2023 University Research Symposium

Afternoon Session Abstracts

AGRICULTURE

CROPPING SYSTEMS MANAGEMENT ON PENNYCRESS

Presenter: Dangol, Rashmi
Graduate, Agriculture

Mentor: Prof. Nicholas Heller

Corn-soybean rotation in the Midwest includes low-diversity cropping systems with high fertilizer inputs that leave the land fallow for around eight months of the year. Integrating an annual winter crop into the summer-annual-dominant cropping system could be an approach to increase diversity and sustainability in farming practices providing both economic benefits and ecosystem services. Pennycress (*Thlaspi arvense*) has been developed as a winter annual cash cover crop oilseed that can be integrated into a traditional corn-soybean rotation.

Despite its potential as feedstock and biodiesel production, limited information is known about the best agronomic management practices for its high production. The objective of the study is to optimize when and how we can grow pennycress between different crop rotation systems to maximize crop productivity and oilseed yields. This study is conducted at Illinois State University Research Farm, Lexington using a randomized block experimental design to compare four treatments systems: Cereal Rye-Pennycress-Soybean, Silage Corn-

Pennycress-Soybean, Grain Corn-Pennycress-Soybean, and Soybean-Pennycress-Corn. The annual summer crops were grown in spring 2022, and pennycress was drilled in fall 2022. Following the pennycress, soybean and maize will be planted as summer cash crops. Cash crops biomass and yield and pennycress spring canopy cover, biomass, yield, and the total net income of each plot will be evaluated to compare these systems.

STUDY ABROAD PROGRAMS AND STUDENT STRESS: AN ANIMAL SCIENCE CURRICULUM CASE STUDY

Presenter: Lawrence, Jayden
Graduate, Agriculture

Mentor: Prof. Drew Lugar

Authorship: Jayden Lawrence, Michael Barrowclough, Drew Lugar

Study abroad programs increase a student's exposure to different cultures, traditions, and ways of life. This has been referred to by some as 'gaining cultural intelligence'. While the benefits of participating in a study abroad program have been well documented, language, cultural, and/or environmental barriers may present themselves to program participants. These barriers have the potential to introduce additional stress to students, in conjunction with the stress more typically experienced during a 'traditional' college experience.

This study examines the relationship that participating in a study abroad program has on student stress, whether physiological or perceived. Over a 12-day period in December 2022 in Mexico City, Mexico, students participated in an Animal Science focused study abroad program. The program included conventional course lectures as well as agricultural and cultural excursions.

In addition to student demographic information, heart rate variability (via chest strap heart rate monitors) and perceived stress surveys were collected before (PRE), during (ABRD), and after (POST) the nearly two-week program.

Preliminary analysis shows that Caucasian students had higher overall perceived stress compared to non-Caucasian students ($P = 0.004$). Perceived stress scores were higher in the PRE phase compared to the ABRD and POST phases, regardless of ethnicity ($P = 0.001$ and $P = 0.025$, respectively). Heart rate variability levels were higher during the PRE phase for Caucasian students than non-Caucasian students ($P=0.043$).

An abundance of research has sought to individually examine the influence that study abroad programs and stress have on student academic success. To the authors' knowledge however, no research currently exists that analyzes the potential relationship between the two.

EXPERIENTIAL LEARNING INFLUENCES STUDENT PERSPECTIVES ON CAREER ASPIRATIONS, INDUSTRY NETWORKING, AND SOFT SKILL DEVELOPMENT

Presenter: Neuleib, Lauren
Graduate, Agriculture

Mentor: Prof. Michelle Kibler

Authorship: Lauren Neuleib, Michelle Kibler, Jennie Ivy, Lacey Johnston

Equine industry internship and career options are diverse and can prove difficult for college students to navigate when entering the workforce. An equine industry course, with classroom and experiential learning trip components, was developed to expound educational and networking opportunities provided in traditional animal science curriculum. The objective of this study was to determine how course participation influenced future career aspirations, willingness to relocate for employment, and soft skill development. Students (n=24) from the University of TN (n=20) and IL State University (n=4) participated in an 8 d experiential learning trip which contained 17 individual stops across industry, reproduction, nutrition, agritourism and manufacturing locations in TN, OK and TX. Pre and post trip surveys were conducted (Qualtrics) to assess, prior experience with equids, career aspirations, personal, professional skills and knowledge learned from the trip. Soft skill abilities, willingness to travel, and knowledge gained were assessed on a 5 point Likert scale. Career aspirations, involvement in the equine industry and skills developed post trip were assessed through open ended questions.

Data were assessed for descriptive statistics using StataSE 17. Most students (65%, n=15) were previously involved in the equine industry and/or equids for more than 5 years, were animal science majors (88%, n=22), and were raised in rural/on-farm communities (53%, n=13). Post trip 54% (n=24) of respondents change career aspirations including but not limited to nutritionists, barn manager, reproductive specialist, and equine veterinarian. Post trip students indicated they have gained more knowledge of internships (68%, n=22), awareness of careers (66.67%, n=24), value of equi-tourism (41.67%, n=24) and overall additional knowledge of equine gained (66.67%, n=24). Open ended questions indicated students (n=24) developed professionally, with skills including networking (25%, n=6), importance of connections (20.83%, n=5), and knowledge of new career opportunities (37.5%, n=9). Students gained social skills (12.5%, n=3), communication skills (8.33%, n=2), confidence (41.67%, n=10) and expanded personal comfort zones (29.17, n=7) (n=24). The experiential learning trip enhanced student knowledge, experience, and soft skills that would have otherwise been inaccessible in a traditional course setting. Additional assessment should be conducted to quantify the benefit of experience-based learning in career aspirations and developing marketable skills.experiential learning, equine industry, hybrid instruction, internships, careers

FARM INPUT AND FARMLAND PRICE CORRELATION

Presenter: Schmid, Julia
Undergraduate, Agriculture

Mentor: Prof. Michelle Kibler

Co-Mentor: Prof. Justin Rickard

Authorship: Julia Schmid, Michelle Kibler, Justin Rickard

Global supply chain issues, shifts in spending patterns, and the recent surge in U.S. inflation created by Covid-19 caused soring farm input prices (Jiao, Trends). The recent increase in farmland values is correlated with fluctuant farm input prices in Illinois and the U.S., and this study provides evidence to prove this theory. The average 2022 price of Illinois farmland was $8,900.00 per acre, a 12.7% increase since 2021 (Jiao, Illinois), while fertilizer prices have experienced the most significant price increases compared to other inputs. In April 2022, anhydrous ammonia prices were up 179.0%, while potash prices increased by 107.5% (Jiao, Trends). Over the past 20 years, agricultural seed prices have significantly increased, as conventional seed prices have risen by 200% while genetically modified seed prices have increased more than 700% (Kovak). On average, it cost approximately 19% more in 2022 to raise a corn crop than in 2021 (Dehlinger). As vital as inputs are to crop production, farmers have recently been forced to significantly decrease the amount of each input they use, which imits production. In the U.S., soybean and corn production are both down due to weather that caused prevent planting this spring (Williams et. al.), while farmland prices increased by about 15% from 2021-2022 (Land). Within this same time frame, anhydrous ammonia and potash prices increased approximately 130% and 100% respectively (Quinn, Potash Leads; Quinn, Potash Retail). Results from this study provide evidence that increased farm input prices are correlated with high farmland values.

The main objective of this research was to identify the correlation of farm input and farmland prices. Secondary objectives include comparing current industry prices to forecast future prices and creating a price index to place current prices in context of the past few decades. Data was collected for input and farmland prices from 1960-2022 for the United States and Illinois. Most data sets used were broken into monthly prices and calculated to find averages and weighted averages of each input to determine average yearly prices. The importance of this study is to provide a connection between input prices and farmland values to provide members of the agricultural industry, specifically farmers, with data to forecast future prices. It is anticipated that this research will educate and prepare farmers to budget and financial plan in the future to avoid non-profit years by learning from past situations.

INTERACTION BETWEEN STARVIN AND P38KB TO TARGET PROTEIN LAMIN AS A NEURODEGENERATIVE DISEASE MODEL

Group Leader:	Acquah, Bismark Graduate, Biological Sciences
Group Member:	Shira Archie, Undergraduate, Biological Sciences
Mentor:	Prof. Alysia Vrailas-Mortimer
Co-Mentor:	Prof. Tom Hammond, Biological Sciences
Authorship:	Bismark Acquah, Shira Archie, Alysia Vrailas- Mortimer

Neurodegenerative diseases are characterized by the progressive loss of neuronal function and cell structure. One potential therapeutic strategy involves targeting Lamin, the major components of the nuclear lamina where they provide a platform for the binding of other proteins to the chromatin and confer mechanical stability (Dittmer *et a*l.,2011). Mutations in the human LMNA gene result in at least 15 distinct disorders ranging from muscular dystrophies to neurological disorders to lipodystrophies (Vytopil *et al*.,2003). Interestingly, some mutant forms of Lamin protein aggregate, which may be toxic to the cells. However, it is unknown how specific mutations in Lamin give rise to tissue specific disease. We hypothesize that certain tissues are susceptible to specific Lamin mutations due to the inability of tissue specific quality control mechanisms to degrade those mutant forms, leading to protein aggregation and cellular toxicity. We will be testing if tissue specific disease mutations in Lam Dm0, one of the fly homologues of LMNA, cause the protein to aggregate in muscles and neurons of *Drosophila melanogaster*. We found out that the main forms and the farnesylated forms of the different Lam Dm0 mutant proteins have different expression patterns in the muscles of the flies. In addition, we found that the p38 MAPK (p38KB) interacts with Starvin and the CASA complex to regulate the degradation of Lam Dm0. Future experiments will characterize how these mutant forms of lam Dm0 affect the functionality of the muscles and neurons in flies.

CAENORHABDITIS ELEGANS' AMPHID SHEATH GLIA MODULATES TOUCH-INDUCED ESCAPE RESPONSES

Presenter: Awe, Temitope
Graduate, Biological Sciences

Mentor: Prof. Andrés Vidal-Gadea

Authorship: 'Tope Awe, Jessica Adams, Laura Kelly, Shifat Niha, Andrés Vidal-Gadea

Glia are non-neuronal cells in the nervous system that provide structural and metabolic support to neurons. They are involved in different aspects of neuronal function such as synaptic transmission and plasticity. In addition, glia are now increasingly appreciated as active regulators of numerous physiological processes initially considered exclusively under neuronal regulation. For instance, the amphid sheath glia (AMsh) of *Caenorhabditis elegans* mediate adaptive response of the ASH neurons to repeated exposure to aversive odorants. This is in addition to their other supportive functions to neurons. Previous studies have also shown that these glia respond to nose touch. However, the molecular mechanism and the behavioral significance of the AMsh response to touch were unknown. Using RNA interference, we identified that *mec-12* is required for the normal response of AMsh glia to nose touch. To understand the behavioral significance of AMsh's response to touch, we measured the activity of the AMsh during touch-induced and spontaneous reversal movements using calcium imaging. Our findings indicate that AMsh activity peaks at the end of touch-induced reversals as well as spontaneous reversals. These findings suggest that AMsh glia play a role in modulating the touch-induced escape response in *C. elegans*.

UNDERSTANDING HOW THE NEW OILSEED WINTER COVER CROP, PENNYCRESS, RESPONDS TO DROUGHT

Presenter: Bayliss, Ryan
Undergraduate, Biological Sciences

Mentor: Prof. John Sedbrook

Co-Mentor: Liza Gautam

Authorship: Ryan Bayliss, Liza Gautam, Carol Kiam Assato, Spencer O'Flaherty, Arjuman Lima, Autumn Salmon, Amanda Darcy, John Sedbrook

Pennycress (*Thlapsi arvense* L., Field Pennycress) is a winter annual oilseed plant related to Brasssica rapa and Brassica napus (rapeseed and canola). It is being rapidly domesticated into a new winter cash cover crop and renewable diesel feedstock for the U.S. Midwest Corn Belt due to its unique combination of agronomic traits. Rapidly changing climate dynamics has led to uneven distribution of rainfall which has resulted in drought as a serious threat to crop growth and yield. Hence, the use of novel technologies including CRISPR-Cas9 gene editing which can improve drought resilience in plants and help plants adapt to climate change is much needed. Little is known about how pennycress responds to drought. To learn more, we have analyzed pennycress seedling and plant responses to different challenges including water withholding as well as chemical treatments that mimic drought. Our initial analyses suggest pennycress naturally has drought tolerance, which may be related to its extreme cold tolerance. We also generated pennycress single, double, and triple mutants using CRISPR-Cas9 mutagenesis targeting 10 genes important for drought responses in other species. Preliminary phenotypic analyses of these mutant lines also support our hypotheses that pennycress may have relatively higher drought tolerance than its close relative, the model plant Arabidopsis thaliana. These data will be presented and discussed.

THE NEWLY DISCOVERED GENE *rcrB* IS THE MAIN DRIVER BEHIND UROPATHOGENIC *ESCHERICHIA COLI'S* INCREASED RESISTANCE TO HYPOCHLOROUS ACID

Presenter: Bennis, Mehdi
Undergraduate, Biological Sciences

Mentor: Prof. Jan-Ulrik Dahl

Authorship: Mehdi Bennis, Sadia Sultana, Jan-Ulrik Dahl

Urinary tract infections (UTIs) are among the most prominent bacterial infections that affect about 150 million people worldwide, presenting a burden to healthcare costs. 70-80% of all UTIs are caused by uropathogenic *Escherichia coli* (UPEC), which commonly resides harmlessly in the gut but turns into a serious pathogen upon entry in the urinary tract where they can cause significant morbidity and mortality. To establish a successful infection, UPEC needs to access the urinary tract, ascend to the bladder to colonize, and invade the bladder cells. Prior to colonization, however, UPEC must overcome an onslaught of host's defense mechanisms including attacks by innate immune cells such as neutrophils. Neutrophils sense and eliminate invading pathogens by generating a toxic cocktail of antimicrobial compounds, including hypochlorous acid (HOCl). HOCl is also the active ingredient of household bleach, one of the most potent disinfectants worldwide but can be generated in the human body mainly by the heme-containing enzyme myeloperoxidase. Not surprisingly, HOCl is highly effective in killing microorganisms by causing severe cellular damage. Recently, we discovered that UPEC is significantly more resistant to HOCl and neutrophil-mediated killing compared to other E. coli pathotypes, which might explain why only UPEC is able to cause UTIs. In this study, we show that the *rcrB* gene is an essential component for UPEC's HOCl defense, as a deletion of *rcrB* causes UPEC to be significantly more susceptible to HOCl- mediated stress. Our data suggest that *rcrB* is either directly or indirectly responsible for UPEC's ability to counter HOCl stress and protects UPEC during phagocytosis. Consequently, this defense system can serve as a potential antimicrobial therapy to improve the host's own innate immune response and capacity to fight UTIs.

GIANT MICE ON SMALL ISLANDS: MECHANISMS OF GIGANTISM IN PEROMYSCUS MANICULATUS GULF ISLAND POPULATIONS

Presenter: Berg, Rachel
Graduate, Biological Sciences

Mentor: Prof. Pirmin Nietlisbach

Authorship: Rachel Berg, Pirmin Nietlisbach

Island rodent populations frequently exhibit island gigantism, presenting with larger body sizes in comparison to mainland counterparts. Proposed mechanisms to explain gigantism include benign island habitats and lack of mainland predators and competitors. However, island populations tend to be denser than mainland populations, increasing conspecific competition. With extrinsic sources of pressure largely missing from island habitats, conspecific competition may become a selecting force for larger body sizes in island populations. Here we examine presence of gigantism in North American deermouse (Peromyscus maniculatus) populations throughout the Gulf Islands of British Columbia, Canada and assess if population density is an underlying mechanism. Deermouse populations were live trapped on nine of the Gulf Islands as well as on the lower mainland of British Columbia to assess gigantism. We found that deermouse populations on islands have larger body mass than populations inhabiting the mainland. However, no significant relationship was found between population density and body mass. Due to the large variation in ecological composition of islands selected for study, follow-up analyses were conducted on other possible mechanisms. Study sites with reports of higher predator species richness were found to have smaller mice in comparison to islands with few to no predator species reported. Gigantism continues to be a complex phenomenon likely driven by several mechanisms. Furthermore, these mechanisms may vary across metapopulations, requiring further study.

CHARACTERIZING THE EFFECTS OF ESTRADIOL AND TWO POTENTIALLY ESTROGENIC CHEMICALS ON THE GROWTH AND SURVIVAL OF CHICKEN EMBRYOS

Presenter: Bernauer, Alyssa
Undergraduate, Biological Sciences

Mentor: Prof. Ryan Paitz

Authorship: Alyssa Bernauer, Ryan Paitz

Studying prenatal exposure to chemicals found in our everyday environment allows for prevention of early embryonic mortality. Phthalates and triclosan are two examples of potentially estrogenic chemicals we interact with daily that have been found to reduce fertility and disrupt endocrine functioning. I tested the hypothesis that early embryonic exposure to DEHP would reduce embryo mass and survival. I also tested the hypothesis that early embryonic exposure to triclosan and estradiol would reduce embryo mass and survival. Chicken eggs were injected with oil as a control group, a solution containing low DEHP, or a solution containing high DEHP. The embryos were incubated for 14 days prior to being weighed. The data collected showed no statistically significant differences between the treatments for embryo mass and survival. In a similar study on the effects of estradiol and triclosan, chicken eggs were injected with oil as a control group, estradiol as a control group, triclosan, or a solution of triclosan and estradiol. The embryos were incubated for 14 days prior to being weighed. The data collected showed no statistically significant differences between the treatments for embryo mass and survival rate. Based on the results of this project, DEHP, triclosan, or estradiol had no effect on the survival rate and mass of chicken embryos.

EXPERIMENTAL MANIPULATIONS OF OFFSPRING FOOD AVAILABILITY SUGGEST BEGGING CONTAINS LITTLE INFORMATION IN A FROG WITH FACULTATIVE PARENTAL CARE

Presenter: Brooks, Olivia
Graduate, Biological Sciences

Mentor: Prof. Matthew Dugas

Authorship: Olivia Brooks, Evan Talbott-Swain, Matthew Dugas

Offspring solicitation signals (begging) are hypothesized to evolve to communicate information about how an offspring might benefit from parental investment. Much of what is currently known about the information content of begging signals comes from species where offspring are entirely dependent on parents for food. However, early in the evolution from non-begging to begging, the ability of offspring to self-feed may have shaped the benefits of producing begging signals. In Neotropical poison frogs, most tadpoles forage within their nurseries, but in some species, mothers provide unfertilized trophic eggs to their developing young. While egg-feeding is obligate in some lineages, in others, tadpoles both self-feed and beg for food. We tested hypotheses about what information is contained in tadpole begging in the mimic poison frog *(Ranitomeya imitator*), a species in which tadpoles can self-feed and beg for trophic eggs from parents. We reared tadpoles on three different diets shown to affect mass at metamorphosis, a common predictor of fitness in amphibians. We then assayed begging effort and intensity throughout development. Tadpoles reared on different diets did not differ in begging effort or intensity at any point during development. Our data suggests that *R. imitator* begging does not contain information about long-term differences in food intake. However, we also found that tadpoles did not beg often overall and that begging intensity decreased within a trial. Taken together, this suggests that early in the evolution of begging, offspring signals may have served simply to alert parents of their presence.

CHARACTERIZING AMPHETAMINE-INDUCED DOPAMINE SIGNALING IN THE STRIATUM UTILIZING CARBON-FIBER MICROELECTRODE ARRAYS

Presenter: Chicosky, Rebecca
Graduate, Biological Sciences

Mentor: Prof. Paul Garris

Authorship: Rebecca Chicosky, Jacob Giles, Paul Garris

Drugs of abuse increase extracellular levels of brain dopamine (DA), a key neurotransmitter modulating motor (i.e., movement) and limbic (i.e., emotional) functions. This elevated DA state is thought to underly the pathological reinforcing behaviors of abused drugs. Amphetamine (AMPH), a psychostimulant with high abuse potential, is historically believed to increase extracellular DA by efflux, an action potential-independent form of DA release. However, recent studies have contradicted this belief and demonstrated that AMPH elicits burst firing of DA neurons, which generates fast DA concentration changes called DA transients. Currently, it is unknown if AMPHinduced DA efflux and transients coexist and if so, whether these signals are segregated functionally or anatomically. Previous techniques using the gold-standard fast-scan cyclic voltammetry at a carbon-fiber microelectrode only afforded single-site recording and therefore, biased DA measurements towards one type of DA signal, fast. This bias may have led to an incomplete understanding of how AMPH alters DA function in the striatum, a forebrain region implicated in reward learning and found to have diverse DA signals. Here, we utilize two newly developed 16-fiber carbon-fiber microelectrode arrays (CF-MEAs) for simultaneous 32-channel DA recording in the dorsal and ventral striatum. This new technique affords us the ability to study DA signaling within the urethane-anesthetized rat striatum without a bias toward fast signals. Measurements, which capture heterogenous DA signals before and after AMPH administration (i.p./i.v.) permit relating observed different effects of AMPH to functional domains of DA signals in vivo.

MECHANISMS OF INITIATION OF CORTICAL SPREADING DEPRESSION IN MIGRAINE DISORDERS

Presenter:	Crowe, Grace Undergraduate Biological Sciences
Mentor:	Prof. Wolfgang Stein
Co-Mentor:	Prof. Allison Harris
Authorship:	Grace Crowe, Wolfgang Stein, Allison Harris

An estimated 1 billion people worldwide experience migraines with symptoms including intense headache pain, nausea, and sensitivity to varied stimuli. Some forms of migraine are preceded, and perhaps initiated, by visual auras before pain onset. Auras are caused by a slowly traveling wave of inactivity in the visual cortex, referred to as cortical spreading depression (CSD). Cortical inactivity results from a loss of potassium homeostasis in the space surrounding the cortical neurons that is elicited by a rapid and dramatic increase in cortical neuron activity. A wave of inactivity then slowly propagates through the cortex.

While the consequences of a loss of potassium homeostasis are well-understood, the larger-scale dynamics and mechanisms that initiate the loss, and thus ultimately CSD, remain poorly understood. In patients with familial hemiplegic migraine (FHM-2) it has been hypothesized that mutations in the Na+//K+ pump, an enzyme essential for potassium homeostasis and present in all brain cells, plays a key role in initiating CSD. It is not clear to what extent the severity of the defects caused by the mutation, or how the spatial distribution of defects within the cortical network, affect CSD initiation. Our project aims to address these issues by studying how local inhomogeneities in pump strength can lead to the initiation of CSD. We use a computational model of 25 cortical microcircuits to examine the effects of spatial variations in pump strength. The micro-circuits are coupled through the extracellular space, allowing for the diffusion of ions, such as potassium, across the network.

Introducing a reduced pump strength into a single location of the network was sufficient to elicit inactivity characteristic of CSD. However, inactivity was restricted to the micro-circuit manipulated and did not spread across the whole network. With a further decrease in pump strength, CSD only spread to a few neighboring micro-circuits, demonstrating that cortical networks with healthy pumps can terminate ongoing CSD. Even a dramatic reduction in pump strength of a single micro-circuit was unable to overcome the dampening effect of the surrounding healthy circuits. This suggests that a single defect in pump strength is insufficient to overwhelm a healthy network and should prevent CSD.

As a next step, we are testing whether more widespread pump defects will cause CSD to spread

SQUIRREL-LOCK HOLMES, A TOUGH NUT TO CRACK: INVESTIGATING THE FORAGING AND VIGILANCE BEHAVIORS OF THE WESTERN GRAY SQUIRREL (SCIURUS GRISEUS)

Group Leader: Darter-Krantz, Ava
Undergraduate, Biological Sciences

Group Member: Peyten Toney, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Ava Darter-Krantz, Peyten Toney, Rebekka Darner

The purpose of this research project is to examine the foraging and vigilance behaviors of Western grey squirrels (*Sciurus griseus*). We sought to address four research questions. First, we inquired whether the vigilance displays of Western gray squirrels are similar to that of the California ground squirrel. Secondly, we would like to know whether the vigilance behaviors of Western gray squirrels are affected by wind levels. Thirdly, we would like to know whether time of day influences Western gray squirrel foraging. Finally, we would like to know whether squirrels spend more time foraging when humans are present. Studying the vigilance and foraging behaviors of Western gray squirrels is important due to their implications for human-squirrel interactions, which contribute to the spread of zoonotic disease, ecological disruption, and, on a broader scale, the effects of climate change and habitat fragmentation.

VIGILANCE AND FORAGING AMONG EASTERN GRAY SQUIRRELS AND EASTERN FOX SQUIRRELS

Group Leader: Davis, Michaela
Undergraduate Biological Sciences

Group Member: Hailey Burnett, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Michaela Davis, Hailey Burnett

The purpose of this research project is to investigate foraging and vigilance behaviors among Eastern gray squirrels (*Sciurus carolinensis*) and Eastern fox squirrels (*Sciurus niger*). We sought to address four research questions. First, does conspecific presence influence vigilance behavior in Eastern gray squirrels? Second, does the biome in which the squirrel is living have an impact on foraging behavior observed in Eastern fox squirrels? Third, is there a relationship between squirrel vigilance in Eastern gray squirrels and the number of dogs in proximity? Finally, is the Eastern fox squirrel foraging behavior impacted by people nearby? This study is important due to its implications for understanding how human activity and other animal presence leads to alterations of habitat that affect squirrel behavior.

STRUCTURE OF MALE SONG IN HOUSE WRENS: CONTEXT-SPECIFIC VARIATION IN A COMPLEX SEXUAL TRAIT

Presenter: DiSciullo, Rachael
Graduate, Biological Sciences

Mentor: Prof. Charlie Thompson

Co-Mentor: Prof. Scott Sakaluk

Authorship: Rachael A. DiSciullo, Scott K. Sakaluk, Charles F. Thompson

Ornaments shaped by male-male competition and female mate choice are often multifaceted. These components, such as those that comprise bird song, collectively influence reproductive success. To identify how sexual selection has shaped these often-correlated song components, we must first describe the basis of this elaborate, complex trait, when it is produced, and identify the extent to which its components are shared among members of a population. In house wrens (*Troglodytes aedon*) male song composition is highly variable both intra- and interindividually, and its presentation patterns change throughout the breeding season. We have characterized this variation as a first step in determining which song components are favored by sexual selection, and to evaluate how song may play a role in other functions such as social cohesion. Here we present the first described “dictionary” of the male song and syllable types present in a central Illinois population of northern house wrens, to help determine the functional significance of male song in this species.

