL OF MICROFILM FORMATION IN ATOMIZATION COOLING OF MICROMACHINING
Faculty Mentor: Dr. John Wentz

In order to have an effective machining process, microtools must have sufficient cooling and lubrication and the metal chips should be easily evacuated from the cutting zone. Traditionally, flood cooling is used for this purpose. However, these methods cannot be used in micromachining. Therefore atomization-based cooling systems have been used to coat the tool in a microfilm. This research used a high-speed camera system to gather experimental data about the formation of a microfilm formed on a rotating cylindrical surface, similar to a tool geometry. Based on the data, a previously published mathematical model for microfilm formation was validated and a maximum speed for the delivery tube air was determined.

HIDDEN NARRATIVES IN WRITING CENTER CONSULTATIONS: THE EFFECTS OF PERCEIVED DIFFERENCE
Faculty Mentor: Dr. Susan Callaway

The objective of college writing centers is to foster critical thinking skills to encourage students to improve their writing. Writing centers are concerned with the writing process, not the final written product. Therefore, it is very difficult to evaluate the “success” of writing consultations on student writing development. Furthermore, writing consultants must develop rapport with writers to cultivate trust to create fruitful writing consultations. However, rapport may be difficult to develop if consultants and writers must negotiate perceived difference, which may include cultural, age, and gender differences. I hypothesize that perceived difference between writers and consultants may affect the success and satisfaction of the consultation. This research project used a mix-method to identify areas of perceive difference and narratively describe the effects of difference on the success of writing center consultations. I
analyzed perceptions of writers and consultants and hopefully conclude by proposing measures whereby writing consultants, tutors, and instructors can bridge the gap of perceived difference to facilitate successful collaborations.

Shannon Heitkamp

WRITING ACROSS CULTURES: INTERNATIONAL STUDENTS’ LITERACY NARRATIVES
Faculty Mentor: Dr. Susan Callaway

This paper examines international students’ writing, reading, and communicating across disciplines at the university level. International students are a growing percentage of students who use our university’s writing center; testimonials or literacy narratives from international students serve as invaluable resources to describe reading and writing challenges. This study gives international students a voice to express their educational challenges and achievements through interviews. Analytic induction was used to analyze the interviews to uncover meaningful patterns and themes expressed by students. I conclude by proposing measures whereby our university writing center and others who support ESL students can implement.

Jackie Heitzman

NEUROENZYMATIC ACTIVITY OF MONOAMINE OXIDASE AFTER EXPOSURE TO MINNESOTA AND CHICAGO RECLAMATION PLANT EFFLUENT
Faculty Mentor: Dr. Dalma Martinovic-Weigelt

Water reclamation plant (WRP) effluents are one of the most important points of entry of neuroendocrine-active pharmaceuticals (NAP) to the aquatic environments, from which they can enter drinking water supply. NAPs typically occur in mixtures and together with their metabolites and other pharmacologically active compounds. Many NAPs have similar modes of action, resulting in possible additive effects. Monoamine oxidase (MAO) modulators are of special interest as they have potential to alter availability and metabolism of serotonin and dopamine, both of which play an important role in regulation of fish behavior and reproduction. This study investigated potential of commercially available MAO luminescence assays for quantifying total MAO-activity of complex environmental mixtures such as WRP effluents. For the mammalian assay, purified MAO-A enzyme was used and whole WRP effluent samples (n=8) were tested either alone or spiked with clorgyline (MAO inhibitor). A modified MAO-Glo assay (Promega, WI, USA) was used to detect MAO activity. The WRP effluent samples were found to suppress the in vitro mammalian MAO activity relative to the control water samples. The assay was found to be capable of detecting environmentally relevant concentrations within a complex environmental matrix such as effluent. We are currently working on the optimization and validation of in vitro based MAO-activity assay and plan to evaluate whether it is sufficiently sensitive for quantitative assessment of MAO activity in environmental samples. Furthermore we plan to use this assay to generate data about species-specific activity.
Andrew Hornik

HIGH RESOLUTION CHIRAL REFRACTOMETRY
Faculty Mentor: Dr. Adam S. Green

Chirality is an attribute of molecules often used for identification. Every chiral molecule has a direction and degree of chirality. Both direction, also known as handedness, and degree can be measured using light. The first method I used for measurement uses polarized light, and measures the optical rotation or degree of chirality. There are two systems that can do this, one using two crossed linear polarizers, and another using an opto-electric device known as a photoelastic modulator. The crossed polarizer method can measure the degree of rotation to within 0.02 degrees, and the photoelastic modulator can measure to within 0.001 degrees. Unfortunately both of these methods rely heavily on optical path length. A third method of measurement presented in the paper this research is attempting to replicate uses refractometry instead of polarization. Unlike the first two methods refractometry relies only on boundary conditions and refractive indices. This method also has the potential to measure degree of rotation to within 20 micro degrees or better. Ultimately the goal of this research is to measure the concentration and handedness, using the degree of optical rotation, of very small samples of chiral molecules such as glucose. This has applications in the classification of new molecules as well as a non-invasive way to measure blood sugar content in diabetics.

Emily Hurd

CROME YELLOW: A CRITICISM OF LOVING FLOWER TO FLOWER
Faculty Mentor: Dr. Emily James

Little research and criticism has been published regarding Aldous Huxley’s first novel Crome Yellow. Of what little writing is published regarding the novel, nearly all of it concerns Huxley’s satirical political and economic social commentary of the intellectual and artistic elitist circles during the early modernist period in England. However, Crome Yellow examines more than just the goings-on of the British elite; the novel makes powerful commentary on Huxley’s concerns about the modern practices of sex. This is where my research will be focused—my paper will be on the critical analysis and explication of Huxley’s criticisms on the sexual norms of his day in his novel Crome Yellow. I will work to better understanding Huxley’s considerations of sex and modernism and put that in conversation with research of society’s changing sexual norms after the turn of the twentieth century. I will analyze two different sexual sub-plots in Crome Yellow, each promoting a modern conception of or technology regarding sexuality; however as Huxley unfolds the storylines, each scenario comes to a seemingly more damaging end than was expected. These scenarios are: Scogan’s promotion of dissociation of love from propagation (i.e. birth control) and Mary’s obsession to release her uncontrollable sexual repressions. In both of these cases, the character upholds a modern belief of sexuality which Huxley shows is liable to sexual perversion, emotional harm, and exploitation.

