Undergraduate Research & Creative Achievements Forum

Spring 2015
Schedule of Events

Tuesday, April 21
1:30-3:00 p.m. — Poster Session A, McQuinn Atrium
2:30-4:00 p.m. — Poster Session B, McQuinn Atrium
3:30-5:00 p.m. — Poster Session C, McQuinn Atrium

Wednesday, April 22
12:05 p.m. — Student & Mentor Recognition Ceremony, McQuinn Atrium

Abstract book prepared by:
Office of Undergraduate Research

Director: Dr. Linda Blockus
Assistant Director: Mike Cohen
Administrative Assistant: Pam Cooper
Student Assistants: Joey Fening and Kayla Symonds
Sprin 2014 Forum Awards for Excellence & Honorable Mentions

Arts & Humanities

**Excellence Award:** Tyler Talbott, English, St. Joseph, MO; Dr. Scott Cairns, English; Queer Nature in E.M. Forster’s The Machine Stops and Howard’s End

**Honorable Mention:** Logan Felder, Music Education, Independence, MO; Dr. Brian Silvey, Music; Effects of baton usage on college musicians’ perceptions of ensemble performance

**Honorable Mention:** Alyssa Jensen, Architectural Studies, St. Louis, MO; Lindsay Webb, Architectural Studies, St. Louis, MO; Dr. Bimal Balakrishnan, Architectural Studies; Examining collaborative thinking: Shared work environments

Social & Behavioral Sciences

**Excellence Award:** Marnae Chavers, Human Development & Family Studies, St. Louis, MO; Dr. Gustavo Carlo, Human Development & Family Studies; Predicting the relationship between prosocial behavior and academic achievement in European American and Asian American college students

**Honorable Mention:** Michael DeCrescenzo, Political Science, Parkville, MO; Dr. John Petrocik, Political Science; Voter ID requirements, turnout, and Republican electoral advantage

**Honorable Mention:** Michael Leahy, Political Science, Linn Creek, MO; Dr. Bill Horner, Political Science; The existence and effect of a profit bias: A comparison of public and private online news

Life Sciences

**Excellence Award:** Mallory Ferguson, Communication Science & Disorders, Columbia, MO; Rachel Lazenby, Communication Science & Disorders, Joplin, MO; Dr. Teresa Lever, Otolaryngology; In search of human correlates for lick rate

**Honorable Mention:** Chris Peritore, Biological Sciences, Columbia, MO; Dr. Doug Randall and Dr. Elizabeth Hoyos, Biochemistry; Functional genomics of the E2 subunits of mitochondrial pyruvate dehydrogenase

**Honorable Mention:** Jeanette Rimbey, Biological Sciences, Columbia, MO; Dr. Pam Brown, Biological Sciences; A candidate therapy to prevent infection by the tumor causing plant pathogen, Agrobacterium tumefaciens

**Honorable Mention:** Cale Roberts, Biological Sciences, Excelsior Springs, MO; Dr. Timothy Domeier, Medical Physiology & Pharmacology; TRPV4 and cardiomyocyte contraction in the aged murine heart

Physical Sciences, Engineering & Math

**Excellence Award:** Morgan Spratt, Bioengineering, Philadelphia, MO; Dr. Satish Nair, Electrical and Computer Engineering; Mechanisms that regulate firing synchrony in crab cardiac ganglion

**Honorable Mention:** Andrew Allee, Biochemistry, Liberty, MO; Dr. William Jacoby, Bioengineering; Pretreatment of lignocellulosic biomass with supercritical carbon dioxide explosion

**Honorable Mention:** Anna Rudy, Bioengineering, Platte City, MO; Dr. Heather Hunt, Bioengineering; Determining the optical properties of mesoporous silica via Total Internal Reflection Photoacoustic Spectroscopy for future use as optical waveguides

2014 Outstanding Undergraduate Research Mentor Awards

Dr. Nicole Campione-Barr
Psychological Sciences

Dr. Heather K. Hunt
Bioengineering
Referee bias and league policy: The case of Major League Soccer

Anders Aarhus and Nicholas Watanabe

A great deal of research has been conducted on the potential bias exhibited by referees in various sporting contexts. Predominantly, the extant literature on referee bias has focused on the sport of soccer, with the majority of these studies being conducted with long established soccer traditions such as England. Major League Soccer (MLS) presents a unique context to consider referee bias as it is one of the only professional soccer leagues in the world which does not have lower divisions which is part of its league structure. While there have been referee associations in the U.S. for a long time, it has only been since 2012 that the United States Soccer Federation (USSF) and MLS have helped create an organization focused to the professionalization, monitoring and training of referees. Due to the introduction of more specific training and monitoring of MLS referees, the league has tried to improve officiating by giving referees directives about managing games, including calling penalties. From 2011 to 2013, the average rate of a penalty being called in a MLS match was around 0.25 penalties per match. In 2014, the rate of penalties increased to around 0.49 penalties per match, with fans and media noting that the number of penalties possibly being linked to league policy. For the purpose of this research, regression analysis of match data from the MLS is conducted to examine whether changes in referee monitoring has impacted potential referee bias in the league. Results of this research point towards the importance of monitoring and training of match officials, especially in professional sport leagues where match outcomes can have impact on fan interest and team revenue.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Carmen Aboytes, Katy Beyer, Andrew Briedwell, Matt Fleissner, Andrew Pelikan, Virginia Trauth, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
An observational study of score study practices among undergraduate instrumental music education majors

Lee Acton, Mark Montemayor, Christopher M. Baumgartner, and Brian A. Silvey

The purpose of this study was to investigate undergraduate instrumental music education majors’ score study practices. Participants (N = 30) were videorecorded while completing (a) two, 20-minute score study sessions, and (b) two conducting performances of the scores they had studied previously. In the first score study session, all 30 conductors studied Mini-Suite for Band, Movement 1. In session 2, participants studied Portrait of a Clown, but this time either with a model recording (n = 15) or without one (n = 15). We computed the overall duration of participants’ score study behaviors for both pieces. Additional data included graduate students’ evaluations of participants’ post-score study conducting “run-throughs” and an inventory of participants’ score study markings. Although groups of participants appeared similar to one another in terms of the types score study strategies they employed while studying both pieces (e.g., silent score study, marking the score, singing), we did find a significant difference in the proportion of time spent in score studying activities between the model and no model condition conductors. Evaluations of participants’ conducting revealed a significant difference between those participants identified as “stronger” conductors versus “weaker” conductors in Mini-Suite for Band, but no differences between those conductors who used a model and those who did not while studying Portrait of a Clown. Our analysis of conductors’ score markings revealed small, notable differences between groups and between conditions. Implications for undergraduate conductor preparation programs are discussed.
Monitoring the changes in glyphosate-resistant weed populations in continuous dicamba-resistant soybean for four years

Isaiah Akers, Meghan Biggs, Alex Long, Mandy D. Bish, and Kevin W. Bradley

Agricultural loss in the United States due to weeds is estimated at approximately 23 billion dollars annually. Producers now face larger problems as continued use of inexpensive and traditionally effective herbicides has led to an increase in herbicide resistant weeds. Therefore, the need exists for novel herbicidal chemistries and new weed management technologies.

Dicamba-resistant soybean (dt-soybean) is one new product awaiting commercialization. Dicamba herbicide has been registered and utilized in the United States for the control of broadleaf weeds in grain crops such as corn since 1967. However, soybeans and other broadleaf crops are traditionally sensitive to dicamba. With the introduction of dt-soybean, dicamba may provide a new mechanism for weed control in soybean.

In this study we investigated 9 herbicide programs that will likely be recommended for use on dt-soybean and their impacts on weed populations. The study was conducted from 2011 to 2014, and located in the same research plots each year. One herbicide program consisted of applying glyphosate (a commonly-utilized herbicide) without other herbicides all 4 years. Other programs incorporated glyphosate with additional herbicide chemistries or omitted glyphosate from the program altogether.

Each spring, prior to herbicide applications, soil samples were collected and placed in the greenhouse. Weeds that emerged were screened for glyphosate resistance (GR). Over the course of this study the percentage of GR weeds increased in samples collected from plots treated with only glyphosate or glyphosate-with-dicamba all 4 years. Similar results were found in the field; although, the weed species found in the glyphosate-only plots shifted over time. Soybean yield in the glyphosate-only plots was highest in 2011 (2147 kg/ha) and dropped to 690 kg/ha by 2014. Other herbicide programs tested were more effective. Our data suggest dt-soybeans can be effective in weed management when herbicide chemistries in addition to glyphosate are incorporated.
Partisanship and will to serve: A study of term limited state houses

Fares Akremi and Marvin Overby

The purpose of this research is to determine whether the relationship between partisanship and retirement decisions previously observed in the U.S. House of Representatives extends to state houses of representatives. Using data from states with lifetime term limits because they offer a standardized metric for “voluntary early retirement,” it can be determined whether Democrats or Republicans are more likely to retire before they are termed out. This study uses a blend of quantitative and qualitative approaches to add to the literature on partisan philosophical differences and their impacts on retirement and retention rates in legislatures. The operative hypothesis is that Republicans will retire at rates disproportionately higher than their Democratic peers as a result of ideological differences, and this hypothesis appears to be confirmed.

This project was completed to fulfill a Capstone requirement.
Improving bioethanol production with the supercritical carbon dioxide explosion process

Andrew Allee, Jian Xu, Ellen Wan, and William Jacoby

Though we currently reside in an era of fossil fuel dependence, biomass will become our primary carbon resource in the future. Lignocellulose, the predominant component of tough plant materials such as corn stalks, prairie grasses, and wood, is one cheap source of carbon in the form of biomass. Bioethanol is produced via a seven-step process that converts plant matter into liquid fuel. The least efficient step in this process is the breakdown of cellulose to yield sugars that can be fermented into this biofuel. The tightly-bound chemical structure of lignocellulose makes the biomass resistant to breakdown, requiring a pretreatment step to ready it for the production process. Supercritical Carbon Dioxide (scCO$_2$) is a fluid capable of penetrating the lignocellulose. During pretreatment, the biomass is soaked in a high-pressure batch reactor and saturated with scCO$_2$. Then, a rapid pressure release ("explosion") causes the scCO$_2$ to rush violently from the innermost parts of the tough lignocellulose. The explosion weakens the structure of the plant material and increases the exposed area on its surface, thereby improving the efficiency of the next step in the bioethanol conversion process: enzymatic hydrolysis.

We studied the effect of the scCO$_2$ explosion process on the efficiency of enzymatic hydrolysis. 16 different trials of varying temperature, pressure, and residence time parameters were conducted. The dependent variable for each trial was the glucose yield of subsequent enzymatic hydrolysis. That is, the amount of simple sugars produced from the pretreated biomass that can be carried on to the next phase of bioethanol production. Our findings suggest that scCO$_2$ explosion can indeed be used to pretreat biomass. However, the high temperature and pressure of process operation are difficult to achieve quickly and consistently.
Brittany Allen, Jessica Stromsdorfer, and Bret Ulery

The long-term goal of the research is to create new solutions for repairing bone that is lost due to osteoporosis or non-union bone defects due to injuries or tumors. The first phase of the project was to establish a bank of progenitor osteoblast MC3T3-E1 cells. After enough cells were generated, they were divided into one control group and eleven experimental groups, adding different concentrations of molecules that have shown preliminary promise as inductive simple signaling molecules. Half of the project investigated calcium and phosphate ions, which can cause stem cells to differentiate into bone cells. Ideally, therapeutic concentrations will also be biocompatible. These studies will hopefully determine what ratio of molecules should be added to the cells to reach the ideal differentiation states. From the findings, additional in vitro studies as well as in vivo experiments will be conducted.

The other half of our project is to determine the optimal concentration of hydrogen peroxide to induce blood vessel formation. MC3T3-E1 cells to a peroxide concentration gradient to determine the highest concentration that does not cause adverse effects. This process is similar to the one described above for calcium and phosphate ions. After the optimal concentration is found, we will integrate it with a polymer that can be used at the nanoscale to deliver the peroxide in order to the target tissues in the body. As a whole, the lab is developing integrated biomaterials systems to promote proper growth of bone tissue in vivo. The problem with current musculoskeletal regeneration models is that they cause all the stem cells to differentiate into osteoblasts and do not take into account that those osteoblasts need neural and vascular networks to survive.
Decreased food intake in zebrafish with defective migration of facial branchiomotor neurons

Badr Almadi, Kyle Schafer, and Anand Chandrasekhar

Feeding in humans takes place by rhythmic jaw movements. These movements are controlled by branchiomotor neurons. The simple vertebrate, zebrafish, is an excellent model for branchiomotor neuron research because neural networks are conserved between fish and mammals. The Chandrasekhar lab is interested in understanding the organization and function of branchiomotor circuits. A deeper understanding on how mutations affecting branchiomotor neuron organization affect jaw movement and feeding may help us understand and develop therapies for motor neuron disorders like Lou Gehrig’s disease and Moebius syndrome. We aim to determine whether the landlocked mutation that blocks the migration of a subset of branchiomotor neurons reduces food intake in mutant zebrafish larvae. This is determined by the average amount of fluorescent food ingested by wild-type (normal) and landlocked (mutant) larval zebrafish. To examine the possibility that defective swimming behavior could impact food intake in mutant larvae, we are using software to image the swimming behavior of wild-type and affected larvae. Using other software, we will reconstruct the swimming paths, instantaneous velocity, and turning frequency. We expect that these parameters will be similar between wild-type and mutant larvae, suggesting that reduced food intake in mutants reflects defective function of branchiomotor circuits.
The detection of *Helicobacter hepaticus* using Whispering Gallery Mode microcavity optical biosensors

Mark Anderson, Emily O’Brien, Emily Grayek, James Hermensen, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
William Blake’s visualized racial ideal in “The Little Black Boy”

Marleigh Anderson and Johanna Kramer

William Blake’s works, though scarcely read during his lifetime, were revolutionary in their critiques of late-eighteenth century British society. This presentation examines how Blake’s philosophy, poetry, and illustrations interact to show his opinion on race and slavery during his time period. Specifically, I focus on racial ideals in “The Little Black Boy” from the Songs of Innocence (1789).

I first consider Blake’s philosophy on “contraries” or perceived opposites, which he describes in The Marriage of Heaven and Hell (1790) as necessary for human existence, since “without contraries is no progression.” Blake does not assign ‘good’ or ‘bad’ to respective contraries, instead believing that “everything that lives is holy.” I examine how he applies this philosophy to the relationship between the black boy and the white boy in “The Little Black Boy.” Finally, I analyze Blake’s illustrations of the poem, which show that he vacillated in depicting his idealized hopes for racial relationships.

An example of these hopes appears in a line by the black boy: “I from black [cloud] and he from white cloud free,” imagining a world in which everyone is free from racial identity. However, this abstract ideal is difficult to translate into a concrete color illustration. Blake re-printed multiple versions of his poems, making small changes each time. In some versions of the illustration, the black boy is black; in other versions, he is white. In the final version (1829), the black boy and white boy have a similar skin color that is neither black nor white, but multi-colored with oranges, reds, and greens. I argue that this final print is Blake’s representation of an ideal physical and spiritual world where differences in race are not perceived. My analysis of Blake’s experimentation with color ultimately shows that his illustrations served as testing ground for his social theories.
Faculty Mentors: Dr. Mary Myers and Dr. Patrick Pinhero, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

Analysis of mastery learning: 1st and 2nd laws of thermodynamics

Samantha Anzalone, Susan Bell, Mary Myers, and Patrick Pinhero

The current Chemical Engineering first-term Thermodynamics course was adapted from a traditional lecture-based structure into a more modular structure that focuses on mastery learning principles. As the subject matter is both abstract and difficult, lectures have been revamped to present the theory behind the application of one or more thermodynamic principles. The modular structure is segmented to keep students on pace with the flow of the course and to promote mastery learning through thorough and multiple application of concepts. By providing students with greater interaction, prompt feedback, and multiple opportunities to recall and repeat exercises, a deeper understanding of thermodynamic principles is fostered. Tests are specifically designed to assess mastery learning of these principles. This presentation focuses on the performance of students during each of the past three semesters since the institution of this new instructional paradigm to determine its overall efficacy.
Keisha Avery
St. Louis, MO

Faculty Mentor: Dr. Heather K. Hunt, Bioengineering

Effective methods of removing the inorganic template in mesoporous silica

Keisha Avery, Lauren Kesselring, Charissa Nowak, Anna Rudy, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
How learning to fly drones affects tactics in tropical forest firefighting

Teresa Avila and Bill Allen

In the Guanacaste Conservation Area (ACG) in northwest Costa Rica, forest fires are a major threat to the area’s tropical forest restoration efforts. Historically, the native dry forest has not encountered forest fires during the dry season, so the plant life has not developed any defenses against fire. Human activity has introduced such fires, which have destroyed native habitat and allowed invasive grasses to take over. The park rangers at ACG control fires as part of their work to bring back the forest and its accompanying biodiversity. Firefighting can be a dangerous business, however, and new tools and tactics are always welcome.