INVESTIGATION OF BEHAVIORAL CHARACTERISTICS AMONG EASTERN FOX SQUIRRELS (*SCIURUS NIGER*)

Group Leader: Ellis, Marissa
Undergraduate Biological Sciences

Group Member: Chloe Pryor, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Marissa Ellis, Chloe Pryor

The purpose of this research project is to investigate behavioral characteristics such as alert feeding, foraging, and vigilance among Eastern Fox Squirrels (Sciurus niger). We sought to address four research questions. First, on college campuses, what time of day are fox squirrels most likely to alert feed? Second, are fox squirrels more vigilant in urban areas compared to deciduous forests? Third, is there a relationship between fox squirrels' vigilance and their proximity to humans? Finally, is alert foraging more common among fox squirrels when there are more dogs present? This study is important for understanding feeding and foraging patterns, what time of the day fox squirrels are most likely to alert feed, what affects their activity level, and if foraging is more common when dogs are present. This study can also gain insight into the purpose of their behavior and how they communicate, which can be important to conservation and survivability of the species, as they are important ecologically.

STERILE INSECT TECHNIQUE WILL CONTROL MOSQUITOES WHEN IMPLEMENTED EARLY IN THE SUMMER

Presenter: Evans, Katherine
Graduate, Biological Sciences

Mentor: Prof. Steven Juliano

Authorship: Katherine G. Evans, Steven A. Juliano

Sterile Insect Technique (SIT) is a species-specific pest control technique used to target Aedes mosquitoes. Benefits of SIT include reduced pesticide use for mosquito control, increased effectiveness of control of pesticide-resistant populations, and minimizing harm to non-target organisms. There are environmental contexts in which SIT releases larvae from competition, which may yield no reduction, or even increased, adult production. Thus, it is important to identify such contexts, so that they can be avoided, to maximize the effectiveness of SIT against Aedes. I hypothesized that SIT is effective when resource level and larval density do not result in strong negative-density dependent effects on adult production. I predicted that SIT will be effective in the early summer, when Aedes albopictus populations are low. I further predicted that SIT would yield more adults in the late season in containers with low resource levels.

We collected Aedes eggs, water, and detritus from 26 containers placed in the field for one week, then transferred the field material to controlled lab conditions. We simulated larval density reduction by SIT as a treatment for half of the containers by adding Aedes albopictus at 50% the observed egg density for the associated field container; we added Ae. albopictus at the original egg density to control containers. We collected detritus resources (which support the microorganisms that are the food of Aedes larvae) from the field containers weekly and added those to the corresponding experimental containers. We conducted this experiment in summer of 2022 – once in June and again in August, when Aedes abundances were expected to be low and high, respectively.

We recorded the number of adult Ae. albopictus that emerged from each experimental container. Resource levels did not affect the number of adult Ae. albopictus emerging in either the control or simulated SIT containers in June. Data from the August experiment are still being analyzed, but preliminary data exploration shows that egg densities were much greater in August than in June. Our results suggest that targeting Ae. albopictus in June with SIT would be an effective control measure. Our research will help guide managers on when to implement SIT effectively to reduce a mosquito population.

ECOLOGICAL IMPACTS OF BTI LARVICIDING ON EPHEMERAL POOL COMMUNITIES

Presenter: Everly, Jaclyn
Graduate, Biological Sciences

Mentor: Prof. Steven Juliano

Larviciding is a mosquito control method targeting immature aquatic larvae with the goal of decreasing adult populations. In larviciding, pesticides are applied directly to the aquatic habitat of immature mosquitoes to reduce vector populations at their source and limit the spread of vector-borne diseases. Culex mosquitoes are vectors of viral diseases like West Nile Virus, which are acquired from and passed among hosts during blood-feeding by female mosquitoes. In the Midwest, larviciding is used against Culex mosquitoes inhabiting ephemeral pools, ditches, ponds, and temporary wetlands. Although larviciding is beneficial to public health, there is a pervasive concern that it may harm non-target organisms in ephemeral pools via direct (e.g., pesticide-induced mortality) or indirect (e.g., mortality induced by reduction of prey, or intraguild predation) effects. This may in turn affect ecosystem functioning and biodiversity in ephemeral pools that serve important ecological roles as refuges for organisms such as aquatic plants and algae, micro- and macro-invertebrates, and amphibians, particularly in disturbed and agricultural areas. To test whether larviciding directly or indirectly harms ephemeral pool communities, I conducted a 10-week field experiment with the Macon County Mosquito Abatement District (MMAD) in Decatur, Illinois during the summer of 2022. Each week, an MMAD technician applied the biorational larvicide Bti (Bacillus thuringiensis israelensis) at their discretion to 10 experimental pools while I collected invertebrate samples from the 10 experimental pools plus 4 untreated control pools to test for changes in community (e.g., diversity) and trophic (e.g., food web) structure over time and across treatments. I predicted that 1. Culex abundance would be lower in Bti-treated pools compared to untreated pools (direct effect), 2. community composition would differ between Bti-treated and control pools (direct and indirect effects), and 3. predator abundance would be lower in Bti-treated pools compared to untreated pools (indirect effect). I hypothesized that repeated larviciding with Bti, resulting in elimination or reduction of mosquito larvae and susceptible non-target species, alters community composition and trophic structure via direct and indirect effects on individuals in ephemeral pool communities. The results of this research highlight which organisms are most heavily affected by larviciding, what potentially important ecological roles those organisms fill in ephemeral pool ecosystems, and how their absence from the community may impact future efforts in freshwater conservation and public health.

TONNEAU RECRUITING MOTIF ROLE IN CELL DIVISION

Presenter: Falk, Tyler
Graduate, Biological Sciences

Mentor: Prof. Viktor Kirik

Authorship: Tyler Falk, Trevor Rickerd, Viktor Kirik

Cell division is a complicated process that is regulated by many different genes and proteins. It is better understood and studied in animal and prokaryotic cells while most of the processes regulated and controlling plant cell division are unknown. In addition to a cell membrane plant cells have a cell wall that gives plant cells their unique shape and structure. When plant cells don't divide properly it can cause them to have abnormal shapes and alter the function of the cells and the plant as a whole. It is known that plants use a specific microtubule array called the preprophase band to properly orient the cell wall during cytokinesis acting as a guide during division. It is a ring-shaped structure that goes around the cell on the cell cortex and forms perpendicular to the way that the plant cell grows. Another microtubule array that is essential to plant cell division is the phragmoplast. It builds the plate that will divide plant and daughter cells and is made up of microtubules and microfilaments. It builds the plate at the site where the preprophase band was.

A protein in plants that helps regulate preprophase band formation is the tonneau 1 protein. This protein binds to Tonneau recruiting motifs (TRMs). By attaching GFP to different TRMs we are able to look for spots in the plant cells that have the corresponding proteins. These are locations where TRMs are likely to exhibit their functions. Once the purpose or location of individual TRMs are found, crosses will be made using plant lines that have insertion mutations in individual TRM genes. TRM genes are also believed to have redundancy they are grouped together in "families". By crossing plant mutants in the same TRM "family" we can then look for defects in the cell shapes and cell division in their progeny.

UNCOVERING THE DIFFERENT FUNCTIONAL ROLES OF DYSTROPHIN ISOFORMS IN STRIATED MUSCLE

Presenter: Fazyl, Adina
Graduate, Biological Sciences

Mentor: Prof. Andrés Vidal-Gadea

Authorship: Adina Fazyl, Jessica Adams, Sabrina Kollbaum, Martin Engel, Andrés Vidal-Gadea

Duchenne muscular dystrophy (DMD) is a genetic disorder characterized by progressive muscle degeneration and weakness, caused by a mutation in the gene that codes dystrophin. Dystrophin is a protein that is part of a larger protein complex called the dystrophin-glycoprotein complex (DGC). The DGC helps anchor the actin cytoskeleton to the extracellular matrix and plays a crucial role in maintaining the structural stability of muscle fibers. In recent years, *C. elegans* has been used to study the biology of muscular dystrophies, including DMD. In *C. elegans*, the homolog of the human dystrophin gene has been identified and characterized. Little is known about how many dystrophin isoforms of *C. elegans* there are, where and when those isoforms are expressed, if the expression patterns vary, and how they match the functional needs of the tissues they are expressed in. To determine tissue-specific patterns of dystrophin isoform expression we built transcriptional reporter strains. GFP or mCherry expression is driven by promoters targeting the regulatory region upstream of different dystrophin isoforms. Here we show that *C. elegans* expresses two isoforms of marked different lengths in the body wall musculature responsible for locomotion. To understand how these different isoforms of dystrophin contribute to muscle function within the same cell we are performing targeted antibody staining coupled with behavioral assays designed to challenge the musculature through its natural physiological range while monitoring the expression of these isoforms through fluorescent reporters and qPCR. This study will help us understand the differential contribution of different isoforms of dystrophin to muscle function and might have relevance for therapeutic approaches introducing truncated protein forms as treatment for dystrophic muscles.

Funding provided by NIH (NIAMS) Award 2R15AR068583-02 to AGVG and ME. Some strains were provided by the Caenorhabditis Genetics Center (funded by NIH Grant P40 OD010440).

PENNYCRESS (*THLASPI ARVENSE*) SEED SIZE MUTANTS AFFECT SEED OIL ACCUMULATION DIFFERENTLY

Presenter: Gautam, Liza
Graduate, Biological Science

Mentor: Prof. John Sedbrook

Authorship: Liza Gautam, Ryan Bayliss, Spencer O'Flaherty, Win Phippin, John Sedbrook

Pennycress (*Thlapsi arvense*, Field Pennycress) is being developed as an oilseed-producing winter cover crop for the U.S. Midwest Corn Belt owing to its extreme cold tolerance, high seed yields, and relatively short life cycle. Varieties have been bred to produce over 1,500 pounds of seed per acre, yielding 65 gallons of oil and 1,200 pounds of meal per acre. Seed compositional changes have resulted in the creation of the new crop, CoverCressTM, in partnership with CoverCress, Inc. Along with compositional improvements, we have been taking both forward and reverse genetic approaches including CRISPR gene editing to increase seed size allowing for better seed handling of the grain and the ability to plant the seeds at greater depth. Three genes in which we have generated mutations are DA1, DA1-RELATED (DAR1), and UBIQUITIN PROTEIN LIGASE3 (UPL3). In Arabidopsis, DA1 and the related homologue, DAR1, encode ubiquitin receptors thought to set final seed and organ size by restricting the period of cell proliferation in the seed integuments. UPL3 mediates proteasomal degradation of, among other targets, the transcription factor LEC2. LEC2 activates expression of seed maturation and seed lipid accumulation genes. We found that single da1 mutants phenotypically grew like wild type and produced seeds about 14 to 20 percent larger than wild type. Double da1dar1 mutants were found to have seed sizes about 40 percent larger than wild type. Like da1dar1 double mutants, upl3 mutant seeds were bigger than wild type (17 to 32 percent larger) and plants were taller with bigger flowers, pods, and leaves and took relatively longer to flower. Surprisingly, pennycress upl3 mutant seeds had reductions in total oil content, which is opposite to what was observed with Arabidopsis upl3 mutant seeds. Omics analyses are underway to understand how these pennycress genes function relative to orthologues in other Brassica species.

CHARACTERIZING THE HETEROGENEITY OF ELECTRICALLY EVOKED DOPAMINE SIGNALS IN THE RAT STRIATUM UTILIZING CARBON-FIBER MICROELECTRODE ARRAYS

Presenter: Giles, Jacob
Undergraduate, Biological Sciences

Mentor: Prof. Paul Garris

Authorship: Jacob Giles, Rebecca Chicosky, Paul Garris

Dopamine (DA) is a neurotransmitter in the brain with important functions related to movement, motivation, and learning. The densest projection of DA neurons in the human brain originates in the midbrain and ascends to the striatum, a forebrain region critical to the brain circuitry mediating movement, cognition, and motivation. Abnormal DA signaling in this region has been implicated in the debilitating neuropathologies of Parkinson's disease, schizophrenia, and substance use disorder. Fast-scan cyclic voltammetry at a carbon-fiber microelectrode has been considered one of the best measurement techniques for quantifying extracellular DA levels in the brain of laboratory animals such as rodents in vivo. However, because of the provision for single site recording only, this technique has limited ability to assess the heterogeneity of DA signaling. As a result, DA measurements are often biased in favor of regions that exhibit one type of signal characteristics, such as fast and robust as opposed to, e.g., slow and small. Here, we utilize newly developed self-inserting carbon-fiber microelectrode arrays (CF-MEAs) to characterize DA signaling in the urethane-anesthetized rat striatum at multiple sites (i.e., up to 32) simultaneously. Measurements of the dorsal and ventral regions of the striatum show marked heterogeneity in both the concentration of DA elicited and the kinetics of these DA concentration changes. Our results suggest that the striatum exhibits functional heterogeneity of DA signaling and demonstrate the utility of CF-MEAs for investigating the role of DA in reward learning, drug addiction, and neurological disorders.

MACROINVERTEBRATES AS BIOINDICATORS OF THE SUCCESS OF RIPARIAN RESTORATION IN CENTRAL ILLINOIS

Presenter: Hoberg, Joe
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. William Perry

Authorship: Joe Hoberg, Bill Perry, Ryan Meyer, Ava Darter-Krantz

Urban streams are often impacted by channelization, fertilizer and salt runoff, and the loss of riparian vegetation. The resulting response of stream ecosystem structure and function has been called the urban stream syndrome. The increased water temperatures, decreased organic matter inputs, increased peak floods, and lower summer water levels impact the whole food web from algae to macroinvertebrates to fish. Cities such as Bloomington-Normal, Illinois aim to restore urban streams by restoring riparian zones. Healthy riparian zones provide abiotic conditions more suitable for aquatic communities. The objective of this study is to determine the effects of riparian restoration on water quality and aquatic diversity. An array of metrics will be used to assess water quality, including the Family-level Biotic Index, which utilizes aquatic macroinvertebrate diversity, richness, and pollution sensitivity as a bioindicator of water quality. Macroinvertebrates were collected from seven streams in the Bloomington-Normal area with sampling sites upstream and downstream of a restored riparian zone in each stream. Each sampling site consisted of three standardized macroinvertebrate samplers which were left in-stream for four weeks during the fall of 2022. After four weeks the samplers were collected and macroinvertebrates were preserved in ethanol. Macroinvertebrates from each sample will be counted and identified to family. We predict that if restoration is having an effect on streams, we will see improved water quality as measured by macroinvertebrate biotic indices from upstream to downstream on average. The results of this study will help indicate the effectiveness of riparian restoration on water quality.

PATHOLOGICAL ALTERATIONS IN DYSTROPHIC MUSCLE DURING MYOGENESIS

Presenter: Jazireian, Parham
Graduate, Biological Sciences

Mentor: Prof. Andrés Vidal-Gadea

Authorship: Parham Jazireian, Kiley Hughes, Emily Killian, Martin Engelke, Andrés Vidal-Gadea

Duchenne muscular dystrophy (DMD) is a degenerative disease caused by loss-of-function mutations in the gene encoding dystrophin affecting roughly 1 in 5000 males. It is characterized by elevated sarcoplasmic Ca2+ levels, muscle fiber damage and necrosis, loss of ambulation, and ultimately, death. Dystrophin has both structural and signaling functions in muscles, serving as a stabilizer during contraction and mediating the membrane localization of important ion channels. Recent evidence suggests that dystrophic phenotypes begin during embryogenesis. However, there is a lack of understanding about the development of dystrophic muscles compared to healthy ones. Particularly, it is not known to what extent the signaling and structural roles of dystrophin contribute to the onset of dystrophic phenotypes. This makes it important to study dystrophic muscles during their developmental stage. Dystrophic C. elegans lay translucent eggs that complete embryonic development within 14 hrs. and are amenable to experimental manipulation and observation. We used calcium ratiometry (GCaMP) to compare myogenesis in dystrophic and healthy nematodes. We found that sarcoplasmic calcium levels show an early increase in dystrophic muscles. We are currently using RNA interference to determine the relative contributions of the signaling vs structural roles of dystrophin to increased sarcoplasmic calcium levels. Understanding how the absence of dystrophin during myogenesis alters muscle physiology will be important for treatments aimed at reducing or reversing this impact.

CHARACTERIZING THE ROLE OF P38KB AND GARS IN CHARCOT MARIE TOOTH DISEASE

Group Leader: Klos, Piotr
Graduate Biological Sciences

Group Member: Lauren Naeger, Undergraduate, Biological Sciences

Mentor: Prof. Wolfgang Stein

Authorship: Piotr Klos, Lauren Naeger, MacKenna Duncan, Megan Cross, Julia Martin, Alysia Vrailas-Mortimer

Charcot-Marie-Tooth Disease (CMT) is a progressive neuropathology caused by the deterioration of neuronal function in the peripheral motor and sensory nervous systems. Motor symptoms include tripping, ankle twisting, and clumsiness, and sensory symptoms include sensations such as pins and needles and burning pain. There are no preventive therapeutics, but mutations in several tRNA-synthetase genes have been implicated in causing CMT. Though mutations in a variety of genes can give rise to CMT, several of the genes are tRNA-synthetases. We have recently found that the p38 MAPK (p38Kb), a kinase involved in aging and age-dependent locomotor deficits, regulates the levels of several tRNA-synthetase proteins during aging. p38Kb interacts with the Chaperone-Assisted Selective Autophagy (CASA) complex to mediate the degradation of misfolded or nonfunctional proteins, a process that contributes to clearing tRNA-synthetase proteins that are damaged from aging. Failure to clear damaged proteins may result in disease symptoms or worsening of symptoms. We hypothesize that p38Kb-mediated regulation of tRNA synthetase degradation is crucial for maintaining proper neuromuscular function. Utilizing D. melanogaster, we tested interactions between p38Kb and the tRNA synthetase GARS and how their contribution to CMT-like phenotypes in flies by measuring p38Kb-mediated clearance of mutant GARS. Western blots of p38Kb knockout flies indicated accumulation of GARS, but sucrose density gradient separation suggested that tis accumulation was not aggregation-based. We also found that overexpression of p38Kb in fly muscles improved locomotor function, and that mutant GARS expression in the mesoderm was sufficient to induce neuropathology. In contrast, overexpression of p38Kb in motor neurons decreased locomotor function, indicating a possible tissue specific mechanism of p38Kb functionality. Overall, we have found that knockout of p38Kb in muscles increases GARS levels, and that p38Kb appears to have tissue-specific functionality.

COURSE-BASED UNDERGRADUATE RESEARCH EXPERIENCES TO ADVANCE SCIENCE COMMUNICATION SKILLS: A SYSTEMATIC REVIEW

Presenter: Korkor, Ebenezer
Graduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Ebenezer Korkor, Rebekka Darner

In this study, we performed a systematic literature review using review methods outlined by Bearman et al. (2012) to understand how course based undergraduate research experiences (CUREs) might foster scientific communication (SciComm) skills among undergraduate students. We explored the pedagogical strategies used in developing SciComm skills in undergraduates. Subsequently, we examined the literature on pedagogical strategies used in the implementation of CUREs, and then we did a comparative analysis to decipher point of intersection among pedagogical strategies used in CUREs and to foster SciComm. Most SciComm instructional strategies such as analyzing existing literature, blogging &Infographics, writing and/or summarizing reports and oral presentations have been successfully utilized in one or more CUREs, but they are underutilized. To harness the impact of CUREs, its implementation should be coupled with more explicit SciComm skill development and assessment, particularly regarding communication with lay audiences, which would better prepare students for the workplace, graduate school, and most importantly, as change agents in society.

VIGILANCE AND FORAGING BEHAVIOR IN EASTERN FOX SQUIRRELS (*SCIURUS NIGER*) IN RESPONSE TO ENVIRONMENTAL FACTORS

Group Leader: Krivograd, Sophie
Undergraduate, Biological Sciences

Group Member: Rylynn Heintz, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Sophie Krivograd, Rylynn Heintz

The purpose of this research project is to investigate vigilance and foraging behaviors among Eastern fox squirrels (*Sciurus niger*). We sought to address four research questions. First, how does the proximity to safety impact the vigilance of fox squirrels? Second, how does the number of humans nearby affect fox squirrels' vigilance? Third, how does the time-of-day impact how often fox squirrels forage? Finally, how does precipitation affect fox squirrels' foraging behavior? This study is important due to its implications for understanding how habitat can influence behavior, how potential nearby threats can affect squirrel vigilance, and how environmental conditions impact squirrel foraging behavior. Squirrels have a significant role in the ecosystem; understanding what influences vigilance and foraging behaviors can help scientists understand the impact Eastern fox squirrels have on the ecosystem and their ecological interactions.

DOES INDIVIDUAL QUALITY AFFECT THE PRODUCTION OF A SECOND BROOD IN HOUSE WRENS (*TROGLODYTES AEDON*) IN ADDITION TO TIMING?

Presenter: Leischner, Lauren
Graduate, Biological Sciences

Mentor: Prof. Pirmin Nietlisbach

Authorship: Lauren Leischner, Charles Thompson, Scott Sakaluk, Pirmin Nietlisbach

Climate change affects the reproductive success of migratory species as they are limited by time and appropriate weather conditions during the breeding season. This research asked whether variation in individual quality, in addition to timing, explains some of the variation in production of a second brood. Female house wrens (*Troglodytes aedon*) that nest early often have high quality territory, may be in better condition, and have an increased probability of having a second brood. Because of this, it is unclear whether the production of a second brood is solely due to the constraints of time or also due to female quality. To test this question, we cross-fostered eggs between early, high quality females and later, low quality females. This leads to high quality females raising hatchlings later in the season than intended. We are able to examine the effect of quality while keeping the effect of time equal when comparing to control nests through this manipulation. If delayed, high quality females have a greater probability of producing a second brood compared to the controls, quality may affect the production of a second brood in addition to timing. An association of quality and the production of a second brood could suggest that the population is constrained to evolutionary change over time when responding to climate change. As climate change may extend favorable conditions during the breeding season, the population may benefit from this change if time is the only factor affecting the production of a second brood.

POTENTIAL PREDICTORS FOR VIGILANCE IN EASTERN GRAY SQUIRRELS (*SCIURUS CAROLINENSIS*)

Group Leader: McLarty, Allie
Undergraduate, Psychology

Group Member: Rachel Moore, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Allie McLarty, Rachel Moore

The purpose of this research project is to investigate vigilance behavior among Eastern gray squirrels *(Sciurus carolinensis*). We sought to address four research questions. First, is there a relationship between sunny weather and vigilance in Eastern gray squirrels? Second, is there a relationship between vigilance in Eastern gray squirrels and the number of humans present? Third, is there a relationship between vigilance and habitat type? Finally, is there a relationship between vigilance and the number of conspecifics nearby? This study is important for better understanding why Eastern gray squirrels exhibit vigilance and if some stimulus are more likely to predict vigilant behavior over others.

POTENTIAL FOR PENNYCRESS TO IMPROVE FRESHWATER QUALITY IN THE UPPER MISSISSIPPI WATERSHED

Presenter: Meyer, Ryan
Graduate, Biological Sciences

Mentor: Prof. Bill Perry

Authorship: Ryan Meyer, Nicholas Heller, Bill Perry

Nutrient loading to freshwater systems is a key environmental issue concerning agriculture in the Upper Mississippi Watershed (UMW). In Illinois, EPA suggested nutrient reductions are being met by wastewater treatment and industrial facilities, but not by agricultural producers. Solutions are needed to reduce nutrient losses from agricultural fields. In the tile drained systems of the UMW, edge-of-field practices are not sufficient to meet nutrient reduction goals. In-field practices such winter cover crops are a promising tool for agriculture to meet nutrient reduction targets. Pennycress, a new winter cash crop being domesticated for biofuel and animal feed purposes, may help meet nutrient reduction goals while also providing economic incentive to producers. Our objective is to quantify how pennycress may help the UMW meet nutrient reduction targets as a winter cash crop. Using replicated and independently drained 0.8ha plots we assessed the potential for pennycress to immobilize nutrients in-field and in subsurface drainage systems. Our results demonstrate that pennycress is an effective short-term, winter to spring nutrient sink. Pennycress use resulted in up to 5-fold reductions in soil porewater nitrate-nitrogen relative to fallow conditions and significant reductions in soil nitrate-nitrogen relative to fallow conditions. Additionally, pennycress reduced subsurface discharge, resulting in near zero nutrient export to freshwater systems. We show that by utilizing in-field nutrients pennycress may effectively eliminate nutrient export to freshwater systems during the winter fallow period of the UMW. The use of pennycress as a short-term nutrient sink will assist the UMW in meeting EPA nutrient reduction goals.

PROSPECTS FOR HETEROLOGOUS EXPRESSION IN NEUROSPORA CRASSA

Presenter: Mierendorf, James
Graduate, Biological Sciences

Mentor: Prof. Thomas Hammond

Authorship: James Mierendorf, Thomas Hammond

The filamentous fungus Neurospora crassa has been utilized in molecular research for decades, most notably in the fields of genetics and biochemistry. Despite this, Neursopora's research value as a model system has been diminished by its recalcitrance towards expressing certain non-native DNA sequences inserted into its genome. Molecular techniques requiring such heterologous expression are largely incompatible with Neurospora research, despite being successfully implemented in other model systems. We propose this phenomenon results from heretofore unidentified native regulatory mechanisms encoded within the fungal genome which targets heterologous sequences for silencing and is itself susceptible to inactivation through mutation. To test this an experimental transgenic strain was created containing inexpressible cas9 sequence fused upstream of the native leucine synthesis gene leu-1. This renders the experimental strain auxotrophic, with a distinct poor growth phenotype in the absence of supplementation due to heterologous silencing activity. By subjecting the clonal conidia spores of the experimental strain to random mutagenesis by UV exposure, we successfully generated a mutant lineage in which heterologous silencing of the construct has been disrupted. Here we demonstrate that this heterologous expression positive (hep) mutation is heritable and resides within the third chromosome of N. crassa. crassa.