Maxine Johnson

A PILOT STUDY: EFFECTS OF A FIRST-PERSON NARRATIVE ON BELIEFS ABOUT PROSTITUTION
Faculty Mentor: Dr. Roxanne Prichard

Prostitution is widespread in the United States. Perceptions about prostituted females are largely negative and these negative, stereotypical beliefs likely influence how prostitutes are treated by legal and social service systems. In order to better understand what beliefs people hold about prostituted women and whether these beliefs can be changed, we surveyed the community about their perceptions before and after they watched a short first-person narrative from prostituted women. This study hypothesized that initial beliefs would be negative and that by using a first-person
narrative, we would be able to change them into more compassionate or empathetic beliefs. An online, anonymous survey composed of qualitative and quantitative questions was used to measure beliefs before and after the first-person narrative was shown. Seventy-eight participants fully completed the survey. Preliminary quantitative results suggest that after viewing a short, three minute first-person narrative, people have a more empathetic view towards prostitutes. This research has implications for local organizations trying to find what current beliefs are held about prostituted women so that they may potentially decrease the stigma that may be held.

Jacqueline Kapla

QUANTIFYING CULTIVABLE ANTIBIOTIC-RESISTANT BACTERIA IN SURFACE WATERS
Faculty Mentor: Dr. Kristine Wammer

Bacterial resistance to antibiotics is an emerging issue of concern. Overprescription and misuse of antibiotics has led to their increasingly frequent detection in the environment, especially in local waterways. Antibiotics can select for resistant organisms and this could become potentially dangerous for human health. The goal of this study is to identify and quantify cultivable antibiotic-resistant bacteria from multiple sampling sites in the Minnesota and Mississippi Rivers in order to determine whether antibiotic resistance impacts surface waters. For the first phase of this study, which occurred on the Minnesota River, bacteria resistant to four antibiotic classes were isolated from surface water samples. Four classes (fluoroquinolones, tetracyclines, macrolides, and sulfonamides) commonly used by humans and in agriculture were targeted. The results from Phase I suggest that wastewater treatment plants are the main contributor of antibiotic-resistant bacteria to the environment in the study area. Phase II of this study is focused on bacterial resistance to antibiotics in the Mississippi River, a major source of local drinking water. Tap water samples were also tested to compare the amount of antibiotic-resistant bacteria in drinking water to the source water. Based on the results from Phase I, the targeted antibiotics were chosen because of their high use in human medicine. Results will be presented for the classes of antibiotics researched in Phase II, which include -lactamases, dihydrofolate reductase inhibitors, fluoroquinolones, sulfonamides, and macrolides.

Tamnet Kidanu

CONSONANCE AND DISSONANCE: EXPLORING THE EXPERIENCES OF HEALTH EDUCATORS TEACHING SEXUALITY CURRICULUM
Faculty Mentor: Dr. Sarah Sevcik

This study explores whether there is an incongruence between sexuality curriculum being taught and the material health educators’ within the Twin Cities metro area of Minnesota believe are relevant to their students’ needs, adding to the currently limited research on the perspectives of health educators teaching sexuality curriculum. An email was sent to fifty health educators with a link to a survey and an invitation to participate in individual interviews. There were thirteen respondents to the online survey and four participants for the interview. The researcher found there was incongruence between the current sexuality curriculum being taught and the preferences of health educators, in terms of time and curriculum needs.
Shannon Koester
ENVIRONMENTAL ISSUES AND SOCIAL WORK
Faculty Mentor: Dr. Ande Nesmith

This research project focused on the connections between social work and the environment. This research project involved conducting individual interviews of social work students in order to see what they knew about environmental problems, how they thought environmental problems impact their social work careers, and if they thought incorporating environmental issues into the social work curriculum would be beneficial for their future careers. The results from the interviews showed that social work students did not know very much about environmental issues, but they felt like these issues impact their clients and their work as social workers.

Rebecca Kramer
THE EFFECTIVENESS OF DOMESTIC ABUSE SHELTER INTERVENTIONS IN THE MIDWEST IN REDUCING SYMPTOMS OF TRAUMA IN MOTHERS AND THEIR CHILDREN
Faculty Mentors: Dr. Canan Karatekin and Dr. Lisa Waldner

There is a distinct lack of evidence that services provided for mothers and their children, residing in domestic violence shelters are effective. The purpose of this study is to evaluate the effectiveness of two shelter programs aimed at families exposed to domestic violence located in the Midwest. My main question is to what extent are the needs of women and children being met by the end of their shelter stay? Second, to what extent do these programs reduce symptoms of trauma in women and their children? Third, to what extent do these programs enable the mothers to adopt healthier attitudes regarding relationships by the end of their shelter stay? Fourth, to what extent is one shelter's programming more effective than the other? This research is ongoing. Results indicate, thus far, that before entering the shelter, woman express more problems in general (specifically about their abuser or confusion of what to do). After going through the shelter program, the women reported less confusion: “I need to find a lawyer” versus “I am worried about getting custody of my children” and generally had less problems and more self-assurance.

Lindsey Landgraf
A TEENAGE GIRL'S VOICE BEHIND WHAT INFLUENCES HER CLOTHING CHOICES
Faculty Mentor: Dr. Ande Nesmith

The current situation for girls today is that seven out of ten believe that they are not good enough or don’t measure up in some way, including their looks. Supported by past research, the struggle of teenage girls today is defining their deep identity and expressing it outwardly. Clothing is one way that girls express themselves and their image outwardly. Research is the past has not spoken directly to teenage girls about the problems that they face. Thus, I developed my research around focus groups. I wanted to hear what the girls had to say about this issue. Their thoughts are not only surprising but express much truth.

Understanding the struggles of teenage girls is a two-part process. First, you must allow them to define the issue. I asked the girls, how do you see the issue? Responses ranged from trying to fit in with others to being the hardest critiques on themselves. Second, give them space to define the solutions. What does it mean to be confident? To love who you are and to let that shine was one such answer. What a girl wears says something about who she is at the core: her heart, what she honors, and her personality. It is important to ask girls questions and allow them to figure out the solutions on their own. How would you describe your clothing? Let them think about how they define themselves.
because a girl’s clothing is her own just like her identity. The result is girls knowing what is already there, being authentic, and ignoring pressures to conform. In other words teenage girls learn to be independent and dress for themselves, not others. And ultimately this transformation shines onto other girls and encourages them to outwardly express their true selves.