One potential tool is a small, remote-controlled drone. We theorize that by attaching a camera to the drone, and transmitting real-time images to the ground, firefighters can get a bird’s-eye view of a situation and more effectively subdue a forest fire. Over the course of a week, several Costa Rican park rangers are taught the basics of how to use a Phantom drone. Through interviews and observations, we study how firefighters choose to use this technology in firefighting, and whether they see applications for the drones in other areas of their work. This case study can demonstrate how other conservation programs that deal with fire can use drones to their advantage. Results are pending and will be presented at the Forum.
Determining the feasibility of drone usage for last mile delivery

Adithyan Babu, Michael Huber, Dominic Vollmer, and Cerry Klein

This research focuses on determining the feasibility of using drones to facilitate last mile delivery of goods. This was inspired by the recent push for drone delivery by companies such as Amazon. Some benefits of drone usage would include same day delivery, environmentally friendly energy usage compared to gas powered trucks, and reduced amount of missed deliveries due to customers not being home. A drone delivery system would be almost completely automated, limiting the amount of labor needed to complete deliveries from warehouses to customers. Therefore, if there was added revenue due to the advantages listed, in addition to any decrease in operating costs compared to the current delivery system, it would be feasible for companies to look at using drones for last mile delivery of goods.
Faculty Mentor: Dr. Alina Zare, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

**eFUMI: An improved approach to multiple instance learning**

Jordan Backes, Sheng Zou, and Alina Zare

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Using pooled genome sequencing of a backcross to identify a hae/hsl2 suppressor mutant in Arabidopsis

John Baer, Isaiah Taylor, and John C. Walker

The model plant Arabidopsis undergoes a process called abscission to shed floral organs following pollination. This process is mediated by two receptor-like protein kinases HAESA (HAE) and HAESA-like 2 (HSL2). A plant containing loss of function mutations in both of these genes exhibits a phenotype completely defective in abscission and fails to shed its floral organs. We have recently isolated a mutant allele of hsl2 displaying an intermediate abscission deficient phenotype that is able to shed roughly half of its floral organs. This allele contains a single amino acid substitution in the extracellular domain. Using this intermediate mutant, a genetic screen was carried out to isolate enhancers and suppressors of the partial abscission defect. One mutant isolated from this screen suppressed the partial abscission defect, making the phenotype similar to wild type. To identify the mutation, we backcrossed the suppressor mutant to the partially abscising parent and allowed the phenotype to segregate in the F2 generation. Pools of tissue from either abscising or partially abscising plants were collected and DNA was isolated for genome sequencing. Sequencing both pools allowed for comparison and removal of mutations not linked to the suppressor phenotype. This analysis revealed a mutation in a splice site of a gene encoding the protein ALG9, which is involved in the ER-associated degradation process of misfolded proteins. Our results indicate that this mutation results in retention of this intron. We hypothesize that the partially functional hsl2 protein is misfolded and normally subject to ER-associated degradation. We further hypothesize that the loss of ALG9 function in the suppressor mutant interferes with ER-associated degradation of the mutant HSL2 protein. This could allow for increased accumulation of mutant HSL2 in the plasma membrane, where it is able to signal sufficiently to cause abscission.

This project was completed to fulfill a Capstone requirement.
Kelcy Bai
St. Charles, MO

Faculty Mentor: Dr. Andrew McClellan, Biological Sciences
Funding Source: Life Sciences Undergraduate Research Opportunity Program

Changes in properties of lamprey reticulospinal neurons following spinal cord injury: Contributions of retrograde axonal transport

Kelcy Bai, Timothee Pale, and Andrew McClellan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
United States sanctions on Cuban women: A case study

Alex Bailey and Cooper Drury

In Cuba, women have equal rights as men in political, economic, and social fields, per article 44 of the Cuban constitution. Additionally, Cuba’s position on the Global Gender Gap index is 15th of 136 eligible countries, eight ranks ahead of the United States. Yet female leaders insist there is work to be done. Erlich (2009) notes economic woes combined with the machismo perpetuated a glass ceiling effect in particularly lucrative industries of science, technology, and engineering, whilst domestic violence remains omitted from Cuban legislation. There is a need to identify the United States’ role, if any, in the static nature of women’s rights in Cuba from a political, economic, and social lens. Sanctions as a gendered construction of stagecraft as they relate to Cuba are discussed. Political rights for Cuban women were most likely shaped by communist philosophies rather than the embargo. While it is possible the United States indirectly made life for the Cuban woman more difficult by stymieing economic progress, a direct link cannot be found. Social rights for women in Cuba regressed in correspondence to strengthening the embargo, but it is unlikely the embargo was the reason for social regression.

This project was completed to fulfill a Capstone requirement.
The role of parental military service on the exhibition of dominance and nurturance in sibling relationships

Keisha Bailey, Sonia Giron, and Nicole Campione-Barr

Previous research has almost entirely examined the relationship between United States service members and seemingly disproportionate rates of sexual harassment, suicide, homelessness and mental illness compared to the civilian population (Montgomery, Cutuli, Evans-Chase, Treglia & Culhane, 2013). What remains unknown, and what the present study seeks to examine, is the effects of parental military service on other familial dyads; specifically the expression of nurturing and dominant behaviors among dependent siblings. Additionally, we investigated sibling gender composition with relation to birth order to observe whether these characteristics differentially influence sibling relationships (Furman & Buhrmester, 1992; Tucker & Updegraff, 2010).

Sixty-seven parents (mostly mothers) in military families reported on the nurturance and dominance behaviors of their first- and second-born children utilizing the Network of Relationships inventory (Furman & Buhrmester, 1985), via online surveys. Results revealed that first-borns displayed more nurturing behaviors than second-borns and mixed sexed dyads more so than same sex dyads. In the examination of dominance, females displayed more dominate behaviors than males. Additionally, first-borns exhibited higher rates of dominant behaviors than second-borns. Findings suggest that military siblings follow similar dynamics as previously researched non-military family samples. However, the study of children’s sibling relationships should account for the distinct challenges faced by military personnel and their families and their transient nature, which challenges the conventional framework for interpersonal relationships, family dynamics and developmental outcomes of dependent children.

This project was completed to fulfill a Capstone requirement.
The profile of the African American intercollegiate athletic directors

Dawon Baker and Scott Brooks

The number of black athletic directors is disproportioned to their numbers as student athletes. The Institute for Diversity and Ethics in Sport (TIDES) conducts research regarding the racial and gender report card. In the report, TIDES examines the percentage of minorities that hold athletic positions such as management, directors, and coaches in college sport, including student athletes in division 1, 2, and 3 collegiate athletics. Black athletic directors only make up 9.6% of athletic directors in division 1 athletics (TIDES, 2012). In contrast, White student athletes make up 60% of division 1 athletics, and 78% of athletic directors at the division 1 level. 55% of athletic directors where former student athletes (Wong, 2014), while blacks make up 22.4% of all student athletes (TIDES, 2013). The gap between blacks in these athletic director positions and black athletes at the collegiate level is wide. The lack of blacks in the athletic director positions indicates the need to increase diversity in college athletics. With diversity becoming an important standard in our world, one may think that athletic directors would be proportioned to the number of student athletes, or in proportion to football and basketball participants, where blacks are highly represented. It is important to expand the group of individuals who are earning these positions. Through qualitative interviews, we will collect data from the black athletic directors at the collegiate level. Despite being represented by low numbers, it may be possible to determine the similarities in each black athletic director and the process of their hiring. Noting similarities may create a possible trend, which may increase the chances of blacks that will pursue a career in collegiate sports. The goal is to create a profile of the African American athletic director in college athletics.
Hydrogels as pharmaceutical drug delivery scaffolds

Marcos Barcellona and Matthew Bernards

A common challenge in the biomedical field is that pharmaceutical drugs, based on their specific chemistries, may require different delivery methods, targeting of specific tissues, or drugs to be released at different rates in order to obtain the desired results. Hydrogels are a type of water-based material that can be modified in order to have a range of different properties. For our project, we have made a hydrogel whose adjustable pore structure would make it an adaptable drug delivery system that could be modified to allow pharmaceuticals of different charges and molecular sizes to be released at rates adequate for diverse treatments. Additionally, our hydrogel's nonfouling properties (i.e. the gel's ability to resist nonspecific protein adsorption) would make it “invisible” to the body, and could thus be implanted into the body without inducing blood clotting, restricting fluid flow, or otherwise triggering the immune system to recognize the hydrogel as a foreign object. We tested the rates at which methylene blue, metanil yellow, and caffeine, all of which have different ionic charges and molecular sizes, move across the gel by placing them in the gel, and then allowing the gel to sit in a solution for predetermined amounts of time. We were then able to directly relate the amount of light absorbed at different wavelengths for each of the solutions to the amount of each molecule that was released. We also explored the ability of bovine serum albumin, a positively charged protein, to move through the gel in order to observe and quantify our hydrogel’s nonfouling properties. Our data suggests that these hydrogels could be used to deliver pharmaceuticals of different sizes and charges in time periods ranging from several hours to several weeks. The combination of the hydrogel’s physical structure and nonfouling chemical composition could lead to potential uses in the fields of tissue engineering, drug delivery for a wide range of procedures, and many other healthcare applications, while limiting the potential negative effects often caused by implants, such as swelling and implant encapsulation and rejection. Furthermore, hydrogels can be made in varying sizes and drug concentrations. Consequently, these hydrogels could be used for specific targeting of isolated areas without disrupting the body as a whole, and could thus be used for a variety of different treatments.
Teacher characteristics and the achievement gap

Olivia Barfield, Courtney Isaak, and Stephen Whitney

This research explores different teacher characteristics to determine which contribute to the reading achievement gap of students from different racial and income backgrounds. The Achievement Gap refers to the difference in standardized test scores based on race and socioeconomic status. The participants of the study included all students from the ECLS k-8 data set in the eighth grade wave (n=4,549). The ECLS k-8 data set is a nationally representative longitudinal secondary study focusing on administrators, teachers and students from kindergarten to the eighth grade. Participants were grouped based upon four race categories (White, Black, Hispanic, and Asian) and three of the five quintiles of SES (upper class, middle class and poor). The teachers’ characteristics included Teacher efficacy, Teacher burn-out, Satisfied with Teaching, Positive working environment, and Culturally competent teachers. Analysis were conducted using a general linear model (GLM) controlling for age and biological sex. Only teacher burn out was a significant factor of the reading achievement gap between the different races and income groups. Black poor and Black middle class had the highest rates of teacher burn-out and Asian upper class had the lowest. The non-significant findings were unexpected but may be due to problem of restricted range. For example, all teachers rated high on self-efficacy. The findings indicate that support for burn-out teachers may be a promising approach to reducing the racial an income achievement gap in reading within the eighth grade.
The review of environmental non-governmental organizations in the Amazon and their impact on oil exploration in the Amazon Rainforest

Whitney Barr and Heidi Appel

Oil exploration in the Amazon Rainforest has come to the forefront of environmental literature addressing the environmental movement in reaction to recent globalization trends. Global political actors have exploited the environment for economic benefit. This research begins by reviewing the effects globalization and international players have directly on the Amazon Rainforest. Next, I analyze how the political structure in Latin America as well as transnational and national funding, and social movements affect the work of non-governmental organizations in the Amazon basin. A fundamental aspect to this research includes the analysis of interplay between global investments in the Amazonian oil industry and the environmental protection efforts non-governmental organizations. Finally, a conclusion will be drawn as to what impacts non-governmental organizations have on oil exploration in the Amazon.
Accounting for ethanol in nitrogen input analysis

Clare Bassi and Christine Costello

The Net Anthropogenic Nitrogen Input (NANI) Toolbox was created by Cornell University to estimate human controlled-nitrogen inputs in watersheds and has been shown to be a good predictor of riverine nitrogen export at a large scale. NANI uses a net balance and mass balance approach and allows a user to specify unique watersheds using GIS tools. The model was adapted by Costello to incorporate life cycle thinking to the model to look holistically at nitrogen’s role in crops, animals, and people within a watershed. In particular, these additions make it possible to estimate changes in NANI to all watersheds in the U.S. as a function of changes in diet. This model allows users to see the direct effects of their current diet and the differences small changes can make on a large scale. Corn is one of our nations most prominent crops and recently the demand for ethanol production has increased. The NANI model did not explicitly include corn used to produce ethanol and the feed co-products. The NANI framework was re-built in MATLAB and incorporates corn-derived ethanol. This new model allows for a better estimation of nitrogen inputs that include the ethanol industry. Generally speaking, through allocating a portion of the nitrogen associated with corn production to ethanol the per unit nitrogen impact of producing animal-based food products decreases slightly. However, increased corn production results in increased nitrogen inputs to watersheds and thus exports to riverine systems in the U.S.
**In vitro effects of an epigalltocatechin gallate-collagen template on the macrophage inflammatory response**

Zakary Beach, David Grant, and Sheila Grant

**Introduction:** Chronic wounds affect approximately one million Americans each year, most of them being diabetic. People with diabetes have slow healing rates due to poor circulation, nerve damage or problems with the immune system. As a treatment, collagen scaffolds could be utilized as wound dressings; however collagen is weak in its pure form and must undergo crosslinking to increase its stability and resistance to degradation. Unfortunately, crosslinking changes the compatibility of collagen in the body. EDC (1-Ethyl-3-(3-dimethylaminopropyl)carbodiimide) was utilized to attach gold nanoparticles (AuNPs) to collagen to improve collagen’s structural properties. AuNPs impart properties to the collagen scaffolds such as enhanced biocompatibility, resistance to degradation and reduced inflammation. To further reduce the inflammation, an anti-inflammatory agent, EGCG (epigallocatechin-3-gallate), was also conjugated to the scaffolds using EDC. The goal of this study was to find a reduction in inflammatory agents and oxidative species while EGCG is present on the scaffolds.

**Materials and Methods:** Type I porcine collagen was utilized as the tissue scaffold. EDC, 100 nm AuNPs and EGCG was used during the fabrication of the collagen scaffolds. The following tests were used to characterize the scaffolds: Scanning Electron Microscopy (SEM) was utilized to examine the morphology of the scaffolds and to confirm the conjugation of the gold and silver nanoparticles; Differential Scanning Calorimetry (DSC) was utilized to determine the stability (via denaturation temperature) of the scaffolds; WST-1 cell culture assays were used to determine cytotoxicity; reactive oxygen species (ROS) assays were used to determine the scaffold’s ability to reduce cell oxidative stress due to hydrogen peroxide; enzyme-linked immune assays (ELISA) were used to measure the amounts of IL-6, IL-4 and IL-10 released from U937 macrophage-like cells while in the presence of the scaffold. ANOVA was used to quantitatively compare the properties.