FORAGING AND SOCIAL BEHAVIORS IN EASTERN FOX SQUIRRELS (*SCIURUS NIGER*)

Group Leader: Nguyen, Kathleen
Undergraduate, Biological Sciences

Group Member: Kendy Reyes-Cruz, Undergraduate, Biological Sciences

Mentor: Prof. Rebekka Darner

Authorship: Kathleen Nguyen, Kendy Reyes-Cruz

The purpose of this research project is to explore foraging and social behaviors among Eastern fox squirrels (*Sciurus niger*). We sought to address four research questions. First, is there a significant difference between foraging times in fox squirrels near conspecifics versus in the absence of them? Second, how does number of conspecifics influence alert foraging behavior in fox squirrels? Third, are fox squirrels in core college campuses more social than squirrels in deciduous forests? Finally, how does the number of humans influence vigilance in fox squirrels? This study is important due to its implications for understanding habitat altercations' impact on squirrel behavior. Squirrels are important organisms for tree seed dispersal, and if habitat alteration impact squirrel behavior in a way that prevents them from being able to disperse seeds that promote tree growth or to forage, this would result in larger ecological implications. This study would also highlight ways in which Eastern fox squirrels maintain healthy population sizes in the context on habitat degradation.

FUNCTION OF DYSTROPHIN ISOFORMS IN THE NERVOUS SYSTEM

Presenter: Niha, Shifat
Graduate, Biological Sciences

Mentor: Prof. Andrés Vidal-Gadea

Authorship: Shifat Niha, Andrés Vidal-Gadea, Adina Fazyl

Duchenne Muscular dystrophy (Dmd) is a degenerative disease caused by mutations in the gene encoding the dystrophin protein. The dystrophin protein (DYS-1) plays an important structural role for both muscles and neurons. Loss of dystrophin leads to muscle degeneration and is often accompanied by neurological impairments. Several isoforms of dys-1 are expressed throughout the nervous system; however, the exact functional role of these isoforms in neurons is still not fully understood. How the loss of the gene leads to known neurological phenotypes of this disease is also unknown. The goal of this study is to map out the neuronal expression of the dystrophin isoforms, their role in the nervous system, and how their loss leads to the neurological phenotypes of DMD. Preliminary data has shown that different isoforms of dys-1 being expressed in different neurons resulting in certain behavioral defects. The completion of this study will allow us to get a better understanding of the function of dystrophin in the nervous system and the cognitive defects associated with the loss of the gene.

CHARACTERIZATION OF THE SILVER-CONTAINING NOVEL ANTIMICROBIAL AGXX®

Presenter: Orellano, Carl
Undergraduate, Biological Sciences

Mentor: Prof. Jan-Ulrik Dahl

The development of antimicrobial resistance is a growing public health concern, which is intensified by the lack in the discovery of new novel antibiotics. The opportunistic pathogen *Pseudomonas aeruginosa*, which is found, among others, in patients with cystic fibrosis, burn wounds, and urinary tract infections, is characterized by its high intrinsic antibiotic resistance. *P. aeruginosa* has evolved many mechanisms that contribute to its pathogenesis, including its ability to form biofilms and produce and release a plethora of virulence factors upon infection, which require novel treatment regiments. The silver and ruthenium-based antimicrobial surface coating *AGXX®* has recently been shown to kill multi-drug resistant gram-positive bacteria through the production of reactive oxygen species (ROS), while it was non-cytotoxic to mammalian cells. However, how gram-negative bacteria, such as *P. aeruginosa*, respond to and defend AGXX® is currently unknown. In my work, I exposed the *P. aeruginosa* strain, PA14, to increasing concentrations of different of *AGXX®* formulations (AGXX894 and AGXX720C) and compared their survival, growth behavior, and virulence factor production. My growth and survival data indicate that AGCXX894 is more potent in killing PA14 as lower concentrations were needed to see substantial killing. Exposure of PA14 to sublethal AGXX720C concentrations resulted in elevated production of pyocyanin, a ROS-generating compound. AGXX720C induced changes in pyoverdine and pyochelin levels, two molecules that aid in iron intake. These were in stark contrast as pyoverdine levels were increased and pyochelin production decreased. Rhamnolipids, a factor that aids in quorum sensing, motility, and biofilm formation, showed declined levels upon exposure of PA14 to AGXX720C. A deeper understanding of how *P. aeruginosa* respond to this ROS-generating antimicrobial may provide insights into how they develop resistance and ideas on how to develop treatments more efficiently.

PLASTICITY IN THE COMPOSITION OF NUPTIAL GIFTS IN RESPONSE TO VARYING RISK OF SPERM COMPETITION: A MOLECULAR DISSECTION OF A POTENTIAL GENOTYPE x ENVIRONMENT INTERACTION IN DECORATED CRICKETS

Presenter: Rengifo, Laura
Graduate, Biological Sciences

Mentor: Prof. Ben Sadd

Co-Mentor: Prof. Scott Sakaluk

Authorship: Lauren Rengifo, Bert Foquet, Scott Sakaluk, Ben Sadd

Although mating in sexually reproducing species is a necessity, the male and female interests during and after mating may be at odds, leading to sexual conflict. In polyandrous systems in which females mate with multiple males, females can derive indirect genetic benefits by producing offspring with different sires. However, males benefit by monopolizing female reproduction, and have evolved manipulations to this end. This includes plastically increasing sperm allocation under a high risk of sperm competition, when females are likely to mate with additional males. However, less is known about plasticity in non-sperm components of the ejaculate. Nuptial gifts provisioned to females by males are a widespread sexual tactic in insects used by males to maximize sperm transfer. In decorated crickets, *Gryllodes sigillatus*, the gift comprises a portion of the spermatophore, the spermatophylax, that the male transfers at mating. Proteins in the spermatophylax may function to modify female behavior and physiology to increase male paternity. By experimentally varying the perceived risk of sperm competition of males derived from genetically distinct lines, I will test the hypothesis that sperm competition risk and male genotype influence the composition of food gifts. Specifically, I will assay gene expression profiles of accessory-gland proteins putatively involved in sexual conflict. A molecular dissection of the ability of males of different genotypes to plastically modify the composition of their gifts in response to increased sperm competition risk will deepen our understanding of the importance of sexual conflict in the evolution of nuptial gifts.

INVESTIGATING THE EFFECTS OF LATE CORTICOSTERONE EXPOSURE ON EMBRYONIC DEVELOPMENT

Presenter: Roseland, Anna
Undergraduate, Biological Sciences

Mentor: Prof. Ryan Paitz

Authorship: Anna Roseland, Ryan Paitz

Investigating embryos within the first few weeks of development allows for further understanding of embryonic endocrinology and their responses to their environment. Previous investigations demonstrated that early embryonic exposure to glucocorticoids was lethal, but this lethal effect could be prevented by pharmacologically blocking the glucocorticoid receptor with the drug RU486. However, administering RU486 early in development led to decreased embryo mass by day fourteen of development. To further study the effect of RU486 and cortisol on growth and survival later in development, chicken eggs were given late exposure on day six of development to cortisol and RU486. The hypothesis of this experiment was that late exposure will not affect mortality rates while simultaneously limiting the decrease in birth weight. The aim of this study was to determine if late exposure to RU486 and cortisol would continue to decrease mortality while also maintaining birth weight of the embryos, and to compare the findings. To conduct this experiment, chicken eggs were injected with a control group of oil along with the experimental groups RU486 and cortisol. The eggs were removed from the incubator, removed from their shells, and weighed on day fourteen of development. There was not a significance of any treatment on mortality. Embryos that were injected with cortisol averagely weighed more than the eggs injected with RU486, but less than the eggs injected with oil. The embryos exposed to RU486 injections resulted in the lowest birth weights. This study shows that late injection of cortisol and RU486 did not have a significant effect on mortality, unlike the lethality resulting in early exposure. However, cortisol and RU486 exposure continued to decrease birth weight similarly to early injection.

PEPTIDE MODULATION ENABLES TEMPERATURE ROBUSTNESS IN PATTERN-GENERATING NEURONS OF DUNGENESS CRAB

Presenter: Sanford, Mason
Graduate, Biological Sciences

Mentor: Prof. Wolfgang Stein

Authorship: Mason Sanford, Wolfgang Stein

The abnormal rise in ocean temperatures and the persistent extreme weather conditions over the last few decades pose significant challenges for marine wildlife. Ectothermic aquatic animals that live in the intercoastal areas are the most affected since they experience a wide range of temperatures, and their body temperature closely mirrors the ambient temperature. Maintaining nervous system function in extreme temperature conditions is particularly critical because the nervous system controls various biological processes, including decision-making, respiration, and other vital behaviors. The extent to which nervous systems are temperature-sensitive and how much rising environmental temperatures affect neurons and their activities are currently being investigated. Still, recent studies have suggested the release of peptide neuromodulators, either hormonally or by neurons, enables the nervous system to become more robust against extreme temperatures.

We investigate the effects of neuromodulation on temperature robustness using the crustacean stomatogastric nervous system (STNS), an established model for studying how neural circuits generate rhythmic behaviors. The STNS contains well-studied central pattern generators (CPGs), making it ideal for studying temperature sensitivity in neural circuits. We compare temperature robustness in three crab species: Cancer borealis (Jonah Crab), Cancer magister (Dungeness Crab), and Callinectes sapidus (Blue Crab). Data from Cancer borealis suggested that increased temperatures cause the CPG to become less excitable, eventually ceasing neuronal activity. Studies have also shown that the release of peptides from neuromodulatory neurons that innervate the CPG increases excitability and contributes to how tolerable the nervous system is when exposed to excessive temperatures. We hypothesize that this is a general mechanism by which neurons achieve temperature robustness.

In this study, we test whether neuropeptide release increases temperature robustness also in Cancer magister. Using electrophysiology, we will isolate the nervous system, record rhythmic CPG activity, and then expose the CPG temperature until it is arhythmic. We will then increase neuropeptide release from modulatory projection neurons by raising the bath temperature in which they are located. We predict that this will restore rhythmic CPG activity.

Our preliminary data show that the CPG became arhythmic within 4-5 °C (n=2) when only the CPG was heated. However, when the modulatory projection neurons were heated up along with the CPG, the rhythmic activity was maintained at a much higher temperature (8-9 °C). This suggests that peptide neuromodulation plays a critical role in the temperature robustness of the STNS in Cancer magister and that this phenomenon is not idiosyncratic to one crab species.

MAINTAINING ORDER IN THE GUT: THE ROLE OF HOST IMMUNITY IN SHAPING MICROBE COLONIZATION OF THE BUMBLE BEE GUT

Presenter: Shosanya, Teni
Undergraduate, Biological Sciences

Mentor: Prof. Ben Sadd

Authorship: Teni Shosanya, Logan Sauers, Bert Foquet, Ben Sadd

Organisms harbor microbial communities termed microbiota, with gut microbiota often important for many aspects of health including digestion, detoxification and infection resistance. Factors shaping the composition of these communities and thus their functional effects on host health are therefore critical. Host immunity is proposed to play a role in determining microbiota structure, but the importance of innate immunity has not been extensively investigated in systems with relatively consistent and vertically transmitted microbiota. Members of the beneficial microbial communities in bumble bee guts have been shown to be vertically transmitted and have specific patterns of colonization depending upon the host and bacterial genotypes. I hypothesize that the innate immune system of the bumble bee determines community composition, by limiting the colonization of foreign microbes while maintaining native microbial strains. I will investigate the interaction between the innate immune system and the beneficial gut microbial community using RNA interference (RNAi) to knock down the Toll and IMD antimicrobial pathways combined with cross inoculation of microbiota native and foreign to the host lineage. We anticipate that the colonization of the foreign microbiota will be closer to that of the native in knockdown treatments, as host control is reduced. Currently, RNAi knock down of immune genes is being validated to use in this approach. Understanding the effect of host immunity on the structure of their microbial communities will add to our knowledge of the evolution of these interactions and factors moderating them.

A TWO-PRONGED APPROACH TO CHARACTERIZE A NOVEL NA, K-ATPASE INVOLVED IN ADAPTATION OF BRINE SHRIMP TO HIGH-SALINITY ENVIRONMENTS

Group Leader: Strandquist, Evan
Graduate, Chemistry

Group Members: Julia Retter, Undergraduate, Biological Sciences; PJ Patterson, Undergraduate, Biological Sciences; Cameron Tyler, Undergraduate, Biological Sciences

Mentor: Prof. Craig Gatto

Authorship: Julia Retter, PJ Patterson, Tyler Cameron, Kerri Spontarelli, Craig Gatto, Evan Strandquist

Brine shrimp (*Artemia*) are members of an elite club of animals that can survive in the high-salinity waters of inland salt lakes. Many animals cannot survive in these environments because of the extreme osmotic and ionic forces present in these environments. Previous work by the Gatto group found that *Artemia* utilize an isoform of the Na, K-ATPase, named α2KK, which pumps out 2 Na^+ and takes in 1 K^+ every cycle, as opposed to the otherwise ubiquitous stoichiometry of 3 Na+ :2 K^+ observed in all other isoforms of the Na, K-ATPase. We believe that this novel pump is related to *Artemia's* osmoregulation and the organism's capacity to survive in the demanding environment. Analysis of the Na, K-ATPase activity was performed using a two-pronged approach involving both electrophysiological and chemical kinetic means. As the pump works, a net +1 charge is exported from the cell. This movement of charge creates a current that is related to the membrane potential of the cell. Two-electrode voltage clamping (TEVC) is an electrophysiological technique that allows for the study of cell membrane voltage and changes in current produced by ion transporters by inducing a voltage potential and measuring the reactionary current produced as the pump functions. When used in conjunction with the Xenopus laevis oocyte expression system, TEVC is an invaluable and universal tool to study the Na, K-ATPase. The work described involves the analysis of a dose-response analysis of oocytes expressing α2KK to the steroidal Na, K-ATPase inhibitor ouabain. Our results show that the α2KK isoform of the Na, K-ATPase has a significantly higher $K_{0.5}$ than uninjected controls, suggesting that this novel isoform has a remarkable resistance to inhibition by ouabain. In addition to TEVC, chemical kinetic analyses were performed. Hydrolysis of ATP by the pump produces inorganic phosphate (P_i), which can be measured using a molybdate-based colorimetric assay. Dose response to the substrate K+ can be performed to characterize the protein, reported as K_M. This work contributes to a growing body that characterizes this fascinating α2KK isoform.

CHARACTERIZING A NOVEL NA, K-ATPASE ASSOCIATED WITH BRINE SHRIMP ADAPTATION IN HIGH OSMOLARITY ENVIRONMENTS

Group Leader: Strandquist, Evan
Graduate, Chemistry

Group Members: Kathleen Nguyen, Undergraduate, Biological Sciences; Gracie Trader, Undergraduate, Biological Sciences

Mentor: Prof. Craig Gatto

Authorship: Kathleen Nguyen, Gracie Trader, Alyvia Hogge, Kerri Spontarelli, Craig Gatto, Evan Strandquist

Brine shrimp (*Artemia*) are a model organism that live in high-salinity inland lakes. These organisms have adapted mechanisms of water retention and changes to proteins that transport ions across membranes in order to fight enormous osmotic and ionic gradients. Previous investigations from the Gatto laboratory reveal that Artemia express a novel isoform of the Na, K-ATPase (α2KK) that has a stoichiometry of 2Na:1K, as opposed to the ubiquitous stoichiometry of 3Na:2K seen in all other Na, KATPases recorded in nature. It is hypothesized that this isoform is upregulated when shrimp are introduced to a high-salt environment, as its novel stoichiometry facilitates this organisms unique survival in an extreme, saline environment. To study the α2KK isoform, various molecular biological techniques were used to insert modified subunits of the Na, K-ATPase into frog (*Xenopus laevis*) oocytes for characterization of the Na, K-ATPase via Two-Electrode Voltage Clamping (TEVC). TEVC is an important technique to analyze ion pump activity, as each catalytic cycle results in a net charge moving out of the cell. The potential difference (voltage) across the membrane is maintained by a flow of charge through an injector electrode, which is controlled and recorded by the instrument. An increase in the injected current required to maintain a constant membrane potential represents an increase in the activity of the Na, K-ATPase, as more current injected into the cell is required to equilibrate the increased loss of charge by pump activity. The data presented below represents the techniques used to insert a gene into a plasmid, transcribe it, and produce mRNA for oocyte injection. We successfully transformed NEB5α E. coli cells with a control α-subunit isoform of the Na, K-ATPase, though we were unable to successfully construct the corresponding ß-subunit. Despite this, the *X. laevis* oocyte expression was successfully utilized in combination with TEVC to analyze isoforms of the Na, K-ATPase. Specifically, the Na, K-ATPase isoform sensitivity to the steroidal inhibitor ouabain was studied. Previous studies suggest that oocytes expressing the α2KK Na, K-ATPase have demonstrated significant resistance to ouabain relative to *X. laevis* wild-type. We studied this more carefully via TEVC by measuring the dose-response of current to increasing amounts of ouabain. Remarkably, α2KK-expressing oocytes demonstrated a much higher $K_{0.5}$ (134 μM) for ouabain than uninjected oocytes (<1μM). This work contributes to a growing body that describes this novel Na,K-ATPase.

CHARACTERIZING NA, K-ATPASE ISOFORMS IN *ARTEMIA* GROWN IN LOW AND HIGH SALT

Group Leader: Strandquist, Evan
Graduate, Chemistry

Group Member: Emily Pranskevicius, Undergraduate, Biological Sciences

Mentor: Prof. Craig Gatto

Authorship: Emily Pranskevicius, Michael Marcheschi, Joe Boyer, Craig Gatto
Evan Strandquist

The Na, K-ATPase is a heterodimeric transmembrane protein found in all animal cells that is essential in maintaining the membrane potential. The stoichiometry of the Na, K-ATPase is three Na^+ transported out of the cell for two K+ transported into the cell, at the cost of one equivalent of ATP to power the reaction. Interestingly, the brine shrimp (*Artemia*) maintains a novel isoform of the α-subunit of the Na, K-ATPase (α2KK) that has different stoichiometry of 2 Na^+ and 1 K^+ at the cost of one ATP molecule. This novelty is quite rare in the animal world, as is the ability of *Artemia* to survive in such high salinity environments as those of the inland salt lakes. It is possible that this unique isoform of the Na, K-ATPase is upregulated to overcome the high osmolarity environment that give the brine shrimp their common name. The goal of this work was to characterize and compare the Na, K-ATPase isolated from *Artemia* that was lab-grown in either low- or high-salt environments. Characterization was performed using a dose-response colorimetric assay, indirectly measuring Na, K-ATPase activity by monitoring the formation of phosphate as a product of ATP hydrolysis. Kinetic data of Na, K-ATPase protein preparations from the low salt and high salt growth conditions were collected for the Na^+ substrate. We found that Na, K-ATPase preparations from *Artemia* grown in 250 mM salt water indicated a K_M of 3.6 mM Na+ , while the protein extracted from *Artemia* grown in 2 M salt water showed a similar K_M of 3.5 mM. The Km values are the same, suggesting the binding affinity for Na^+ of the Na, K-ATPase present in the preparations are not different. This is an interesting finding, as transcriptomics suggest a significant change in expression levels of the α2KK isoform when *Artemia* are raised in high salt. Additional work is recommended to further characterize the protein preparations of Artemia in different conditions, to be performed in tandem with gene expression analyses. Finally, this work is the result of the investigator's involvement in a CURE course, a multilevel training experience that reinforced scientific skills at both the undergraduate and graduate levels, while providing training to graduate students as future mentors.

This work was supported by NSF grant MCB-2003251.

THE EFFECTS OF HEMIPARASITIC PLANTS ON INTRASPECIFIC AND INTERSPECIFIC COMPETITION IN NATIVE PRAIRIE SPECIES

Presenter: Thompson, Margaux
Undergraduate, Biological Sciences

Mentor: Prof. Victoria Borowicz

Authorship: Margaux Thompson, Victoria Borowicz

In Illinois, multiple factors have reduced the extent and threatened the functioning of native prairies. Consistent with other ecological communities, competition between species in prairie grasslands is prevalent and for threatened or endangered prairie species, interspecific competition could lead to local extinction. A novel idea to manage interspecific competition among prairie species is the addition of hemiparasitic plants. Hemiparasites are green plants that attach to the vascular system of neighbors and steal water, minerals, and other nutrients to the detriment of the host. Hemiparasites are hypothesized to be keystone species in a community if they promote increased species diversity. For the keystone effect to occur, less competitive species must gain greater access to resources in the presence of hemiparasites, resulting in species coexistence and increased species diversity. However, if the less competitive species is more strongly suppressed by the hemiparasite, it could be competitively excluded, depressing community diversity. In our experiment, we test the keystone hypothesis and postulate that the annual hemiparasitic species Agalinis tenuifolia promotes coexistence by more strongly reducing growth of the competitive dominant in interspecific competition. In order to test this hypothesis, we need to compare the effects of competition between two species without the interference of the hemiparasite and when the hemiparasite is present. We will determine the strength of competition between pairs of host species, by measuring the growth of a single target plant when grown with 0, 1, 2, or 4 competitors of the same (intraspecific competition) or other species (interspecific competition). If our hypothesis is supported, growth of competing species should be more even in the presence of A. tenuifolia.

DECIPHERING THE MECHANISMS UNDERLYING THE LETHAL CONSEQUENCES OF EMBRYONIC EXPOSURE TO CORTICOSTERONE

Presenter: Tillman, Libby
Undergraduate, Biological Sciences

Mentor: Prof. Ryan Paitz

Authorship: Libby Tillman, Ryan Paitz

During stressful events, vertebrates increase their production of glucocorticoids in order to help coordinate a physiological response to the stressor. However, if developing embryos are exposed to elevated glucocorticoids, that can result in decreased embryo weight and even embryonic death. These effects are thought to arise in the embryos because glucocorticoids activate the glucocorticoid receptor and induce inappropriate gene expression. In this experiment, we tested the hypothesis that blocking activation of the glucocorticoid receptor prevents early embryonic death. To block the receptor, RU486, an inhibitor that blocks the glucocorticoid receptor and prevents these receptors from binding to glucocorticoids, was injected into chicken eggs already injected with glucocorticoids (corticosterone). Oil (control) and corticosterone alone were also injected into the eggs. After being incubated for fourteen days, the embryos were dissected from their shells and weighed. Injections of cortisol resulted in decreased embryo mass and survival rate. Injections of RU486 plus corticosterone prevented the negative effect of corticosterone on embryo survival rate, but surviving embryos were smaller than control embryos. These results illustrate that activation of the glucocorticoid receptor is necessary to induce the pathways that result in embryonic mortality. Depression Scale, to self-report trait anxiety. Then, they will complete two working memory tasks and a long delay prospective memory task to text the researcher after a several hours or a few days. We predict that elevated levels of anxiety will have a negative effect on both working memory and performance in the prospective memory task.

HOW DOES COLD SNAP EXPOSURE AFFECT SEX DETERMINATION IN A FRESHWATER TURTLE?

Presenter: Warren, Clinton
Graduate, Biological Sciences

Mentor: Prof. Rachel Bowden

Co-Mentor: Prof. Ryan Paitz

Authorship: Clinton Warren, Anthony Breitenbach, Rachel Bowden, Ryan Paitz

In species with temperature-dependent sex determination, temperatures above or below a threshold result in the formation of either an ovary or a testis. Although these thresholds exhibit limited variation within species, individuals vary in the time it takes to respond to a thermal cue. Consequently, we are characterizing temporal variation as a metric of thermal responsiveness to warm and cool temperatures in red-eared slider turtle embryos (*Trachemys scripta*). We previously demonstrated that an 8-day heat wave is enough to induce ovary formation and produce a female-biased sex ratio but that embryos become less responsive to heat wave conditions with further development at cooler baseline temperatures. Here, we similarly exposed embryos to cold snaps at varying points in development from warmer baseline conditions. We predicted that responsiveness to cold snaps would decrease with developmental stage as embryos spent more time at baseline conditions. Lastly, we examined the necessary length of cold snap exposure needed to produce a male-biased sex ratio. We found that cold snaps beginning on incubation day 14 were early enough to induce testis formation as indicated by increased expression of the testis-producing gene *Dmrt1* and suppression of the ovary-producing gene *Cyp*19A1 across development in embryonic gonads. Conversely, cold snap treatments beginning on incubation day 18 or 22 both resulted in an eventual rise in *Cyp*19A1 expression and either minimal or unchanged *Dmrt1* expression, suggesting responsiveness to cold snaps decreased with developmental stage. Furthermore, sex ratio data revealed that embryos swapped to cold snap conditions on incubation day 14 require 21-24 days of exposure to commit to males; roughly 13-16 days longer than that previously shown for heat waves to produce a female-biased sex ratio, suggesting sexual development in *T. scripta* is more responsive to warm than cool thermal cues.

LIVER X RECEPTOR HELPS PROTECT EMBRYOS FROM CORT INDUCED MORTALITY

Presenter: Waters, Sara
Undergraduate, Biological Sciences

Mentor: Prof. Ryan Paitz

Co-Mentor: Prof. Emily Harders

Authorship: Sara Waters, Ryan Paitz, Emily Harders

During times of stress, developing embryos can be exposed to elevated levels of glucocorticoids and this can be lethal for the embryo. To protect themselves from glucocorticoid exposure, extraembryonic membranes contain the enzyme 5β-reductase (AKR1D1) to convert maternally derived glucocorticoids into inactive metabolites. Given this important role of this enzyme in development, we wanted to better understand how AKR1D1 levels are regulated. One potential receptor involved in the regulation of AKR1D1 is Liver X Receptor (LXR) since it is a nuclear receptor activated by a variety of cholesterol derivatives present in the yolk. When activated, it acts as a transcription factor and increases expression of a target gene, in this case, AKR1D1. We hypothesized that LXR regulates the expression of AKR1D1 to confer protection against the lethal effects of corticosterone. To test this, we injected chicken (Gallus gallus) eggs with either oil, a LXR inhibitor, corticosterone, or a combination of LXR inhibitor and corticosterone on day zero of development. We incubated the eggs for 14 days, then determined the proportion of embryos that survived. We found being exposed to corticosterone while LXR was inhibited significantly reduced survival compared to when embryos were exposed to only cort ($p = 0.0277$). Ongoing studies are characterizing the effect of LXR inhibition on AKR1D1 expression. By understanding how AKR1D1 is regulated, we can learn more about the capacity of embryos to protect against glucocorticoid exposure early in development.