Hannah Larsen

STABILIZING THE 1:1 (LA:SR) ALLOY IN EPITAXIAL LA(2-X)SRxCuO4 FILMS
Faculty Mentor: Dr. Brittany Nelson-Cheeseman

Layered perovskites are a promising new material for use in thermoelectrics to fuel cells. Layering cations with different charges, instead of the normally alloyed cations, creates local electric fields which change bond lengths and angles, which in turn can create novel properties in the material. In order to create these layered materials, it is essential to be able to stabilize a 1:1 ratio of the La$^{3+}$ and Sr$^{2+}$ in La$_{(2-x)}$Sr$_x$CuO$_4$ in order to maximize the difference in charge between the layers. Due to a lack of literature in films where x > 0.5, it is essential to determine the outcome of introducing Sr up to a 1:1 ratio. Films were grown 10 unit cells thick in an oxygen rich Molecular Beam Epitaxy (MBE) chamber. Using this method, films can be grown one atomic monolayer at a time. Analysis of the samples was done using X-ray diffraction (XRD) and X-ray reflectivity (XRR) to determine the crystalline structure and the c-axis lattice parameter. Atomic force microscopy (AFM) was used to examine the surface of the samples and measure the average surface roughness (RMS value). A trend of a decrease in crystallinity and an increase in surface roughness was found with increasing Sr content. The c-axis lattice parameter peaked at x = 0.25 due to competing effects of the cation sizes: Sr > La, but Cu$^{2+}$ < Cu$^{3+}$. Future directions include studying the effects of growth temperature and growth order on film crystallinity, roughness, and the c-axis lattice parameter.

Sherry Le

THE STUDY OF XYANTHOPHYLL AND ANTHOCYANIN PIGMENTS IN OAK (QUERCUS) AND MAPLE (VIBURNUM ACERIFOLIUM) TREES
Faculty Mentor: Dr. Amy Verhoeven

During autumn senescence, the leaves of oak (Quercus) and maple (viburnum acerifolium) trees go through a highly regulated programmed cell death that involves the remobilization of nutrients (Keskitalo et al. 2005). The chlorophylls and their carotenoids are broken down and remobilized back into the tree, leaving the leaf looking yellow or red depending on species. The yellow color has been linked to the retention of xyanthophyll pigments, while the synthesis of the red color is thought to show the presence of anthocyanin in the leaf (Lee et al. 2003). Because of this, xyanthophyll and anthocyanins are they are thought to have a photoprotective function. Studies have shown that these pigments may be specie specific, as xyanthophyll are found mainly oak, and anthocyanins in Maple trees during senescence. The results show that anthocyanin is in present in maple leaves, and very little in Oak leaves throughout senescence. Through HPLC, levels of xyanthophyll pigments were observed higher in oak leaves than maple; which was expected.
Sarah McNamara

OPTIMAL FORAGING AND BIOENERGETICS ANALYSIS OF COREGONUS ARTEDI AND IMPLICATIONS OF CLIMATE CHANGE
Faculty Mentor: Dr. Kyle Zimmer

Coregonus artedi are a species of cold-water fish found in Minnesota that live in habitats with high levels of dissolved oxygen. Cisco are extremely vulnerable to climate change because the warming temperatures and eutrophication are decreasing the good quality habitat in lakes. The warming temperatures will also change the metabolism of the fish and make it more difficult to survive. I combined optimal foraging and bioenergetics models to assess how water temperature and variability in prey might impact growth rates and survival of cisco. Model inputs included water temperatures, prey size, prey density, and size of cisco we’ve observed in Minnesota lakes with cisco populations. Results showed that cisco are very sensitive to changes in prey abundance and water temperature, especially in larger fish. Moreover, cisco require multiple prey types when their preferred prey (Daphnia) are at either low abundance or small body size. However, lack of oxygen in the deep water areas of some lakes may restrict their ability to find alternative prey. This suggests that summer die-offs of cisco in some Minnesota lakes may be due in part to energetic constraints due to insufficient access to prey.

Ryan Merry and Julia Frebault

KINETICS OF RECOVERY FROM WINTER STRESS IN EASTERN WHITE PINE (PINUS STROBUS) AND WHITE SPRUCE (PICEA GLAUCA)
Faculty Mentor: Dr. Amy Verhoeven

During cold periods evergreen trees maintain low levels of photosynthetic capacity due to low temperature inhibition of chemical reactions within the cell. During these times light that is normally harvested for photosynthetic reactions is dissipated to protect cells from damage due to oxidative reactions catalyzed by the excess light energy. Since evergreens retain leaves during cold periods they must undergo a recovery upon warming where photochemical efficiency will increase gradually over time. Artificial recovery studies were performed by removing branches from winter stressed Pinus strobus (eastern white pine) and Picea glauca (white spruce) and maintaining them in the lab for 8 days. It was hypothesized that proteins involved in photosynthesis also react to this recovery. Photochemical efficiency ($F_v/F_m$) was measured over the 8 day period and recovery curves constructed from which time to half recovery was analyzed for each species using PRISM software. D1, a major photo-center protein from photosystem II, as well as several light harvesting complex (Lhc) proteins (Lhcb 1,2,4, and 5 from photosystem II and Lhca 1 and 4 from photosystem I) were analyzed using percent increases obtained from Western Blotting. Pine recovered significantly more slowly than spruce (half recovery times were 75.6 hours and 26.6 hours respectively). A variety of proteins were found to increase in concentration in concert with the increases seen in photochemical efficiency. Other photosynthetic proteins were found to maintain similar levels throughout the recovery, suggesting a role in maintaining the winter conformation of the photosynthetic apparatus.
Sarah Millholland

PROGRESS TOWARDS A ROBUST ALGORITHM FOR LYAPUNOV EXPONENT CALCULATION FROM A CHAOTIC PHYSICAL SYSTEM
Faculty Mentor: Dr. Marty Johnston

The complicated behavior of chaotic systems is difficult to analyze with standard techniques alone. Even for deterministic systems, the motion often appears incomprehensibly random. To describe the behavior, we must rely on different measures. One such parameter is the Lyapunov Exponent, which quantifies a chaotic system’s sensitivity to initial conditions. Our long term goal is to characterize an experimental chaotic system through the determination of its Lyapunov Exponents.

A dynamic system has one Lyapunov Exponent for each variable describing the system’s state. The Largest Lyapunov Exponent (LLE) specifies the average rate at which trajectories in state space exponentially diverge. The LLE of a chaotic system is positive; trajectories with nearly identical initial conditions exponentially diverge. Nonchaotic systems have a LLE of zero since initially close trajectories remain close together.