Results and Conclusions will be presented at the Forum.
Susan Bell, Samantha Anzalone, Mary Myers, and Patrick Pinhero

The current Chemical Engineering first-term Thermodynamics course was adapted from a traditional lecture-based structure into a more modular structure that focuses on mastery learning principles. As the subject matter is both abstract and difficult, lectures have been revamped to present the theory behind the application of one or more thermodynamic principles. The modular structure is segmented to keep students on pace with the flow of the course and to promote mastery learning through thorough and multiple application of concepts. By providing students with greater interaction, prompt feedback, and multiple opportunities to recall and repeat exercises, a deeper understanding of thermodynamic principles is fostered. Tests are specifically designed to assess mastery learning of these principles. This presentation focuses on the performance of students during each of the past three semesters since the institution of this new instructional paradigm to determine its overall efficacy.
Metamaterials are a class of synthetic functional materials that possess the ability to constructively superimpose electromagnetic waves. The Pinhero Team is attempting to exploit this effect to capture blackbody radiation and frequency red-shift heat energy into compressed density of plasmons for capture by nanoantenna. Copper has gained interest over the years for its use in fabricating the metallic component of metamaterials, due to its excellent mechanical properties and high thermal and electrical conductivity. In the team’s prior work, they demonstrated that electrodeposition through acidified copper electrolytes in the presence of additives (chloride ions, 3-mercapto-1-propanesulfonate (MPSA), and polyethylene glycol (PEG)) helped promote bottom-up super-filling of micron and sub-micron scale features. In the current study, a new additive, polyvinylpyrrolidone (PVP), is added to the electrolyte mix, resulting in the leveling effect of the surface of copper deposits. The cross sections of the copper deposits were characterized by using optical microscope. As a result, super-filling of the trenches and leveling of the top of deposits has been achieved. The results indicated that PVP has an impressive performance of leveling, as compared to those whose copper layer was deposited without PVP in solution and resulted in non-consistent layering.
Athletics or academics: The effects of university conference switches

Philip Bergman and Nicholas Watanabe

This study examines the effect that switching athletic conferences has on the admissions rate of Division I-A universities since 2010. In the modern collegiate sport environment, revenue and profitability are considered to be one of the main driving factors in making the decision to switch conferences. While this may be accomplished for the athletic department, does such a switch have other positive implications for an academic institution? Over the past five years, 40 of the 118 eligible Division I-A schools (around 34%) have switched to a different athletic conference for football. This study analyzes net and percentage changes in admissions rates at schools which have switched to new conferences within the last four years. Through the use of a regression model to control for a variety of factors including tuition, student aid, and other variables, the estimated results find that there are potential short-term gains in admissions for schools that switch conferences. Six models were run considering different measures of admissions and length of time. Results from the models indicated that switching a conference had a positive effect on net admissions to a university in a two-year time frame. The average gain in admissions during the two year window was around 1,835 students, an effect which disappeared in the third and fourth year. Results indicate that switching conferences may have short-term gains for an entire academic institution in the number of students, but raises the question of the long-term benefits this behavior may have for universities.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Anna Beyer, Carmen Aboytes, Andrew Briedwell, Matt Fleissner, Andrew Pelikan, Virginia Trauth, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
Altered expression of an RNA decapping protein in cells identifies RNA targets of a nuclear degradation pathway

Sarah Biehn, Matthew Martin, and Brenda Peculis

Within the nucleus of a cell, DNA is transcribed to RNA. In the cytoplasm, the RNA is translated to protein. Many control steps that exist along the way cause differences in the amounts of proteins in a cell. One way a cell alters which RNAs are translated into protein is by RNA degradation, either by removing the polyA tail or by removing the 5’ cap. Our lab is trying to identify RNA targets that are degraded by the nuclear protein Nudt16. In vitro, Nudt16 can remove the 5’ cap from RNA. This implies that in a cell, this protein would be involved in a very early step of gene regulation, like degrading an RNA before it even left the nucleus. We hypothesized that if we altered the amount of catalytically active Nudt16 protein in a cell, a change would occur in the cellular levels of the RNAs that are targeted by this protein. Xenopus laevis tissue culture cells were transiently transfected with plasmids that encoded a mutant of Nudt16 that was not active for cap hydrolysis. After the isolation of total RNA, high throughput next generation sequencing (RNA-seq) and computational output data identified three categories of RNAs: Nudt16 as a proof of principle, stress response RNAs that were upregulated in transformed cells relative to untreated cells, and RNAs with altered expression due specifically to changes in Nudt16 levels. qPCR was used to validate the changes in stability level of RNAs from each category.
A study of small animal locomotion through indirect scientific rotoscoping

Nicholas Bira and Kevin Middleton

Studying movement in animals provides useful data concerning how bodies in motion work, as well as information about our own capacity for movement. These data can be used in the study of diseases, evolutionary patterns, and biomechanics. Scientific rotoscoping is one technique used to measure the movements, or kinematics, of various animals by tracking positions of bones and joints and then animating a 3D representation of their displacements. Current rotoscoping methods utilize two x-ray video cameras to record motions which are then combined to create the final moving model. These methods face challenges when applied to small animals such as mice, which do not appear clearly or accurately on x-ray film. I developed a cost-effective and streamlined process for evaluating the kinematics of small vertebrates through indirect rotoscoping. Two commercially available video cameras were used to collect the raw images of landmarked objects. These landmarks located on the surface correspond to underlying joints. After recording, the video was programatically undistorted and digitized to create sets of 3D coordinates. These coordinates were used to predict the location and movements of the underlying joints. Experimental validation of the methods revealed that points could be tracked at up to 70 cm/s with error in the range of 1%. Because mice typically run less than 40 cm/s, this method allows adequate collection of kinematic data on mouse movement that has been previously unobtainable. The coordinates obtained this way can be used to animate a MircoCT scan of the mice, which ultimately provides detailed skeletal interactions and angles. This data is being analyzed to provide insight into gait adaptations acquired over two weeks of exercise. This alternative procedure is the first to use rotoscoping without expensive slow-motion x-ray videography and time-consuming post-analysis, as well as being produced at a small fraction of the financial investment.
Laws? Where we’re going we don’t need any laws: How biology explains without scientific laws

Kevin Bird and Andre Ariew

Scientists are no strangers to the fact that biology, as an explanatory science, seems to function quite differently than physics and chemistry. While physics and chemistry deal with neatly predictable systems, biology tries to study dynamic, contingent systems that are connected by the overarching theory of evolution. It’s due to this contingent nature that the presence of laws in biology has been called into questions by philosophers of biology. The conclusion has been that evolutionary biology has no distinctly biological laws, or that the only biological laws are the laws of natural selection. The absence of laws is then used as an indictment of the weak explanatory power of evolutionary biology. Ultimately, I find the reasoning behind both of these arguments to be based on a questionable assumption that only laws can provide reliable explanations, and that the explanatory power derives from the empirical nature of laws. Instead of the traditional view I contend that evolutionary biology is composed of a priori (non-observational) model explanations. However, I don’t believe that the explanatory power of biology is derived from parallels between forces in physics and evolutionary forces as some have argued. Instead I argue that the explanatory power derives from the models used to represent evolutionary phenomena which results in a distinct type of generalization that is non-causal and capable of explaining and predicting biological phenomena without reference to empirical laws. A better understanding of the models used in biological explanation can aid scientists in building better models and better using models in their experiments to resolve complex evolutionary questions.

This project was completed to fulfill a Capstone requirement.
Building a genetic foundation for the biofortification of *Brassica rapa*

Kevin Bird, Michael Gore, Joanne Labate, Larry Robertson, and Chris Pires

Biofortification — the enhancement of crop nutritional quality through plant breeding — is potentially a sustainable and cost-effective strategy for addressing micronutrient deficiencies throughout the world. Success of biofortification depends on the identification of favorable genes associated with nutritional quality, followed by increasing the nutritional value of locally adapted crop varieties by selecting favorable alleles of identified genes in breeding populations. Without connection of phenotype to genotype, biofortification will likely be ineffective for improving targeted nutritional traits. *Brassica rapa* L. is an agriculturally important vegetable crop, with 100 million tons harvested globally in 2012. It is a source of vitamin C, an essential nutrient that also enhances the uptake of iron—the most commonly deficient micronutrient in human populations. Plants in the Brassicaceae family also contain a unique class of sulfur-containing compounds called glucosinolates that show anti-carcinogenic activities. These nutritional traits make *B. rapa* ideal for biofortification. We will use whole-genome sequencing (WGS) of a global panel of *B. rapa* and a Genome Wide Association Study (GWAS) to dissect the genetic basis of vitamin C and glucosinolates. The WGS data will be cleaned and analyzed using TASSEL, and a best linear unbiased prediction (BLUP) will be obtained for collected vitamin C and glucosinolate data to estimate heritability and to optimize data to fit the GWAS models. After removing low quality Single nucleotide polymorphisms (SNPs), the set will be used to test association between the BLUPs and filtered SNPs. The amount of phenotypic variation and polymorphisms will be determined using an $R^2$ test and Multi-locus mixed model (MLMM), and the GWAS will be re-ran including the polymorphisms. The success of this program could result in a great improvement of iron biofortification efforts with a vitamin C rich diet that increases iron absorption and improved cardiovascular health and reduced cancer risk due to increased glucosinolates.
Exploring the canine model of muscular dystrophy using 6-axis inertial measurement unit data

Nathan Birenbaum, Nicholas Roberts, and Gang Yao

Motion processing technology is embedded in a variety of consumer electronics, medical devices, and scientific applications. Using 6-axis inertial measurement unit data, it is possible to determine the acceleration and angular speed of the any object that these sensors are attached to. In this setup, an Arduino microcontroller is used to read, process, and send 6-axis data from the inertial measurement unit to a computer via Bluetooth for further processing and visualization in MATLAB.

Previous muscular dystrophy studies have compared the gait of normal dogs with dogs affected by golden retriever muscular dystrophy as a model to explore Duchenne muscular dystrophy in humans. These gait studies have historically used video recordings alone to determine gait, but 3-axis accelerometry data has recently emerged as an alternative, more efficiently quantifiable method for determining the gait of dogs. By including measurements of rotational velocity, the 6-axis inertial measurement data allows for the detection of additional gait patterns absent from 3-axis accelerometry data. Through the inclusion of additional gait patterns shown by the 6-axis inertial measurement unit data, it is hoped that the differences in gait in dogs affected by muscular dystrophy can be more completely understood.
Small town Missouri speech

Ariel Blaser and Matthew Gordon

Missouri’s central, Midwest location leaves it prime for a diverse collection of regional dialects, gathering influence from all directions. Previous studies have primarily focused on linguistic information regarding Missouri residents from the metropolitan areas (such as Kansas City and St. Louis). The goal of this study was to conduct sociolinguistic interviews and then analyze the recordings for a number of factors to get an overall picture of the language patterns happening in Butler, Missouri. The project is titled “Small Town Missouri Speech” to allow a contrast from the urban studies and because the population of Butler is around 4,500. Because it is my hometown, connecting to potential participants was simplified because I don’t have outsider status. I used my family and personal connections to recruit. The interviews were one on one and lasted approximately an hour: 45 minutes of free speech prodded by open questions and then 15 minutes of reading materials and minimal pair tests. The purpose of the reading materials and tests was to illicit particular environments for vowels in which changes are known to occur. The materials also allowed for exploration of any non-standard grammar in use. The bulk of the analysis has revolved around vowels and what they are doing. Interviews were first transcribed and then a program was used to take acoustic measurements in order to get a map of where vowels are being uttered within the vocal tract. With the measurement data and information about grammar patterns being collected, the eventual goal is to compare what is happening in Butler speech to trends elsewhere in the state. Analysis is still underway and results will be ready for presentation at the time of the Spring Forum.

This project was completed to fulfill a Capstone requirement.
Neuromodulation within the dopamine reward system and other circuits

Chris Blasius, Feng Feng, Pranit Samarth, Vinay Guntu, and Satish Nair

Research on the brain is beginning to reveal the effects of neuromodulation on intrinsic and synaptic properties of cortical neurons. The intrinsic effects relate to changes in channel conductance of neurons, while the synaptic effects include changes in presynaptic release probability and post-synaptic receptor trafficking. Pathology in neuromodulation (dopaminergic, noradrenergic, serotonergic, and cholinergic) is thought to play an important role in disorders related to the mammalian fear circuit, which includes PTSD and other anxiety disorders. In addition, dopaminergic changes in the striatum are believed to be the basis for emotional and behavioral effects from cocaine exposure.

Studying the effects of neuromodulation on cellular excitability using computational models could shed light on the role of neuromodulation in both normal and pathological functioning of fear and cocaine circuits. Towards this end, the effects of neuromodulation on intrinsic and synaptic parameters of cells in the amygdala have been created for use in single and 1000-cell models of these regions. The computational models are being developed using the software package NEURON. In a parallel project, striatal responses to the effects of cocaine were explored and data was acquired on the concentration of molecules integral to structural changes during cocaine learning. In addition, various literature reviews were performed to mine for electrophysiological data of neurons in the Lower Urinary Tract (LUT) and full-scale models of the Perirhinal Cortex.
Quantifying maize Sucrose transporter1 expression in different cell types from RNA in situ hybridizations

Nathaniel Boyer, R. Frank Baker, David M. Braun

One method to determine the cellular expression pattern of a gene is to perform RNA in situ hybridizations, with the RNA typically detected via precipitation of a colored product. However, the conclusions from these experiments are generally qualitative rather than quantitative. We have been studying the function of the maize Sucrose transporter1 (Sut1) gene, which functions to load sucrose into the phloem in leaves. Based on similarity to phloem loading SUTs in other plants, we hypothesized maize Sut1 would be expressed in the phloem companion cells and/or sieve elements (CC/SE).

To test this hypothesis, we performed RNA in situ hybridizations on mature leaf tissues. Maize Sut1 RNA was indeed expressed in the CC. Surprisingly, we also detected the RNA in additional leaf cells that, in some instances, appeared to show stronger staining intensity. To characterize the magnitude of the expression differences between the CC versus these other cell types, we quantified the relative signal intensities between them using ImageJ. Here, we describe a method for using the “Color Pixel Counter” plugin to obtain quantitative signal expression data from microscopy images. In the large veins, the expression level in the CC (measured within the CC/SE area of the phloem) was ~67% relative to that of the other cell types. By contrast, the expression level in the other cell types was 63% and 38% relative to that of the CC in the intermediate and small veins, respectively. The progressive difference in the relative signal intensity across the vein classes appeared to be due to the increasing percentage of the area represented by the weakly-expressing bundle-sheath cells within the non-CC/SE cell types expressing ZmSut1. Our in situ expression data suggest maize Sut1 functions in both phloem loading of sucrose in the CC and in sucrose retrieval from the apoplasm in non-conductive cell types.
Many students believe that it is the instructor’s responsibility to teach every element introduced during a class period, while instructors perceive that some information is not their responsibility to teach (Bauman, 2003). Consequently, there have been shown disparities in expectations of learning responsibilities, creating gaps and reducing productive class time (Pease, 2012).

In this light, we conducted a survey in a Midwestern University after an approval of Institutional Review Board. A total of 37 different software techniques, 17 specific to Excel and 20 specific to Illustrator, were presented to Merchandising and Product Development students, respectively, asking responsibility levels of each technique. A 5-Likert scale was used: 1 as “Mostly student’s responsibility,” to 5 as “Mostly instructor’s responsibility.” A total of 92 surveys were collected. Instructors were also surveyed using the same questions, and 6 data responses were collected.

The average student response to the questions about responsibility for learning specific Excel tasks was 3.06, while that of the instructors was 2.73. This indicated that on average, students believed that it is a nearly equal responsibility of both students and instructors to learn and teach various techniques of Excel, while instructors thought it is more of the students’ responsibility. Regarding Illustrator, the results were the opposite. Average student response was 3.33 and instructor response was 4.23. That is, instructors felt that they are responsible for teaching all 20 Illustrator techniques.

These results suggest that instructors may want to consider setting clear requirements of student learning responsibilities, and possibly requiring students to take an assessment to test their knowledge of Excel or Illustrator prior to enrolling. This study can be improved by increasing the scale and recruiting more participants, especially instructors.
In vitro investigation of a novel chitinNP-AgNP-collagen template

Janae Bradley and Sheila Grant

Effective wound treatments are needed for diabetics with chronic wounds and ulcers. People with diabetes have slow healing rates due to poor circulation, nerve damage or problems with the immune system. It is proposed to develop a collagen construct with attached silver and chitin nanoparticles as a radical new wound dressing. Collagen constructs have excellent biocompatibility, however collagen is weak in its pure form and therefore must undergo crosslinking to increase its stability and resistance to degradation; unfortunately synthetic crosslinkers can alter the overall biocompatibility of collagen. To avoid these potential problems of synthetic crosslinkers, a non-toxic, natural crosslinker, genipin, will be utilized. The use of silver nanoparticles (AgNPs) will enhance biocompatibility, antimicrobial effects, and resistance of the collagen template to degradation. The use of chitin nanoparticles (chitinNP) conjugated to the collagen templates will encourage constructive remodeling. Chitin has been shown to induce interleukin-4 (IL4) production from cells; IL4 is an anti-inflammatory agent and promotes the polarization of M2 macrophages. Chitin is also nontoxic, biocompatible and biodegradable.