CHEMISTRY

AN ASYMMETRIC GLYCOLATE ALDOL ADDITION STRATEGY FOR THE PREPARATION OF A P1-STRUCTURALLY MODIFIED DARUNAVIR DERIVATIVE WITH AN AROMATIC MOTIF: STEREOSELECTIVE SYNTHESIS OF α-NAPHTHARUNAVIR

Presenter: Bambalas, Lillian
Undergraduate, Chemistry

Mentor: Prof. Shawn Hitchcock

Authorship: Emmanuel Ayim, Jasmine Service, Shawn Hitchcock

Darunavir is a potent non-peptidic HIV-1 protease inhibitor developed by Ghosh and coworkers.[1] Darunavir was approved by the Food and Drug Administration accelerated approval for rerating drug-experienced adults who do not respond to therapy with other anti-retroviral drugs. Ultimately, darunavir was approved for the treatment of patients with HIV/AIDS infection. Even though darunavir has received much success, there is an ongoing search to structurally modify the core structure to increase the efficacy of darunavir. In this regard, our research group is interested in the synthesis of structurally modified derivatives of darunavir in order to determine if our proposed changes would lead to increase efficacy in *in vitro* studies.

The process involves reducing the commercially available 1-naphthylacetic acid with borane to the corresponding naphthyl alcohol. This product was then oxidized to the corresponding aldehyde by using the Swern oxidation using dimethylsulfoxide as a reactant with oxalyl chloride at -78 ^{o}C. This process gave rise to the aldehyde as determined by ^{1}H NMR spectroscopy. With the aldehyde available, our synthetic work will be focused on conducting an asymmetric aldol addition reaction using an N-methoxyphenoxylacetyl-1,3-oxazolidine-2-thione chiral auxiliary. The product of the asymmetric aldol addition reaction is anticipated to be a single diastereomer that will be taken through of transamdiation using isobutylamine. The product of this product is expected to be the corresponding N-isobutyl amide. The molecular structure of this compound will be confirmed through a combination of ^{1}H and ^{13}C NMR spectroscopy, infrared spectroscopy, and high resolution mass spectrometry.

The amide will be reduced using borane generated in situ to afford the corresponding beta-aminoalcohol, and this material in turn will be treated with two equivalents of *para*-nitrobenzenesulfonyl chloride to create a beta-*p-nitrobenzenesulfonamido-p-nitrobenzene nosylate*. Reaction of this intermediate with sodium azide in dimethylsulfoxide is expected to cause nucleophilic substitution to yield the azide. The overall synthesis is planned to be concluded by oxidatively cleaving the p-methoxyphenoxy (PMP) protecting group. Finally, reduction of the ntiro group of the *para*-nitrobenzenesulfonamide and the azido functional group in the presence of the darunavir bis(tetrahydrofuran)carbonate will yield the desired target of the P1-naphthyl modified system.

1. Ghosh, A. K.; Sridhar, P. R.; Leshchenko, S.; Hussain, A. K.; Li, J.; Kovalevsky, A. Y.; Walters, E. Wedekind, J. E.; Grum-Tokars, V.; Das, D.; Koh, Y.; Maeda, K., Gatanaga, H.; Weber, I. T.; Mitsuya, H. Structure-Based Design of Novel HIV-1 Protease Inhibitors to Combat Drug Resistance. J. Med. Chem. 2006, 49, 5252-5261.

A MODIFIED 3D-PRINTED CONE SPRAY IONIZATION (3D-PCSI) SOURCE FOR ON-SITE, TRACE FORENSIC EVIDENCE PROCESSING VIA INTEGRATED VACUUM COLLECTION

Presenter: Bondzie, Ebenezer
Graduate, Chemistry

Mentor: Prof. Christopher Mulligan

Authorship: Adewale Adehinmoye, Christopher Mulligan

Trace evidence (e.g., fibers, hair, soil/dust, gunshot residue (GSR), etc.) has long been of value to forensic investigations, as it can potentially associate suspects with specific crimes and/or crime scenes or identify individuals via DNA typing. The vacuum-based collection is commonly employed at crime scenes for this, and the filtration media employed is processed at off-site facilities. Often, these are targeted efforts, and exogenous chemical residues that could be of investigative value are not examined. Here, we report a novel MS ion source that integrates vacuum collection of trace evidence, as well as extraction, filtration, and ionization, from a singular vessel, allowing simplistic and reliable usage in field by non-technical operators via portable MS systems.

Post-processing of filtration media via MS methods can allow complimentary, chemically specific information to be collected after targeted, trace physical evidence has been removed. The intention here is to collect as much ancillary information from collected evidence as possible. To demonstrate and evaluate the utility and performance of vacuum collection 3D-PCSI-MS, mock scenarios were generated to mimic crime scenes commonly probed for trace forensic evidence, including clothing samples and automotive upholstery surfaces. Systematic studies were undertaken to determine the detection limit, robustness, repeatability, and reliability of this combined sampling and analysis method. Here, it was established that vacuum collection had the capability to sample material weights as low as 1 µg, and analyte-specific detection limits were found to be in the mid-nanogram range

EFFORTS TOWARD N-HETEROCYCLIC CARBENE (NHC)-CATALYZED INTRAMOLECULAR OXIDOPYRYLIUM-BASED [5+2] CYCLOADDITIONS

Presenter: Darko, Kwabena
Graduate, Chemistry

Mentor: Prof. Andy Mitchell

The cycloaddition reaction is an important transformation in the field of organic chemistry since it serves as an indispensable tool in organic synthesis. The oxidopyrylium-based [5+2] cycloaddition reaction has received enormous attention in chemical synthesis due to its usefulness in the formation of seven-membered heterocyclic ring systems present in bioactive complex natural product. Previous work revealed [5+2] cycloadditions at room temperature for enamine-based reactions.

The aim of this work is to provide an alternate method to generate electron-rich dipolarophiles. A silyloxypyrone-α-chloroaldehyde generated from the corresponding silyloxypyrone-aldehyde was treated with the NHC catalyst and Et_3N. Despite not obtaining the desired cycloadduct, adding alcohols afforded esters in moderate yields (25-72% yield). This provides evidence for the formation of the key Breslow intermediate needed to obtain the NHC-catalyzed [5+2] cycloaddition. Work is still ongoing in the Mitchell research group to subject the silyloxypyrone-esters synthesized to enolate chemistry.

CATALYSIS BY THE ENZYME GLYCEROL KINASE FROM THE THERMOPHILIC ORGANISM SULFOLOBUS ISLANDICUS

Presenter: Drew, Emily
Undergraduate, Chemistry

Mentor: Prof. Jon Friesen

Authorship: Emily Drew, Sara Walis, Caleb Welsh, Jon Friesen

Sulfolobus islandicus is a thermophilic organism that grows in hot springs under high acidity and temperature. In order for a cell to grow and divide a variety of protein molecules, called enzymes, are needed to catalyze a multitude of chemical reactions. We have studied catalysis by a specific enzyme called glycerol kinase. Glycerol kinase catalyzes the first step of glycerol metabolism by transforming glycerol into glycerol 3-phosphate. To synthesize the recombinant glycerol kinase protein, we employed E. coli cells (BL21(DE3) RIPL) that contained the gene encoding Sulfolobus islandicus glycerol kinase. We expressed the protein by ligating the amplified DNA into the plasmid vector pET-45b and transforming the vector into E. coli cells. The protein was then successfully purified before being assayed. The protein was then assayed to determine the varying concentration between the fractions obtained from the purification process. After determining which fractions of the wash column contained the highest concentration of glycerol kinase, we performed phosphorus NMR to ensure that the enzyme successfully transformed glycerol and ATP into glycerol 3-phosphate and ADP. After a successful round of phosphorous NMR displayed a peak for glycerol 3-phosphate, we then began the identification of ideal conditions for glycerol kinase. The ideal time for glycerol kinase to react was the first aspect tested. The enzyme was permitted to work at various time intervals along with a control group. A phosphorous NMR was then run and when analyzing the data, the intended product of glycerol 3-phosphate was found to be produced at all time intervals but showed higher efficiency at 4 minutes. The ideal temperature was determined next by allowing the enzyme to be placed in water baths at various temperatures for 15 minutes. When analyzing the phosphorous NMR, it was determined that glycerol 3-phosphate was produced at temperatures of 55°C and 75 °C. The ideal divalent cation and amount of enzyme will be the next conditions to be tested.

INVESTIGATING THE INTERACTIONS BETWEEN $[RE_6SE_8]^{2+}$ CLUSTERS AND TBDPS MALTOL

Presenter: Ingram, Kalli
Undergraduate, Chemistry

Mentor: Prof. Lisa Szczepura

Authorship: Kalli Ingram, Lisa Szczepura

The synthesis of $[Re_6Se_8]^{2+}$ clusters has been widely studied throughout the years. In particular, the reactivity of $[Re_6Se_8]^{2+}$ clusters has been examined in terms of ligand coordination. However, cyclization reactions between $[Re_6Se_8]^{2+}$ clusters and organic compounds are widely unstudied. We are investigating the cyclization abilities of $[Re_6Se_8]^{2+}$ clusters and protected maltol. Various solvents were tested for their abilities to maintain a reaction without allowing a deprotection of TBDPS maltol. The reactions are monitored through ^{1}H and ^{31}P NMR and products are confirmed using the integration values of the triethylphosphine ligand and aromatic region peaks. Chlorobenzene proved to be the ideal solvent to run the cyclization reactions in, as no deprotection was observed. A high temperature is required to produce a reaction between the two compounds. Further characterizations on the products are performed to establish the success of the reactions and evaluate the identity of the products.

SPECTROSCOPIC STUDIES INVOLVING RHENIUM CLUSTERS

Presenter: Lauper-Cook, Brianna
Undergraduate, Chemistry

Mentor: Prof. Lisa Szczepura

Authorship: Brianna Lauper-Cook, Julia Edwards, Lisa Szczepura

Hexanuclear rhenium selenide clusters have importance in the development of functional and multifunctional materials with applications in temperature sensing, spectroscopy, and holography. The Szczepura group has a specific focus of incorporating new terminal ligands onto this rhenium selenide cluster core. Some of these ligands include alkoxy groups, acetonitrile, and thiolates. My project thus far has been to synthesize, purify, and explore the stability of these compounds in different solvents for their use in spectroscopy. The stability of alkoxy and thiolate ligand complexes in acetonitrile has been tested through NMR spectroscopy. This presentation will focus on an analysis of the spectroscopic data for these compounds, specifically UV-Vis and emission spectroscopy. The four compounds of interest are $[Re_6Se_8(PEt_3)_5(X)]^+$ (where X = $^-$OMe, $^-$OPh, $^-$SPh, and $^-$STol) This spectral data is important to obtain for characterization purposes as well as for reporting data for publication. The emission spectra give an indication of relative quantum yield for use in the rhenium clusters' various applications, such as sensing.

CHARACTERIZATION OF AN ARCHAEAL INORGANIC PYROPHOSPHATASE FROM SULFOLOBUS ISLANDICUS USING A [31P]-NMR-BASED ASSAY

Presenter: Oliver, Ethan
Undergraduate, Biological Sciences

Mentor: Prof. Jon Friesen

Authorship: Ethan Oliver, Joshua Friesen, Jacob Walker, Steven Peters
Christopher Weitzel, Jon Friesen

Inorganic pyrophosphatase catalyzes the conversion of pyrophosphate to phosphate and is often critical for driving reactions forward in cellular processes such as nucleic acid and protein synthesis. Commonly used methods for quantifying pyrophosphatase enzyme activity employ reacting liberated phosphate with a second molecule to produce measurable absorbance changes or employing a second enzyme in coupled reactions to produce a product with a detectable absorbance, or the use of radiolabeled phosphorus [32P] to track and measure high energy beta particles. Despite the significance of older methods, colorimetric spectroscopy is not always feasible, and special care must be taken with radioisotopes. In this investigation, a novel [31P]-NMR spectroscopy-based assay was used to quantitatively measure the formation of phosphate and evaluate the activity of inorganic pyrophosphatase from the thermoacidophilic Crenarchaeota Sulfolobus islandicus. The enzymatic activity was directly measured via integration of the [31P] resonance associated with the phosphate product (δ = 2.1 ppm). Sulfolobus islandicus inorganic pyrophosphatase preferentially utilized Mg^{2+} as a divalent cation and had pH and temperature optimums of 6.0 of 50 °C, respectively. The Vmax value was 850 µmol/min/mg and the Km for pyrophosphate was 1.02 mM. Sequence analysis indicates the enzyme is a Family I pyrophosphatase. Sulfolobus islandicus inorganic pyrophosphatase was shown to be inhibited by sodium fluoride with an IC50 of 2.26 mM, compared to an IC50 of 0.066 mM for yeast inorganic pyrophosphatase. These studies reveal that a [31P]-NMR spectroscopy-based assay is a safe, sensitive, and effective method for analyzing catalysis by phosphate-producing enzymes

IN SILICO INVESTIGATIONS OF SURFACE IMPACT ON HALOGEN···HALOGEN INTERMOLECULAR FORCES

Presenter: Sage, Jarrod
Graduate, Chemistry

Mentor: Prof. Bhaskar Chilukuri

Authorship: Jarrod Sage, Bhaskar Chilukuri

As chemistry converges on a complete understanding of the nature of the covalent bond, it has become clear that turning attention towards the nature of non-covalent interactions is vital for developing, controlling, and understanding complex chemical systems. Intermolecular interactions involving halogen atoms—"halogen-bonding" (XB) interactions—are prolific in contemporary literature regarding self-organization and nanotechnology development. XB interactions between two halogens (X---X) have even greater potential here, as the relative weakness of their interaction allows for fine-tuning of molecularly assembled structures. The work presented here probes the nature of X---X bonds in self-assembled monolayers with insight gained from X---X bonding model simulations in silico. A wide scope of haloarenyl substrates were used to study X---X bonding on surfaces, with both non-periodic and periodic density functional theory (DFT) calculations performed with Gaussian 16 and the Vienna Ab Initio Simulation Packages (VASP) respectively. VASP calculations allow for the exploration of the impact of substrate physisorption on surfaces common in self-assembly literature, like highly ordered pyrolytic graphite, gold(111), and silver(111).

SYNTHESIS OF N-METHYLPHENANTHROPORPHYRINOIDS WITH EXTENDED CONJUGATION PATHWAYS

Presenter: Salrin, Jared
Undergraduate, Chemistry

Mentor: Prof. Timothy Lash

Authorship: Jared Salrin, Timothy Lash

Fusion of aromatic rings to porphyrins and their derivatives has been shown to cause variable bathochromic shifts that can give insights into how extended conjugation effects the aromaticity of the porphyrin ring. Fusion of phenanthrene has been studied in the past in an attempt to induce bathochromic shifts in the UV-vis spectra, and to potentially expand the normal porphyrin 18 pi-electron pathway through the phenanthrene ring to give a 30 pi-electron circuit. These effects were not found to be as strong as predicted, possibly due to the favored tautomer 1a providing a conjugation pathway that avoids the fused aromatic unit. Addition of an N-methyl group to this system allows an alternative tautomer 1b to be locked into place, thereby enabling a 30 pi-electron pathway. A MacDonald-type “3+1” condensation was used to react N-methyl phenanthrotripyrrane 2 with a pyrrole dialdehyde 3 to afford N-methyl phenanthroporphyrin 4. Furan, thiophene, selenophene, and indene dialdehydes were similarly condensed to afford a series of N-methyl heteroporphyrins with a fused phenanthrene units. A palladium(II) complex of N-methylphenanthrobenzocarbaporphyrin 5 was also synthesized and spectroscopic evidence was obtained that demonstrated that methyl group migration across the porphyrinoid macrocycle to give 6 had occurred. These compounds all showed bathochromic shifts towards the red region and downfield shifts in the 1H NMR spectra when compared to N-unsubstituted porphyrinoids.

ELECTRON AFFINITY EQUILIBRIUM STUDIES OF N1 AND N2-PHENYLTRIAZOLE ISOMERS

Presenter: Santarelli, Joseph
Graduate, Chemistry

Mentor: Prof. Steven Peters

Authorship: Joe Santarelli, Steven Peters

Substituted 1,2,3-triazoles have displayed use as effective agents in numerous pharmaceuticals. Specifically, compounds containing substituents at the N1 and N2 position have shown promise as antifungal and anticancer agents. The medicinal potential of these compounds can be derived from their structural stability, polarity, and ability to hydrogen bond to macromolecules. Our previous work involves low temperature EPR studies of N1 and N2-alkyltriazole anion radicals, reveal that much of the electron spin density resides within the N3 moiety of the triazole ring. A comparison of the electron affinity of these anion radicals was not possible due to the short lifetime of the N1-alkyl anion radical species. Phenyl substituted triazoles are expected to exhibit greater stability as anion radicals since the unpaired electron can delocalize throughout the difference in electron affinity of both N1 and N2-Phenyltriazoles is of interest to us. N1 and N2-Phenyltriazoles were successfully synthesized using methods developed by Patterson et al. (2020) and Chen et al. (2020), respectively. The low-temperature potassium metal reductions were performed in THF, and stable anion radicals of each were generated. EPR spectra have been successfully obtained and simulated, and the hyperfine coupling constants (hfccs) were carefully measured. DFT calculations were performed, and the calculated hfccs agree with the measured values. Our results indicate a majority of the spin density resides on the N1 and N3 atoms in the N2-phenyltriazole species, while most spin resides on the N2 atom in the N1- isomer. Equilibrium electron affinity studies of these phenyl triazole isomers are currently underway. The syntheses/characterization of these two triazole compounds, the EPR-spectroscopic results, and the preliminary results from the equilibrium electron affinity studies will be presented.

COMPUTATIONAL MOLECULAR-LEVEL STUDY OF PORPHYRIN SYSTEMS

Presenter: Suthaharan, Sivanujan
Graduate, Chemistry

Mentor: Prof. Bhaskar Chilukuri

Authorship: Sivanujan Suthaharan, Bhaskar Chilukuri

Porphyrins are macrocyclic molecules with impressive structural and functional properties with a broad spectrum of applications. Porphyrins function as crucial components in many electric and electronic systems including dye sensitized solar cells, chemical sensors, optoelectronics and field effect transistors. The characteristic porphine group with a large pi-electron conjugated system present in porphyrins leads to their fascinating chemical and structural behavior. Porphyrin systems have received increased attention related to their intrinsic electronic, magnetic and spectroscopic characteristics. Theoretical and computational investigations best complement the experimental approaches analyzing these molecular properties. Quantum mechanical density functional theory (DFT) calculations help understanding characteristic features including orbital configuration, electronic nature and stability. In this work we investigate select porphyrin systems via quantum mechanical calculations of molecular properties at the DFT level.

EVALUATING THE LEISHMANIA TARENTOLAE RESPONSE TO INORGANIC STRONTIUM BASED OXYFLUORIDES

Presenter: Terry, Katelyn
Undergraduate, Biological Sciences

Mentor: Prof. Marjorie Jones

Leishmaniasis is a vector-born parasitic disease, caused by the protozoa parasite genus Leishmania, found in portions of the tropics, subtropics, and southern Europe. Transmission of this disease in humans starts with a bite from an infected female phlebotomine sand fly. The sand fly can become infected with the parasite by sucking blood from an infected animal[1]. Phlebotomine sand flies are silent and hard to see, so infection can go undetected for a long time, and prevention is extremely difficult. infection can leave lifelong effects such as scarring and decreased immune response as the parasite is not eradicated from the body with the treatments that are available[2]. There are currently several drugs used as treatment, consisting of pentavalent antimonies, miltefosine, and amphotericin B, all of which are not without faults[3]. Resistance is developing quickly, and the side effects are extensive. This abstract aims to evaluate the effects of strontium-based compounds on cultures of Leishmania tarentolae, a species of Leishmania that is found in reptiles and has been shown to act similarly to human strains, in order to find a substance suitable for potential novel therapeutic use. Using methodology previously performed by Apuzzo et al.[4], we will culture cells with novel strontium compounds—in collaboration with Dr. Sullivan, University of Northern Florida—and evaluate their viability and enzyme activity over time.

CATALYSIS BY THE ENZYME, RIBOFLAVIN KINASE, FROM THE THERMOPHILIC ORGANISM SULFOLOBUS ISLANDICUS

Presenter: Walis, Sara
Undergraduate, Chemistry

Mentor: Prof. Jon Friesen

Authorship: Sara Walis, Emily Drew, Jon Friesen

Sulfolobus islandicus is an archaeon which optimally grows at a pH 2-4 (acidophiles) and temperatures of 65-85°C (thermophiles). Sulfolobus islandicus was first isolated from acidic springs in Iceland and they can also be found in hot springs in Yellowstone National Park. Scientists use Sulfolobus islandicus as a model system for understanding cellular processes such as DNA replication and repair. Riboflavin kinase catalyzes the phosphorylation of riboflavin (vitamin B2) to form flavin mononucleotide (FMN). It is required for the synthesis of FMN from riboflavin. Archaeal riboflavin kinase is CTP dependent and has a name riboflavin 5' -phosphotransferase which catalyzes the reaction: cytidine triphosphate (CTP) + riboflavin → cytidine diphosphate (CDP) + flavin mononucleotide (FMN). Eukaryotic and bacterial riboflavin kinases utilize ATP instead of CTP.

To study riboflavin kinase, the enzyme first had to be isolated from Sulfolobus islandicus. To do this the enzyme's gene was amplified through a polymerase chain reaction. The protein was then successfully ligated into plasmid DNA, pET-45b, where then it was transformed into competent E. coli cells. Riboflavin kinase was then successfully expressed and purified. The enzyme was then run on a sodium dodecyl sulfate polyacrylamide gel electrophoresis and showed up on the gel as two bands around 24 kDa and 57 kDa, which demonstrated that riboflavin kinase was a dimer. Multiple tests were conducted, such as using different concentrations of sodium dodecyl sulfate and different amounts of time in an 80-90°C water bath. Through this the dimer broke apart successfully into its monomer and showed a band around 24 kDa on the gel, the size of riboflavin kinase. We then wanted to determine if the enzyme catalyzed riboflavin to flavin mononucleotide, what divalent cation was necessary for catalysis, and if riboflavin kinase utilized ATP or CTP. To do this, enzyme assays and phosphorous NMR were run. The results were inconclusive, and more research and assays need to be conducted to figure out the best conditions for catalysis.

A STEREOSELECTIVE SYNTHESIS OF BETA-ALKOXYOXETANES USING A ASYMMETRIC GLYCOLATE ALDOL ADDITION METHODOLOGY

Presenter: Wright, Daniel
Undergraduate, Chemistry

Mentor: Prof. Shawn Hitchcock

Authorship: Jordan Witte, Gregory Ferrence, Shawn Hitchcock

The functional group of oxetanes are valuable structural conformations in modern medicinal organic chemistry (1). Oxetanes are not common in nature but with the few that appear in nature the functional group is integral to the bio-physiological effects of the compounds. A few examples of these compounds are Oxetanocin A, or Taxol. Taxol is a very prominent chemotherapy drug for treating lung, breast, and ovarian cancers. While other synthetic routes and functional group synthesis are being tested for Taxol derivatives, Taxol is still one of the highest efficacy chemotherapy drugs. The oxetane containing derivative of Taxol is still the leading form of the drug used globally. Because many modern drugs and chemicals that contain oxetanes are chiral and have relevant stereochemistry, stereo- and regioselective oxetane cyclization is important. The goal of Hitchcock organic synthesis lab at Illinois State University is to explore synthetic methodology towards the development of new synthetic tools that can be exploited in the synthesis of value added compounds such as pharmaceutical agents. This poster presentation will feature the work that has been completed on the usage of an asymmetric glycolate aldol addition based reaction pathway in the synthesis of beta-alkoxyoxetanes.

(1) James A. Bull, Rosemary A. Croft, Owen A. Davis, Robert Doran, and Kate F. Morgan. Chemical Reviews 2016 116 (19), 12150-12233. DOI: 10.1021/acs.chemrev.6b00274

COMMUNICATION

IDENTIFYING GAPS BETWEEN FIRST- AND CONTINUING-GENERATION COLLEGE STUDENTS IN THEIR LEVEL OF COLLEGE PREPAREDNESS: AND ITS INFLUENCE IN THEIR SELF-EFFICACY IN HIGHER EDUCATION

Presenter: Del Rosario, Kathryn
Graduate, Communication

Mentor: Prof. John Baldwin

Authorship: Kathryn Del Rosario

This study examined the gaps present between first- and continuing-generation college students in their level of college preparedness and how these gaps affect their self-concept and self-efficacy. Semi-structured interviews were conducted with a total of 8 participants from different backgrounds participated in the study. They were asked questions pertaining to their educational background, source of support, and self-efficacy. The findings showed several gaps within students' college preparedness: gaps between first- and continuing-generation students; and potential solutions to closing these gaps. Continuous research in identifying these gaps would allow for better understanding of the support needed by both students.

“IT IS STILL ME”: THE INFLUENCE OF INSTAGRAM BEAUTY FILTERS ON FEMALE COLLEGE STUDENTS' PERCEPTIONS OF BEAUTY STANDARDS

Group Leader: Gomes, Gabriela
Graduate, Communication

Group Member: Daria Parfenova, Graduate, Communication

Mentor: Prof. John Baldwin

Authorship: Gabriela Gomes, Daria Parfenova

This qualitative study examined Instagram beauty filters effects on the beauty perceptions of female college students. Ten students participated in one-on-one in-depth interviews and were asked questions about their use of filters, feelings, and beauty standards surrounding filtering practices. Results revealed positive, negative, and neutral influence on young women. We found that beauty filters promote unrealistic beauty standards, which lead to frustration and dissatisfaction with self-image. However, the female students seemed to recognize the harmful impact of editing tools on themselves and future generations, promoting positive self-image awareness. Implications for marketers and creators, as well as limitations of this study, were discussed.