We have developed a robust computational program to perform LLE calculation from time series data using the well-known Rosenstein algorithm. In addition to the Rosenstein algorithm, the program involves four supporting algorithms. Two algorithms are needed to reconstruct comprehensive system dynamics from the time series of a single measured variable. Two other algorithms characterize the linear region of the curve output by the Rosenstein algorithm. The slope of this linear region is the LLE and therefore must be carefully estimated.

We present the application of our techniques to the well-studied chaotic Lorenz system and demonstrate agreement of the calculated LLE with the theoretical value. While noise-free data of the Lorenz system returns an accurate estimation of the LLE, the analysis of data corrupted by noise consistently underestimates the LLE. This poses a problem for the analysis of experimental systems, where data is inherently noisy. We discuss measures taken to remedy systematic errors due to noise, and we weigh the improvements and drawbacks of these modifications.

Jenna Ness

CLIMATE CHANGE ATTITUDES AND BEHAVIOR: IS IT POWERED BY PSYCHOLOGICAL DISTANCE AND ACTION GOALS?
Faculty Mentor: Dr. Elise Amel

Global climate change is a critical problem that is directly related to human behavior, yet many people perceive it as irrelevant, affecting other people somewhere else, far off into the future (Liserowitz, 2005). Even if people do accept the urgency of problem they often feel helpless about how to engage in mitigation efforts (Liserowitz, 2004). Therefore, it is important to study how people respond to different frames about the effects of climate change and climate change solutions. We suspect that a higher degree of relevance and greater specificity of solutions will stimulate positive feelings towards taking action and a greater propensity to take action. The purpose of this experiment was to test if there were differences in climate change attitudes when the threat seemed near or far away, as well as whether or not specific information was received about taking personal action against climate change. Participants were 225 undergraduates at St. Thomas recruited through research pool and randomly assigned to an experimental condition. Participants began by reading a short essay about climate change effects in Minnesota, Arizona, or were put in a control group about internet privacy. The second manipulation including either a general goal for action, reducing greenhouse gasses by 2% per year until 2050, or a specific goal for action, reducing driving by 60 miles per month by taking the bus, carpooling or combining trips. An online survey was then completed measuring climate change knowledge, psychological distance, self-efficacy, goal commitment, statement credibility, and requests for further information. We hypothesized that close physical distance would reduce psychological
distance. Specific action primes were also predicted to show increase in self-efficacy and goal commitment. We expected the combination of close distance and specific goals to increase the likelihood of taking action. Results of a 2-way MANOVA will be presented.

References:


Eleanor O’Neil and Caitlyn Wright

**A MICROENTERPRISE EVALUATION IN URBAN AND RURAL MINNESOTA**

Faculty Mentor: Dr. Richa Dhanju

Despite widespread international success of microenterprise, scholars question whether this approach is viable for poverty alleviation in the US. Existing research indicates that, given the highly regulated and competitive economic environment in the U.S., people with fewer resources, education, and social networks are particularly challenged to start and maintain a small business. We evaluated the effectiveness of a microenterprise development program initiated in 2010 by a St. Paul based non-profit organization which adapted a model commonly used in the developing world to provide microloans and training to potential entrepreneurs in one urban and one rural setting in Minnesota. We conducted 26 semi-structured interviews and an online survey with program stakeholders to investigate the impact of this program. The urban microenterprise initiative has repaid all outstanding loans, continues to cover costs of business, and has recruited 80 consigners. Despite no significant increase to entrepreneurs’ individual incomes, this initiative was successful in increasing entrepreneurs’ business skills and bolstering social networks. Participants in the rural initiative, which used an individual lending approach, reported high satisfaction with training, but none applied for a loan. Further, shame and stigma around poverty emerged as a strong theme in both urban and rural interviews. Our research demonstrates that microenterprise is a feasible undertaking when individuals with diverse skills and resources come together, as was the case with the urban initiative. Our research furthers scholarship in a critique of microenterprise as an individual intervention for a systemic problem.

Nicholas Ose

**THE SELFISH HERD HYPOTHESIS: INVESTIGATING SURVIVAL STRATEGIES**

Faculty Mentor: Dr. Paul Ohmann

Many animals in the wild tend to aggregate into herds under threat of a predator. This is not necessarily due to individuals acting to protect the herd as a whole, but rather individuals looking to improve their own personal chances of survival. We call these “selfish herds.” This study hopes to discover effective strategies that an individual in the selfish herd can use to escape predation. We have constructed a simulation in which animals, both predator and prey, are represented by individual points on a plane. The prey will follow a few different movement rules, but the simulation is kept simple enough to be realistic as they seek to escape the predator. In this way we can see if those within a herd are more likely to survive than those who are more spread out. From their movement in our simulation we hope to see the effects of the choices that animals in the wild make: some choices will lead to survival, while others will lead to demise at the hands of the predator.
Mark Painter

CHARACTERIZATION OF RAP1A AND RAP1B EXPRESSION ACROSS CELL TYPES AND IDENTIFICATION OF THEIR CORE PROMOTER ELEMENTS

Faculty Mentor: Dr. Jennifer Cruise

The RAP1A and RAP1B genes are members of the RAS oncogene family of GTPases and are implicated in many processes, including cell adhesion, growth, and signal transduction. Cell type-specific expression of these genes and their regulatory elements, however, have been poorly investigated. Our lab has worked to define the levels of RAP1A and RAP1B native expression in a variety of human cell lines and to characterize the cis-regulatory elements controlling this expression. In investigating native expression, RNA was isolated from eight different lines and analyzed using qRT-PCR. Our findings suggest that RAP1A is expressed at statistically similar levels in all lines tested, while RAP1B shows more variable expression. Putative promoter fragments for both genes were identified using the UCSC genome browser, cloned by PCR, and inserted directly upstream of the Green Fluorescent Protein (GFP) gene. Plasmids were transiently transfected into a variety of cell lines, and GFP expression was analyzed by fluorescence microscopy. Activity of the core promoter for RAP1A appears to explain the observed native expression, and a possible repressor element has been identified. For RAP1B, the identified core promoter fails to explain cell type-specific native expression, requiring further analysis of potential enhancer regions. Additionally, lack of RAP1B core promoter function in an osteosarcoma line may be SP1-mediated.