Two constructs, AgNP-collagen construct and AgNP-chitinNP collagen construct, were synthesized and characterized. During fibrillogenesis of collagen, the AgNPs and chitin particles were conjugated to the collagen fibrils. Scanning electron microscopy (SEM), differential scanning calorimetry (DSC), WST-1 cell viability, Dynamic Light Scattering (DLS), collagenase study, and antimicrobial studies (using *Staphylococcus aureus*) were performed in order to determine morphology, stability, viability, size distribution, and resistance to infection respectively. The results demonstrated an open microstructure with AgNPs and chitinNPs conjugated to the collagen fibrils. DSC demonstrated increased stability over non-genipin templates. The WST-1 assay indicated that the crosslinking process and the addition of silver and chitin nanoparticles were not toxic to the cells. The antimicrobial study demonstrated enhanced resistance to bacterial attachment may be achieved with higher concentrations of AgNPs. These findings indicate that the presence of AgNPs, chitinNPs and the genipin crosslinker will result in a collagen construct with high cell viability, stability, and biocompatibility. This study provides evidence that the collagen templates could be used as effective and cost efficient wound dressing for people with diabetes.
Effect of caterpillar feeding on the phenolic compounds of *Arabidopsis thaliana*

Samantha Breckenridge, Dhruveesh Dave, Clayton Coffman, and Heidi Appel

To defend against herbivory, plants produce chemicals that can deter insect feeding. More of these chemicals are produced when plants detect attack, but the level of induction may depend on the extent of damage. In this experiment, we wanted to determine whether the amount of caterpillar damage on *Arabidopsis thaliana* influences the production of phenolic compounds. We varied the amount of damage on each plant by allowing caterpillars to feed either on one leaf or three leaves using clip-cages. We controlled for the effect of the clip cage itself by treating plants with empty clip cages for the same amount of time. We hypothesize that when *P. rapae* are allowed to feed on three separate leaves of *A. thaliana* plants, the result will be a higher induction of phenolics compared to plants that received caterpillar feeding on a single leaf or plants that were undamaged. We have yet to complete this experiment; however, results will be ready in two weeks in plenty of time for the forum.
Investigation into side aperture acoustic sensing

Eric Brewster, James Keller, and Kevin Stone

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Andrew Briedwell, Carmen Aboytes, Katy Beyer, Matt Fleissner, Andrew Pelikan, Virginia Trauth, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
Role of 5’TG3’-interacting factors (TGIFs) in vorinostat (HDAC inhibitor)-mediated corneal fibrosis inhibition

Justin Brooke, Ajay Sharma, and Rajiv R Mohan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Christian Brooks
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Junior
Civil & Environmental Engineering

Faculty Mentor: Dr. Carlos Sun, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option

Crash report analysis for highway safety manual calibration

Christian Brooks, Katie Haberberger, Kristin Hofstetter, and Carlos Sun

The Highway Safety Manual (HSM) provides transportation specialists a way to quantitatively assess the safety of different highway facilities; it uses the technical analysis of different aspects of highway design so that safety can be tested and ultimately improved. Also, the HSM provides predictions on the crash frequency and severity of common highway facilities, such as interchanges. Crashes at interchanges often relate to the geometry of the entrance and exit ramps on a highway, including the interchange signals. The combination of changing lanes, abiding by traffic signals, and changing speeds at an interchange can all have effects on safety. In order to calibrate the HSM, crash reports are reviewed and assigned to proper highway facilities. Completing a crash report consists of compiling information regarding the circumstances of a roadway accident. This is generally performed by a police officer, but there are often inconsistencies in the reports. A tutorial for analyzing these crash reports written by police officers was developed in the ZouTrans transportation laboratory at the University of Missouri. This tutorial describes the process of assigning a collision to a specific terminal at an interchange. HSM calibration helps to improve the accuracy of the Highway Safety Manual by identifying sites that could use improvement in safety, determining the conditions that are posing issues at the site, recognizing possible solutions, programming these solutions, and finally evaluating the reduction of crashes from the changes.
Crowdsourcing for remote sensing

Michael Brooks, Daniel Hanson, Huy Trinh, and Alina Zare

We are developing a method to collect uncertainly labeled training data for remote sensing using crowdsourcing techniques. Traditional supervised machine learning methods require very accurate and precise training labels from which to learn. Collecting accurate training data is very time consuming and expensive. Multiple-instance learning algorithms relax that requirement and only need positive and negative sets of data points, called “bags.” Positive bags are defined as having at least one of the target points within the bag. Negative bags are defined as having only non-target points within the bag. The solution presented uses the idea of a crowdsourcing web application in order to gather the training data to be used with multiple-instance learning algorithms. The web application has one view for selecting a specific region and a second view that shows the multispectral image corresponding to the selected region. Once the user has selected a region from the first view, they will look at the corresponding multispectral image and then record what features they believe are present in the segment. The features the user selects as being present in the multispectral image will be saved to a database. Since the user data is not guaranteed to be correct, the data qualifies as the uncertainly labeled training data, however, our ongoing research shows that this type of data can be used within multiple-instance learning algorithms.
Carbohydrate partitioning is the biological process in which carbohydrates (e.g., sucrose) are transported from photosynthetic source tissues (e.g., mature leaves) to non-photosynthetic sink tissues (e.g., developing leaves, ears, and roots). Although this process is essential for plant growth and development, the regulation of carbohydrate partitioning and the genes involved are not well understood. The carbondate partitioning defective7 (cpd7) mutant of maize was identified by pale-green coloration of the mature leaves and progressive anthocyanin accumulation within these pale-green regions. Staining these regions for starch revealed hyper-accumulation of starch in cpd7-1 mutant leaves as compared to leaves from wild-type siblings, indicating the Cpd7 gene plays a role in carbohydrate partitioning. Two additional mutants with similar phenotypes, cpd7-2 and cpd7-3, were verified to be allelic to cpd7-1 through complementation testing and mapping. To identify the causative mutation, a positional cloning strategy was undertaken, delimiting a 60,000 bp region on chromosome 9, containing two candidate genes. A complementation test between cpd7 and a Mutator transposable element insertion in one of the two genes has led to the identification of the putative causative gene, which is currently being sequenced in cpd7-1, cpd7-2, and cpd7-3. This information will aid in the identification of genes involved in controlling whole-plant carbohydrate partitioning.
Bradley Buettner and Caixia Wan

Bacteria cellulose is a naturally occurring organic compound and can be synthesized from bacteria such as *Gluconobacter xylinus*. It has great potential for biomedical applications given its biocompatibility and unique three-dimensional structure of nanofibers. Gold nanoparticles can be inserted into the 3-D network of bacterial cellulose and potentially provide beneficial aspects such as increased acute vascularization and facilitation of acute drug delivery. In this study, BC-Au nanocomposites will be *in situ* biologically synthesized with the addition of gold nanoparticles to the culture media of *G. xylinus*. The gold nanoparticles will be prepared through a “greener” route that utilizes soybeans and/or tea leaves in the reduction reactions of gold salts. The effects of the sizes and loadings of gold nanoparticles as well as the fermentation parameters on the formation of BC-Au nanocomposites will be investigated. The structure and mechanical properties of the BC-Au nanocomposites will be characterized.
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Senior  
Computer Science

Faculty Mentor: Dr. Chi-Ren Shyu, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option

Data mining on medication database and minimum dataset for Lymphedema research

Kimberly Butler and Chi-Ren Shyu

The purpose of this research is to analyze data in the American Lymphedema Framework Project (ALFP) medication database and minimum dataset and to use an analytics tool to give ALFP observations of medications that correlate with limb volume changes. The research also entails the development of a web analytics tool for individual patients to visualize limb volume changes overtime and medications taken for patients. The visualization tool is developed using D3.js and allows the visual analysis of each patient, including limb volume measurements at each visit measured and the timeframe that medications were taken and prescribed to the patients. Through data mining algorithms, we will have concrete correlations between limb volumes and medications. We expect to see associations and temporal trends with medications and limb volume changes to provide clinicians and patients unique informatics tools for diagnosis and disease management.
Analyzing growth on early writing measures: Getting students off to the “write” start

April Byrd, Kate Waidmann, and Erica Lembke

Curriculum-based measurement (CBM) is an efficient, standardized, valid, and reliable tool to examine students’ performance and progress in academic areas. Writing is an area where students continue to struggle and the most recent NAEP data (2011) suggest that a large number of students with and without disabilities are not at the basic proficiency level. There is a need for teachers to use time efficient measures like Curriculum-Based Measures (CBM) in early writing to make data-based decisions about their students’ writing progress. In this study, we investigated the differences in early writing growth between gender, socioeconomic status (SES), and ethnicity in first- through third-grade students in two Midwest schools in one school district. We measured student growth by examining three writing tests given in the fall and spring of one academic year and determined differences between fall and spring scores. The first test, Word Dictation focused on students writing words. The second test, Picture Word, focused on student’s sentence structure. The third test, Story Prompt, focused on student’s paragraph structure.

We separated student data into three subgroups—gender, socioeconomic status (as determined by free and reduced lunch status), and ethnicity—for analysis. To analyze these differences we looked at the data for individual grades (first, second, and third) by themselves, as well as the total population of students in first- through third- grade. Our data suggests that students who are male, receive free or reduced lunch, or identify as African American lag in early writing growth. We chose to look at first through third graders because these are critical years in developing writing skills. Helping students that are struggling at the beginning of their schooling will allow them to get back on track. Our findings provide teachers and principals with information that can be utilized to design plans that support struggling students.
Junkai Cai
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Senior
Computer Engineering

Faculty Mentor: Dr. Michela Becchi, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

**Acceleration of graph applications on parallel platforms**

Junkai Cai and Michela Becchi

Graph applications are broadly used in several domains, such as social networking, computer networking, bioinformatics, and computational chemistry, to name a few. Parallel platforms, such as multi-core general-purpose processors (CPUs) and many-core Graphics Processing Units (GPUs), enable increased graph processing speed. In particular, GPUs are massively parallel platforms containing hundreds of light-weight processing cores and custom memory architecture, and can lead to better performance than CPUs. On these platforms, graphs are often represented in Compressed Sparse Row (CSR) format, a matrix-based representation that allows for an efficient memory use and fast operation. Commonly used graph algorithms include Breadth First Search, Single-Source Shortest Paths, and All-Pairs Shortest Paths.

My research focuses on the parallelization of graph algorithms on GPUs using the CUDA parallel programming framework. First, I will explain how the CSR format works. Second, I will present a graph generation algorithm that produces random graphs in CSR format. Then, I will show how graphs in this format can be automatically exported into a graph visualization tool called GraphViz. Then, I will show how the algorithms above can be implemented using CUDA and based on the CSR format to allow high processing speed on GPUs.
Colt Canepa
Saint Louis, MO

Faculty Mentor: Dr. Jason Cooley, Chemistry

Forces driving the lateral reorganization of proteins in membranes

Colt Canepa, Mia Brown, and Jason Cooley

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Influence of agricultural and remedial land use practices on the ability of soil to support a diverse arbuscular mycorrhizal community for Central Missouri prairies

Christine Carson, Alice Tipton, and Candace Galen

Restorations in Missouri are important for maintaining natural resources for human health and improving soil health. In central Missouri, Prairie Fork Conservation Area (PFCA) managers focus on returning agricultural land to native prairie. Restoration success is often influenced by soil microbes, but restorations are not managed with consideration of microbial communities. Arbuscular mycorrhizal fungi (AMF) aid in prairie reconstruction by facilitating plant nutrient uptake and community succession, but currently it’s unclear how AMF communities change during the reconstruction process.

To better understand how AMF communities affect reconstruction processes, we collected soil from nine sources: an agricultural field, a sequence of six prairie reconstruction stages at PFCA (one, two, three, seven, eight, nine and ten years since reconstruction began), and an un-plowed prairie remnant (Tucker Prairie). Field soils were subjected to phospholipid fatty acid (PLFA) analysis to determine microbial community composition in each site. We then collected ten individual Schizachyrium scoparium (little bluestem) at Tucker Prairie, split each plant into nine daughter plants (ramets), and planted ramets from each original plant into pots containing soil from one of the nine source sites. After the growing season, we collected roots from each plant. AMF DNA taken from roots of each ramet will reveal the diversity of AMF. These data will allow us to determine if AMF diversity and composition changes during restoration.

Preliminary results from PLFA analysis revealed significant differences in AMF biomass between agriculture, reconstructed prairie, and remnant prairie soils. The agricultural treatment displayed the lowest and unplowed treatment displayed the highest AMF biomass. Due to these preliminary results, we expect AMF diversity to increase over time in restored prairies. Results from the full project will provide insight to how AMF communities change in reconstructions and address potential needs for integrating AMF management practices into PFCA reconstruction efforts.
Maeve Casey  
Park Ridge, IL

Faculty Mentor: Dr. Josephine Stealey, Art

Mapping

Maeve Casey and Josephine Stealey

My work gives physical form to my interest in memory, particularly my own. As humans we have the ability to organize, classify, and memorize moments that have occurred to us throughout our lives. We have the capability to recall these moments worth remembering at any given time. But what happens when you begin to forget details from memories you kept through the years?

Psychology tells us that our memory is not as reliable as we would like to think it is. It has been said that our memories are located in an area between reality and misrepresentation. This allows for reconstruction, alternation, and/or distortion to interfere with the memories we have made.

My interest in this topic has inspired me to make work based around my own memory. I think of someone’s memory in terms of a map, each memory has a location and can be connected to other memories through information found within those moments. For the last four years I have been living in Columbia, Missouri but originally I am from Park Ridge, Illinois. Park Ridge is located just on the edge of Chicago city limits, or in other words where the majority of the memories I have made while back home are located. Recently I have noticed that I am beginning to lose details from my memories in Chicago, which is causing my memory map to alter. This work stands as a representation of the distortion that is occurring to my memory map.

*This project was completed to fulfill a Capstone requirement.*
Performance of pump health monitoring system

Brandon Casteel and Roger Fales

For any hydraulic system, the fundamental purpose is to ultimately transform shaft power into fluid power which can then be transferred throughout the system to perform various functions. That being said, steering mechanisms for off-highway trucks are critical in any mobile machine and depend significantly on its pump performance. This thesis involves comparing the test performance of a new pump to that of an older, used pump. The results will be used for health monitoring of the system. The benefits of evaluating differences in efficiency data between pumps provide information for improved safety, reduced life cycle costs, and heightened system readiness to name a few.

Several aspects will be evaluated between the two pumps including volumetric efficiency and torque efficiency. Volumetric efficiency compares measured flow to theoretical flow determined by physical volumetric displacement and pump speed. Tests on the pump will be conducted running from typical to severe operating conditions using various applied pressures, flow rates and pump speeds in an effort to evaluate pump performance at worse than ordinary operating conditions. These tests will provide us with information that will not only be used to evaluate efficiency of the pumps but also for a graduate research project in an effort to predict system behaviors at varying loads and pressures while making more accurate failure predictions during the life cycle of the pump.
The learning effect of augmented reality training in a computer-based simulation environment

Tiffany Chan, Wei Du, and Jung Hyup Kim

The purpose of this experiment was to investigate the learning effect of Augmented Reality (AR) in a computer-based simulation environment for training an operator to interact with a radar screen. The research team designed the AR training system for Anti-Air Warfare Coordinator (AAWC) and the training textbook for an identical task. The team compared the performance between the group trained using the AR method with the group trained using the textbook method. A total of 24 Junior and Senior levels undergraduate students took part in this experiment. This experiment consisted of two sessions: training session and practice session. During the training session, 12 students were trained using the AR training material (Group A), while the other 12 students were trained using the AAWC training textbook. In order to evaluate the performance of the AAWC task, we used Situational Awareness Global Assessment Technique (SAGAT). The ANOVA results showed a significant performance difference among Group A and Group B, F (1,12)=12.29, p < 0.01. Participants who were instructed with the AR training demonstrated higher situation awareness compared to others. This supports that AR training can provide a positive learning effect in computer-based training simulation.
Huanyu Chen, Xiaowen Xu, and Robert O’Connell

Nowadays, energy is a big issue in the world. Smart distribution networks, which supply electricity directly from the transmission system to end users, will need to undergo significant developments to cope with the decarbonisation of electricity generation, transport and heat. From small to large scale smart distribution networks, power loss should be given a priority in our research work to help solve the energy problem. To decrease the power loss, the distributed generators will be interconnected to the existing distribution networks, which are primarily radial. Distributed generators interconnected into the distribution network are regulated to within certain limits, based on the technical interconnection problems. The next generation smart grid will be required to accommodate increased customer demands and will require distributed generator units to ensure a high power quality and energy efficiency. This project is focused on power loss reduction, including the effects of distributed generators based on a certain network. A direct approach for unbalanced three-phase distribution load flow solutions is using to calculate the power losses for the 32-bus test system in different study cases. A method for placement of distributed generators is considered based on the analysis of power flow continuation and determination of most sensitive buses to voltage collapse. The project results show that proper placement of distributed generators can effectively reduce the power losses and improve the voltage quality. In the case that generators inject both real power and reactive power, reactive power plays a prior role in the power losses.
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Funding Source: College of Engineering Undergraduate Research Option

Gen network display tool for SoyKB

Yuxuan Chen, Jiaojiao Wang, Dong Xu, and Trupti Joshi

Soybean Knowledge Base (SoyKB) is a comprehensive all-inclusive web resource for soybean. It is designed to handle the storage and integration of the gene, genomics, EST, microarray, transcriptomics, proteomics, metabolomics, pathway and phenotype data. Since a hallmark of modern biology is tremendous amounts of complex omics data, we do want to develop some tools for scientists to get a better understanding of the data and hypothesis generation.

The project is used to display the data of soybean gens in a graphic way. This tool is aimed at help bio-scientists to analysis the gens data more easily. Base on the data offer by scientists, the related graph will be automatically generate. The gens will be show as a node and the relation between them will be shown as the lines between these nodes. The node is dynamical, so user can drag and place them at any position in their moving range. And when one node is moving , all the node beside this one will separate evenly . In this way, user is more easy to focused on one nodes.
Effect of phosphate solutions on crosslinking time and physical properties of chitosan thermogels

Emily Cheng and Bret Ulery

Thermogels are of great interest for the treatment of osteoporosis due to their potential as non-invasive drug delivery carriers. These networks in water exist as an injectable solution at cold temperatures that can be directly delivered into an osteoporotic fracture site where they will solidify into a hydrogel as they warm to body temperature. Ionic crosslinking is one method that can be used to form such complex networks and can be achieved by a variety of ions, some of which possess potent biochemical effects. Of particular interest are two classes of phosphate-containing molecules: phosphates and bisphosphonates. The first class possesses known bone generating effects, whereas the other class is known to kill osteoclasts inhibiting bone resorption.