Keywords: AR beauty filters; Instagram; self-perception; social comparison; self-discrepancy; beauty standards.

MUSIC AND SOCIAL CHANGE

Presenter: Mangels, Rebekah
Graduate, Communication

Mentor: Prof. John Baldwin

Authorship: Rebekah Mangels, Emily Bollinger

In this study, we explored ways in which musicians in Central Illinois attempt to influence social change. Previous research has claimed popular music genres such as rock and punk music simultaneously reinforced dominating structures while also subverting them. Using open-ended interviews and qualitative methods of analysis, we found that participants reported varying levels of commitment to political activism. Through their lyrics, venue choices, and performance choices, participants have reportedly attempted to create more equity in areas such as mental health, race relations, reproductive rights, and gun control. Lastly, we found the participants played songs in popular genres, reaching local and even global audiences. Therefore, we concluded that the field of popular music studies would benefit from understanding musicians' intentions for social change. Keywords: music, social change, audience, lyrics, activism.

HOW ORGANIZATIONS CAN CREATE PSYCHOLOGICAL SAFETY IN THE WORKPLACE FOR ATTRACTING AND RETAINING GEN ZS

Presenter: Okoli, Ebuka
Graduate, Communication

Mentor: Prof. John Baldwin

As organizations continue to evolve to have a competitive edge in the global market, they focus on recruiting a vibrant and reliable workforce. The latest generation joining the workforce is Gen Z, and they come with peculiarities that distinguish them from other generations. This study investigates these peculiarities by interviewing members of the Gen Z workforce. The findings demonstrate that the Gen Z workforce value a safe work environment where they can express their creativity and where their opinions can make a difference. Overall, this study shows that for organizations to improve the workplace, they need valuable input from the Gen Z workforce.

SCIENTOLOGY IS YOUR PARENT: CHILDREARING IN SCIENTOLOGY

Group Leader: Smith, Courtney
Graduate, Communication

Group Member: Reilly Card, Graduate, Communication

Mentor: Prof. Lindsey Thomas

Authorship: Courtney Smith, Reilly Card

Despite recent popular interest on the minutia of Scientology, virtually no studies have analyzed the effect Scientology practices have on children. Close Textual Analysis is used to uncover the meaning behind the writings of L. Ron Hubbard and the docuseries Leah Remini: Scientology and the Aftermath as it pertains to childrearing within the Scientology. Several themes emerged in the data; a better life, parenting techniques, abuses, disconnection, and mental illness. These themes are flushed out fully in the analysis. Conclusionary statements reiterate that Scientologist parenting techniques can be viewed as unethical and potentially lead to incredibly damaging effects. Limitations of this study include alienation of the effects of disconnection on adulthood and the role of the researchers as outsiders. Future research may focus on motherhood specifically in Scientology.

GENDER OFFENDERS: GENDER REPRESENTATIONS OF SERIAL KILLERS ACROSS 100 YEARS IN *"SERIAL KILLERS"*

Presenter: Smith, Courtney
Graduate, Communication

Mentor: Prof. John Baldwin

Employing social role theory and constructs of monstrosity, I examine a female and male serial killer from each of three time periods in American history using the podcast Serial Killers on Spotify. Social role theory explains the significance of gender stereotypes in societal expectations and implications assigned to each sex due to roles that each group has historically been responsible for. Monstrosity is the label attached to individuals that dare to deviate from their prescribed gender roles. These individuals are associated with horror, unspeakable acts, and evil. Emergent themes suggest a need to qualify and demonize female serial killers over males, discrepancies between graphicness of introductory stories, identity, and impact of media. Based on gender roles, stories reveal biases based on societal expectations. Knowing how gender expectations are created and maintained is the first step to combating these stereotypes.

COMMUNICATION SCIENCES AND DISORDERS

ACCESS TO HEARING HEALTH CARE FOR RURAL AND AGING POPULATIONS

Group Leader: Barkauski, Natalie
Undergraduate, Communication Sciences and Disorders

Group Members: Kip Crozier, Undergraduate, Communication Sciences and Disorders;
Maggie Zibutis, Undergraduate, Communication Sciences and Disorders;
Madison Aimone, Undergraduate, Communication Sciences and Disorders;
Channing Collins, Undergraduate, Communication Sciences and Disorders

Mentor: Prof. Antony Joseph

Authorship: Natalie Barkauski, Kip Crozier, Maggie Zibutis, Madison Aimone
Channing Collins, Antony Joseph

The primary purpose of this project was to determine the degree to which the literature has described the status of access to hearing health care for rural and aging populations. Using publicly available data, we discovered that the median age in Illinois was lower (younger) for more populated counties, and older for more rural, less populated, counties. Previous research conducted in the laboratory identified that the prevalence of hearing loss is significantly higher for older populations than younger ones, especially for those over 80 years of age. From this information, we surmise that residents of rural Illinois counties may be older and hearing impaired. In addition, occupations and businesses in the agricultural sector contribute to increased rates of auditory injury and noise-induced hearing loss. Taken together, we should expect a higher level of hearing health care access in rural areas, but the opposite is true. We turned to the literature to determine the number of studies that have explored this phenomenon. Solutions to this problem could include remote-satellite audiology clinics, mobile audiologic rehabilitative care, and tele-audiological health services. Geographic information systems may be used to analyze datasets using specific overlays and mapping methods to identify viable solutions for Illinois and other states.

SIGNIFICANCE OF CAREGIVER COACHING IMPLEMENTATION IN EARLY INTERVENTION PRACTICES

Group Leader: Hemp, Tori
Undergraduate, Communication Sciences and Disorders

Group Members: Rebbeca Nygren, Undergraduate, Communication Sciences and Disorders; Allie Robinson, Undergraduate, Communication Sciences and Disorders

Mentor: Prof. Jamie Mahurin Smith

Co-mentor: Prof. Ciera Lorio

Authorship: Tori Hemp, Rebecca Nygren, Allie Robinson

Early Intervention (EI) services are offered to children birth-three years of age who present or are at risk for developmental delays (Getting Started in Early Intervention, 2022). EI providers implement caregiver coaching strategies, where providers instruct caregivers on how to practice EI strategies during everyday routines when a provider is not present. This allows children to receive the maximum benefit of EI (Friedman et al., 2012). While many speech-language pathologists (SLPs) and other EI providers acknowledge the importance of caregiver coaching implementation during intervention services, it is often overlooked. This qualitative study aimed to provide rationale behind the lack of coaching implementation in EI services as well as benefits of the use of coaching and improvements for future provider training.

INFANT-TODDLER SHARED BOOK READING PROJECT: AIMS, DATA COLLECTION, AND CODING

Group Leader: Johnson, Reece
Graduate, Communication Sciences and Disorders

Group Members: Peyton Kraft, Undergraduate, Communication Sciences and Disorders;
Alyson Garnhart, Undergraduate, Communication Sciences and Disorders;
Emma Maier, Undergraduate, Communication Sciences and Disorders;
Lauren Graue, Undergraduate, Communication Sciences and Disorders;
Natalie Swartz, Undergraduate, Communication Sciences and Disorders

Mentor: Prof. Ciera Lorio

Authorship: Peyton Kraft, Alyson Garnhart, Emma Maier, Lauren Graue,
Natalie Swartz, Reece Johnson

Shared book reading is a common routine in many American households; however, little is known about the shared book reading behaviors between parents and their infants/toddlers. This poster describes a longitudinal study that has recently moved to the video coding stage. Shared book reading interactions between parents and their infants and toddlers were tracked across various time points, beginning when the child was 6 months through 36 months of age. Videos are being coded for parent behaviors, child behaviors, and parent responsiveness. Descriptions of the participants, coding schemes, and our initial findings from coding procedures will be shared.

ACCESS TO HEARING HEALTH CARE FOR URBAN, DIVERSE, AND AGING POPULATIONS

Group Leader: Meadors, Taylor
Undergraduate, Communication Sciences and Disorders

Group Members: David Vargas, Undergraduate, Communication Sciences and Disorders;
Daniel Ferguson, Undergraduate, Communication Sciences and Disorders;
Isabel Gardner, Undergraduate, Communication Sciences and Disorders;
Jenna Hedge, Undergraduate, Communication Sciences and Disorders

Mentor: Prof. Antony Joseph

Authorship: Taylor Meadors, David Vargas, Daniel Ferguson, Isabel Gardner
Jenna Hedge, Antony Joseph

This project was designed to describe how access to hearing health care for urban, aging, and diverse populations has been studied in the literature. The significantly unmet need for accessible hearing health care has been estimated to be 67% and 86%. Our society has predetermined that racially-diverse individuals will have less healthy lives than others due to exposure to poor housing, inadequate insurance coverage, and minimal access to preventive health care. Besides this pre-disposition, there is a profound lack of racially and ethnically diverse professionals in healthcare, health management, and graduate school training programs. The State of Illinois contains one of the largest cities in the world, Chicago. Although this city boasts of having some of the most medically advanced, hospitals in the world, most urban, aging, and diverse Chicago residents have limited access to hearing-health care. Previous research conducted in the laboratory identified that there is an inadequate number of adult and geriatric Audiology courses in many doctoral programs. So, Doctors of Audiology are not being prepared extensively with clinical-rehabilitative coursework about aging adults. Overwhelmingly, there are not enough audiologists to accommodate the aging sector of the patient population, especially those who reside in urban areas where door-to-door transportation is lacking. We explore solutions for this truly deplorable condition, including mobile audiology clinics, web-based quality resources, physician outreach, and geographic information systems.

AN INTERDISCIPLINARY EARLY INTERVENTION LEARNING EXPERIENCE FOR UNIVERSITY STUDENTS

Group Leader: Milton, Jillian
Undergraduate, Communication Sciences and Disorders

Group Members: Hannah Rudkin, Undergraduate, Communication Sciences and Disorders;
Christina Rauwolf, Undergraduate, Communication Sciences and Disorders

Mentor: Prof. Ciera Lorio

Authorship: Jillian Milton, Hannah Rudkin, Christina Rauwolf

There is currently a nationwide shortage of early intervention (EI) providers (Barton et al., 2012), and there are limited EI experiences for students at Illinois State University. To meet this need, professors in Communication Sciences and Disorders (CSD) and Special Education designed the Early Intervention Learning Community (EILC). The EILC is an interdisciplinary independent study that includes undergraduate students from CSD and Special Education programs. The students learn about EI topics through self-guided modules, readings, reflections, guest speakers, and community-based observations of EI providers. A total of 20 students have participated in the EILC across 3 semesters, and we are currently analyzing their written reflections to learn more about their experiences in the program. This poster will highlight the components of the EILC program and some of the themes that are emerging from the qualitative analysis of students' written reflections. The results of this study will support the EILC faculty in improving the EILC experience for future cohorts of students.

CRIMINAL JUSTICE SCIENCES

ANTI-ASIAN AMERICAN PACIFIC ISLANDER RHETORIC AND THE LIKELIHOOD OF HATE CRIME VICTIMIZATION REPORTS: A THEMATIC LITERATURE REVIEW

Presenter: Conde, Alyssa
Undergraduate, Criminal Justice Sciences

Mentor: Prof. Ashley Farmer

Anti-Asian American Pacific Islander (AAPI) hate crimes have been continuously rising since the start of the COVID-19 pandemic, but reported statistics may be a gross underestimation as AAPI victims are less likely to report their experiences to law enforcement than other racially marginalized groups. Since the start of the COVID-19 pandemic, anti-AAPI rhetoric has also begun to rise. Asian American Pacific Islander or "AAPI" is defined as having ancestry in Asia or the Pacific Islands. A hate crime in this review will be defined as a criminal act committed against an individual such as, but not limited to, verbal, physical, or sexual assault, vandalism to personal or private property on the basis of sex, gender, race, ethnicity, sexual orientation, and/or ability. The purpose of this review is to explore the relationship between anti-AAPI rhetoric and the likelihood of AAPI victims reporting their experience(s). This review of literature will examine hate crime legal definitions, anti-AAPI rhetoric in historical events and COVID-19, the examination of the shifts within legal definitions of anti-LQBTQ+ hate crimes, and calls for further research. Pulling definitions of another marginalized community poses solvency and allows for similar reform in the legal framework for AAPI victims.

ECONOMICS

A GAME WITHIN A GAME: MINIMAX PLAY IN MAJOR LEAGUE BASEBALL

Presenter: Riffle, Samuel
Graduate, Economics

Mentor: Prof. Susan Chen

Authorship: Samuel Riffle

This paper investigates the existence of mixed strategy Nash equilibria in two-player games between a pitcher and a batter in baseball. The findings of the existing studies on real-life data are inconclusive. Using a unique sample from the 2017-2022 seasons of Major League Baseball (MLB), my analysis shows that pitchers deviate from all three conditions of Von Neumann's Minimax Hypothesis, (i.e., equalized expected payoffs across actions, actions played with a positive probability must have a higher expected payoff than actions that are not played with positive payoff, and serial independence of selected actions across games) I thus conclude that no mixed strategy Nash equilibria exist in the MLB games in the sample. My research adds to the literature by using the latest available data and the dynamic panel estimation method (i.e., the generalized method of moments, or GMM). Finally, these results entail important implications for optimal strategies implemented by Major League pitchers, and I offer recommendations for improving their payoffs.

HOW MUCH COULD AMERICANS SAVE IN AUTO EXPENSES?

Presenter: Van Plew, Michael
Undergraduate, Economics

Mentor: Prof. Susan Chen

The personal auto market is constantly changing in almost every way. There are countless factors affecting running costs, prices of used and new cars, gas prices, and so on. This has an effect on the purchase decisions from the consumer's perspective. I study a sample retrieved from the US Department of Transportation's Bureau of Transportation Statistics on "Average Cost of Owning and Operating a Vehicle" between 2000 and 2022 (along with other supporting data). My analysis will take into consideration highway congestion cost, gasoline prices, total vehicle sales, average age of automobiles in operation, and personal expenditures on transportation, and examine how these factors affect average Americans' expenses on vehicles. I hypothesize that if there was less congestion, smoother roads, etc., people would waste less gas, pollute less toxins, have a more efficient running cost in the long run, and ultimately save a significant amount of time and money.

FAMILY AND CONSUMER SCIENCES

FALSE NARRATIVES OF INCARCERATION AS PORTRAYED IN FILM

Presenter: Ryan, Delaney
Undergraduate, English

Mentor: Prof. Cristina Prestin-Beard

The reality of incarceration has been repeatedly falsely advertised in modern media forms, such as television and movies. Not only does this alter the views of the public about what life is like as an inmate, but dehumanizes those who are incarcerated. By collecting data on what the general public has experienced through the media about life as an incarcerated individual, I will hopefully break stereotypes of prison life. Most of society's views of prison life today come from TV shows such as Orange is the New Black, Criminal Minds, and Netflix's newest bank heist thriller, Kaleidoscope. While shows like these are action-packed and highly entertaining, they contain a plethora of misinformation about life in prison. After visiting the McClean County Jail and doing in depth research on other aspects of incarceration in America, I will hopefully provide insight on the advancements that have been made in the prison system, and some things that the media has simply gotten wrong.

MEDIA PORTRAYAL OF FEMALE MODELS' SEXUALIZATION IN FASHION ADVERTISEMENTS

Presenter: Tellez, Damaris
Undergraduate, Family and Consumer Sciences

Mentor: Prof. Ui-Jeen Yu

Authorship: Damaris Chantal Tellez, Sydney Kokenes, Allie Carlson, Emma Watson, Ui-Jeen Yu

Fashion magazines tend to reflect beauty and fashion ideals of current times. Females are more likely affected by the appearances and sexuality of model images in fashion ads. Obviously, sexuality today is more accepted than it was during the 1990s, but it is meaningful to examine how media portrayal of sexualized model images have changed in fashion ads over time. This study aims to examine whether sexuality and ethnicity of female models in fashion ads differ from the 1990s to the 2020s. Body objectification theory was applied to explain how fashion magazines influence body objectification and sexualization of females in U.S. culture. A total of 100 fashion ads from August issues of Vogue in 1990, 2000, 2010, and 2020 were collected. Through content analysis, sexuality and ethnicity of female models in the fashion ads were analyzed. Results indicated significant increases of sexualized model images in 2000 and 2020, but a decrease of sexualized model images in 2010, compared to those in 1990. A majority of female models depicted in Vogue was predominantly white across all decades, but the ethnicity of female models was more diversified in 2020. Overall, white female models were more sexualized in the ads, indicating greater influences of sexualization on white viewers than other ethnicities. This study provides an understanding of media portrayal of female models' sexualization and their ethnicity in fashion ads, which potentially influence young women's body objectification and self-sexualization tendency.

GEOGRAPHY, GEOLOGY, AND THE ENVIRONMENT

INFLUENCE OF TILE WATER ON NITRATE CONCENTRATIONS IN THE GROUNDWATER: A CASE STUDY OF A SATURATED RIPARIAN BUFFER ZONE, MCLEAN COUNTY, CENTRAL ILLINOIS

Presenter: Abdulsalam, Aminat
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Eric Peterson

Authorship: Aminat Absulsalam, Eric Peterson

Agricultural activities, particularly the use of inorganic fertilizers and animal manure are a major cause of the increase in nitrate levels in our water bodies in many areas of the world. The use of tile drains coupled with the excessive application of nitrogen fertilizers, which is a prevalent practice in the U.S. Midwest, alters water quality, leading to eutrophication, the development of harmful algal blooms, and hypoxic conditions of surface water bodies. This study focuses on understanding the interaction between the redirected tile-drain water and nitrate concentrations in the groundwater. To this end, we utilized historic data that spans seven years (2015-2022) from a saturated riparian buffer (SRB) zone, adjacent to an agricultural field in McLean County to observe the trend that exists over time between the nitrate concentrations in the groundwater and the tile-drain water. The collected data include nitrate as nitrogen (NO_3-N) concentrations, dissolved oxygen, and water elevation. NO_3-N concentrations of the tile-water (diversion box), groundwater upgradient from the tile, and groundwater downgradient of the tile will be compared during two different regimes, when the tile is running and when the tile is not running to assess the influence of tile-drain water on the groundwater within the SRB. A two-way ANOVA will be used to test the hypothesis that higher NO_3-N concentrations will be observed in the downgradient water when the tile is running as compared to when the tile is not running. Additionally, the downgradient water will be compared to the upgradient water under both tile conditions to evaluate if changes in the NO_3-N concentrations of the downgradient water occur independent of NO_3-N concentrations trends in the upgradient water. It is expected that the downgradient water will have higher NO_3-N concentrations when the tile is running, and lower concentrations when the tile is not, which is a consequence of the presence and absence of the tile water. Lower NO_3-N concentrations will also be observed in the downgradient water than the tile as a result of the processes in the soil such as plant uptake, denitrification and dilution. Also, for upgradient water, I expect to see steady NO_3-N concentrations in both tile conditions, and the level of NO_3-N concentrations in the downgradient water slightly higher than the upgradient water (background concentration) when the tile is not running. Further, the results of this work will show how tiles control nitrate concentrations in the system.

THE INFLUENCE OF TILE FLOW ON WATER MOVEMENT IN THE VADOSE ZONE, AND THE TRANSPORT AND FATE OF NITRATE IN A SATURATED RIPARIAN BUFFER: A CASE STUDY OF THE T3 SITE, CENTRAL ILLINOIS

Presenter: Akrofi, Benedicta
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Eric Peterson

Authorship: Benedicta Akrofi, Eric Peterson

An increase in nitrate (NO_3^-) concentration in surface water and groundwater from agriculture is a growing cause for concern all over the world. As farmers seek to meet global food demand, the amount of available nitrogen in the terrestrial cycle has doubled as more nitrogen (N) fertilizer is being applied to fields to enhance grain crop yield and quality. The Midwest States, including Illinois, have highly fertile soils and represent one of the most intense areas of land growing corn and soybeans. Approximately, 7.7 billion kilograms of N-fertilizer are applied to Illinois corn and soybean fields annually. While fertile, the soil does not drain well, which has resulted in the installation of tile-drainage systems. Tiles drain the soil above it directly into streams giving little opportunity for denitrification, plant uptake, and microbial immobilization to remove nitrogen, hence, short-circuiting the roles of the soils in the nitrogen cycle and contributing to pollutants in surface waters. Excessive nitrate accumulation in surface waters has led to eutrophication and the development of hypoxic zones in aquatic environments. One method that has exhibited success in lowering NO_3^- concentration is the diversion of tile-drained waters from the agricultural fields into a saturated riparian buffer (SRB) before the water enters a stream. Previous works have shown a reduction in the concentrations of nitrate as nitrogen (NO_3-N) in water flowing through an SRB, but what happens in the immediate area near the tile in terms of water flow and nitrate transport and fate is unknown. Most NO_3-N exported from tile-drained watersheds in the Midwest occur from January to June, which corresponds to periods of tile flow. The top 20 cm of the vadose zone serves as a critical nitrogen storage location and foci for biogeochemical processes that utilize nitrate. This study is to examine the influence of tile flow on water movement in the vadose zone, and the transport and fate of nitrate in a saturated riparian buffer at the T3 site in Hudson, Illinois. Two questions will be explored to understand the research objectives: (1) How does tile flow change the flow in the vadose zone; Vertical flow may be slow, and horizontal flow may increase. When the tiles start running, the water table rises, and water is delivered to the SRB. 2) Will nitrate be collected and transported as the tile water saturates the zone than when the tiles are not running? Nitrate sampling will be undertaken once every week from March to September 2023; when the tiles are running versus when the tiles are not running. A two-way ANOVA will be used to determine how independent variables, time (when the tiles are running versus when the tiles are not running) and among the various depths, 0.3m, 0.6m, and 1.5m from subgroups (wells, head data from tension meters) affect a dependent variable, NO_3-N concentration (mg/L). We expect to see a lower nitrate concentration in the vadose zone when the tiles are running as compared to when the tiles are not running. As the water table rises, water is delivered to the SRB and saturates the vadose zone, collecting and transporting some of the nitrates out of the vadose zone.

INTERNAL FACTORS THAT INFLUENCE OVERALL ROCK STRENGTH: ST. PETER SANDSTONE IN STARVED ROCK STATE PARK, ILLINOIS

Presenter: Bowen, Adeline
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Lisa Tranel

Authorship: Adeline Bowen, Lisa Tranel

Weathering and erosion of exposed rocks like those of the St. Peter Sandstone in Starved Rock State Park is an ongoing process driven by a multitude of factors, both internal, such as rock strength, and external, such as human-made carvings. Rock strength is an important characteristic to examine when studying erosion, and many things can influence rock strength, such as grain size, cementation, and porosity. Schmidt hammer tests performed on fallen boulders in various canyons throughout Starved Rock State Park gives us a range of rock strength values to analyze with corresponding rock thin section samples. Thin section samples were analyzed using a petrographic microscope to quantify grain size, amount of cement, and amount of pore space. Following analysis of thin sections and comparison to rock strength values, we hypothesized that there is a negative correlation with rock strength and grain size and porosity. This shows that as grain size, amount of pore space, or both increases, a rock's strength decreases. A positive correlation was expected with rock strength and cementation, showing that a rock with greater amounts of cement will have a larger rock strength value. This study allowed us to further our understanding of the relationship between a rock's internal characteristics and its strength and how this affects erosion mechanics in the sample area. This study could further help us with predicting erosion patterns, specifically in susceptible, high-trafficked areas such as Starved Rock State Park.

MONITORING INVASIVE SPECIES DIEBACK IN RESPONSE TO AN INTRODUCED PREDATOR

Presenter: Brasen, Jake
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Jonathan Thayn

Authorship: Jonathan Thayn, Jake Brasen

Early settlers in the American west introduced tamarisk, or salt cedar, to fight erosion along riverbanks. Tamarisk quickly displaced native species; like box elder, cottonwood, and willow; and reduced the habitat of native birds and mammals. The National Park Service has spent years trying to burn, dig and poison tamarisk, but it is too resilient, dense and thorny.

In 2006, after careful study, the NPS and other national and state agencies intentionally released a foreign species in Dinosaur National Monument and other locations along the Green, Colorado and Yampa Rivers. The tamarisk beetle (Diorhabda carinulata) is monophagous, meaning it only eats tamarisk leaves. It is originally found in southern Russia, Iran, Mongolia and western China. We can now add southern Utah to its habitat. If the beetle successfully reduces the extent of tamarisk, it could free-up over a million acres of prime riparian habitat in the American Southwest.

While several small-area studies have shown that beetle-caused die-back is occurring, no large-area, repeated monitoring program is in place. The large extent of the effected area prohibits traditional field-based methods; however, satellite and drone imagery could be used to track the annual distribution and condition of tamarisk. During the early summer of 2022 we conducted a field census of tamarisk beetles along the Colorado River near Arches and Canyonlands National Parks. We also collected extensive low-altitude drone imagery, particularly in the near-infrared portion of the spectrum. The drone data was used to calibrate a model that predicted the amount of healthy tamarisk in each pixel of satellite imagery. Our results suggest that satellite sub-pixel analysis can be easily and accurately used to monitor tamarisk die-back over time. Future work will include time-series analysis of satellite data and field expeditions to determine which species replace the tamarisk plants.