Crystal Pomerleau

CLIMATIC AND TECTONIC CONTROLS ON LACUSTRINE ISOTOPIC VARIABILITY WITHIN THE MIOCENE HORSE SPRING FORMATION, SOUTHERN NEVADA

Faculty Mentor: Dr. Lisa Lamb

The Horse Spring Formation (HSF), found throughout the Lake Mead area, contains several thick lacustrine carbonate units ranging in age from >24 to 12 Ma. Detailed mapping, geochronologic, tephrochronologic and stratigraphic work have allowed us to define a detailed chronostratigraphic framework for these carbonate units, which have great potential to address two issues: the evaluation of tectonic models of continental rifting and Miocene climate change in the southwest.

We collected 715 stable isotope samples throughout the HSF from lacustrine authigenic carbonates and present data from the Bitter Ridge Limestone (BRL, 13.9-14.4 Ma) and Lovell Wash (LW, 12-13.9 Ma) Members. We focus on two measured sections: the Lovell Wash Syncline and White Basin areas. d18O curves from both locations follow very similar trends, confirming our interpretation that these locations represent deposition in a single, large basin. The absolute values vary between the two curves, as the White Basin values are consistently more positive than the syncline area values. We interpret this as different depositional locations within the same basin, i.e. marginal (White Basin) vs. basinal (LW Syncline) settings.

We also compare these curves to the Laskar et al. (1993) insolation model and Zachos et al. (2001) marine isotope curves. Consistent variations in the BRL member suggest that Milankovitch cycles control some of the variability. At the start of LW deposition, there is a change to fluvial deposition that may be climatically forced: the Zachos et al. (2001) marine d18O curve shows an abrupt shift at this same time. This fluvial setting is replaced upward by a variety of depositional environments recorded by lateral and vertical facies changes. d18O values become highly variable both vertically and laterally throughout this portion of the upper LW. We interpret this change is due in part to growth faulting, basin partitioning and increased hydrothermal activity.
Nathan Rubin

THE EFFECT OF DEHYDROEPIANDROSTERONE (DHEA) ON SONG REPERTOIRE SIZE IN ADULT MALE EUROPEAN STARLINGS (*STURNUS VULGARUS*)
Faculty Mentor: Dr. Sarah Heimovics

Although most temperate-zone breeding songbirds do not alter their song repertoire size throughout the year, some species such as European Starlings increase their repertoire size in the non-breeding season. However, the hormone mechanism behind this process remains unclear. A previous study found that implanting starlings with testosterone (T) during non-breeding season increases their repertoire size. Yet, this study lacks ethoecological validity, as starlings would not naturally be in a state of elevated levels of circulating T in the non-breeding season. However, an inert steroid hormone and precursor to T called dehydroepiandrosterone (DHEA), is elevated during the non-breeding season and thus was selected as the hormonal mechanism to explore for this experiment. Non-breeding male starlings were given either DHEA or control implants (n=12/group) and song recordings were collected from the subjects. The goal of this project was to visually analyze these songs through Raven, an interactive sound analysis software, to compare post-treatment to baseline repertoire size, as well as other measures of song composition of the starling song. A starling song consists of four distinct components: an intro whistle, variable, rattle, and high frequency phrases. Within each song component are one to two second phrases and the number of total distinct phrases is defined as the subject’s repertoire size. Due to time constraints of this project, only the phrases from the intro whistle and high frequency components were analyzed. From these data, we did not see a significant effect of DHEA on song repertoire size. However, when the variable and rattle phrases are analyzed and combined with the data from the intro and high frequency data, we may find an overall significant effect of DHEA on repertoire size. Once this happens, we will gain a clearer understanding of the hormone mechanism behind the modulation of non-breeding season song in male European starlings.

Kayla Ryan

TOWARD THE SYNTHESIS OF GROUP TWO METAL ARYLOXIDES
Faculty Mentor: Dr. Marites Guino-o

Metal Organic Frameworks (MOFs) are compounds consisting of metal centers coordinated with organic linkers or compounds forming structures containing a porous cavity. MOFs have potential for drug transport within the body due to presence and various sizes of pores, which are influenced by the organic linker and metal center. In the past, MOF composition has focused mainly on transition or d-block metals; however, transition metals can be toxic within the body at high amounts. This research is interested in the synthesis of group two MOFs, utilizing magnesium (Mg), calcium (Ca), strontium (Sr), and barium (Ba) as metals because they are benign when in the body. 2,5-dihydroxy-1,4-benzoquinone is utilized as the organic linker. The goal of this research is to characterize structures of previously synthesized group two MOFs. Methodology of this project involves utilizing Fourier Transform Infrared (FTIR) spectroscopy, Raman spectroscopy, Thermal Gravimetric Analysis (TGA), and X-ray Fluorescence (XRF) to determine the structure of the samples obtained. If needed, Single Crystal X-ray Diffraction will determine the crystalline structure of the product.
Mitchell Schaps

NICE RIDE: HOW UST HAS USED THE SYSTEM, AND HOW UST WILL USE IT IN THE FUTURE
Faculty Mentor: Dr. Paul Lorah

Last year, a University of St Thomas Geography course wrote a grant to the Campus Sustainability fund for discounted annual Nice Ride passes. The grant passed, and the passes started to be sold last spring. Now, a year later, the discounted annual passes have been available for a whole Nice Ride season, and usage statistics for St Thomas have been gathered for that season. My poster displays maps showing where St. Thomas students have used the system to go to, as well as facts about the campus community’s usage of the system. My poster also highlights research that I have done through GIS that shows UST community members on campus where they can go in the future. This includes a map I have made called the Nice Ride activity space, and an online Nice Ride trip planner I have made.

Nicholas Sinn

REDUCTION OF HCG 44 GALAXY
Faculty Mentor: Dr. Elizabeth Wehner

For the past few months, I have been working on analyzing the HCG 44 galaxy cluster. Using PyRAF and data provided by the WIYN 0.9m telescope I have been working to reduce the data into usable images that we can use for further research to gain a better understanding of how the galaxy works.

Ryan Slechta

INCREASING THE EFFICIENCY OF BITMAP RANGE QUERIES THROUGH DYNAMIC COLUMN REORDERING
Faculty Mentor: Dr. Jason Sawin

Successful user interactions with social media, search engines, and online cat videos require the ability to quickly process vast quantities of data. Large database systems often use advanced indexing techniques for quick data access. A bitmap index discretizes database tables into distinct bins, which produces a course representation of the data. Bitmap indexes have two major benefits: compression and querying using quick hardware operations. Our work focuses on improving query efficiency of bitmap indexes.