This project focuses on studying the effect of phosphate and bisphosphate solutions on crosslinking time and the physical properties of chitosan thermogels. Chitosan has been crosslinked with ammonium hydrogen phosphate (AHP) in previous studies. Building upon this result, a number of experiments were conducted, varying the type of ion and its concentration. Gelation time was measured using an inversion test. We have found that dibasic sodium phosphate induces uniform gelation in approximately 4.5 minutes while disodium pyrophosphate and tetradsodium pyrophosphate gelate nearly immediately yielding a solid segment and a liquid. By determining the effect of phosphate solutions on crosslinking time and the physical properties of the thermogels, we will be able to manipulate the parameters to produce a range of hydrogels capable of treating a variety of osteoporosis-related injuries including vertebral compression fractures and long bone pathological fractures, which require different mechanical properties and gradients of biological repair cues.
Enhanced TOC removal in drinking water treatment process using treatment plant residuals

Joseph Clamp and Enos Inniss

Organics removal and disinfection are two vital parts of the drinking water treatment process. Inefficient removal of Total Organic Carbon (TOC) leads to formation of carcinogenic Disinfection By-Products (DBPs) when chlorine is used as the disinfectant. The newly promulgated Stage-2 Disinfectant and Disinfection By-Product (D/DBP) regulations force water utilities of all sizes to be more concerned with their finished and distributed water quality. Compliance requires adopting new treatment technologies while managing existing financial and infrastructural constraints.

This study is performed in an effort to develop a simple, non-invasive and cost-effective technology that will effectively lower organic precursors while helping the water utilities to reuse their treatment residuals, what would otherwise need to be disposed of. Jar tests are used to simulate drinking water treatment unit processes in the lab with the 3 most commonly used coagulants (Alum, Poly-Aluminum Chloride (PACl) and Ferric Chloride) and their respective residuals. Ten Coagulant to Residual (C/R) ratios are tested for additional TOC removal with raw water from Missouri River, City of Columbia, Odessa, Booneville and Marceline.

It is statistically proven that addition of treatment residuals with available pore spaces result in heavier floc formation and lead to better sedimentation of organics. An average of 21%, 28% and 33% additional TOC removal can be achieved with C/R ratios < 1 with Alum, PACl and Ferric chloride respectively. It is also observed that instead of expected aluminum and iron leaching effect, this new technology allows for additional removal of these metals from the water there by improving the finished water quality.
Expectancies and meaning in life

Kelsey E. Clark and Laura A. King

Meaning in life (MIL) is often regarded as something vitally necessary, yet impossible to obtain or understand. However, research has shown that mundane experiences of pattern, regularity, and environmental coherence can influence the phenomenological experience of MIL (Heintzelman & King, 2014a). For example, the Meaning Maintenance Model (Heine et al., 2006) posits that expectancy violations threaten MIL. When preexisting expectancies are violated, life feels less meaningful (Heintzelman & King, 2014b). The present study examined the role of expectancies in MIL, using associations between holidays and the time of the year. We predicted that “Halloween” primes (e.g., pumpkin) on October 29th-31st would promote MIL, compared with “Fourth of July” primes (e.g., fireworks) on those days.

Participants (N =113) were approached in public places. They were randomly assigned to one of two word find conditions: Fourth of July (n =59) or Halloween (n =54) and instructed to find 5 of the words in the puzzle and then complete the Presence of Meaning subscale of the Meaning in Life Questionnaire (α=.85; Steger et al., 2006), two items measuring the belief that human life is meaningful (r=.63, p <.001), and single item measures of mood and life satisfaction.

Because of our directional hypotheses, one-tailed tests were used. As predicted, participants in the Halloween group endorsed higher MIL than those in the Fourth of July, t(111) =1.09, p =.14, d =0.21, though this difference was not significant. Controlling for general meaning F(1,110) =24.79, p < .001, the condition effect was significant, F(1,110) =3.11, p =.041. These findings promote the idea that MIL is indeed influenced by environmental coherence.

This project was completed to fulfill a Capstone requirement.
The effect of illuminance on the reliability of visual inspection

Zane Clark and Glenn Washer

Condition assessments of highway bridges typically rely on visual inspection for the initial detection and evaluation of damage. These inspections assess the condition of the members, focusing in particular on the detection of cracking in steel members, which could undermine the structural integrity of the bridge. Inspections rely on the inspector’s ability to detect cracks visually; however, previous research on the reliability of this process has indicated that crack detection rates are very low. One factor that affects an inspector’s ability to detect a crack is the degree to which the member under inspection is illuminated. The visual nature of this task requires that adequate lighting be available during the inspection. However, the geometric environment of a bridge is such that many regions of the bridge are poorly lit; due to this, and the lack of lighting requirements in this field of assessment, inspections are typically conducted in relative darkness. The low contrast provided by a crack in the steel surface may be difficult to detect under these circumstances.

The objectives of this study are to determine adequate lighting levels, spatial and contrast resolution, and overall visibility necessary for reliable crack detection. The first task’s objective was to identify which commercially available lights or types of lights met certain standards in other industries and, therefore, were a starting point for investigating in visual bridge inspection. The research task was to assess the performance of a series of flashlights in a number of areas, for example illuminance and uniformity of light. The second task is to test visual resolution and reliability of detection under differing lighting conditions using actual study participants. The future aim of this research is to provide a useful reference on the nature of illuminance during inspection and to make recommendations for the improvement of inspection reliability.
This research examines community members’ and educators’ beliefs about language education programs. Specifically, Columbia Public Schools (CPS) is considering a Spanish-English dual language (DL) program, which would provide content and literacy instruction to students in two languages within the same classroom. This promotes bilingualism, cultural awareness, and academic achievement for English Learners (ELs) and English-speaking youth (Howard et. al, 2007). However, prior research demonstrates that developing DL policies is a value-laden, political process, where different stakeholders’ beliefs and values can shape program implementation (Dorner, 2011). Thus, our study asked: What is the current model of EL education in CPS? What do parents, teachers, and administrators think about changing to a DL program?

CPS currently has 1,010 EL students who speak 58 different languages, including 26% who speak Spanish. Data was collected through six months of participant observation in one EL-focused elementary school, four interviews of CPS teachers and administrators, and two interviews with parents. Analyses also examined demographic data, four newspaper articles, and letters to the editor about the district’s consideration of a new DL program.

Preliminary findings indicate that while the current approach to EL education is believed to be effective, there are challenges with the model. Specifically, the current EL model has a growing number and diversity of students, which makes it challenging for teachers to fully meet their various needs. Meanwhile, parents believed that DL models could improve education for EL students and offer an additive, bilingual education for native English speakers. At the same time, educators expressed questions about which language community to serve in a DL model, and whether the district could secure the proper funding, teachers, and necessary resources for it. Implications will discuss how the district may move forward with planning given these varieties of beliefs and opinions.
The role of ephrin-A3 in slow muscle fiber development of the diaphragm

Nathan Coffey, Laura Arnold, Danny Stark, and Dawn Cornelison

Skeletal muscle fibers (myofibers) are classified as either fast or slow, based on the specific myosin heavy chain gene they express. This confers unique contractile, physiological, and metabolic functions on individual myofibers. The patterning of fast and slow myofibers in each of the 200+ skeletal muscles in the human body are adapted to that muscle’s unique function. No mechanism has yet been published for how fast and slow myofibers specifically pattern during development. Recent work from our lab suggests that expression of ephrin-A3, a repulsive transmembrane ligand, is restricted to slow myofibers in the hindlimb of mice and promotes innervation of slow motor neurons by repelling fast motor neurons, which express ephrin-A3’s receptor EphA8, to preserve slow myofiber identity in muscle. Mice genetically lacking ephrin-A3 have no slow myofibers in all but one hindlimb muscle. Slow myofibers are also prevalent in the diaphragm, a skeletal muscle from a different developmental lineage than limb muscle. We therefore asked if the same ephrin-A3 expression and function are conserved in the diaphragm.

We discovered that, similar to hindlimb muscle, the expression of ephrin-A3 is restricted to slow myofibers and EphA8 is restricted to fast motor neurons. When we compared the number of slow myofibers in the diaphragm of wild type and ephrin-A3/-/- mice, we saw a significant difference in the number of slow myofibers. Overall, our results suggest that the function of ephrin-A3 in hindlimb muscle is conserved within the diaphragm. Understanding how the diaphragm's myofibers develop will help uncover how this muscle can atrophy and function aberrantly, which is important because suffocation due to atrophy of the diaphragm is the leading cause of death in patients in with muscular dystrophy.

This project was completed to fulfill a Capstone requirement.
Optimization of process for effective heat removal in high efficiency laser arrays

Nicholas Cole, Charles Meyer, and Gregory Triplett

The Compound Semiconductor Research lab produces single-crystal semiconductor samples by depositing thin arsenide/antimonide multi-quantum well laser structures of approximately 3 microns, on 350 micron GaAs/GaSb substrates via molecular beam epitaxy (this is a technique that deposits high quality semiconducting layers one atomic monolayer at a time). These multi-quantum well structures have been optimized to minimize carrier loss, a mechanism that degrades power conversion efficiency. However, once these samples are produced, the relatively thick substrate prevents quick removal of heat when the device is operational, which leads to increased current levels for maintaining constant optical power. In order to minimize these negative effects of thick substrates, we aim to reduce the back side of the substrate, while retaining the optical properties of the deposited structures.

To accomplish this, we remove material through a multiple step lapping process, with the goal of removing 150-200 microns of the substrate layer and retaining the crystalline quality of the sample. The multi-quantum well sample is cleaved into smaller (1/4 of a 2” diameter substrate) pieces, mounted to a substrate holder using clear mounting wax, thinned using a sequence of grit lapping pads on top of a rotating lapping plate, and polished to produce a mirror-like finish.

The goal of this work is to evaluate surface roughness using optical microscopy and ensure high performance of these light producing devices. With this technique, we are able to remove more than 50% of the substrate and increase the heat extraction capability of the multi-quantum well structures. These thinned samples undergo metallization (Ti/Pt/Au) on each side of the substrate, mounting to a c-mount laser block, contact bonding using a ball-wedge bonder, and electrical-pulsing using a laser driver and thermoelectric cooler. This technique has been developed to meet packaging and performance requirements for our near-infrared to mid-infrared photonic devices.
Evaluation of cell growth potential on PCL-scaffold with and without collagen coating

Alex Cook, Aaron Stoker, James Cook, and Ferris Pfeiffer

The goal of this project is to evaluate the cell growth potential of PCL scaffolds for use as osteochondral plugs. Damage to articular cartilage is a common occurrence in aging adults and individuals with a history of joint injuries. Due to repetitive loading, these defects generally do not have the ability to heal themselves. In these instances, osteochondral allograft procedures are the primary treatment to replace damaged cartilage with healthy donor tissue. However, problems with donor tissue compatibility and availability persist, and the need for an artificial bioconductive scaffold to help induce native tissue growth has increased. Our long term goal is to develop and artificial osteochondral plug that facilitates native articular chondrocyte growth and migration. To that end, it is critical to thoroughly evaluate the cellular growth potential of biocompatible scaffolds.

Eight 80,000 molecular weight polyvinyl chloride disks were obtained, sanitized with isopropyl alcohol for 72 hours and separated into two groups (n=4). The negative control group (N) was placed into a 12 well plate and covered with 2ml of PBS overnight. The collagen group (C) was placed into the same 12 well plate and covered with 1ml of a 4.36mg/ml collagen 1 solution overnight. The constructs were then each seeded with 1,000,000 chondrocytes and cultured for 15 days in 2ml of DMEM supplemented with 5% FBS at 37°C and 5% CO₂. Media was collected and replaced every 3 days for biochemical analysis. Cell viability was assessed after 15 days of culture.

This project was completed to fulfill a Capstone requirement.
Analysis of the metabolic response of meniscal tissue to injury and inflammation \textit{in vitro}

Alex Cook, Aaron Stoker, James Cook, and Ferris Pfeiffer

Objective: This study was designed to begin to characterize the metabolic responses of meniscal tissue to injury and inflammation.

Methods: Menisci were aseptically collected from the knees of skeletally mature dogs (n=9) euthanatized for reasons unrelated to this study. Explants were impacted at 0%, 25% or 75% strain based on tissue thickness. Impact and control explants were cultured in 2ml of supplemented DMEM with or without 0.1ng/ml rcIL-1β. Explants were cultured for 12 days at 37°C, and media were changed and collected for biomarker analysis every 3 days.

Results: Treatment with IL-1β alone significantly (p<0.05) increased NO, PGE2, general MMP activity, IL-6, IL-8, KC, and MCP-1 media concentration compared to the negative control. Impact at 75% significantly increased PGE2, IL-6, IL-8, and KC media concentration compared to the negative control. The combination of IL-1β and 75% strain significantly increased the production of PGE2 compared to IL-1β and 75% strain alone.

Discussion: These data indicate that injury to the meniscus not only has the potential to destabilize the biomechanical function of the knee, a known factor in the initiation of OA, but can also contribute to the increase in joint inflammation and degradative enzyme concentration often associated with OA pathogenesis and progression.
Arguably no sport has embraced the statistical revolution more so than baseball. Players used to be evaluated by their physical build, confidence level, and basic statistics such as fielding percentage - a statistic that takes the amount of successful plays a fielder converts and divides it by the total chances a player has to make a play. Ever since the release of the book *Moneyball* by Michael Lewis in 2003, advanced statistical analysis has made its way into most Major League Baseball front offices. Because of this new strategic focus by many organizations, players are now evaluated by advanced statistics including: WAR, (Wins above Replacement), FIP, (Fielding Independent Pitching), and OWP, (Offensive Winning Percentage). However, the new wave of statistics, often referred to as “Sabermetrics,” generally focuses on the offensive or pitching production of players. When mathematically calculating how many wins a team produces, one must include the number of runs scored as well as given up in games. Considering this, there is a need for researchers and stakeholders to examine the value of both offensive and defensive capabilities of baseball players. One factor which the advanced analysis of on-field baseball performances has failed to analyze is the fact that there are no standardized sizes or shapes for playing fields in baseball. With this in mind, the current research calculates the defensive capabilities of Major League Baseball teams by adjusting defensive statistics by the size of playing fields. Findings from this study help to provide enhanced understanding of the value that certain players may have in preventing runs, and contributing to their teams winning more. Through such analysis, this research provides important managerial implications in determining whether a team should seek certain types of defensive players based on the home stadium they play in.
The effects of relative power on sibling relationship quality

Vaness Cox, Anna Lindell, and Nicole Campione-Barr

Previous research suggests that girls and siblings closer in age perceive higher levels of dominance from their siblings than boys and further spaced siblings. Additionally, older adolescents perceive holding more power than younger adolescents. However, it appears that the sibling relationship becomes more egalitarian with age (Buhrmester & Furman, 1990; Furman & Buhrmester, 1992). While these few previous studies have investigated relative power within sibling relationships, little is known about how relationship quality is affected by power dynamics and how this may change with age. We aim to: 1) confirm the effects of family structural variables on relative power, and 2) investigate the role of relative power on sibling relationship quality.

The sample included 145 predominantly White, middle-class, sibling dyads (total n=290). Siblings completed the Network of Relationships Inventory (Furman & Buhrmester, 1985) to assess their relative power and relationship positivity. Analyses revealed that the closer in age younger siblings are to their older sibling, the greater their relative power. Also, sister-sister dyads report having less relative power than mixed-sex dyads. Girls and sister-sister dyads report more positive relationships than boys and other dyads. In the youngest age cohort, relative power was not significantly related to positivity. However, for the middle and oldest cohorts, the less relative power they reported, the more positively they rated the relationship. These findings suggest that with age, sibling relationships must become increasingly egalitarian for them to be high quality.
User Interface and functionalities design and development for iOS devices’ application

Hang Cui, Dahai Liu, Liping Tu, Meng Zhang, Duan Ye, and Dong Xu

The group designed and developed an algorithm, which can process an image of tongue and diagnose user’s current health status. The algorithm has been implemented on iOS application as an App iTongue. The App can generate advices for user to improve current health status and provide recommendations for menu selection in a restaurant based on the processed image, questionnaire answers and a list of food/menu in the database. In addition, a list of suggestion for general diets will also be generated by the App.
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Is the curse real? Professional athletes on video game covers and declines in their performance

Brad Curd, Kristin Halford, Zachary Ricketts, and KangJae Jerry Lee

This study investigated professional athletes’ performance before and after the appearance on the cover of video games. Rumors suggest that athletes selected for the cover experience substantial declines in their performance. Although it has been widely recognized as a curse or jinx, no scientific investigation has been conducted on this controversial topic. This study examined if athletes indeed demonstrate worse performance after the cover appearance by examining most recent video games from 1999 to 2015.

We used various indicators to evaluate athletes’ performance. The performance information from the year before athletes were on the cover and the year when they were on the cover were collected from sports-reference.com. The data consisted of 50 cases. Athletes were categorized into three groups based on the average percentage change in performance: -1 = more than 20% decrease, 0 = percentage change within -20% to +20%, and 1 = more than 20% increase. The numbers of athletes in each category were 27, 21, and 7, respectively. A paired sample t-test was performed on the number of games played and assists. The number of games played by athletes significantly decreased from the year before the cover appearance ($M = 67.96, SE = 6.69$) to the year of cover appearance ($M = 59.74, SE = 7.15$), $t(49) = 2.393, p <.05, r = .10$. The number of assists also decreased from the year before the cover appearance ($M = 155.03, SE = 33.22$) to the year of cover appearance ($M = 143.65, SE = 41.03$). However, this difference was not significant $t(25) = .54, p >.05, r = .01$. We are currently expanding our analytic approach by collecting more data from the cover athletes on Sports Illustrated. The future study is expected to draw a stronger and more generalizable conclusion about the jinx.
In search of clinicopathological biomarkers for early detection of dysphagia in amyotrophic lateral sclerosis


**Purpose:** The study of dysphagia (difficulty in swallowing) pathophysiology in amyotrophic lateral sclerosis (ALS) requires an animal model with adult-onset symptoms. The goal of this study was to compare two transgenic SOD1-G93A mouse models of ALS: the high copy number (HCN) and low copy number (LCN) mouse. Our previous work showed that the lick rate of 3 week old HCN mice was significantly lower than that of age-matched LCN/control mice. The tongue is directly innervated by efferents from the hypoglossal nucleus (HN) in the brainstem. Therefore, the goal of this study was to identify pathology of the HN and tongue correlating with early lingual dysfunction in ALS-affected mice.