ASSESSMENT OF SPATIAL AND TEMPORAL VARIATIONS IN CHLORIDE CONCENTRATION IN AN AGRICULTURAL TILE-DRAINED AREA IN CENTRAL ILLINOIS

Presenter: Commander, Okiemute
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Eric Peterson

Authorship: Okiemute Commander, Eric Peterson, Catherine O'Reilly, Johnathan Thayn, Bill Perry, Rick Twait

Long-term increase in chloride (Cl-) concentration in surface water and groundwater from anthropogenic sources, including deicing salts, agriculture, septic effluents, and wastewater treatment plants is a growing cause for concern all over the world. In rural areas with less impervious surface cover, agriculture may serve as a source for Cl- in water systems. A saturated buffer zone (SBZ) installed adjacent to a Central Illinois stream (tributary of Lake Evergreen) to reduce nutrient losses was used to identify groups of Cl- in the SBZ and to identify temporal Cl- variation within the SBZ. Water samples collected from 37 wells, a diversion box and stream over a 7-year period within the SBZ were analyzed for major anions. Based upon well depth and locations within the SBZ, subgroups were delineated into deep groundwater, downgradient shallow groundwater, upgradient shallow groundwater, diversion box, and stream. Seasons were divided to correspond with agricultural practices: spring/planting, summer/growing, fall/harvest, and winter/fallow. A cumulative probability plot indicates three populations of Cl-, and two-way ANOVA results identify three distinct groups: 1) stream, 2) upgradient shallow groundwater, and 3) diversion box, downgradient shallow groundwater, and deep groundwater. The ANOVA identified seasonal differences in only the stream, while both the stream and upgradient shallow subgroups were spatially different from the others. Principal component analysis (PCA) of the water chemistry data indicated that water-rock interaction explained 28% of the variance while surface processes explained 23% of the variation. Classifications from the PCA correspond to the three groups of Cl- population within the SBZ, hence supporting results from the ANOVA and the cumulative probability plot. Understanding the different populations and seasonal variations of Cl- within the SBZ will help in reducing chloride and other nutrients loading into the stream and further downstream into Lake Evergreen (City of Bloomington water reservoir).

Keywords: ANOVA, Chloride, Cumulative probability plot, Principal component analysis, Saturated buffer zone

WATER COLOR OF MINNESOTA'S SENTINEL LAKES (SLICE) BY SATELLITE REMOTE SENSING

Presenter: Dooley, Andrew
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Wondy Seyoum

Authorship: Andrew Dooley, Wondy Seyoum

Surface waters are preciously vital resources requiring expensive and time intensive labor to effectively monitor for adequate water quality management. New applications of water color analysis by satellite remote sensing are a promising holistic approach to water quality monitoring for scientific, industrial, recreational, and cultural benefit. This research expands previous applications of lake water color analysis and pioneers water color patterns of midcontinent lakes in Minnesota, USA. In documenting lake water color, the first observations of water color homogeneity within ecoregions and color consistency through historical satellite mission data may begin. NASA's Landsat 8 OLI satellite provides an active historical record of visible light reflectance of the Earth's surface. Chromaticity analysis concludes unbiased interpretation of dominant visible wavelength as water color from tristimulus reflectance samples. The Sustaining Lakes In a Changing Environment (SLICE) program, predefines "Sentinel Lakes" representative of the population of lakes within major ecoregions of Minnesota. Visible light reflectance records will be extracted at randomly generated points within Sentinel Lakes at late summer when peak insolation bolsters trophic activity. The expected results of this work will provide groundwork of lake water color distribution and variability across the State of Minnesota. Cartographic representation of Sentinel Lake modal water color will aid in interpretation of water color variability within ecoregions. Graphical displays of modal dominant visible wavelength from each ecoregion will yield quantifiable comparison of water color as wavelength. All Sentinel Lakes within an ecoregion are expected to share consistent water color. Ecoregions are anticipated to possess distinguishable water colors from each other. Chromaticity diagrams of historical water color will display what trends of water color exist and compile ecoregion water color trends since Landsat 8's launch. Individual Sentinel Lake water color trends are hypothesized to not remain a consistent color through time. The results of this project further develops the possibilities of water color analysis for water quality monitoring and surface water management at unprecedented scales. Cost reduction, historical backlogs, and recurrent sampling are few of the major benefits for further scientific investigations with water color methodology for water quality monitoring.

TRANSPORT OF SUSPENDED SEDIMENT AND PHOSPHOROUS IN AN AGRICULTURAL WATERSHED: A CASE STUDY OF THE MONEY CREEK WATERSHED, CENTRAL ILLINOIS

Presenter: Efobo, Oghenevwede
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Eric Peterson

Authorship: Eric Peterson, Bill Perry, Catherine O'Reilly

Suspended sediment and phosphorus are a threat to surface waterbodies. Excessive supply of suspended sediment to streams can alter water quality, reduce reservoir storage capacity, and degrade ecological functions including the displacement of aquatic habitats. Phosphorus is a limiting nutrient in freshwater. Excessive phosphorus in streams has led to eutrophication, the development of harmful algal blooms and hypoxic conditions that restrict the water for fisheries, recreation, industry, and drinking. For the City of Bloomington, central Illinois, high nutrient loads and sediment concentrations are a major problem in water reservoirs. The primary sources of suspended sediment and phosphorus in the area are from agriculture, which dominates local land- use. To aid our understanding of the transport dynamics between suspended sediment and phosphorus between April 2018-December 2019, two hypotheses were proposed. They are: (1) the flow-weighted concentration of total suspended sediment (TSS) will be linearly related to the flow- weighted concentration of total phosphorus (TP) for storm events, and (2) there will be seasonal variations between the flow-weighted concentration of TSS and flow-weighted concentration of TP. For hypothesis 1, a nonlinear regression analysis was used to evaluate a potential relationship between the independent variable, TSS concentration and the dependent variable, TP concentration. For hypothesis 2, a Kruskal-Wallis test was used to identify statistical differences among flow-weighted TSS and TP concentrations throughout the four seasons. The Pairwise Wilcox test was used to determine which seasons the differences in flow-weighted TSS and TP concentrations were significant. Results showed a strong positive linear relationship between flow- weighted TSS and TP concentration for all storm events (R^2 = 0.86); this relationship was observed among the storms in the winter (R^2 = 0.84), spring (R^2 = 0.95), summer (R^2 = 0.64), and fall (R^2 = 0.97). Both the median flow-weighted TSS and TP concentrations were statistically similar among the seasons, with the exception between summer-fall when both TSS and TP concentrations were different. Despite the similarity in flow-weighted concentrations among the seasons, discharge controls sediment transport. The higher the discharge, the more TSS and TP that were transported. Summer discharges were the lowest, producing low flow-weighted concentrations for both TSS and TP. Winter and spring saw elevated discharge volumes that produced higher flow-weighted concentrations. Elevated discharge in winter and spring were due to high precipitation and snowmelt. Mitigation strategies should be focused on the winter and spring in which high TSS and TP have been reported.

DO ANIMALS USE URBAN STREAMS AS CORRIDORS?

Presenter: Fever, Lacey
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Catherine O'Reilly

Co-Mentor: Michael Brown

Authorship: Lacey Fever, Catherine O'Reilly, Michael Brown, Cathy Oloffson

Wildlife are increasingly found in urban environments. However, it is not clear how wildlife moves around the urban landscape. The purpose of our project is to determine whether animals use urban streams as corridors to move through town. We speculated that animals use the town's streams as a corridor to cross into residents' yards. To test this hypothesis, trail cameras were set up alongside the creeks at Hidden Creek Nature Sanctuary, Anderson Park, Oakdale elementary, and North Blair Drive in Normal, Illinois. The cameras were used to collect data between September 2021 and September 2022. The footage was reviewed on a weekly basis and the images were routinely uploaded onto Colorado Parks and Wildlife (CPW) Access database. Information identified by visually inspecting the images was then used to create graphs. The input data consisted of the animals' species, location, and time of day. Results from the camera images and our graphs indicated that raccoons and coyotes are often present at Hidden Creek Nature Sanctuary around 3:00am. Raccoons and stray cats were commonly observed near Oakdale elementary around 3:00am. Squirrels and ducks were common at Anderson Park around 12:00pm. Birds were common at North Blair Drive around 7:00am to 7:00pm. We also saw herons, chipmunks, dogs, foxes, opossums, and rabbits. There was seasonality in animal activity. The data collected through the trail cameras support our hypothesis; animals do use streams as passageways through town. By inspecting the trail camera footage and noting wildlife location and direction of movement, we observed various native species using the streams to travel through town.

EVALUATING THE POROSITY AND ROCK STRENGTH OF CARTER COUNTY, KY

Presenter: Hoberg, Joe
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Eric Peterson

Authorship: Joe Hoberg, Eric Peterson, Ethan Conley

Carter Caves State Resort Park (CCSRP) located in, Carter County, KY, is a fluviokarst system consisting of 106 km2 deeply incised valleys characteristic of the Cumberland Plateau. Stratigraphically the region consists of approximately 25m of Mississippian age limestone of the Slade Formation overlain by the lower Carter Caves sandstone member of the Mississippian Paragon Fm. Over the course of the last decade, numerous studies conducted terrain analyses to characterize CCSRP for cave collapse, paleoclimate data, and evolutional history. These studies have primarily focused on the use of digital elevation models (DEM) and GIS driven techniques to identify and correlate cave levels to stream incisions.

This region lacks numerical descriptions of in-situ parameters, such as porosity and rock strength, that are commonly used as components in hydrogeologic and karst genesis models. There has been minimal efforts completed to conduct or advance any research in porosity in recent time. Ultimately, this has limited the ability and domain to which further advancements in characterizing CCSRP could be done.

Two samples of the Warix Run member and five samples of the Mill Knob member of the Slade formation were collected near the entrances to Horn Hollow cave. The Mill Knob member consists of light-olive-grey quartzose calcarenite and lesser calcilutite while Warix Run contains calcarenite and calcilutite with lesser amounts of dolomite and shale. In general, both also contain medium- to coarse-grained red and grey chert, silt, and sand with large crossbedding.

All samples were evaluated for rock strength using a Schmidt hammer, and four samples were evaluated for porosity. Thin sections of these samples were acquired and applied with a blue dye epoxy to enhance the visibility of any pore spaces. Using ImageJ and INFINITY ANALYZE 7 , 25 images at 4x magnification of each slide were digitized to calculate the average porosity of each sample as well as a cumulative average for both geologic members. The porosity data for Mill Knob displays a mean of 5.05%, with a range from 3.16% to 6.62% while the Warix Run data illustrate a mean of 2.63%. Rock strength data for Mill Knob shows a mean of 28 5 n/mm2, with a range from 21.5 to 42 n/mm2 while Warix Run data displays a mean of 26.5 n/mm2, with a range from 22 to 30.5 n/mm2.

UNDERSTANDING GROUNDWATER FLOW IN A SATURATED BUFFER ZONE (SBZ) USING NUMERICAL MODELS: CASE STUDY OF T3 SITE, MCLEAN COUNTY, CENTRAL ILLINOIS

Presenter: Nsude, Henry
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Wondy Seyoum

Co-Mentor: Prof. Eric Petereson

Authorship: Henry Nsude, Wondy Seyoum, Eric Peterson

Excess nitrate due to use of fertilizers is a threat to surface water bodies in the United States. It leads to high nitrate content in water discharged to streams which degrade aquatic ecosystems through process of eutrophication and subsequent hypoxic conditions. The presence of nitrate also threatens the potability of numerous aquifer bodies globally due to their high solubility in water. To tackle this problem, the Environmental Protection Agency (EPA) recommends the use of saturated buffer zone (SBZ) as best management practice for filtering nutrients from nitrate laden water prior to discharge at streams. However, there isn't a good understanding of how groundwater flows in the SBZ. This knowledge is important as it will aid in optimal design of the width of the buffer zone. To aid understanding of groundwater flow in the SBZ with the T3 site as case study, the aim is to prove two hypotheses: (1). Radius of influence will increase as rate of discharge of tile water increases. (2). There is interaction between regional groundwater flow and local tile water flow and vice versa To test the first hypothesis, a finite difference groundwater modeling software (MODFLOW) is used to produce a three-dimensional steady state groundwater model. After calibration using autocalibration techniques, several scenarios are run where tile discharge is increased and the resulting change in radius of tile water measured. To test for the second hypothesis, a particle tracking software (MODPATH) is used to place particles at the eastern edge of the model and run flow simulations to compare fluid flow when the tile is turned on to when the tile is turned off. It is expected that the radius of influence of tile water will increase as discharge of tile water is increased up until the point the tile water reaches the stream. At that point, the radius no longer increases but flattens (takes shape of asymptote). It is also expected that there would be interaction between the regional groundwater flow and local tile water flow. Thus, a buildup of hydraulic head is expected when tiles are turned on. This would lead to a reduction in percentage of particles entering the buffer zone as compared to when the tiles are turned off.

EXPLORING THE EFFICACY AND ETHICS OF PRONATALISM: HOW GOVERNMENT POLICIES SHAPE POPULATION DYNAMICS

Presenter: Panek, MK
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Matt Himley

Authorship: MK Panek

Declining fertility rates in many parts of the world have contributed to a surge of interest in 'pronatalist' policies, or policies designed to stimulate an increase in birth rates. These propositions vary from an expansion of social welfare programs (parental leave, subsidized childcare, free education) to more coercive mechanisms, such as limitations on access to abortion and birth control. Reasoning behind these policies ranges from economic to military – and are, in some parts of the world, shaped by ethnonationalism. In this context, the present research project asks three interrelated questions: (1) Is there evidence of pronatalist policies effectively increasing birth rates? (2) What sorts of policies have been shown to be most effective? (3) What can an examination of existing pronatalist policies tell us about the ethical/normative implications of pronatalism? To address these questions, the research focuses on the history of pronatalist policies in three countries: France, Hungary, and South Korea. Based on a review of academic and non-academic source materials, the poster presentation will report on the specific historical and cultural contexts in which pronatalist policies emerged in the case study countries. It will be supported by evidence available to date on the effectiveness of policies implemented in each country. And it will reflect on how analysis of the case studies can inform an ethical approach to the world's demographic changes.

MAKE GEOPOLYMER CONCRETE USING WASTE GLASS AND INDUSTRIAL BY-PRODUCTS

Presenter: Roslewski, Lucas
Undergraduate, Geography, Geology, and the Environment

Mentor: Prof. Guang Jin

Co-Mentor: Prof. Pranshoo Solanki, Technology

Authorship: Lucas Roslewski, Guang Jin, Pranshoo Solanki

Portland cement-based products such as concrete are the most common building material used in the world. However, cement production comes with its high energy consumption, emission of greenhouse gasses, and consumption of nonrenewable materials. Geopolymer concrete (GeoPC) offers a more environmentally friendly alternative to Portland cement due to its lower energy consumption, greater durability, and lower greenhouse gas emissions. GeoPC is prepared by mixing an alkaline activator along with industrial by-products such as fly ash, slag, and quarry by-product to form a dense three-dimensional polymeric chain and ring structure of silicon-aluminum minerals.

The purpose of this study is to explore the feasibility of using waste glass as a potential alkaline activator, along with other industrial by-products such as fly ash, slag and quarry-by products, in the preparation of GeoPC. Compressive strength of GeoPCs prepared from recycled glass were also tested and compared with GeoPCs prepared using commercial water glass at equivalent sodium silicate concentration. Results show that compressive strength of GeoPC prepared using recycled glass (fine ground) are comparable or higher than those prepared using commercial waterglass at various mix designs and curing conditions. Further research in expanding recycled glass from fine-ground to coarse-ground is needed in order to further reduce cost.

HUMAN IMPACTS ON EROSION RATES IN STARVED ROCK STATE PARK, IL

Presenter: Thielbar, Savannah
Graduate, Geography, Geology, and the Environment

Mentor: Prof. Lisa Tranel

Authorship: Savannah Thielbar, Lisa Tranel

State and National parks are some of the most visited wildlife areas within the United States, making local geologic features more susceptible to human-induced change. As more people visit these parks throughout the year, we see major impacts on the interactions between biological and geological processes. This study determines if human activity, through rock carvings, influence erosion rates within Starved Rock State Park and provides a new perspective on our compounding anthropogenic influence on Earth. Through natural stream and artificial human erosion, the base of the bedrock slope is potentially changing at a much faster rate than the upper portion of the outcrop. By monitoring the fragile sandstone cliffs that preserve these human-created carvings, we collect specific erosion data on four different canyons within the park. Canyon wall data are collected and monitored using an Empire contour gauge, a rebound Schmidt hammer, and an iPhone 13 LiDAR camera and app program to determine seasonal variations in erosion throughout the park as well as the influence of surficial case hardening on the outcrops. The contour gauge and Schmidt hammer data collected suggest the bedrock of the area is affected on a small, millimeter scale within a course of a year. We compared data collected from the carvings to bedrock that is naturally eroding without human influence to understand localized changes to bedrock and consider connections to long-term erosion of these surfaces. Analysis of Schmidt hammer values and previously collected thin sections indicate that some locations have stronger rock surfaces driven by differences in cement concentrations from the surface to the interior of the rock outcrops. Differences in rock strength produce variation in erosion rates across the canyons and provide context to seasonal implications for weathering. Future research identifying the magnitude of this impact over a longer period, as well as the impact on other lithologies, can prove to be valuable in increasing education and awareness at other state or national parks.

HISTORY

GENDER, RACE, AND "EMPTY SPACE": DEPICTIONS OF THE BRITISH EMPIRE IN THE GOLDEN AGE OF BRITISH CHILDREN'S LITERATURE

Presenter: Ruske, Jessica
Undergraduate, History

Mentor: Prof. Taylor Soja

Authorship: Jessica Ruske

Over the course of a semester, I conducted historical research with the goal of answering questions about how the British Empire has generally been depicted in nineteenth century British children's literature. My research focuses on four books which I believe are important in understanding how to British Empire is portrayed in literature: Rudyard Kipling's *The Jungle Book*, Lewis Carroll's Alice's Adventures in Wonderland, Charles Kingsley's *The Water Babies: A Fairy Tale for a Land-Baby*, and James Matthew Barrie's *Peter and Wendy*. Additionally, I conducted research on the reception of this literature in newspaper articles and the secondary literature describing the popularity of these new children's books and how the "Golden Age" of children's literature came to be.

Through researching these books, I discovered how the British Empire was generally depicted as a place designed for adventures; these books make clear to British children that when they grow up, the British Empire is there for them to eventually explore and live out the dreams they had as children. However, the type of adventures children could have varies greatly depending on gender. Boys were intended to have adventures in which they could explore and have fun, while girls were still expected to uphold the gender roles that British society expected of them. This is especially clear when comparing *The Jungle Book* and *Alice's Adventures in Wonderland*. Mowgli and Alice's adventures contrast each other in almost every way because of gender.

Nineteenth century children's literature portrays the British Empire as being filled with empty space; a place where no one lived and no other cultures existed. We can see this depiction in all four of the books, where the Empire is described only as a place filled by animals and other British individuals. If natives are mentioned, their depictions center around racist stereotypes. The passages speaking of natives refer to them as being less than human, and the images shown in the books reflect racist depictions common in nineteenth century images.

Each of the books reflect how the British viewed their Empire as well as how they wanted their citizens to utilize the Empire. Through my research, I was able to come to the conclusion that the popularity of these books after their release reflect British sentiments surrounding colonization and imperialism in the nineteenth century.

INFORMATION TECHNOLOGY

CHATGPT LITERATURE REVIEW: USE AND IMPLICATIONS IN VARIOUS SECTORS

Presenter: Abadeer, Elyse
Undergraduate, Information Technology

Mentor: Prof. Yousra Javed

ChatGPT is a brand new artificial intelligence tool that was launched on November 30, 2022, by OpenAI. This emerging chatbot technology will likely have many significant implications for information security and privacy, but it also is expected to impact a broad range of other sectors. This research project is a literature review conducted to explore the trends in current research about ChatGPT, to observe how different fields and disciplines are responding to this new technology, and to analyze and draw conclusions about the information found.

COMPUTATIONAL APPROACH TO STUDY ABNORMAL BRAIN ACTIVITY

Group Leader: Jacob, George
Graduate, Information Technology

Group Member: Twinkle Jaswal, Undergraduate, Information Technology

Mentor: Prof. Rosangela Follmann

Co-Mentor: Prof. Epaminondas Rosa

Authorship: George Jacob, Twinkle Jaswal, Rosangela Follmann, Epaminondas Rosa

Neurons are the fundamental building blocks of the nervous system. A neuron is a cell that uses electrical impulses and chemical signals to transmit information between different areas of the brain, as well as with the rest of the nervous system. Computational modeling of neurons can provide a powerful tool to study neurological processes, including neurological disorders. Epilepsy, for example, is a nervous system disorder characterized by excessive brain activity, which includes abnormal neuronal synchronization. It affects around 50 million people worldwide and can have devastating disruptions in their lives. Much progress has been made in the diagnosis and treatment of this disorder, but presently there is no guaranteed cure for the disease. Computer simulation studies using quantitative neuron network models can help the understanding of brain functions under neuropathological conditions. The outcome may be useful not only in the development of detection but also, in the prevention of seizures. In this work, we employ the Huber-Braun neuron model based on the Hodgkin-Huxley equations to provide an accessible, meaningful mathematical representation of neural processes, detailing how action potentials are triggered and simulating neuronal behavior. Moreover, we developed a biophysical model to simulate and analyze a network of coupled neurons following the functional connectivity prior and during the onset of a seizure. We also investigated how temperature changes in the proposed model can trigger seizures, mimicking the conditions observed during fever induced seizures in infants.

KINESIOLOGY AND RECREATION

RELATIONSHIP BETWEEN BMI, WAIST CIRCUMFERENCE, WAIST TO HEIGHT RATIO, PERCENT FAT, AND RESTING METABOLIC RATE

Presenter: Garneau, Renee
Undergraduate, Kinesiology and Recreation

Mentor: Prof. David Thomas

Co-Mentor: Prof. Kristen Lagally

Authorship: David Thomas, Kristen Lagally, Laina Runyon, Alex Cerrato

Overweight and obesity are major problems worldwide. It has been speculated that body fatness is related to resting metabolic rate. PURPOSE: The purpose of this study was to determine the relationship between body mass index (BMI), waist circumference (WC), waist to height ratio (WHtR), percent body fat (%BF), and resting metabolic rate (RMR). METHODS: Twenty-eight (11M, 17F) volunteers (mean age = 21.3 ± 1.4 years) participated in height (Ht), mass, WC, %BF, and RMR measurements in a single session. Ht and mass were measured on a clinical stadiometer. BMI was calculated by dividing mass in kilograms by the square of their Ht in meters. WC was measured using a standard measuring tape, with the measure taken at the narrowest part of the trunk between the ribs and iliac crest. WHtR was calculated by dividing WC by Ht. RMR was measured using a metabolic cart measuring oxygen consumption and carbon dioxide production. Percent fat was measured using air displacement plethysmography. To provide a measure of RMR relative to body mass (RMR/kg), RMR was divided by mass. Means and standard deviations were determined for all variables. Pearson product-moment correlations were used to statistically analyze the results. RESULTS: Means and standard deviations for each variable were: Ht 169.7 ± 9.7 cm; Mass 79.2 ± 18.8 kg; RMR 1666 ± 398.7 kcals/d; BMI 27.3 ± 5.1 kg/m2; WC 81.6 ± 10.9 cm; WHtR 0.48 ± 0.06; RMR/kg 21.4 ± 4.1 kcals/d; and %BF 28.5 ± 12.1%. Correlations between RMR and the body composition variables were: BMI r = 0.49, R2 = 0.24; WC r = 0.6, R2 = 0.36; WHtR r = 0.31, R2 = 0.11; and %BF r = -0.35, R2 = 0.13. Correlations between RMR/kg and the body composition variables were: BMI r = -0.47, R2 = 0.22; WC r = -0.36, R2 = 0.13; WHtR r = -0.39, R2 = 0.15; and %BF r = -0.67, R2 = 0.44. CONCLUSIONS: Results indicate weak to moderate correlations between both absolute and relative RMR, the anthropometric variables, and %BF. The relationships between absolute RMR and the other variables indicates larger people have higher RMR. The relationships between RMR/kg and anthropometric measures and %BF were inverse, suggesting lower metabolic rates per unit of mass, and lower metabolically active tissue in those with higher levels of body fatness.

META-ANALYSIS OF TRADITIONAL ACUPUNCTURE POINTS, ASHI POINTS AND DELAYED-ONSET MUSCLE SORENESS

Presenter: Shao, Yufang
Graduate, Kinesiology and Recreation

Mentor: Prof. Kelly Laurson

Delayed onset muscle soreness (DOMS) is a type of muscle injury that can occur in all exercises following moderate-to-high intensity physical activity. Symptoms of DOMS, such as pain, muscle tenderness, stiffness, and restricted range of motion, occur 6 to 24 hours post-exercise and can continue for three to five days. DOMS may influence performance in athletes and activities of daily living in the general population. More recently, acupuncture has been considered as an alternative treatment method for muscle injury, which includes DOMS. The purpose of the proposed study aims to analyze existing data in the literature through March 2023, to investigate the effectiveness of acupuncture treatment with traditional acupoints or ashi points to treat DOMS. Traditional acupoints are the points on the traditional meridians and have their action and benefits in traditional Chinese medicine (TCM) theory. Ashi points do not have a specific location and are similar to trigger points. Previous meta-analysis studies for DOMS and acupuncture did not find significant evidence to support that acupuncture can help DOMS improvement or prevention, but they found other benefits for acupuncture. The reasons included 1) not enough studies for analysis, and 2) criteria and conditions were not clear for the treatment function. Through this research, we hope to determine the effectiveness of acupuncture for DOMS, while distinguishing between the utility of traditional acupoints and ashi points.

MANAGEMENT AND QUANTITATIVE METHODS

REACTIONS OF STUDENTS BETWEEN USA AND BARBADOS

Presenter: Samake, Oumou
Undergraduate, Management and Quantitative Methods

Mentor: Prof. Tina Williams

Research in psychophysiology reported that the body exhibits evidence of chronic stress after experiencing traumatic events. This research aims to contribute to the conversation by examining whether the racial composition of society influences strain reactions (i.e., frustration, emotional exhaustion, anxiety, or depression) and whether that relationship is significantly moderated by membership in the dominant or marginalized race. This study will use a longitudinal design to assess the strain reactions between students who attend college in the U.S. and Barbados and within students who attend college in the U.S. in different social environments. The research tests whether the relationship between the racial composition of society and strain reactions will be moderated by race and whether the relationship between the racial composition of society and strain reactions will negatively (positively) influence strain reactions when participants are of the marginalized (dominant) race.

SOCIAL ENTREPRENEURSHIP INDEPENDENT STUDY

Presenter: Ward, Faith
Undergraduate, Management and Quantitative Methods

Mentor: Prof. Tina Williams

My project is a focused study on social entrepreneurship. The study is an in-depth look into what social entrepreneurship is, how it is formed, and the impact it has on society in the United States and abroad. The project is a semester-long research on this topic.