We present several methods for increasing the efficiency of range queries. A range query is a series of logical operations applied in sequence to multiple bitmap columns. Range queries can answer questions such as “What employees make between $150,000 and $2,000,000?” The naive implementation applies the logical operations in the order that the columns appear in the bitmap. We investigated several metadata driven enhancements to approximate an optimal column ordering based on column characteristics. Our empirical study showed that our most advanced approach was able to answer queries 1.5 times faster than the naive approach.

Elizabeth Smith, Chloe Lawyer, and Katherine Hanson

ODOR-GUIDED ASSOCIATIVE LEARNING IN ADOLESCENT FEMALE RATS
Faculty Mentor: Dr. Kurt Illig

Previously, we have shown that adolescent male rats learn the predictive value of an olfactory cue associated with a palatable reward significantly more slowly than either juveniles or adults, and that this learning deficit is exacerbated
by significantly increased distractibility during learning in adolescents. Concurrent with these behavioral effects, adolescent rats exhibit significantly higher D1 dopamine receptor mRNA and protein expression in orbitofrontal cortex (OFC) than juvenile rats, suggesting that changes in dopaminergic neural circuitry during development may underlie age-dependent differences in associative learning. In the present study, we employed real-time PCR techniques to examine whether cortical D1 receptors undergo a similar developmental timecourse in female rats, and we used the same odor-guided learning paradigm to test whether female rats also display an associative-learning deficit in adolescence. Interestingly, although we found that adolescent female rats displayed significantly higher D1 receptor expression in the OFC than either juveniles or adults, we found no significant age-related differences in the ability of female rats to learn the association between an odor and a palatable reward. Further, although females displayed a modest increase in distractibility at all ages compared to males, we found no significant age-related differences in distractibility. These results suggest the role of dopaminergic neural circuitry underlying associative learning differs between adolescent male and female rats, perhaps reflecting sex-specific behavior during this developmental period. Because cortical dopamine neurons play a role in drug-seeking behavior, these results also may have implications for sex-related differences in the acquisition and maintenance of drug addiction.

Nicholas Spielman and Shuo Yang

A SPIKING NETWORK MODEL OF THE BASAL GANGLIA IMPLEMENTED ON HADOOP
Faculty Mentor: Dr. Jadin C. Jackson

The basal ganglia (BG) are involved in reward processing, learning, and action selection, and degeneration of various BG structures results in a wide range of disorders. BG comprises several neuronal structures forming an informational loop between cortex and thalamus, which feeds information back to cortex. It is speculated this circuit integrates information from multiple areas of cortex to help an organism select a future action based upon its current environment and past learning experience. One hotly-researched aspect of BG functioning is its ability to swiftly and adaptively resolve conflicts between incompatible motor and cognitive systems, as this mechanism has applications in remediating pathological human behaviors (like drug addiction) and in developing mobile robotic agents with sophisticated decision-making behavior. Computational modeling of BG network activity is a key component in the synthesis of theoretical control schemes for the action-switching behavior of the BG, which may then be falsified through comparisons with physiological data and used to predict and improve the therapeutic effectiveness of treatments for diseases of the BG such as Parkinson’s disease. Current computational models of BG action selection utilize oversimplified physiological schemes to overcome the lack of processing power required to run anatomically-faithful models. Hadoop provides a parallelized framework which allows many computer cores to work together simultaneously to process a single body of data; its capabilities should allow more scalable simulation of the action selection activity seen in the BG, and thus better characterization of the roles played by the various neuron populations in the BG. Using Hadoop, we have generated a spiking network model of BG action-switching, incorporating previously uninvestigated factors such as proportional populations and cortical inputs. As we continue to develop the model, we hope to incorporate additional levels of realism such as axonal delays and ionic conductances, in order to better characterize BG action-switching.

Amy Steingas

THE REACTIVITY OF SELF-OBJECTIFICATION MEASURES
Faculty Mentor: Dr. Britain Scott

Objectification theory, first researched by Fredrickson and Roberts (1997), has become an increasingly prominent area of research in social psychology. The phenomenon of self-objectification has been investigated in several studies using
two primary measures: the Objectified Body Consciousness Scale (OBCS), and the Self-Objectification Questionnaire (SOQ). These measures have been used in previous studies (e.g., Fredrickson et al., 1998; Quinn et al., 2006; Gay & Costano, 2010) in order to measure an individual’s current state of self-objectification. However, there is some speculation that the OBCS and SOQ are reactive, meaning that they actually heighten a person’s level of self-objectification just by completing the measures. If that is the case, the OBCS and SOQ should be used only as manipulations, not as measures; warranting the creation of a measure of self-objectification that is non-reactive. Participants were randomly assigned to take one of four conditions, each corresponding to the scale that participants in that condition will fill out: OBCS, SOQ, the Short Task on Music Preference scale (STOMP), and a condition with no scale. Reactivity was measured by asking participants to perform the Stroop Effect task, and participants were also asked a series of demographic questions. Results indicate that there is some evidence that the OBCS is reactive, with further research required to assess the reactivity of the SOQ.

Acadia Stephan

READY-TO-USE THERAPEUTIC FOOD SUPPLEMENT: VISCOSITY AND OIL SEPARATION STUDY

Faculty Mentor: Dr. Camille George

A Ready-To-Use Therapeutic Food (RUTF) is being formulated to fight severe acute malnutrition in children in developing countries. The material is in the form of a fortified peanut paste that must be thin enough for young, malnourished children to consume easily. It must also remain homogeneous and not exhibit drastic oil separation (Johnson). Six formulations of the RUTF were included in the experiment. These six formulations varied slightly in either composition or method of preparation. Samples were included at varying levels of hydrogenated oil contents, a main determining factor in the sample viscosity and oil separation experienced. These samples were placed in temperature environments of 40ºC, 55ºC, and room temperature and stored here for duration of experiment. The temperatures were chosen to replicate what samples may experience in production, storage, and distribution. Viscosity measurements were taken and oil separation occurring in samples was measured and quantified at 1, 3, 6, and 12-month. Samples were also analyzed empirically for any changes in odor or color change that may indicative rancidity. After 12 months of aging, samples in room temperature environment retained original light beige coloring and sweet smell, a manageable viscosity, and oil separation could be easily reincorporated into sample. Therefore with the RUTF production facility operating at 22ºC, samples would be stable for at least a year. With samples reaching temperatures of 40º-55ºC during summer transport, these samples were more prone to rancidity although samples at 40ºC remained stable for months, long enough to ensure viable transport in this temperature range.