**Methods:** Brains and tongues from 3 week old mice were collected after functional swallow studies. Samples were processed for histochemical and immunohistochemical analysis using brightfield microscopy, and for ultrastructural investigation via electron microscopy. Additionally, 8 features of post-maturational gross tongue anatomy were measured from a cohort of 7 week old mice.

**Results:** There were no significant gross anatomical differences between tongues of HCN, LCN, and control mice. Histological analysis showed no obvious group differences in gross morphology of motor neurons in the HN. However, immunohistochemistry in the HN showed differences in the expression of several proteins between HCN and LCN/control mice. Similarly, preliminary ultrastructural analysis of HN motor neurons showed differences between HCN and LCN/control mice. Histological analysis of the tongue and additional ultrastructural analysis of the brain and tongue are in progress.

**Conclusions:** Subtle evidence of neuropathology was identified in 3 week old ALS-affected mice, which manifests concurrently with lingual dysfunction. Validation of this claim with larger samples sizes is currently underway.
The presence of the P2Y2 receptor provides neuroprotective functions in the mouse spinal chord

Rokeith Daley, Deepa Viswanathan, and Gary Weisman

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Dhruveesh Dave
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Faculty Mentor: Dr. Heidi Appel, Plant Sciences
Funding Source: National Science Foundation grant to H. Appel and R. Cocroft

Effect of caterpillar feeding on the phenolic compounds of Arabidopsis thaliana

Dhruveesh Dave, Samantha Breckenridge, Clayton Coffman, and Heidi Appel

To defend against herbivory, plants produce chemicals that can deter insect feeding. More of these chemicals are produced when plants detect attack, but the level of induction may depend on the extent of damage. In this experiment, we wanted to determine whether the amount of caterpillar damage on Arabidopsis thaliana influences the production of phenolic compounds. We varied the amount of damage on each plant by allowing caterpillars to feed either on one leaf or three leaves using clip-cages. We controlled for the effect of the clip cage itself by treating plants with empty clip cages for the same amount of time. We hypothesize that when P. rapae are allowed to feed on three separate leaves of A. thaliana plants, the result will be a higher induction of phenolics compared to plants that received caterpillar feeding on a single leaf or plants that were undamaged. We have yet to complete this experiment; however, results will be ready in two weeks in plenty of time for the Forum.

This project was completed to fulfill a Capstone requirement.
Strong and lightweight carbon nanotube structural members inspired by biological bone

Benjamin Davis and Matthew Maschmann

Carbon nanotubes (CNTs) are molecular-scale tubes of graphitic carbon with exceptional mechanical strength, as well as thermal and electrical conductivity. However, no effective methods of transferring these properties into large-scale, practical applications has been established. One promising technique is the development of free-standing “buckypapers,” which are entangled and compressed networks of CNTs, sometimes with layers of different densities. Analogous structures of different shapes can be developed that have inherently higher stiffness and functionality. This research aims to develop functionally-graded structural members from CNTs that have a dense outer shell and a sparse inner network.

The novel process of making the structural member allows for versatility in shape and size. Firstly, a porous mold is made of the desired geometry by 3D printing or other methods. Next, CNTs are grown using floating catalyst chemical vapor deposition. The nanotubes are then dispersed in an aqueous surfactant solution to increase cohesion and uniformity. This slurry/solution is poured into the mold and spun using a centrifuge. This forces the liquid through the surface of the mold and forms a dense shell of CNTs. This shell is removed and sparse interior network is subsequently grown inside the hollow shell. The resulting structure is similar in cross section to biological bone, where strength is attributed to the solid exterior surface and the interior allows it to be lightweight.

Preliminary calculations predict that the CNT “bone” can have a superior strength-to-weight ratio, good electrical conductivity and excellent heat conduction. However, these properties are strongly dependent on the orientation of the nanotubes. Further studies will be done to quantify the orientation effects on the overall properties and also to connect many of the bones into a skeleton. Envisioned applications include small aerospace frameworks, load-bearing batteries, prosthetics, and oil absorbing mechanisms. These exciting new applications justify further time and effort to enhance how carbon nanotubes are used in our society.
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Faculty Mentor: Dr. Glenn Washer, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option, Missouri Department of Transportation grant to G. Washer

Field testing of hand-held infrared thermography

James Dawson, Alan Jungnitsch, and Glenn Washer

This research project is based around the modern and non-destructive way of inspecting bridges and other structural members for delaminations in concrete, debonding of material layers and steel corrosion by using Infrared Thermography. There are several other previously used methods for determining if repairs will be needed, but are not as practical due to constraints of the test and typically not as accurate or easy to complete. Our objective is to come up with a procedure to quickly, easily and accurately examine these bridges and other structural members for possible needed repair through the use of Infrared Thermography. Over the last several years, field and lab tests have been performed to try and quantify values within the appropriate constraints (i.e. wind speed, ambient temperature, cloud cover and moisture) by which Infrared Thermography can be considered an accurate, practical and easy way of evaluating bridges and other structural members. More tests are continuing to be run on the constraints mentioned previously, and particularly the effects of wind speed on the accuracy of Infrared Thermography data.
Comprehensive analysis of channel and neuromodulator receptor expression in the stomatogastric ganglion of *Cancer borealis*

Clare Diester, Kawasi M. Lett, Eve Marder, and David J. Schulz

The crustacean stomatogastric nervous system is one of the premiere model systems for studying the physiological effects of neuromodulation on neural network dynamics. Dozens of neuromodulators and neurotransmitters have been identified that modify network parameters such as ionic conductances and synaptic strength to generate highly variable output from a small number of identified neurons. Yet very little is known about the receptor subtypes that mediate these responses. We have used a bioinformatics approach to identify putative receptor and channel subtypes in the neural transcriptome of the crab *Cancer borealis*. In addition, we used orthology to design primers for the β-subunit of the voltage-gated calcium channel, which allowed us to amplify and obtain the desired protein coding sequence through the use of polymerization chain reaction (PCR). We then examined expression patterns in the somata and neuropil, as well as in identified neurons of the stomatogastric ganglia (STG) of crabs through single cell RT-PCR. Our bioinformatics screening has identified at least 20 voltage-dependent channel types, multiple receptor subtypes for serotonin receptors (5HTR1A, 5HTR1B, 5HTR2, and 5HTR7), dopamine receptors (DAR1 and DAR2) as well as other biogenic amine receptors for octopamine and tyramine. Expression analyses reveal cell-type specific expression patterns of these receptors across identified neurons of the STG. Our analysis also includes receptors for small molecule transmitters such as glycine, glutamate, and GABA. Taken together, the identification and classification of channel and neuromodulator receptor sequences in this model system will greatly complement the already well-established body of literature on the physiological effects of these compounds, allowing for a synthesis of approaches to further understand the dynamics of neuromodulation of neural networks.

This project was completed to fulfill a Capstone requirement.
The modification of PVDF hollow fiber membrane with nonfouling polyampholyte polymer

Haofeng Ding, Peng Wan, and Baolin Deng

PVDF membranes, one of the most important types of membranes utilized in separation processes, have attracted world attention in recent years. They are widely used in many areas, such as microfiltration, ultrafiltration, nanofiltration, distillation and reverse osmosis. However, membranes comprising hydrophobic material tend to suffer severe decreases in water flux during operation caused by solute adsorption, pore blocking and cake formation. Membrane fouling is an especially serious problem in the case of protein separation because hydrophobic interactions between proteins and the membrane surface induce a non-selective and irreversible adsorption. Easily fouled membranes need frequent chemical cleaning and replacement of the membrane module, giving a short lifetime, which leads to high utility costs. Several studies have been aimed at improving the hydrophilicity of membranes by coating, adsorption, and surface graft polymerization. Another study used hydrophilic chemical modification of bulk membrane materials. To prolong membrane lifetime, membranes with antifouling properties are required.

In our research, a polyampholyte copolymer will be grafted in high density from the surface of poly (vinylidene fluoride) (PVDF) hollow fiber membrane via atom transfer radical polymerization (ATRP). Attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectroscopy, X-ray photoelectron spectroscopy (XPS) and SEM will be used to characterize the membrane surface. The mechanical property of PVDF membrane is improved by the TMA: CAA copolymers surface layers. With expectation, the grafted polymer layer on the PVDF membrane will show a good stability during the membrane cleaning process. A good prospect in obtaining the TMA: CAA copolymers-modified PVDF membranes with high mechanical strength and good anti-protein-fouling performance is also expected.
Modelling burnup and actinide production of thorium and uranium fuel sources for nuclear power systems

Holly Dinkel, Anthony Pace, Eugene O’Donnell, and Matthew Bernards

Thermal power output and actinide generation are essential factors to consider in the design of fuel structures for use in nuclear energy systems. The purpose of this study is to explore the efficacy of using Thorium (Th-232) rather than Uranium (U-238) for short-term, portable power production by comparing power production per unit mass and proliferative isotope breeding of each fuel source. There is considerable interest in the nuclear energy community in Thorium as an alternative nuclear fuel source because of its low production of unstable fission products after irradiation and depletion. In the initial stages of this investigation, the isotopic depletion code ORIGEN (Oak Ridge Isotope Generator) 2.2 was used to calculate power output and actinide and fission product production. For irradiation time intervals ranging from 1 to 10 hours and a neutron source spectrum in the thermal region, the simulation calculated substantially lower production levels of Plutonium isotopes (Pu-239, Pu-240, Pu-241, and Pu-242) for fertile and enriched Thorium fuels than Uranium fuels.

This preliminary investigation was completed using an initial assumption of a constant neutron flux and did not take into consideration the shape of the sample. To more closely model reactor operating conditions, further study utilized a fast neutron source spectrum found in the TRITON sequence in the SCALE6.1 suite. Unlike ORIGEN 2.2, the TRITON sequence allows for the coupling of isotopic depletion and burnup calculations over time, so that the calculations iterate over specified time steps and update the data as a function of the varying neutron flux. It was discovered through the TRITON sequence that irradiation using fast neutrons, as opposed to the thermal and constant neutron flux used as the basis of calculations in ORIGEN2.2, introduced new major actinides as fission products, including the undesirable actinide Pu-238, in the depletion of Uranium fuel.
Grape-phylloxera galls interrogated by RNA-seq

Wade Dismukes, Patrick Edger, Heidi Appel, J. Chris Pires, and Jack C. Schultz

Insect galls are growths whose development is controlled by an insect. Within a gall, the insect is provided food and shelter at the expense of the plant. Galls, like fruit, are generally symmetrical and strong sink. In fact, Charles Darwin once noted that galls resemble fruit. This has led to our hypothesis that galling insects are utilizing reproductive development genes of the plant in forming these galls. This study compared the differences in gene expression between four developmental stages of galls on grapevines caused by phylloxera, age-matched leaves, buds and flowers using transcriptome sequencing. We found that gene expression of galls was more similar to the gene expression of flowers and buds than it was to the gene expression pattern of leaves. We also found an increase in the expression of some key reproductive development genes as galls develop; however, these genes were not as greatly expressed in galls as they were in flowers or buds. This suggests that the insect is somehow altering the expression of these genes throughout the process of gall development.
Thermoelectric coolers (TECs) have been present in many small scale heat transfer applications such as electronic cooling and small scale refrigeration. Their emergence in the electronics field has allowed for more compact devices and higher heat pumping abilities. However, one problem with the device is its low coefficient of performance (COP) that dictates its heat pumping capability. In an attempt to increase the COP of the device, an addition of a mini ejector cooling system is proposed to create a hybrid that helps increase heat transfer.

The addition of the mini ejector allows the device to use the thermal energy from the thermoelectric cooler to heat a working fluid in an evaporating section which then creates a high temperature and high pressure vapor. The vapor then flows through a converging-diverging nozzle to reach a supersonic flow higher than Mach 2. With this high velocity fluid, it creates a very low pressure vacuum section which fluidly connects a low temperature evaporator that produces cooling.

This entrained fluid will flow through a diffuser and mix. The mixed fluid then condenses in the condenser section. The condenser will be coupled with a heat sink and a fan to transfer the heat to the ambient air. Once the vapor condenses at the top of the device, it travels back to the high temperature evaporator and low temperature evaporator via capillary action inside a wicking structure on the walls.

This whole system essentially acts as a heat pipe: It has evaporator sections, high and low, and a condensing section at the top. The goal is to prove the feasibility of the device and to manufacture and demonstrate that the mini ejector can help increase the system’s COP.
Hydrophilic and hydrophobic nanostructures and their effect on heat transfer in oscillating heat pipes

Alex Dodd, Feng Zhang, and Hongbin “Bill” Ma

Self-contained Oscillating Heat Pipes (OHPs) have been around for while and are on the forefront of research to be made more practical and more efficient. One method of increasing the heat transfer of these novel devices is the application of hydrophilic and hydrophobic nanostructures on the surfaces of the OHPs. Hydrophilic nanostructures cause increased surface wetting and lower contact angles which allows for thin-film evaporation and increased wettability. Hydrophobic surfaces allow for higher contact angles and drop-wise condensation, which has been proven to greatly increase heat transfer.

The nanostructures studied in this paper are formed from anodizing copper in a sodium hydroxide solution. Anodizing etched copper in such a solution for twenty four hours forms hierarchical nanostructures of cupric oxide that provide a surface roughness that allows for a Wenzel wetting state. A Wenzel wetting state describes a state of wetting where water will fill in the spaces in between the nanostructures and will therefore be defined as hydrophilic; the water will lay flat and spread out on the surface of the cupric oxide formed.

In order to form the hydrophobic surfaces on the OHPs, plasma polymers were deposited on top of the said cupric oxide by Physical Vapor Deposition (PVD). Using the expertise of Dr. Yu’s lab, a layer of oxygen was first deposited on the cupric oxide. This layer of oxygen was to help the second layer bond to the cupric oxide. The second layer of polymer was trimethylsilane. This layer provides the hydrophobicity to the surface. The surface roughness of the surface creates a Cassie-Baxter wetting state where the surface tension of the water is greater than the surface energy of the surface of the trimethylsilane, therefore creating a hydrophobic surface where the water will not fill in the “cracks” between the hierarchical nanostructures on the surface.

The different combinations of these surface treatments were the foundation of the tests that were performed on the OHPs. Two modes were tested: with hydrophilic surfaces in the evaporator and hydrophobic surfaces in the condenser and vice versa. These tests were accompanied with tests on a normal untreated OHP and a block of copper the same size as the OHP to test proof of concept.
Integration of inventory requirements and repair prioritization

Kyle Dorge, Lauren Himmelberg, Jason Robke, and James Noble

In this research project, our team is developing a model to integrate inventory levels with repair prioritization for The Boeing Company through the Center for Excellence in Logistics and Distribution (CELDi). Currently, we are reading past research articles from areas such as management of repair of recoverable aircraft spares, design of a spare parts logistics system, maintenance task prioritization, expedition policies, and system-oriented inventory models. As we continue our literature review, we are taking note of assumptions, constraints, and potentially similar models that may be beneficial or necessary in the development of our model. With our model, we hope to answer some, if not all, of the following questions: How do we identify if a repair needs to occur or can it be deferred? If a repair needs to occur, how do we prioritize that repair? What will be impact if certain parts aren’t repaired? How can we identify certain parts as excess, and how should we handle these excess parts? Also, we will have to take a number of considerations into account such as repair budgets, investment budgets, and repair capabilities.
Lance Doughman
Yuma, AZ

Faculty Mentor: Dr. Keith Goyne, Soil, Environmental & Atmospheric Sciences
Funding Source: CAFNR—Agriculture Institute

Effects of organic matter removal and soil compaction on active carbon in the Ozark region 21 years after sawlog harvest

Lance Doughman and Keith Goyne

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Simone Dietrich, Political Science

Foreign aid allocation and democracy abroad: How do donors really react to change?

David Duffeck and Simone Dietrich

Research abstract withheld at the request of the faculty mentor for proprietary purposes.