The project consists of interviews, literature studies, and research abroad in Barbados and on campus. While abroad, I will be analyzing the different kinds of social enterprises, and the impact these businesses have on ex-patriots and native Barbadians while considering intersectionality in Barbados.

The project will also include social entrepreneurship in the visual and performing arts. I will be working with filmmakers in Barbados and analyzing their work and impact on their community.

MATHEMATICS

TRAVELING SALESMAN PROBLEM: HOW A REDBIRD CAN FIND THE FASTEST PATH AROUND ISU?

Group Leader: Domingo, Eugene
Undergraduate, Mathematics

Group Member: Tiyun Harvey, Undergraduate, Mathematics

Mentor: Prof. Mehdi Karimi

Authorship: Eugene Domingo, Tiyun Harvey

Traveling Salesman Problem (TSP), the problem of finding a minimum cost Hamiltonian cycle in a graph, is the most important graph optimization problem, which is NP-complete. In addition to its theoretical importance, the TSP has many applications in transportation, logistics, and microchip design. Even though the TSP has been studied for years by classical optimizers, new approaches in machine learning have been proposed to solve some cases of the problem faster. In this research, we will explore the classical and modern approaches for the TSP for graphs involving the Illinois State University community. By starting with a small data set, we find the shortest distance to visit twelve cities throughout the Midwest of the United States and return to the starting point. After developing this model, we find the shortest tour to visit many points of interest at the Illinois State University campus. To implement classical optimization approaches for the TSP, we use Python and the GUROBI Python API, which is the current fastest commercial integer programming solver. We will also study some machine learning and heuristic techniques for the TSP and their pros and cons compared to optimization techniques. Our techniques can be used for solving large-scale TSP instances.

PREDICTING ENROLLMENT FROM PROSPECTIVE STUDENT DATA AND SCHOLARSHIP VALUE

Group Leader: Martin, Emma
Undergraduate, Mathematics

Group Members: Robert Skudnig, Undergraduate, Mathematics; Emma Rouger, Undergraduate, Mathematics; Brandi LaFountaine, Undergraduate, Mathematics

Mentor: Prof. Mehdi Karimi

Authorship: Emma Martin, Robert Skudnig, Emma Rouger, Brandi LaFountaine

In this research project, we use modern Data Science and Machine Learning techniques to optimize the scholarship process at Illinois State University (ISU). Almost every academic institution provides some form of scholarship to first-year students classically based on factors such as GPA, SAT score, and financial situation. This project aims to analyze the previous data sets thoroughly to find a model that optimizes the scholarships while maintaining an acceptable enrollment. This comprehensive data science project contains data preparation and pre-processing, model definition and training, model evaluation, and data visualization and presentation. We use the Python programming language, several machine learning packages, and mathematical tools in this project to develop a more robust and efficient method of awarding scholarships. The data set has 20,000 entries of historical information on admission and enrollment. We explore several models, such as neural networks (NN), to model a function that approximates the likelihood of enrollment from a prospective student's data and possible scholarship award amount. We explain our methodology and results with effective visualization techniques to simplify decision-making by the administration. The data science methods and models we develop can be used in many decision-making scenarios at ISU and outside companies.

ON THE RISK FACTORS OF CARDIOVASCULAR DISEASES

Group Leader: Mozid, Nishat Ara
Graduate, Mathematics

Group Member: Kwabena Duku, Graduate, Mathematics

Mentor: Prof. Olcay Akman

Authorship: Kwabena Duku, Nishat Ara Mozid, Olcay Akman

Cardiovascular diseases (CD) are one of the leading causes of death worldwide. They include coronary heart disease, strokes, transient ischemic attacks, peripheral arterial disease, and aortic disease, among others. With this study we investigate the association between these risk factors and non-physiological categories of risk factors such as demographics, health practices, and biological markers as they relate to the development of CD. We also derive the risk coefficient of developing CD as a result of inclusion in specific risk factor groups.

A COMPUTATIONAL MODELING APPROACH TO UNDERSTANDING THE OUTCOME OF ISCHAEMIC HEPATITIS

Group Leader: Utterback, Madison
Undergraduate, Mathematics

Group Member: Christiana Beard, Undergraduate, Mathematics

Mentor: Prof. Olcay Akman

Authorship: Christiana Beard, Madison Utterback, Aditi Ghosh, Priya Kohli

Ischemic Hepatitis (IH) is a liver injury preceded by hepatocyte death. The only way to diagnose this disease is to eliminate the possibilities of all other liver injuries currently. To combat this issue, our goal is to explore computational models that are able to predict the outcome in terms of death or survival of a person who suffers from IH based on various biomedical indicators such as: creatinine peak, international normalized ratio peak, aspartate aminotransferase peak, alanine transaminase peak, and bilirubin peak. The real patient data was collected across multi centers from the US by the Acute Liver Failure Study Group. We clean, process, and analyze the data utilizing classification models like logistic regression and regression tree method, including BART, to predict the outcome of the patients suffering from IH. We then apply SMOTE and boosting techniques to improve the prediction accuracy. Obtaining the sensitivity and specificity of the testing methods helps us compare the outcome to determine the best model.

NURSING

THE FUTURE OF HEALTHCARE- FOUNDATIONS FOR CHANGE

Presenter: Avise, Leah
Undergraduate, Nursing

Mentor: Prof. Melissa Calvillo

Authorship: Leah Avise, Melissa Calvillo

Healthcare professionals are expected to maintain an understanding of current research and adapt to new evidence in order to provide excellent patient care. To understand important contributors to the long-term success of our healthcare system, a special issue of the International Journal of Environmental Research and Public Health was reviewed and synthesized. This issue includes 15 articles from international scholars regarding the future of the healthcare workforce. A critical theme that emerged is the importance of professional development and continuing education at all healthcare system levels. Creating a culture that supports this further learning also allows for innovation and improves employee satisfaction. A shortage of healthcare workers is an international phenomenon. Employee retention is key to maintaining staff-patient ratios which contribute to a safe environment for patients, therefore it is important for the system to promote the satisfaction of employees. An additional theme includes a workplace culture that encourages communication and interdisciplinary teamwork. An interdisciplinary approach to problem-solving facilitates creativity and, ultimately, improved efficacy. Interdisciplinary teams also increase compliance with treatment plans and general well-being for both patients and staff.

PHYSICS

NANOMATERIAL GROWTH USING BLOCK COPOLYMER AS A TEMPLATE

Presenter: Herbert, Carter
Undergraduate, Physics

Mentor: Prof. Mahua Biswas

Authorship: Carter Herbert, Amelia Korveziroska, Mahua Biswas

Nanomaterials, the building blocks of many developed and emerging technologies have received significant attention in last few decades. There are tremendous efforts in nanomaterial synthesis and patterning with well controlled size, shape, composition and spatial arrangement for device applications. Hence identifying and developing a process that allows for controllable size and shaping is critical. For well-ordered and tunable size and spacing control of the nanostructures on a substrate one of the most effective strategies is to use template-based fabrication that allows for a high degree of control. In our experimental physics laboratory at Illinois State University, we use block copolymers (BCPs), a special type of polymer with self-assembly property to create nanostructures, as templates and different inorganic deposition methods for the fabrication of inorganic material nanostructures with different morphology. BCPs have the capability to create nanopatterns of different shape, size and spacing which can be tuned by tuning the properties of BCPs such as molecular weight and volume fraction. In my presentation, I will give an overview of the BCP template fabrication method and inorganic material nanostructure fabrication using BCP as template that we perform in our laboratory at ISU.

FABRICATION OF NANOMATERIALS USING POLYMER AND SEQUENTIAL INFILTRATION SYNTHESIS

Presenter: Korveziroska, Amelia
Undergraduate, Physics

Mentor Prof. Mahua Biswas

Authorship: Jaydah Bell, Mahua Biswas

The demand for higher efficiency, compact, and cost effective technologies creates a need for smaller dimension nano-materials. These materials are used on a daily basis and in advancing scientific revolution such as in our phones, laptops, emerging devices like solar cells, nanolasers, memory devices, and sensors. To improve these technologies, we study the fabrication of nanomaterials and advancement of their properties. Exploring different methods of making patterns on inorganic nanomaterial with adjustable size and spacing becomes necessary. This research focuses on developing a sequential infiltration synthesis (SIS) process for silicon nitride (Si_3N_4) and silicon dioxide (SiO_2) materials. SIS involves gas phase molecular assembly reactions and enables the control of localized inorganic nanopatterns using a polymer as a template inside an atomic layer deposition (ALD) chamber. The selective infiltration in SIS is important for assuring large-scale uniformity in mass production of organized nanoscale materials with controlled material properties and for patterning purposes. We have studied the growth process of Si_3N_4 and SiO_2 during SIS deposition using in-situ Fourier Transform Infrared (FTIR) Spectroscopy in collaboration with Argonne National Laboratory. We worked with films and nanoparticles of polymers as templates for the SIS deposition and studied the growth process and parameters using in-situ FTIR Spectroscopy and X-ray photoelectron spectroscopy (XPS). In our work, we identified the precursors which have significant interactions with the polymers using in-situ spectroscopy. There are significant SIS interactions between four polymers and SiO_2 precursors and we have observed weak interactions between Si_3N_4 and polymers.

NANOPATTERNING INORGANIC MATERIALS FOR EMERGING TECHNOLOGIES

Presenter: Patra, Sudarshana
Graduate, Chemistry

Mentor: Prof. Mahua Biswas

Co-Mentor: Prof. Uttam Manna

Authorship: Sudarshana Patra

The research and developments of nanomaterials has made great strides in recent years. Nanomaterials have revolutionized the way technology is used in modern society and is showing promises for emerging technologies. With their unique properties, these materials have enabled numerous applications that could not be imagined before. Their small size and high surface area can lead to enhanced optical, electrical, and mechanical properties. Nanopatterning of inorganic materials is an emerging field with a wide range of applications. It has been used in various fields, such as electronics, optics, photonics, energy, and biomedical engineering. Sequential Infiltration Synthesis (SIS), an inorganic materials infiltration method has shown potential for nanopatterning inorganic materials used for microelectronics and optoelectronics industry. SIS involves the alternate deposition of two different precursor chemicals onto a patterned polymeric surface which acts as a guiding material. SIS can be used to create a wide variety of nanostructured materials, including metal oxides, metals, and semiconductors, with precise control over their size, shape, and composition, making it useful for making long range patterns for various applications such as electronics, energy, and catalysis. In our work, we grow nanometer-scale inorganic material (such as aluminum oxide (Al2O3), aluminum nitride (AlN), and gallium nitride (GaN)) patterns using SIS. In our laboratory, we study the growth mechanism of these inorganic materials in polymers using Scanning electron microscopy, energy dispersive x-ray electron spectroscopy and Fourier Transform Infrared spectroscopy. Our work also focuses on the challenges associated with SIS and provides possible solutions to these challenges. In this presentation, an overview of current and future research works in our group on SIS nanopatterning will be presented.

PSYCHOLOGY

THE IMPACT OF TEACHER RELATIONSHIPS ON STUDENTS' SELF-ESTEEM AND CONDUCT PROBLEMS

Group Leader: Bradley, Brittany
Graduate, Psychology

Group Member: Arielle Flint, Graduate, Psychology

Mentor: Prof. Brea Banks

Authorship: Brittany Bradley, Arielle Flint

As part of the current study, we will examine (a) between school differences in adolescent students' perceptions of school climate, (b) the relation between school climate perceptions and self-reports of conduct problems and self-esteem among adolescent students, and (c) gender and race differences amount these associations. We recruited 700 participants from a Midwestern school district in an urban area. Participants were in grades 6-12 at the time of data collection and were recruited from two alternative schools, three high schools, and five middle schools. We administered a survey electronically via Qualtrics. Participants first completed demographic items before being presented with the following measures: Teacher Relationships Scale (created by researchers), the Rosenberg Self Esteem Scale (Rosenberg, 1965), and the Conduct Problems Scale (created by the author).

We are beginning data analysis this month, as data have already been collected. We will use a multilevel regression analysis to examine variable relations while accounting for nesting that may have occurred given data collected at multiple schools within the same district. Our primary research questions surround the impact of teacher relationships (Teacher Relationships Scale) on self-esteem (Rosenberg Self-Esteem Scale; Rosenberg, 1965) and self-reported conduct problems (Conduct Problems Scale). We will also explore the role of race and gender as moderators on the above relations. We hypothesize that: (1) positive perceptions of teacher relationships/social support will predict higher ratings of self-esteem and lower ratings of conduct problems among participants, (2) negative perceptions of teacher relationships/social support will predict lower ratings of self-esteem and higher ratings of conduct problems, and (3) gender and race will moderate these relationships. Specifically, it is predicted that the association between perceived teacher relationships/social support and self-reported conduct problems and self-esteem will be stronger for girls than boys, as well as for Students of Color than white students.

During the proposed session, attendees will learn the results of the study, as they will specifically obtain information surrounding the impact that students' perceptions of student-teacher relationships have on their self-reporting of self-esteem and conduct problems. Further, research and practice implications surrounding ways to improve school climate and address systemic inequities present in school systems, along with future directions and limitations, will be discussed.

THE GOLD STAR MISSION: BICYCLE RIDE TO REMEMBER FALLEN MILITARY VETERANS

Group Leader: Brandys, Larysa
Graduate, Psychology

Group Member: Erin Marchand, Graduate, Psychology

Mentor: Prof. Eric Wesselmann

Co-Mentor: Prof. Mark Swerdlik

Authorship: Larysa Brandys, Erin Marchand, Eric Wesselmann, Eros DeSouza, Mark Olson, Mark Swerdlik

This research provides a quantitative approach to evaluating one of the Gold Star Mission's key events: the Gold Star 500 bicycling event. This year's event was conducted in a face-to-face group setting, which differed from the virtual versions conducted during the COVID-19 pandemic. Thus, we will discuss the results from both the in-person event and the previous virtual event for comparison. This year's event also had guest participants from a Polish Veterans' Organization, which provides an opportunity to examine the event's impact on participants from two different countries.

We collected a sample of Gold Star 500 riders and volunteers (virtual event N = 43; in-person event U.S. sample N = 32, and Polish sample N = 27). Participants from the virtual event received emails with an anonymous survey link over listservs moderated by the GSM. Participants from the in-person event completed survey measures either in hard copy survey or by scanning a QR code and completing them online. Polish participants completed version of the survey measures translated into Polish. All participants completed measures assessing the perceived efficacy of the GSM program in meeting its goals (e.g., preserving the memory of our fallen heroes; providing support to Gold Star Families), the degree to which GSM activities provided participants a general sense of belonging, and the degree to which participant influenced their meaning in life. Veterans also answered questions assessing how the GSM events influence their perceptions of military-based social support.

Analyses for the in-person event are in progress. Results from the virtual event suggest that participants perceived moderate-to-high levels of the GSM meeting its goals and providing a general sense of belonging. Further, there were significant positive correlations between perceived goal success and belonging, success and desire for future participation. Finally, participants perceived that their participation in GSM events increased their perceived meaning in life on pre-post recall measures.

The virtual data provide promising support that the GSM generally is effective in satisfying its goals. We anticipate that the in-person event data will replicate these findings, with the effects perhaps being descriptively larger given the increased intimacy of the event format. Further, data from the Polish participants will provide interesting explorations for cross-cultural considerations, both for the GSM specifically and for military-focused social support initiatives broadly.

MICROAGGRESSIONS AND SCHOOL PSYCHOLOGISTS' SATISFACTION WITH THE FIELD

Presenter: Callahan, Mackenzie
Graduate, Psychology

Mentor: Prof. Brea Banks

Authorship: Brea Banks, Mackenzie Callahan

Although research suggests that school psychologists are generally satisfied with their experiences in the field, scholars have yet to examine how exposure to racial microaggressions, or subtle race-based insults, may impact satisfaction. The purpose of the current study was to examine the relation between exposure to microaggressions and satisfaction among practicing school psychologists, students, and university faculty. We were particularly interested in the role of race. We collected survey data from 93 school psychologists, and found that exposure to microaggressions predicted reported satisfaction with jobs and placements, but that the relation was only relevant for People of Color (POC). We also found that the relation between microaggression exposure and satisfaction was moderated by the demographic of one's work setting, as POC in settings that were primarily Black and Brown reported less satisfaction when they experienced high levels of microaggressions. Future directions and implications for the field of school psychology are discussed.

EFFECTIVENESS OF MINDFULNESS TRAINING FOR PARENTS

Group Leader: Giannakouras, Demetria
Undergraduate, Psychology

Group Member: Jackie Kasalko, Undergraduate, Psychology

Mentor: Prof. Adena Meyers

Authorship: Jackie Kasalko, Demetria Giannakouras

Stress levels among parents of children with intellectual and developmental disabilities are often higher than those of parents of children with typical development. Mindfulness-based practices have been shown to alleviate parental stress. This study examines the effectiveness of mindfulness-based lessons in reducing stress levels in parents of children at The Autism Place (TAP). The mindfulness-based lessons will be held weekly at TAP for an hour. They will include a variety of formal and informal mindfulness practices, such as meditation and mindful movement. The effectiveness of these mindfulness-based lessons will be measured through quantitative surveys as well as qualitatively, by having participants complete semi-structured interviews. Researchers used scales and also created interview questions that would help determine if the mindfulness-based lessons effectively increased participants' levels of self-compassion and mindfulness while decreasing symptoms of stress, anxiety, and depression.

Keywords: mindfulness, stress, parent wellbeing

RELATIONSHIP BETWEEN INSTAGRAM USAGE AND ANXIETY AMONG COLLEGE FRESHMEN

Presenter: Israels, Emma
Graduate, Psychology

Mentor: Prof. Gary Cates

Authorship: Emma Israels, Luke Jasinski, Casey Grage, Gary Cates

This study investigates the relationship between Instagram usage and anxiety among college freshmen. Specifically, college freshmen were asked to provide their data related to total number of posts, how long they have had their account, how many accounts follow them (number of following), and the number of followers they have. In addition, these students were asked to complete an anxiety measure. Correlations between the above variables were calculated. Results and discussion focus on implications of understanding the relationship between social media usage and mental health. Discussion also focuses on directions for future research.

BRAIN TRYPTOPHAN HYDROXYLASE IMMUNOREACTIVITY AFTER PCPA-INDUCED SEROTONIN DEPLETION AND THE EFFECTS OF THE 5-HT1A AGONIST 8-OH-DPAT ON CARDIAC AND RESPIRATOR RATE

Presenter: Kant, Caitlyn
Graduate, Psychology

Mentor: Prof. Byron Heidenreich

Authorship: Caitlyn Kant, Byron Heidenreich

This study investigates the relationship between Instagram usage and anxiety among college freshmen. Specifically, college freshmen were asked to provide their data related to total number of posts, how long they have had their account, how many accounts follow them (number of following), and the number of followers they have. In addition, these students were asked to complete an anxiety measure. Correlations between the above variables were calculated. Results and discussion focus on implications of understanding the relationship between social media usage and mental health. Discussion also focuses on directions for future research.

IS PRECRASTINATION THE DEFAULT TENDENCY IN TASK ORDER CHOICES?

Group Leader:	Masih, Sanaii Undergraduate, Psychology
Group Members:	Mackenzie Brownrigg, Undergraduate, Psychology; Katherine Lichter, Undergraduate, Psychology; Scott Paul, Undergraduate, Psychology
Mentor:	Prof. Dawn McBride
Authorship:	Sanaii Masih, Mackenzie Brownrigg, Katharine Lichter, Scout Paul

Precrastination describes the tendency to complete tasks as soon as possible despite the action requiring more effort (Rosenbaum et al., 2019). In this study, the relationship between precrastination and working memory was examined by studying the relation between working memory task performance and task order choices. This was achieved by presenting a randomized three-part task order to each participant. The three tasks included a Stroop Test, Simon Task, and a Box-Moving Task, with the box moving task involving six different category item list generation tasks. The box moving task required participants to solve simple math problems in order to move the boxes in numerical order. Participants were also instructed to choose to generate the category items during the box moving task at any time they were not moving a box (i.e., before moving any boxes, after moving all of the boxes, or between moving any one of the boxes). The trial position chosen by each participant was measured. We expected that the majority of participants would choose to generate the category items early during the box moving task based on previous studies, and that trial position would be predicted by working memory task performance.

Keywords: precrastination; working memory; effect task type; task order

ACADEMIC STRESS AND COPING: POTENTIAL MODERATING ROLES OF PERFECTIONISM

Group Leader: Meyer, Derek
Undergraduate, Psychology

Group Members: Jennifer Fishman, Undergraduate, Psychology; Sarah Galati, Undergraduate, Psychology

Mentor: Prof. Jeffrey Kahn

Authorship: Jeffrey Kahn, Jennifer Fishman, Sarah Galati, Derek Meyer

College students routinely experience academic stress. This stress is partly determined by one's perfectionistic tendencies (Rice et al., 2016), but perfectionism is associated with different forms of coping (Dunkley et al., 2000). Concerning interpersonal emotion regulation (Zaki & Williams, 2013), students high in perfectionistic concerns tend not to talk with others about distress (Kahn et al., 2021), especially when stress is high (Richardson & Rice, 2015). By contrast, those high in perfectionistic strivings report lower academic stress (Rice et al., 2016) but engage in greater distress disclosure (Kahn et al., 2021). We extended existing research by focusing specifically on simulated academic stressors and examining both interpersonal and intrapersonal coping. We hypothesized that perfectionistic concerns would attenuate the stress-coping relation whereas perfectionistic strivings would amplify the stress-coping relation. College students (N = 268) completed an online questionnaire that included the Almost Perfect Scale-Revised (Slaney et al., 2001) to measure perfectionistic concerns (Discrepancy subscale) and perfectionistic strivings (High Standards subscale). Participants then read 6 scenarios describing academic stressors (e.g., failing a final exam), and they rated how stressful the event would be and how much they would cope using (a) two interpersonal methods (asking someone for advice, venting emotions to someone) and (b) two intrapersonal methods (dealing with it on their own, not dwelling on it).

We conducted four regression models—one for each form of coping—with all two-way interactions among stress, perfectionistic concerns, and perfectionistic strivings specified. Perfectionistic strivings moderated the stress-coping relationship for both interpersonal forms of coping—asking someone for advice, $p = .02$, and venting emotions to someone, $p < .01$. In both cases, stress and coping were most strongly positively related for those high in perfectionistic strivings. Surprisingly, perfectionistic concerns was not significantly associated with any form of coping in this study.

A complete understanding of how academic stress relates to coping requires knowledge of one's perfectionistic strivings. So-called "healthy perfectionists" (Stoeber & Otto, 2006) are likely to ask others for advice or vent emotions to others when faced with academic stress, whereas those who are not healthy perfectionists show less of a stress-coping association. Our poster will expand on these results and connect these findings to broader theory and research on academic stress, coping, and perfectionism. Limitations (e.g., the use of simulated events) will be discussed.

IDEAS DON'T HAPPEN IN ISOLATION: AN ACADEMIC INTERVENTION

Group Leader: Motuelle, Jake
Undergraduate, Psychology

Group Member: Stuart Rand, Undergraduate, Psychology

Mentor: Prof. Jordan Arellanes

Problem or purpose

Inclusion, diversity, equity, and action (IDEA) is being emphasized more than ever in the world of higher education. Incorporating multicultural content into courses has positive effects of supportive climates on student engagement, learning, and perceptions of an inclusive learning environment (Grover et al., 2020). Such strategies are both a pedagogical and strategic imperative. It is critical that our work promotes inclusion and cultural responsiveness, which are practices that respect and honor diversity through the incorporation of cultural interests and preferences, and builds safe, inclusive, and respectful environments for the promotion of justice and equity (Miller et al., 2019).

Procedure

This mixed methods study was designed using a SoTL framework to understand the impact of an IDEA intervention. We measured students' changes in IDEA perspectives during the course. A treatment (students in IDEA classes) and a control group (students not in these classes) completed a pre-test and a post-test at the beginning and end of the semester. A focus group was also completed in each IDEA class to gain additional insight into student perceptions of the university and surrounding community. Paired sample t-tests were conducted to test differences for each group. A thematic analysis was conducted for qualitative data.

Results

The IDEA treatment group demonstrated significant mean increases and a medium effect size for inclusion (Cohen's d = .57***), diversity (Cohen's d = .32*), equity (Cohen's d = .33*), and action (Cohen's d = .62***) across the semester. Qualitative data also supported these findings. Students discussed the value of diversity within a course and of their understanding and feelings of IDEA. "The class spreads a lot of awareness on the whole community, what they go through and believe in. It gives a better understanding and appreciation of culture." Students shared that having a dedicated space to talk about diversity made them feel valued and heard. No significant differences were found in the control group.

Conclusions

The increased need to incorporate IDEA within education requires an effective way to employ it into a course setting. Our work provides a possible solution to increase perceptions of IDEA within undergraduate courses. Emphasizing to professors and faculty the value of including diversity in class discussions could increase students' IDEA perceptions. Students feel more valued and heard in a diversity course and when a professor can connect to them. Students also feel more inclusive and a part of the class and the community.

DOCUMENTATION STATUS, MINORIZED IDENTITIES, AND PSYCHOLOGICAL OUTCOMES IN COLLEGE STUDENTS

Presenter: Saavedra, Anthony
Undergraduate, Psychology

Mentor: Prof. Eric Wesselmann

Co-Mentor: Prof. Eros Desouza

Authorship: Anthony Saavedra, Eric Wesselmann, Eros Desouza

Across all universities/colleges in the United States about 24% of students are immigrants, and 2.14% are undocumented students (Higher Education Immigration Portal, 2018). Researchers have begun assessing how factors like discrimination, both interpersonally and structurally, may foster an environment that makes undocumented Latinx students feel unwelcomed. These experiences may also contribute to poor academic and mental health outcomes. Similar findings occur among students who hold other minoritized identity categories. This study will examine how college students' documentation status and other identity affiliations differ on measures of perceived ostracism, as well as their academic and psychological wellbeing.

Participants will be recruited undergraduate psychology courses. First, participants will complete a demographic measure that includes documentation status, and other identity categories (e.g., race/ethnicity, gender identity), a 10-item perceived ostracism measure, measures of mental and physical health, and their current GPA as an academic outcome indicator. Data are currently being collected.