Rachel Sweet

DIFFERENCES IN DIET AND SELECTIVITY OF COREGONUS ARTEDI BETWEEN ECOMORPHS AND ACROSS LAKES

Faculty Mentor: Dr. Kyle Zimmer

Cisco (Coregonus artedi) is a Minnesota fish species requiring cold water and high oxygen levels, and they are an important prey species for game fish. Unfortunately, eutrophication and climate change threaten cisco through impacts on oxygen and temperatures in lakes, yet the basic biology of cisco is poorly known. I assessed prey selection by cisco in two Minnesota lakes; Greenwood had high habitat quality of oxygen and temperature, while Prairie had stressful levels of oxygen in deep water. The Manly-Chesson Electivity Index was used to compare Daphnia lengths within each lake to those found in the fish diets. Results showed cisco in Prairie lake were selecting for mid-sized Daphnia, while those in Greenwood were selecting for the largest Daphnia available. Together with temperature and
oxygen profiles, these data suggest that a large anoxic layer at the bottom of Prairie lake may provide large *Daphnia* a refuge from cisco predation, while the high oxygen levels at all depths in Greenwood allow cisco to consume the largest *Daphnia* available. As large *Daphnia* provide more energy to cisco compared to smaller individuals, my results indicate eutrophication may reduce growth and survival of cisco by creating refuge for their preferred prey.

Meghan Talbot

INVESTIGATING THE ROLE OF TRIAZOLE BASED LIGANDS IN A NICKEL CATALYZED DEHYDROGENATION OF AMMONIA-BORANE

Faculty Mentor: Dr. Marites A. Guino-o

A family of organometallic catalysts were synthesized, each with unique stereoelectronic properties, and used in R. Tom Baker's dehydrogenation reaction of ammonia-borane. The catalysts were used in the dehydrogenation reaction in order to determine which stereoelectronic properties contribute to producing the most hydrogen gas. The reaction time of the dehydrogenation was shortened to accommodate this screening process. Fourier Transform Infrared Spectroscopy and Single Crystal X-Ray Diffraction were used to quantify the electronics and steric of each catalyst respectively. The dehydrogenation was monitored via NMR Spectroscopy.

April Terres and Sarah McNamara

COMPARING MODERN AND HISTORICAL MICROBIALITE DEPOSITS OF THE LOWER PAHRANAGAT LAKE AND HORSE SPRING FORMATION, NEVADA

Faculty Mentors: Dr. Tom Hickson and Dr. Eric Stevens

The Lower Pahranagat Lake near Alamo, NV is a spring fed shallow alkaline lake with high evaporation rates and low precipitation. The lake shoreline is covered in an evaporitic crust that is in turn surrounded by marshy wetlands. Hickson et al. (2013) suggested that the lake is a possible analogue for Miocene lacustrine carbonates of the Horse Spring Formation in the Lake Mead region; our data support this. Microbialite samples were identified from the Paleo-shoreline of lower Pahranagat Lake in addition to modern microbialite samples found on the northern edge of an ephemeral island. Samples were polished and slabbed in order to characterize internal textures and overall microbialite morphology. Morphologies of the Pahranagat lake region include: 1) Domal stromatolites, ranging from 0.5 - 15 cm in diameter; 2) Stratiform stromatolites; 3) Cobble encrusting, layered stromatolites, with varying degrees of post depositional modification; and 4) Tufaceous forms with high porosity and surface clots. Three textures and fabrics can be used to describe the internal character of each of these morphologies: A) mm scaled lamination with alternating light and dark layers; B) 0.1-1.0 cm scale domal lamination separated by vertically oriented pores; C) 0.5-2.0 cm layering with internal vertically oriented pores. Pores range in geometry from 0.5-1.0 mm wide and closely spaced, to 1-5 mm wide and more widely space. XRD results showed the samples were dominantly calcite with trace amounts of quartz and halite. The Pahranaganat Lake marginal microbialites provide excellent examples of comparable Horse Spring Fm. lacustrine microbialite morphologies and textures, further supporting the hypothesis that this system serves as a strong modern analogue for the Miocene units of the Lake Mead region.
Annemarie Thompson

PARISIAN RECONNAISSANCE: MODERN FLÂNERIE THROUGH CITY AND TEXT
Faculty Mentor: Dr. Emily James

As urban development rapidly progressed in the early twentieth century, the relationship between the city and its inhabitants became increasingly significant. Hope Mirrlees' avant-garde experiment, Paris: A Poem, explores the modern city through art. The poem consists of the subjective, embodied viewpoint of the speaker as she wanders through the city's streets, but it also offers a distanced vision of the city to the reader, who sits above the textual territory and can perceive as a whole its disparate elements. Both the speaker and the reader participate in a kind of reconnaissance, surveying the cultural landscape of Paris in 1919 during the speaker's walk through and above the city. Mirrlees explicitly dedicates the poem “en reconnaissance” – in recognition – of the “graces” of Paris. But the poem not only recognizes the laudable aspects of the city. The speaker explores all facets of the metropolis as she attentively records advertisements and sensations, notes the post-war political developments, and incorporates historical associations. The speaker's flânerie – French for a tradition of aimless, urban wandering – fuses with modern surveillance, and thus aims for a comprehensive image of the city.

The reader, then, becomes an aerial observer who performs a meta-reconnaissance of the city-in-a-poem. As an art object that can be perused at arm's length, Paris: A Poem asks to be read spatially. Pieces of the city are physically juxtaposed on the paper, contained by a new city wall of book covers. Drawing on scholarship by literary critic Joseph Frank and sociologist Georg Simmel, I argue that the form of the poem both reflects and addresses the disorientation and unease of the modern city-dweller. Gathering the city into fifteen short pages provides some unity to the otherwise incoherent experience of the urban environment. Mirrlees is what the French poet Charles Baudelaire called a “painter of modern life” – a bright-eyed observer who pursues the truth of the city and creates a composition from its fragments.