This project was completed to fulfill a Capstone requirement.
Duchenne muscular dystrophy (DMD), a severe muscle wasting disease, is caused by an X-linked recessive mutation in the dystrophin gene. It affects 1 in every 5000 male toddlers. The disease is characterized by a whole body progressive loss of muscle function and weakness. The most common and least invasive biomarker for the disease diagnosis is serum creatine kinase (CK), a muscle enzyme that is released from damaged muscles. Unfortunately, CK is not the best biomarker. First, it is a diagnostic marker, not a prognostic marker. CK levels have not been shown to predict either the histology or severity of the disease. Second, CK gets elevated in healthy people following any type of muscle injury, including microtears from normal exercise. Therefore, finding alternative noninvasive biomarkers is needed to determine disease progression and severity. Dystrophin-null canines are an excellent large animal model to study the pathogenesis and the progression of DMD, because they have phenotypic similarities to human patients. To determine if other biomarkers exist within the blood, we conducted a comprehensive analysis on blood chemistry results from 32 normal and 47 affected dogs, collected in the last five years in our dog colony. These reports have been stored in an internal database to facilitate the analysis based on genotype, age, gender, and treatment. As predicted, the CK level was elevated in affected dogs throughout the age we analyzed (0-15 months of age). Interestingly, during the early growth period, up to 3 months of age, both normal and affected dogs have lower red blood cell count, hemoglobin as well as total protein. In addition both normal and affected dogs, during the same early growth period, have increased alkaline phosphatase, while only affected dogs have increased alanine transaminase throughout their lifetime. Our results show that screening blood for biomarkers in the future can provide for an excellent noninvasive method to diagnose DMD.
Carboxyterminal tails found on neurofilament medium and heavy subunits may play a role in determining intermodal length

Charcot Marie Tooth Disease (CMT) is one of the most common genetic neurodegenerative diseases, affecting approximately 1 in 2,500 people in the United States. This disease is caused by mutations in genes that disrupt axonal transport and causes degeneration of peripheral nerves. Neurofilament medium and heavy subunits play a large role on axonal transport. There are carboxyterminal tails on neurofilament medium (NFM) and neurofilament heavy (NFH) subunits that seem to regulate the spacing between neighboring neurofilaments. This spacing may play a role in internodal length, (the space between Nodes of Ranvier) which could alter the performance of the axon; however, I hypothesize that internodal length is not affected by the carboxyterminal tails. To test this hypothesis, we are comparing the intermodal length of NFM/NFH subunits in wild-type mice to mice with a knockout of either one or both of the subunits’ carboxyterminal tail domains. The mice were genetically modified to cause a deletion of the carboxyterminal tail domains. Following this deletion, they are divided into 4 groups to create a wild type, NFM null, NFH null and NFM/NFH null. Mice are raised until 6 months of age before extracting the L5 root from the spine of the animal. Using this root, we are able to tease apart axons underneath a microscope and generate images of the axons. Computer software is utilized to measure the length of internodes in order to quantitatively compare the 3 null groups with wild-type mice intermodal length. Future analyses are needed to determine whether carboxyterminal tails play a significant role in the efficiency of nerves. All of these experiments provide more insight about the mechanisms underlying CMT and are integral to developing methods to combat CMT.
Cerebral blood flow (CBF) is regulated by cerebrovascular autoregulation and functional hyperemia. The latter refers to matched delivery of blood flow to the brain regions with different activity levels. The goal of this project is to study relationship between Ca\textsuperscript{2+} signaling in endothelial cell and CBF change after sensory stimulation. Initially, we have stimulated the hind-limb and used a laser Doppler to find the threshold for a change in CBF in the brain after sensory stimulation. We found that the response threshold for a typical mouse is around 470 µA and will use this information for stimulation to evaluate transgenic mice. To further study the mechanism of functional hyperemia in vivo, we performed in vivo two-photon (2-P) imaging on endothelial Ca\textsuperscript{2+} signaling and CBF following hind-limb stimulation. For imaging endothelial Ca\textsuperscript{2+} signaling, we used transgenic mice to express the genetically encoded Ca\textsuperscript{2+} indicator GCaMP5 in endothelial cells; for imaging vessel diameter and CBF, we injected dextran-Rhodamine in blood vessels. 2-P time-lapse imaging was performed to simultaneously monitor diameters of arterioles and the Ca\textsuperscript{2+} change in endothelial cells after electric and sensory stimulation through an open cranial window on the somatosensory cortex. Our results would establish the relationship between endothelial Ca\textsuperscript{2+} signal and CBF change in live mice.
Postmodern picture books are a specific genre of picture book that reaches out to the reader and requires participation. Postmodern picture books deviate from normal texts in the way the story is conveyed and are thought to be more complex through their use of metafictive devices. Some of the most prevalent metafictive devices found in postmodern picture books are as follows: narrators jumping out and addressing the reader, characters communicating with the narrator, characters giving commentary, more than one narrator, stories within stories, disruptions of time and space, non-linear structure, intertextuality, parody, unique arrangements of text, illustrations, or book layout, and metalepsis (Pantaleo, 2014).

Our research focuses on how five three and four year-old children responded to postmodern picture books in the context of a teacher’s thoughtful mediations. In a two-week time period, researchers Lenny Sànchez and Angie Zapata collaborated with a classroom teacher to create a series of invitations to introduce and support young children’s responses to postmodern picture books. This was done through well-planned immersion experiences with the literature and interactive read alouds of select postmodern picture books.

We analyzed the data for emerging themes and patterns in the way children reauthor the postmodern picture books. We define reauthoring as the ways in which children interact with and influence the narrative beyond the authority of the physical text. We believe that reauthoring allows children to mold the text into their own creation (Sanchez & Zapata, 2014). We identified two salient patterns in students’ reauthoring: verbal reauthoring and performed reauthoring.

It is necessary to understand the ways children respond to this interaction in order to comprehend how young children can digest or interpret these complicated texts. 21st century readers are encouraged by postmodern picture books to deeply engage with the text in a level not previously recognized.
Biomechanical evaluation of posterior cruciate ligament transection and repair in the human knee

Laura Evans, Andrew J. Polk, James L. Cook, Pat Smith, James P. Stannard, Mauricio Kfuri, Matthew Mooberry, and Ferris M. Pfeiffer

Isolated injury of the Posterior Cruciate Ligament (PCL), and compound multi-ligament injuries involving the PCL contribute to a large number of clinical orthopedic trauma cases. It is well known that these injuries contribute to anterior-posterior instability of the knee, and if left untreated, can lead to early arthritis of the knee. Numerous surgical repair techniques currently exist to treat PCL injuries, however the relative efficacy of each technique is debated.

The objective of this project is to examine the biomechanical effects of isolated PCL injury on anterior-posterior (A-P) stability of the knee, and to evaluate the effectiveness of various surgical repair techniques in restoring stability. This project will provide clinicians with a better understanding of the biomechanical function of the PCL, and will lead to improved clinical treatment of PCL injuries. We hypothesized that an isolated PCL injury will significantly destabilize the human knee joint in the A-P direction, and that reconstruction of the injury using one of three repair techniques will restore function to within 80% of the intact state.

Based on the results of this study, we conclude that posterior cruciate ligament attachment significantly contributes to knee joint stability in A-P shear. We also conclude that the method used for PCL reconstruction can significantly affect stability of the surgically repaired human knee in A-P shear.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Matt Fleissner, Carmen Aboytes, Katy Beyer, Andrew Briedwell, Andrew Pelikan, Virginia Trauth, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
Regular physical activity is effective in reducing visceral white adipose tissue (AT) inflammation and oxidative stress, and these changes are commonly associated with reduced adiposity. However, the impact of multiple periods of physical activity intercalated by periods of inactivity, i.e., intermittent physical activity, on markers of AT inflammation and oxidative stress is unknown. In the present study, 5-week old male C57BL/6 mice were randomized into three groups (n=10/group): sedentary, regular physical activity, and intermittent physical activity for 24 weeks. All animals were singly-housed and fed a diet containing 45% kcal from fat. Regularly active mice had access to voluntary running wheels throughout the study period, whereas intermittently active mice had access to running wheels for three-week intervals (i.e., 3 weeks on/3 weeks off) throughout the study. At sacrifice, regular and intermittent physical activity was associated with similar reductions in visceral AT mass (~-24%, p<0.05), relative to sedentary. However, regularly, but not intermittently, active mice exhibited decreased expression of visceral AT genes related to inflammation (e.g., MCP1), immune cell infiltration (e.g., CD68, CD11c, F4/80, CD11b/CD18), oxidative stress (e.g., p47phox), and endoplasmic reticulum stress (e.g., CHOP; all p<0.05). Furthermore, regular, but not intermittent, physical activity was associated with a modest improvement in glucose tolerance (p=0.059). Collectively, these findings suggest that irregular physical activity over a prolonged period of time leads to a reduction in adiposity but with retention of a “sedentary obese” white AT and metabolic phenotype.

This project was completed to fulfill a Capstone requirement.
Investigating how male masking signals inhibit female replies in a duetting treehopper

Micah Fletcher and Rex Cocroft

There is a wealth of research studying the influence of female preference on the evolution of advertisement signals. In contrast, very little is known about the evolution of disruptive signals, which are produced during the advertisement signal to reduce the likelihood of a female response. In the treehopper species *Tylopetla gibbera*, multiple males will duet with a single female. Only the first male to find her copulates successfully and the losing male may not get another chance to mate, so selection for effective mate-searching is strong. In an attempt to inhibit female responses to his rival, each male will produce specialized disruptive signals during the advertisement of the other male. This disruptive signal is unusual because it is used only for duet disruption and it overlaps only a specific feature of the advertisement signal. I am studying the effect of disruptive signals on female perception of the advertisement signal by characterizing the features necessary for signal recognition and by characterizing the disruptive signal most effective at inhibiting female responses. I am playing back synthetic stimuli and modified recordings to females to understand the evolution of signals that are adapted specifically to disrupt other signals.
Design of a new interface creation method for a shock driven variable density turbulence experiment

Shuangjiu Fu and Jacob McFarland

The goal of this undergraduate research is to design a new interface creation method for a shock driven variable density turbulence experiment. The first part is to perform CFD simulation of the initial conditions and the second part is build a shock-tube mock-up to conduct experiments to verify the CFD results.

The interface was to be created in a horizontal shock tube where a heavy fluid was to be separated from a light fluid by a turbulent vertical interface. This type of vertical interface is hydrostatically unstable and only through the dynamic forces of a turbulent jet can it be maintained. This interface is sensitive to parameters such as the jet diameter, outlet diameter, and flow velocities. ANSYS FLUENT was used in to create 2D simulations of this interface. A rectangular domain was used with heavy fluid (CO$_2$) injected into one side while light fluid (N$_2$) is injected into the other side. There are two high velocity jets in the middle of the top side. One is for CO$_2$ and the other is for N$_2$. A jet outlet is on the bottom which allows the mixed gases to escape.

The adaptive mesh is built in this simulation, and the resolution is increased until the results do not change significantly. The elements in the center are 64173, 377039, 420988, 802956, 1367582 and 4174170 respectively. The methods conducted mainly are K-epsilon-realizable, K-epsilon-standard, K-omega-standard, K-omega-realizable, K-omega-SST and K-epsilon RNG. The results show that K-omega-SST is the best fit. However, all the methods diverge when the elements in the center are more than 1367582. Which method is eligible to be conducted is still uncertain. So a transparent shock tube mock-up was designed and built to verify the simulation parts. The experiment is still unfinished but we plan to have preliminary results soon.
Design for the study of curved nuclear fuel plates

Carl Fuemmeler and Gary Solbrekken

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Component analysis of functional behavioral assessment and behavior intervention plans among children with disabilities

Samantha Fullington, Casey Gibbons, Barbara Mitchell, and Timothy Lewis

This research helps teachers determine the cause of the problematic behavior. For the purpose of this study, we defined problematic behavior as high frequency and low intensity disruptive behavior in elementary aged students in a general education room. These students also qualify for special education services. Our interest was to compare outcomes among the indirect and direct methods.

In this research, we investigated indirect methods for assessing students’ problem behavior in comparison to direct assessment method. The indirect methods we used included conducting interviews with classroom teachers, having teachers complete a brief questionnaire about the student’s behavior, and observing the students during a classroom situation (Antecedent-Behavior-Consequence observation). These methods helped us hypnotize what caused the problematic behavior. The direct assessment required experimental trials of several different conditions, including hard tasks compared to easy tasks, and with and without teacher and peer attention, in a contrived setting. By altering these conditions presented to the students, we were able to determine which conditions were most and least problematic for students.

After conducting the direct measure with each student we were able to find out whether the students were acting out because of the difficulty of the task, or if they wanted teacher or peer attention. In all students we found that the students were on-task when they were given an easy tasks or when they were given a hard task with teacher attention. Another result the data showed was that with all students, they were off-tasks when given a hard-task with no teacher attention. This led us to conclude the students desired teacher attention over peer attention. These finding from the direct measures were similar to the findings with the indirect measures.

We want to teach educators that they can conduct their own indirect measures to determine the cause of the student’s problematic behavior, because they are easier and more time efficient than direct measures. After they determine the cause, they are able to implement strategies that would benefit the student.
Why fees signal performance: An analysis of mutual funds and ETFs

Monroe Gamble IV and Shastri Sandy

In this study we track the emergence of Exchange Traded Funds (ETFs) as alternative investment vehicles to mutual funds. As the number of ETFs brought to market continues to rise, we look at the potential risks and disadvantages posed by ETFs in comparison to traditional mutual funds. Detailed in our analysis are correlations between expense-structures and performance. We hypothesize high-expense funds must yield higher returns as to offset costs born to investors. Proven true, this leaves room for future investigation into the use of high management fees as a signal of superior management and increased complexity in trading strategy.

We also examine passive management styles, following ETFs that track major indices (i.e. S&P 500, Russell 2000, CRSP, etc.). We compare ETFs returns, performance and expense ratios to those of actively managed funds. Over time we hypothesize an increased correlation between mutual fund fees and ETF fees due to increased competition.
Creation of biodegradable tissue scaffolds

Carly Garrow, Andrew Polk, and Ferris Pfeiffer

Degeneration of articular cartilage, caused by trauma or a variety of other issues, can lead to degeneration, osteoarthritis, and significant joint pain. Currently, a process to regrow articular cartilage in areas of degeneration does not exist in medical practice. However, assisting the regrowth of articular cartilage can prevent osteoarthritis and joint pain from developing or worsening. The purpose of this research project was to develop the optimal parameters for creating a biodegradable tissue scaffold with an ideal pore size and mechanical strength to be placed in the joint as a substitute for damaged osteochondral tissue.

A 3D-printing process was established in order to create 75 biodegradable tissue scaffolds from Polycaprolactone (PCL) for use in development of an osteochondral implant. Proper tissue scaffolds should contain appropriately sized pores, exhibit symmetry and flat surfaces, and demonstrate ideal mechanical strength. The custom 3D printer used for this project contains manual temperature controls to melt and extrude material. Various design parameters were adjusted to generate optimal pore size and mechanical strength. Prints 6mm in diameter and pieces 6mm in diameter cut from 20mm prints were compared for symmetry and surface flatness. In addition, these pieces underwent indentation testing to evaluate the mechanical strength of each scaffold.

In conclusion, an extruder temperature ranging from 185ºF to 195ºF and a water temperature of 75ºF were established as ideal parameters for creating the optimal scaffold. A 6mm piece cut from a larger print exhibited greater symmetry and surface flatness for each print. Currently, PCL of different molecular weights is being tested for decreased brittleness. In addition, testing of the ability of these tissue scaffolds to sustain cell life in vitro is underway.
Leveraging GPUs to accelerate geospatial image processing

Eric Gaudiello and Grant Scott

The goal of this work is to construct a set of generic algorithms to accelerate the analysis of geospatial image data. These algorithms will be aggregated into a collective open-source framework that operates on sub-rasters of massive geospatial data. To illustrate the contribution of this high-performance algorithm research, consider the problem of finding the geometric or absolute difference between two images. This problem consists of an elementary subtraction on a per pixel level and is relatively simple for small images that fit in memory. Geospatial images however can reach in excess of 10 GB each; and therefore must be decomposed into sub-rasters that are manageable in the operating context of three simultaneous images (two inputs and one output). However, due to the elemental nature of many low-level image processing algorithms, we can apply highly parallel techniques using graphics processing units (GPUs) and CUDA; recombining the solution sub-rasters into the full output. Beyond elemental algorithms, we are also addressing the challenges of complex structural analysis problems, such as object recognition. These algorithms use more sophisticated algorithms, such as mathematical morphology, to identify structural characteristics with images. Due to both the size of satellite images (many GB), the magnitude of imagery collections (many TB to PB), and the computational complexity of these advanced algorithms -- GPU acceleration is a critical need in the field of remote sensing.
Kennady Gee, Jing Zhu, and Peter Tipton

Through the utilization of steady state kinetics, ultra violet spectroscopy, and alternative substrate studies, the nature of PvcB (primarily from *Xenorhabdus nematophila*) as an enzyme in the catalytic pathway of metabolizing isonitrile-containing compounds into the final enzymatic product has been further studied and reviewed. We are defining optimal reaction conditions for both enzyme and substrates based on pH, substrate concentration, enzyme concentration, cofactor concentration, and reagent stability. Kinetic studies are being utilized to further delve into understanding the structural/chemical properties and biological implication of tyrosine isonitrile and 4-nitro phenylalanine isonitrile (a newly identified derivative), which is an inhibitor of the PvcB enzymatic pathway. By implementing the uses of this new inhibitor within PvcB/tyrosine isonitrile reactions, we hope to learn more about properties and interaction of all three components in the future.