Generally, we expect that perceived ostracism will correlate negatively with all indicators of physical, mental, and academic wellbeing. We also expect that individuals who are members of minoritized identity categorizes will have lower scores on wellbeing measures than individuals who are in majorized categories. We will also explore the possibility that undocumented individuals may outperform documented individuals on academic outcomes (i.e., "immigrant paradox").

We expect our data will provide preliminary evidence for the importance of creating an inclusive environment for all students, paying particular attention to providing support and a sense of community for students who are undocumented. The same is true for individuals belonging to other minoritized identity categories. Further, these connections may be intensified for individuals who hold multiple minoritized identities. These data will also connect the research literatures on university climate and ostracism/social exclusion.

MICROAGGRESSIONS SCALE FOR ADOLESCENTS

Group Leader:	Signa, Caroline Graduate, Psychology
Group Members:	Tyra Jackson, Graduate, Psychology; Lourdes Concepcion Caban, Graduate, Psychology; Berenice Contreras, Graduate, Psychology; Lisette Munoz, Graduate, Psychology; Mackenzie Callahan, Graduate, Psychology
Mentor:	Prof. Brea Banks
Authorship:	Brea Banks, Tyra Jackson, Caroline Signa, Keeley Hynes, Lourdes Concepcion, Mackenzie Callahan, Lisette Munoz, Berenice Contreras Caban

We created the Racial Microaggressions Scale for Adolescents to examine the experiences of adolescents of color. Scale development and validation will be discussed, as well as scholarly and practical use.

THE OPENNESS TO DIVERSITY PROGRAM FOR PROMOTING CULTURAL EMPATHY

Group Leader: Strain, Audrey
Undergraduate, Psychology

Group Member: Trevor Goodman, Undergraduate, Psychology; Estrella Gomez Hernandez, Graduate, Psychology

Mentor: Prof. Suejung Han

Authorship: Audrey Strain, Trevor Goodman, Estrella Gomez Hernandez

Background: This study examined the effectiveness of a psychoeducational program Openness to Diversity (OtD). Responding to recent calls for more theory- and evidence-based diversity interventions and given increased diversity and political tensions in the U.S., OtD was developed by the faculty mentor to promote openness to diversity by enhancing cultural empathy among college students. OtD is in a peer-led, small group structured discussion format that takes 1.5-2 hours to complete. From an evolutionary psychological perspective (Confer et al., 2010), humans are naturally inclined not to be open to differences because it had been useful for human survival (Cole & Teboul, 2004). This evolutionarily inherited closed-mindedness may still operate with Background: This study examined the effectiveness of a psychoeducational program Openness to Diversity (OtD). Responding to recent calls for more theory- and evidence-based diversity interventions and given increased diversity and political tensions in the U.S., OtD was developed by the faculty mentor to promote openness to diversity by enhancing cultural empathy among college students. OtD is in a peer-led, small group structured discussion format that takes 1.5-2 hours to complete. From an evolutionary psychological perspective (Confer et al., 2010), humans are naturally inclined not to be open to differences because it had been useful for human survival (Cole & Teboul, 2004). This evolutionarily inherited closed-mindedness may still operate with modern-time diversity because diversity can be perceived as a threat (Strauss, Connerley, & Ammerman, 2003), Similarly, people are more likely to be empathic for ingroup members than outgroup members (Cikara, Bruneau, Bavel, & Saxe, 2014) due to the self-serving bias. OtD aims to normalize such discomfort by a brief psychoeducation on the biopsychological basis of reactions to cultural differences thereby motivating people to be more empathic and open to the culturally different. It also consists of experiential activities for cultural perspective taking and empathy, considering personality factors that affect OtD (e.g., Han & Pistole, 2017; Mallinckrodt, McNett, Celebi, Tsai, & Williams, 2013). It was hypothesized that participants in OtD would show increased levels of Universal-Diverse Orientation (UDO, i.e., appreciation of both cultural similarity and differences) and Ethnocultural Empathy compared to control group participants.

Procedure: Ninety-nine undergraduates enrolled in a Midwestern university were recruited for research participation credits and randomly assigned to either OtD or the control condition (i.e., a focus group discussion on healthy eating) (data collection ongoing). Student research assistants were trained and facilitated the OtD or focus groups. Participants completed the Miville-Guzman UDO-Short Form (Fuertes, Miville, et al., 2000) and the Ethnocultural Empathy Scale (Wang et al., 2003) pre- and post-groups.

Results: Repeated measures ANOVAs revealed that OtD group showed a significantly larger increase in UDO-behavioral component than the control group, Wilk's $\Delta = .95$, $F(1, 97) = 4.66$, $p = .033$. Both groups showed significant increases in all the other outcome variables.

Implications. The program was effective in motivating behavioral approach to cultural differences. The control group participants also reported positive changes in the diversity-related attitudes, suggesting that reflecting on them by completing measures may be effective in promoting more open attitudes at least temporarily.

FACTORS PREDICTING SATISFACTION WITH A MICROAGGRESSION WORKSHOP FOR SCHOOL PERSONNEL

Presenter: Torres González, Nitza
Graduate, Psychology

Mentor: Prof. Brea Banks

Authorship: Brea Banks, Nitza Torres González, Keeley Hynes, Megan Donnelly

Satisfaction with a microaggression workshop for school personnel was predicted by participants' colorblind racial attitudes and interpretations of the training as necessary.

SOCIAL WORK

THE EFFICACY OF SENSORY ROOMS IN SCHOOLS: THE STAFF'S PERSPECTIVE

Presenter: Grealish, Annie
Graduate, Social Work

Mentor: Prof. Christopher Gjesfjeld

Authorship: Annie Grealish, Christopher Gjesfjeld

Many students struggle with sensory processing. Sensory processing has been defined as "part of normal development and reflects one's ability to interpret and respond to daily sensory experiences" (Miller, 2014). Sensory processing can have a great impact on an individual's ability to self-regulate. Previous research on this topic has found that multi-sensory environments or sensory rooms have been used for individuals that have sensory needs, specifically those with autism or other developmental diagnoses. Many of these rooms have a variety of objects to assist with sensory needs such as weighted blankets, rocking chairs, self-massagers, exercise balls, squeeze balls, and sensory swings. Through a literature review, it was found that sensory rooms and objects have had a positive effect on students with autism as it has increased attention and on-task behavior. Additionally, the use of sensory rooms in schools has also shown to be effective for increasing attention, positive behavior, and mood (Unwin, Powell, and Jones, 2021). Along with benefits, studies have also noted challenges with sensory rooms in schools such as students becoming obsessive over the room (Unwin, Powell, & Jones, 2021). After reviewing the literature, it was clear there were studies that provided positive results and negative results. This posed the question: what do staff members think of the sensory rooms? Does the staff feel there is a difference in regulation from before and after sensory room use

The research design of this project will be a nonexperimental cross sectional quantitative design utilizing surveys asking the Brigham Early Learning staff about a child's regulation after using the sensory room. The participants of the study are the consenting staff members of Brigham Early Learning. The measurement tool used in this study asks demographic questions of the participant with an additional two item scale measuring regulation and whether or not the student has an Individualized Education Plan.

Data from this study will be forthcoming March of 2023. Our hope is for our results to assist settings that use sensory rooms to educate staff about its advantages and when it can be contradicted. We would also hope that staff take the results of this evaluation into consideration and make any adjustments we may suggest. Future research may look at what sensory items benefit students the most or what sensory items do children prefer?

AFFIRMATIVE GROUP THERAPY IMPACT ON LGBTQIA+ STUDENT'S MOOD AND IDENTITY

Presenter: Piercy, Emily
Graduate, Social Work

Mentor: Prof. Christopher Gjesfjeld

Authorship: Emily Piercy, Chris Gjesfjeld

Students who identify as lesbian, gay, bisexual, trans, queer, questioning, intersex and/or asexual struggle with mental health concerns at an alarming rate. Oftentimes the cause of mental health concerns, such as depression and suicide ideation, are sourced from bullying, non-inclusive practices, and family rejection. LGBTQIA+ students face multifaceted stigma and microaggressions but have little supports when it comes to social emotional health. Affirmative and inclusive practices reduce depression, anxiety, and suicide ideation among high school students, but not many school districts implement these practices or have programs such as a Gay-Straight Alliance, or Pride Clubs. The AFFIRM method is a form of CBT therapy, that targets negative self-talk and stereotypes while building up coping skills and establishing resources to better support the student.

Participants were recruited by viewing posters about a therapy group that targets LGBTQIA+ mental health issues, which were sent out to every student via school district email during an advisory period and were displayed at various locations around the central Illinois high school. The poster had a QR code to a Qualtrics intake survey where we received contact information for the student wanting to participate. Students were required to attend a 10-15 minute informational presentation that outlined the 6-week program, discussed confidentiality and consent before committing to this study. Parent or guardian consent was achieved by passive consent after 3 contact attempts. Each participant was given two surveys, the U-MICS Sexual Identity and the SMFQ, via Qualtrics during the first session of the intervention and during the last session of the intervention. Data was compared to see if the affirmative therapy interventions improved participant's mood and identity development, and if identity development improved mood.

Data will be forthcoming March 2023. We hope that the AFFIRM intervention is providing LGBTQIA+ students a space to confront and process internalized and externalized homophobia and transphobia. By combatting these stigmas with positive self-talk, coping skills, and a peer support system, we maintain optimism that the mental health of these students may improve. Lastly, we encourage more high schools to adopt similar programs to serve the needs of all students and combat the serious mental health needs of marginalized student populations.

SOCIOLOGY/ANTHROPOLOGY

CHOP SUEY HABITS: THE AMERICAN CHINESE RESTAURANT DURING COVID TIMES

Presenter: Ma, Rebecca
Graduate, Sociology/Anthropology

Mentor: Prof. Nobuko Adachi

Authorship: Rebecca Ma

The Yellow Peril has shown itself once again to be a fixture in American life when the global COVID pandemic started in 2020. People were quick to blame Chinese people for its origin and spread. More than half of all American Chinese restaurants shut down, while others remained only partially open. Nonetheless, numerous American Chinese restaurants have made the decision to try and reopen in 2022. This paper ethnographically examines some of these reopenings, and explores how they cope with the new economic and social challenges, from a changed food-service market to new social attitudes.

ELEMENTAL ANALYSIS OF GROUND STONE AXES FROM NOBLE-WIETING USING PXRF

Presenter: Marvel, Julian
Undergraduate, Sociology/Anthropology

Mentor: Prof. Logan Miller

With my thesis, I am hoping to answer three questions with this research experiment. Can the ground stone axes from Noble-Wieting be associated with known geological sources using pXRF (portable x-ray florescence)? Are the Noble-Wieting axes manufactured from the same sources as those in Greater Cahokia? Is there a difference in source material between axes found in wall trenches and those recovered from other features at Noble-Wieting? By attempting to answer these questions, we can bring a multiscalar perspective into a not so known topic. The pXRF determines the elemental composition of stone and rock. Different stones from different places have different elemental signatures. I will use the pXRF data gathered with comparable data from geologic samples that we tested, as well as, published by Crow (2014) to see if any of the Noble-Wieting artifacts conform to any known sources. This is important because there is no determining research regarding the source location of the materials used in the ground stone axes found at Noble-Wieting. I will also provide a background into Mississippian culture, including Cahokia, c.a. A.D. 1200, to give perspective into the lives and burial traditions of the Mississippian people of North America.

My research gave me definitive data and answered all my questions directly. The data showed that there was correlation between the ground stone axes found at Noble-Wieting and some of the other local samples that we tested as well. However, there was no correlation between the ground stone axes from Noble-Wieting and the geological samples taken from the St. Francois Mountains in Missouri. There was, however, a wide range within the samples from Noble-Wieting. This could mean that there were other locations that the people from Noble-Wieting were getting their materials from. The results may change based on future determining research and available artifacts and are thus, left for review.

IDENTIFYING HANDSAWS FROM CUT MARKS ON BONE: A MICROSCOPIC CUT MARK ANALYSIS

Presenter: Patterson, Sarah
Graduate, Sociology/Anthropology

Mentor: Prof. Shelby Putt

In New York City, it is estimated that for every 224 homicide cases, one will involve human dismemberment. These cases can be difficult to solve, as dismemberment is often used by the criminal to conceal other forms of forensic evidence. In dismemberment cases involving a handsaw, the saw leaves behind characteristic traces on the bone, such as saw marks (kerfs), bone islands, harmonics, and exit chipping, which we hypothesize can be used to identify the type of saw used by the perpetrator. The current study expands on previous research into saw blade cut mark characteristics by examining features on limbs that were fully fleshed when cut. Using microscopy, we tested whether the cut marks (N=54) on mature white-tailed deer (*Odocoileus virginianus*) long bones could be traced back to one of nine handsaws of different brands and blade set types used to make the cuts. Measurements of kerfs, including cut width, blade width, teeth per inch, tooth width, and tooth height, were obtained from photographs taken under an Olympus model BX51M metallurgical microscope. The presence and frequency of blade harmonics, bone islands, and exit chipping were also noted. ANOVA and Tukey post-hoc tests revealed a significant difference between the kerf dimensions produced by different blades. Combined with our qualitative assessment, these results demonstrate that cut mark characteristics can be used to determine the blade that created them. If applied in forensic cases, this technique may aid in identifying the dismemberment tool used in the crime and will generate more reliable convictions.

COMBINATORIAL CAPABILITIES IN NON-HUMAN PRIMATE TOOL USE BEHAVIORS: AN ANALYSIS OF KANZI

Presenter: Schroeder, Michaela
Undergraduate, Sociology/Anthropology

Mentor: Prof. Shelby Putt

Authorship: Michaela Schroeder

Determining if non-human animals exhibit compositionality, a feature described as the cognitive ability to combine smaller meaningful units into a complex and hierarchical structure with novel meaning, is necessary for ascertaining the timing regarding the origin of human language. While various claims of non-human compositionality have been made, the dominant viewpoint is currently that compositionality is unique to humans. Evidence for overlap in neural bases between tool-use behaviors and language production allows for a direct comparison between combinatorial tool-use behaviors and combinatorial linguistic capabilities. It is inferred that the archaeological record may be utilized to determine the origin of compositional capabilities, and as such, the origin of compositional language. This study uses a gradational scale to determine the hierarchical complexity of stone-knapping behaviors exhibited by the bonobo Kanzi. According to this analysis, the bonobo's actions failed to meet the requirements of compositionality, supporting claims that compositionality is a uniquely human trait that evolved after the Pan/Homo divergence.

TEACHING AND LEARNING

STUDENTS' INTEREST IN A VARIETY OF TOPICS UNDER CONSIDERATION FOR INCLUSION IN A FIRST-YEAR EXPERIENCE SEMINAR FOR NATURAL SCIENCE, MATHEMATICS, AND ENGINEERING MAJORS

Presenter: Dutmer, Brendan
Graduate, Chemistry

Mentor: Prof. Amanda Quesenberry

A survey was implemented gauging student interest in a variety of topics that can be covered in a First-Year Experience Seminar (FYES) course focused on a student population composed of Natural Science, Mathematics, and Engineering majors. The survey was a six-point Likert-type survey of unipolar scale concerning agreement responses. The responses were evaluated utilizing appropriate quantitative methods of analysis. The findings will be used to inform the implementation of an FYES Science and Mathematics cohort course at Highland Community College (HCC) in Freeport, Illinois. Cohort models of students in FYES courses are intended to help students in areas such as persistence, student grade point average (GPA), and retention. Previous research has suggested some of the most effective methods in FYES courses for science, technology, engineering, and mathematics (STEM) cohorts include authentic workplace experiences and STEM community socialization.

APPLICATION FOR GRAMMAR SKILLS: A CASE STUDY OF THAI UNDERGRADUATE STUDENTS

Presenter: Kaosayapandhu, Munchuree
Graduate, Teaching and Learning

Mentor: Prof. Miranda Lin

The objective of this study was to investigate the influence of the popular language application Duolingo on English learning. The study was designed as a quasi-experiment. This approach was selected to compare the outcomes for students who used Duolingo to those who did not. The learners were split into groups of users (n = 65) and non-user (n = 63). Data were collected using a pre-test/post-test structure, which allows the researcher to investigate outcomes during the test period. In addition, data were collected using a combination of a previously defined English verb tense assessment and a supplementary questionnaire that examined Duolingo use frequency, completion, achievement, and enjoyment. Data analysis took place in two stages. First, mean differences in Duolingo users and non-users were investigated using paired t-tests ($p < .05$). This determined whether student verb tense management improved over the term and whether Duolingo users achieved a higher mean difference than non-Duolingo users. The next stage of analysis focused on the Duolingo user group. It examined whether the self-reported frequency of use, completion of levels, goal achievement, and enjoyment significantly affected the mean of pre- and post-scores using multiple regression analysis. It also compared regressions between the user and non-user groups to determine whether there was a moderating effect of prior use. This method helped determine which characteristics of Duolingo attainment were significant in verb tense improvement. The results showed that the Duolingo users had a more significant mean improvement in verb tense knowledge. Multiple regression showed that the frequency of Duolingo use, perceived achievement, and enjoyment positively influenced the user group's performance. Moderation analysis also showed that prior use of Duolingo partially moderated the relationships of level completion and achievement on score improvement. The implication is that Duolingo is a potentially useful supplement to classroom learning, although its effects may change over time as users become habituated.

BECOMING A REFLECTIVE PRACTITIONER: AN ANALYSIS OF STUDENT TEACHER REFLECTION

Presenter: Muangthong, Thunsinee
Graduate, Teaching and Learning

Mentor: Prof. Deborah MacPhee

This qualitative study aimed to understand how student teachers reflected on their teaching practice during their student teaching semester and their perceptions on using reflection as a tool to develop their teaching practices. One hundred and twenty-four written and oral reflections by fifteen student teachers were analyzed to categorize their reflections. In addition, semi-structured interviews were conducted with four participants to gain an in-depth understanding of their perceptions on reflection. The findings showed that student teachers' reflections addressed five main themes (instruction, management, relationships, learning experiences, and characteristics of effective teachers), spanned four types (summary, descriptive, comparative, and transformative), and that student teachers structured their written and oral reflection in various ways, including (multiple types and multiple themes, one type with multiple themes, multiple types with one theme, and one type and one theme). Student teachers' perceptions on reflection focused on process and outcome. It is important to note that even though student teachers reflect in different themes, types, or structures, they see reflective thinking assignments as a useful tool to help them develop their teaching practices. Reflection on their own practice helped student teachers look back to see if there was any problem happened so that they could connect to their knowledge and take action to develop their teaching practices. The study has important implications for teacher educators, teacher preparation programs, cooperating teachers, and student teachers. Teacher educators can encourage student teachers to recognize that reflective thinking is a common process for learning from their own experiences. The knowledge of themes, types, structures, and perceptions of reflection can be used to inform how teacher educators should assign reflection assignments to student teachers. Future research can be done on various factors such as types of reflection assignments, duration of time to collect the data, groups of participants, or the use of contemplative practices to help student teachers focus more on their reflective practices.

TECHNOLOGY

TECHNO-ECONOMIC ANALYSIS TO OPTIMIZE SOLAR PHOTOVOLTAIC SYSTEM IMPLEMENTATION ON ILLINOIS STATE UNIVERSITY CAMPUS

Group Leader: Duncan, Michael
Undergraduate, Technology

Group Member: Melker Isaksson, Undergraduate, Technology

Mentor: Prof. Jin Jo

Authorship: Melker Isaksson, Michael Duncan

Academic institutions in the US are massive consumers of energy. The population density of these institutions is a crucial factor in why there is such energy consumption. With many corporations and even the federal government beginning to divest fossil fuel sources and promote renewable energy sources, academic institutions should support such efforts. In this case study, we perform techno-economic analyses of two commercial-scale solar PV systems on top of the Bone Student Center and Milner Library at Illinois State University using HelioScope and the System Advisory Model. With these proposed designs, we determined financial parameters such as the upfront cost and payback period of the system. We also evaluated different financial plans by comparing direct ownership, roof leasing, and a PPA agreement to suggest the most cost-effective option for ISU when incorporating these system designs.

ASSESSING ECONOMIC BENEFITS OF COMMERCIAL-SCALE PHOTOVOLTAIC INTERCONNECTIONS FOR NORTH CAROLINA STATE UNIVERSITY'S SUSTAINABILITY GOALS

Group Leader: Gibson, Daniel
Undergraduate, Technology

Group Members: Gabe Anderson, Undergraduate, Technology; Cheron Elms, Undergraduate, Technology; David Bilger, Undergraduate, Technology

Mentor: Prof. Jin Jo

Authorship: Gabe Anderson, David Bilger, Cheron Elms, Daniel Gibson

North Carolina State University (NCSU) is considering investing in commercial-scale photovoltaic (PV) interconnection to contribute to its sustainability goals, improve student welfare, and reduce future expenses. Currently, NCSU's campus has a few buildings equipped with small educational solar PV systems, but they are mostly outdated. Solar District Cup is challenging us to help bring NCSU to a new standard. We utilize research tools such as Aurora Solar, Open Distribution System Simulator, and System Advisor Model to analyze system sizes and load data to perform cost-benefit analyses for proposed installation sites that range from a floating solar system and battery storage to ground-mount systems and solar carports. Based on comprehensive analyses, the research team proposes a solar PV system that delivers at least 300kW-400kW to achieve a cumulative offset of campus buildings by approximately 10%. Being mindful of improving their quality of life, students can charge electric vehicles and enjoy outdoor recreation enhancements such as solar-powered gazebos. This strategic plan equips NCSU with the solutions necessary to achieve its dream of growing its photovoltaic portfolio.

REDUCING CYBERSICKNESS IN VIRTUAL REALITY DRIVING SIMULATION

Presenter: Kinney, Savanah
Graduate, Technology

Mentor: Prof. Isaac Chang

Cybersickness is a cluster of physical discomforts that often appear in motion-based simulations. These symptoms may include nausea, oculomotor problems, and general disorientation. Studies of sensory conflict theory suggest that the discrepancy between the individual's perceived motion and actual physical movements may be the root cause of motion sickness or cybersickness. Matching body movements with the visual stimulus in motion-based simulations such as driving a car may reduce or eliminate the effects of such sensory conflicts.

With the introduction of virtual reality (VR) in research and education, the issue of cybersickness could negatively affect the quality of the data collected to study learning outcomes, task performance, or user experience. This research project aims to understand whether introducing body movement or haptic feedback through a Stewart platform could reduce the likelihood of cybersickness. By adjusting the position of its six linkages, this platform can let the user move physically with six degrees of freedom. Although the Stewart platform has been used in flight simulators, there is a shortage of literature on whether it could significantly reduce cybersickness in VR-based simulations.

This presentation will discuss a research project that aims to address this problem. Instead of placing the user in a static driving position, a VR simulator that rides on a Stewart platform is being developed to move the user in relation to the motion of the virtual vehicle. The platform's design will be discussed, including its mechanism, control schematics, and algorithms. A scaled-down prototype for verification will be illustrated along with the preliminary test result.

Keyworks: Cybersickness, Sensory Conflicts, Virtual Reality

COST AND ENVIRONMENTAL BENEFIT ANALYSES FOR MID-SIZED BUSINESSES LOCATED IN BLOOMINGTON/NORMAL UTILIZING LIGHTING RETROFIT, SOLAR PV, AND BATTERY STORAGE SYSTEMS

Group Leader: Lopez, Ashley
Undergraduate, Technology

Group Members: Jakell Sharkey, Undergraduate, Technology, Darrell Buchanan, Undergraduate, Technology

Mentor: Prof. Jin Jo

In this study, we analyze the cost and environmental benefits of utilizing energy efficiency through lighting retrofitting, solar photovoltaic systems, and battery storage. Through these methods, we hope to reduce high energy consumption by investing in better alternatives to lighting and more sustainable electricity production. We begin in the Bloomington-Normal area, where we conduct our study on allowing midsize businesses to save energy and money through progressing from LED lighting installations to a tailored Solar PV system, that will eventually generate enough profit to complete with a battery storage system. We have based our model around realistic feasibility, as we provide the customer with rebates and incentives that are offered on various levels based on our proposed modifications. A proposal is then generated to provide business owners an understanding of the differences they are making by choosing better energy alternatives and the profit they are generating with lighting retrofit and renewable energy systems. Our model starts with personalizing each proposal according to their business infrastructure's electricity needs and utility rates. Once we find out the ‘true cost’ of the installation of each of the energy source alternatives, we compare this cost to the funds and resources that are available to help alleviate this cost and reduce the overall payback period for each installation. Thus, with the money saved from retrofitting, the next step would be to use it to add a PV system, that would continue to offset the electrical load and make it possible to receive net metering credits for the customer. Lastly, the profit generated from each previous step will eventually allow the installation of a battery system that will support the existing PV system. Our overall goal of this study is to present different methods of energy efficiency and sustainability at a feasible cost that can benefit both the customer and our environment!

ASSESSING THE TECHNICAL AND ECONOMIC FEASIBILITY OF REPOWERING OUTDATED WIND FARMS IN ILLINOIS

Group Leader:	Tiffany, Will Undergraduate, Technology
Group Member:	Thomas Savage, Undergraduate, Technology
Mentor:	Prof. Jin Jo
Authorship:	Will Tiffany, Thomas Savage

In the years to come, many wind farms will become outdated and they will undergo a repowering process to keep up with current energy demands. The primary focus of our research project is to assess the technical and economic feasibility of repowering outdated wind farms in Illinois. To accomplish this goal, we investigated the initial costs of upgrading wind farms, the potential size of the upgraded wind turbines, and the increased electricity production. Consulting with wind industry experts provided practical information on the repowering processes in the project case study sites, along with an extensive literature review on wind farm repowering projects. The US Wind Turbine Database was used to determine the suitable wind farms for the repowering project by reviewing the rated capacity, manufacturer, and model of the turbines. After selecting the targeted wind farms, we simulated the current production of electrical generation from these wind turbines using the Windographer software. Subsequently, we assessed feasible features to change, such as nacelle replacement or complete turbine replacement. Determining these features will depend directly on the location and local wind resources of the area. After comparing the original turbines' energy production and economic feasibility to the repowered turbines, we determined whether a repowering for the wind farm should be performed or not.