Angela Tipp

QUANTIFYING THE ECOLOGICAL NICHE OF A FISH SPECIES THREATENED BY CLIMATE CHANGE: STABLE ISOTOPE ANALYSIS OF FOOD WEB POSITION AND HABITAT USE BY CISCO IN MINNESOTA LAKES
Faculty Mentor: Dr. Kyle Zimmer

Fish in Minnesota lakes face increasing surface water temperatures due to climate change and decreasing oxygen levels in deep water due to nutrient inputs. These impacts are particularly important for cisco; a group of fish that require cold-water with high oxygen levels. I used stable isotopes to quantify the niche of cisco in two lakes: Bear Island Lake had oxygen all the way to the lake bottom, while St. Mary's Lake was anoxic within 3 meters of the lake bottom. I analyzed stable isotopes of fish tissue, phytoplankton, and zooplankton in each lake, and tested for differences in food web position and habitat use by fish. $^{13}$C showed cisco in Bear Island have a lower $^{13}$C value than cisco in St. Mary's, while $^{15}$N in cisco were similar between lakes. This indicates cisco in both lakes are near the same trophic level, but fish in Bear Island are feeding at deeper depths than fish in St. Mary's. This suggests fish in Bear Island have access to prey in all areas of the lake due to high oxygen levels, while in St. Mary's cisco are limited to feeding in water nearer the surface due to anoxia at greater depths.
Alexander S. Tsadwa

STEREOTYPES AND ATTITUDES TOWARD BLACK-WHITE INTIMATE RELATIONSHIPS
Faculty Mentor: Dr. Buffy Smith

As long as people of African descent have lived in America, Black-White intimate relationships have existed in the country. Throughout American history, these relationships have been stigmatized by law and socially discouraged. This study aimed to identify and understand the stereotypes of and attitudes toward Black-White intimate relationships among undergraduate students from colleges and universities in the Twin Cities metro area. The data was qualitative, collected through the use of a brief demographic survey and a twenty-two question interview instrument. The findings suggest that patriarchy is present in the gender patterns of Black-White intimate relationships, racially homophilous relationships are still the norm and people are still hesitant to fully accept Black-White intimate relationships.

Miguel Velez

EXTENDING SMILES TO ENCODE REACTION MECHANISMS
Faculty Mentors: Dr. Peter Gittins and Dr. Jason Sawin

Cheminformatics combines chemistry and computer science to represent and manipulate molecules in a digital environment. A standard way of representing molecules in a computer readable format is the Simplified Molecular Input Line Entry System (SMILES), a line notation that represents molecules using alpha-numeric characters. SMILES strings can be manipulated using software development kits such as the Chemistry Development Kit (CDK), an open source Java library specific to computer science. These tools enable the comparison of molecules before and after a chemical reaction. However, they do not illustrate the underlying reaction mechanism, which is valuable information in understanding how a reaction takes place. We have created the Simple Mechanism Of Reaction Encoding System (SMORES), an extension of SMILES, which encodes reaction mechanism information.

Our SMORES extension consists of a SMILES string followed by an alphanumeric description of a reaction mechanism. We also extended the CDK in a Java program, to allow processing of SMORES inputs. The program allows a user to enter a SMORES string, which creates a model of the starting molecule. Then the program manipulates this molecule based on the specified mechanism. Finally, a model of the molecule produced by this mechanism is generated. This structure can be used to generate a SMILES string or a graphical representation.

Daniel B. Volovets

EFFECTS OF ACUTE ESTRADIOL ADMINISTRATION ON VOCAL COMMUNICATION IN MALE ZEBRA FINCHES WITH VARIABLE LEVELS OF TESTOSTERONE
Faculty Mentor: Dr. Sarah A. Heimovics

Across vertebrate species, 17β-estradiol (E2) has been shown to rapidly (within 30 minutes) modulate consummatory social behaviors, such as direct aggression and copulation. However, to date, what remains unclear is whether E2 can also influence the expression of appetitive social behavior. The present study was designed to examine the effects of acute E2 administration on appetitive sexual behavior (courtship singing) in male zebra finches. A 500 µg/kg dose of E2 was administered via subcutaneous injection to male birds with either high or low levels of testosterone (T). Levels of T were modulated using a literature-affirmed water restriction paradigm. Directed (courtship) and undirected song expression in response to the introduction of a female conspecific was subsequently analyzed. It was hypothesized that
rapid E₂ administration would significantly increase singing behavior in all subjects, but that the rapid effects of E₂ would be more prominent in low T birds because E₂ has been previously found to exert rapid effects in non-breeding (but not breeding) condition animals. Unexpectedly, we found no rapid effect of E₂ on courtship. However, we did see an effect of endocrine state on courtship, where males with lower levels of T were less motivated to court. To our knowledge, this is the first time that diminished courtship in zebra finches as a consequence of water restriction has been demonstrated. This finding can serve as the impetus for future investigations of the effects of water restriction on the neuroendocrine mechanisms that ultimately bring about courtship behavior.

Laura Willson

CLIMATE-DRIVEN ACIDIFICATION: THE EFFECTS OF CARBON DIOXIDE AND NATURAL ACIDIFICATION
Faculty Mentor: Dr. Gaston Small

Anthropogenic CO₂ emissions are known to contribute to ocean acidification, but CO₂ also makes a contribution to the acidification of some freshwater streams, yet this phenomenon is poorly understood. For a first-order stream in the La Selva Biological Station in Costa Rica, I used stream CO₂, O₂, and pH levels to calculate hourly CO₂ efflux, respiration, and photosynthesis, and inferred, based on mass balance, how much CO₂ entered the stream from groundwater flowpaths. I then used groundwater CO₂ measurements, hourly rainfall, and water table height measurements as potential explanatory variables. Estimated pCO₂ efflux was about 6 times higher than in-stream respiration and respiration rates were 3 times higher than average photosynthesis rates. Therefore, CO₂ efflux is strongly driven by CO₂ inputs from groundwater, and minimally influenced by processes within the stream. Stream pH fluctuated between 5.4 and 5.1; we calculated theoretical pH based on in-stream CO₂ saturation levels, which equaled between 5.1 and 4.9; thus, CO₂ is sufficient to explain the drop in pH. These results illustrate the strong connection between soil biogeochemical processes and stream chemistry, and suggest that soil respiration may be an important contributor to previously observed seasonal pH drops in these rainforest streams.

Joshua Zahrbock

FROM JAPAN TO THE UNITED STATES: SUSHI IN NEW YORK CITY FROM 1980-1985
Faculty Mentor: Dr. Patti H. Kameya

This study examines the popularization of sushi in New York City in the early 1980s as a convergence of two trends: increasing cultural and trade exchange between Japan and the United States, and a growing American appetite for fresh, trendy, gourmet food. It particularly focuses on the aesthetic aspect of how sushi was described and pitched to American consumers as an exotic experience and a healthy alternative food choice.
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