From recent experiments, an enzyme concentration of [0.00022mM] has been utilized via preparation from a 8.01 mg/ml stock solution of XnPvcB. This solution was prepared in 50mM HEPES/150mM NaCl buffer with a pH of 7.82. The addition of 10% glycerol helps to preserve the enzyme stability during the whole reaction. In these experiments, alpha-ketoglutarate (substrate), ascorbic acid (reducing agent), and Fe$^{2+}$ (co-factor) were allowed to stay at a fixed concentration for all ten trials, where as tyrosine isonitrile was added to reaction solution in varied concentrations. Buffer was added in to bring the reaction solution to a final volume of 1mL. The reactions were allowed to incubate for five minute at 25°C in a water bath. Once the incubation reached completion, the reaction was monitored under UV-spectroscopy at 310 nm for one minute. Once completed, enzyme was added into the reaction and monitored for four minutes. The absorbance change versus time plots generated for all the different enzyme concentration is leading us to believe that a 1/1000 dilution of [0.00022mM] is the best fit because there was a linear region in the progress curve, this is where the reaction rate can be determined.

This is further being tested to come to a conclusion.
Component analysis of functional behavioral assessment and behavior intervention plans among children with disabilities

Casey Gibbons, Samantha Fullington, Barbara Mitchell, and Timothy Lewis

This research helps teachers determine the cause of the problematic behavior. For the purpose of this study, we defined problematic behavior as high frequency and low intensity disruptive behavior in elementary aged students in a general education room. These students also qualify for special education services. Our interest was to compare outcomes among the indirect and direct methods.

In this research, we investigated indirect methods for assessing students’ problem behavior in comparison to direct assessment method. The indirect methods we used included conducting interviews with classroom teachers, having teachers complete a brief questionnaire about the student’s behavior, and observing the students during a classroom situation (Antecedent-Behavior-Consequence observation). These methods helped us hypothesize what caused the problematic behavior. The direct assessment required experimental trials of several different conditions, including hard tasks compared to easy tasks, and with and without teacher and peer attention, in a contrived setting. By altering these conditions presented to the students, we were able to determine which conditions were most and least problematic for students.

After conducting the direct measure with each student we were able to find out whether the students were acting out because of the difficulty of the task, or if they wanted teacher or peer attention. In all students we found that the students were on-task when they were given an easy tasks or when they were given a hard task with teacher attention. Another result the data showed was that with all students, they were off-tasks when given a hard-task with no teacher attention. This led us to conclude the students desired teacher attention over peer attention. These findings from the direct measures were similar to the findings with the indirect measures.

We want to teach educators that they can conduct their own indirect measures to determine the cause of the student’s problematic behavior, because they are easier and more time efficient than direct measures. After they determine the cause, they are able to implement strategies that would benefit the student.
Late-infantile neuronal ceroid lipofuscinosis (CLN2), an inherited neurodegenerative disease, is characterized by retinal degeneration, cognitive decline, loss of motor control, seizures, and eventual death. Mutations in TPPI, a gene encoding the enzyme tripeptidyl peptidase-1, result in CLN2 pathology. Dachshunds with a null mutation in TPPI exhibit neurodegeneration and retinal degeneration very similar to that which occurs in human CLN2 disease. The Dachshund model is being used to assess several approaches for treatment. An ex vivo gene therapy study to treat the retina currently underway, is showing promising preliminary results in delaying retinal degeneration as assessed by pupillary light reflex analysis (PLR) and analysis of the disease-related development of distinctive retinal lesions that consist of localized retinal detachments. Assessment of PLR parameters is performed via continuous infrared recording of images of the pupil while delivering timed light flashes of increasing intensity. This is a noninvasive, quantitative measure of both retinal and neurological function and is a marker of disease progression during which the PLR deteriorates. Quantitation of retinal lesion size and number is performed by analysis of scanning laser ophthalmoscopic images of the retina obtained at regular intervals as the dog ages. Preliminary data on a dog treated with ex vivo gene therapy shows partial preservation of the PLR in the treated eye, as well as a reduction in the fraction of retinal area occupied by detachment lesions. These findings suggest that ex vivo gene therapy may be effective in delaying retinal degeneration in CLN2 disease.
Panacea’s Glass: Mobile cloud framework for communication in mass casualty disaster triage

John Gillis, Ashley Bartels, Mihai Popescu, Stephen Barnes, Jennifer Doty, Dena Higbee, Salman Ahmad, and Prasad Calyam

When working with critical-care patients, doctors and nurses need a hands-free way to stay updated on the current status of incoming patients and their needed-care levels. This need to stay updated on new patients is even more critical in a natural disaster scenario where a large volume of patients with varying states of injuries need to be treated by a limited medical staff. Using Google Glass, we can open up new possibilities for mobile healthcare communication allowing for cloud-based coordination with other medical personnel even in a disaster scenario. In this paper, we present our ‘Panacea Glass’, a mobile cloud framework that allows triage personnel who require hands-free communication capabilities along with situational-awareness of patient care coverage. We implement this framework within a WebRTC-based ‘Responder Theater Application’ with features such as video chat application on Google Glass devices, and use of virtual beacon tracking devices. Lastly, we show experiments conducted in determining optimal settings of the application, as well as its utility within an actual ‘Lake Simulation’.
Precision force spectroscopy of nonfouling surfaces

Sonja Glaser, Laura Song, Gavin King, and Matthew Bernards

The elimination of nonspecific protein adsorption is an important challenge in many biomaterial applications. To address this issue, numerous nonfouling chemistries have been investigated. The nonfouling properties of sulfobetaine methacrylate (SBMA) have been thoroughly investigated using a surface plasmon resonance biosensor with fibrinogen, lysozyme, and blood serum solutions. The purpose of this work is to investigate the mechanism of protein absorption to a proven zwitterionic nonfouling surface of SBMA using force microscopy. A carboxylic acid or amine-terminated self-assembled monolayer (SAM) is applied to an atomic force microscopy (AFM) m-SNL tip, and then the tip is used in force microscopy with the SBMA surface. Surface interactions between the charged tip and the SBMA polymer brush are measured as a function of deflection measurements of the tip and the tip spring constant. Results of these measurements will demonstrate any specific or non-specific interactions occurring at the interface of the SBMA polymer and the charged tip. Future investigations will explore potential protein interactions at the SBMA surface by attaching fibrinogen or lysozyme proteins to the AFM tip and carrying out force spectroscopy with the SBMA surface.
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Faculty Mentor: Dr. Amanda Rosenberger, Fisheries and Wildlife Sciences
Funding Source: Missouri Department of Conservation grant to A. Rosenberger

The effect of sculpturing on the comparability of external shell aging for freshwater mussels

Andrew R. Glen, Leslie K. Crawford, Matthew C. Schrum, and Amanda Rosenberger

For imperiled unionoid mussels, understanding population age structure is important for guiding conservation and management policies. Long-lived mussels, in particular, can persist in areas without recruitment for decades - consequently, presence/absence or abundance data could fail to detect impending population collapse. We therefore require mussel monitoring and management plans with information on population dynamics and recruitment. Freshwater mussels produce shell growth annuli often used for external age evaluations. However, the reliability of external aging can be biased due to false annuli and shell sculpturing. Internal aging using shell thin sections can also be used for mussel aging and may more accurately identify false annuli occurring in response to stress or changes in environmental conditions. This study examines the accuracy of external aging techniques for mussels and if bias differs between sculptured versus non-sculptured mussel species. We compared external annuli to shell thin sections of 30 individuals representing two species; the unsculptured Deertoe (*Truncilla truncata*) and the sculptured Threehorn wartyback (*Obliquaria reflexa*).
Characterization of acellular porcine diaphragm construct conjugated with bioactive gold nanoparticles and curcumin

Chris Glover, Sarah Smith, Dave Grant, and Sheila Grant

Biological scaffolds demonstrate promising capabilities in the realm of regenerative medicine. Utilizing the decellularized extracellular matrix from a harvested tissue, such as a porcine diaphragm, as a means to grow other cell lines is a relatively established practice, but it is not without its shortcomings. Human cell lines, for example, often find the scaffolds foreign due to the varied morphologies and structural characteristics that differ from human tissues. This detection of a foreign environment often leads to cellular agitation, instigating an immune response that primarily consists of inflammation. This inflammation can prove to be quite problematic, altering the cells’ adhesion to and proliferation on the porcine scaffold. If the cells cannot properly proliferate on the scaffold, then any tissue formed will contain flawed structures and will be of minimal practical utility.

Curcumin, a derivative of the rhizome of turmeric, is a yellow-orange dye and known anti-inflammatory agent. It is possible that attaching an anti-inflammatory agent such as curcumin could alleviate cellular agitation and help reduce the inflammation of resulting tissues. Using 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide (or EDC) crosslinkers, curcumin will be attached to the porcine diaphragm scaffolds prior to cellular integration. Gold nanoparticles will also be utilized in the crosslinking process for their anti-inflammatory capabilities and to further increase the binding sites available, therefore aiding in curcumin incorporation. After successful crosslinking, characterization of the scaffolds will be performed to analyze their structures and properties. The biocompatibility of the curcumin-infused scaffolds will then be evaluated via exposure to fibroblast and macrophage cell lines.

It is hypothesized that incorporating curcumin molecules and gold nanoparticles into the crosslinked porcine diaphragm scaffolds will reduce the severity of inflammation onset by the macrophages exposed to these scaffolds, increasing their overall biocompatibility.
Estimating the effect of dried distillers grains on feed and crop markets

Michael Graves and Wyatt Thompson

Corn based ethanol production along with its coproducts, chiefly dried distillers grains (DDGs), has significantly increased since the Renewable Fuel Standard, created in 2005 under the Energy Policy Act, became law. The increase in size of the DDG market affected the U.S. feed market, but these rapid changes raise questions about the substitutability of DDGs, corn, and soybean meal in livestock diets, as well as the sensitivity of competing feed use to relative prices. This research project evaluates the impact of the growing DDG market on demand for corn and soybean meal for feed, prices of corn and soybean meal, and planted area of corn and soybeans. Two key findings are that (1) direct application of key parameters from previous studies probably over-state the effects of relative prices now that DDG use has matured current market and (2) the biofuel production path can have important consequences for feed markets, as well as for crop markets and cropland area.
Coping mechanisms involved in breast cancer-related lymphedema

Acacia Grimes and Jane Armer

Lymphedema is a chronic condition in which an excessive amount of protein-rich fluid accumulates in the interstitial spaces, often in the extremities. The precise cause of lymphedema is unknown, but it is prevalent in breast cancer patients who had lymph nodes removed or damaged due to surgery or radiation therapy related to their breast cancer treatment. Lymphedema is associated with symptoms such as swelling and heaviness and risk of infections, all managed by therapeutic interventions such as meticulous skin care, complete decongestive therapy, compression garments, and maintaining optimal weight. The purpose of this study is to analyze how post-breast cancer patients with/without lymphedema cope with the diagnoses of breast cancer and lymphedema. This study offers a primary analysis of the qualitative data from the parent study. Nurse researchers administered the Lymphedema and Breast Cancer Questionnaire (LBCQ) to participants in the laboratory setting during visits scheduled from 36 months post-treatment at six-month intervals through 84 months post-treatment. The study data were collected from item #58 on the LBCQ. The purpose of analyzing this subjective data was to gather a better understanding of participants’ long-term perspectives regarding their experiences with breast cancer and lymphedema and consider new theoretical implications. The significance of the study is to grasp a better understanding of how lymphedema patients cope with their diagnosis and what aspects of their lives keep them going. It is expected that this study will show that maintaining a healthy lifestyle and remaining positive spiritually, mentally, and socially will be associated with healthy coping procedures and will create a mindset of thriving after cancer. Continued research on the coping mechanisms applied by survivors living with lymphedema will provide a foundation for interventions to aid those newly diagnosed in the future.
Crash report analysis for highway safety manual calibration

Katie Haberberger, Christian Brooks, Kristin Hofstetter, and Carlos Sun

The Highway Safety Manual (HSM) provides transportation specialists a way to quantitatively assess the safety of different highway facilities; it uses the technical analysis of different aspects of highway design so that safety can be tested and ultimately improved. Also, the HSM provides predictions on the crash frequency and severity of common highway facilities, such as interchanges. Crashes at interchanges often relate to the geometry of the entrance and exit ramps on a highway, including the interchange signals. The combination of changing lanes, abiding by traffic signals, and changing speeds at an interchange can all have effects on safety. In order to calibrate the HSM, crash reports are reviewed and assigned to proper highway facilities. Completing a crash report consists of compiling information regarding the circumstances of a roadway accident. This is generally performed by a police officer, but there are often inconsistencies in the reports. A tutorial for analyzing these crash reports written by police officers was developed in the ZouTrans transportation laboratory at the University of Missouri. This tutorial describes the process of assigning a collision to a specific terminal at an interchange. HSM calibration helps to improve the accuracy of the Highway Safety Manual by identifying sites that could use improvement in safety, determining the conditions that are posing issues at the site, recognizing possible solutions, programming these solutions, and finally evaluating the reduction of crashes from the changes.
Is the curse real? Professional athletes on video game covers and declines in their performance

Kristin Halford, Braden Curd, Zachary Ricketts and KangJae Lee

This study investigated professional athletes’ performance before and after the appearance on the cover of video games. Rumors suggest that athletes selected for the cover experience substantial declines in their performance. Although it has been widely recognized as a curse or jinx, no scientific investigation has been conducted on this controversial topic. This study examined if athletes indeed demonstrate worse performance after the cover appearance by examining most recent video games from 1999 to 2015.

We used various indicators to evaluate athletes’ performance. The performance information from the year before athletes were on the cover and the year when they were on the cover were collected from sports-reference.com. The data consisted of 50 cases. Athletes were categorized into three groups based on the average percentage change in performance: -1 = more than 20% decrease, 0 = percentage change within -20% to +20%, and 1 = more than 20% increase. The numbers of athletes in each category were 27, 21, and 7, respectively. A paired sample t-test was performed on the number of games played and assists. The number of games played by athletes significantly decreased from the year before the cover appearance ($M = 67.96$, $SE = 6.69$) to the year of cover appearance ($M = 59.74$, $SE = 7.15$), $t(49) = 2.393$, $p < .05$, $r = .10$. The number of assists also decreased from the year before the cover appearance ($M = 155.03$, $SE = 33.22$) to the year of cover appearance ($M = 143.65$, $SE = 41.03$). However, this difference was not significant $t(25) = .54$, $p > .05$, $r = .01$. We are currently expanding our analytic approach by collecting more data from the cover athletes on Sports Illustrated. The future study is expected to draw a stronger and more generalizable conclusion about the jinx.
Crowdsourcing for remote sensing

Daniel Hanson, Michael Brooks, Huy Trinh, and Alina Zare

We are developing a method to collect uncertainly labeled training data for remote sensing using crowdsourcing techniques. Traditional supervised machine learning methods require very accurate and precise training labels from which to learn. Collecting accurate training data is very time consuming and expensive. Multiple-instance learning algorithms relax that requirement and only need positive and negative sets of data points, called “bags.” Positive bags are defined as having at least one of the target points within the bag. Negative bags are defined as having only non-target points within the bag. The solution presented uses the idea of a crowdsourcing web application in order to gather the training data to be used with multiple-instance learning algorithms. The web application has one view for selecting a specific region and a second view that shows the multispectral image corresponding to the selected region. Once the user has selected a region from the first view, they will look at the corresponding multispectral image and then record what features they believe are present in the segment. The features the user selects as being present in the multispectral image will be saved to a database. Since the user data is not guaranteed to be correct, the data qualifies as the uncertainly labeled training data, however, our ongoing research shows that this type of data can be used within multiple-instance learning algorithms.
Effects of employer support on rural working mothers ability to breastfeed

Anastasia Harris and Wilson Majee

Breast milk has evolved to provide the best nutrition, immune protection, and regulation of growth, development, and metabolism for the human infant (Goldman, 2012). For mothers, it lowers the risk of breast and ovarian cancer, osteoporosis, increases postnatal weight loss, and regulates fertility (Blincoe, 2005). Although these benefits are now popular wisdom, breastfeeding rates have remained low. For example, in 2013 Missouri breastfeeding rates at 6 months and 12 months were 39.3% and 21.6%, respectively (CDC, 2013). These were both lower than the DHHS targeted rates of 60.6% at 6 months and 34.1% at 12 months. This speaks to the need to understand the underlying causes of low breastfeeding rates. This study focuses on the barriers and facilitators of breastfeeding among rural working mothers. It explores the question: how does the work environment for rural mothers influence their decision to continue breastfeeding. The goal of the study is to a) document all work related BF barriers and facilitators b) prepare a recommendation report for the local health department. Interest in working mothers stems from the fact that women now make up 57.2% of the workforce and 61.1% are mothers with children under the age of 3 years (DOL, 2013). Thus, it is important to understand the role the workplace environment plays in promoting or discouraging breastfeeding. To my answer, a community-based qualitative study was conducted. County WIC coordinator, staff and researcher designed the study and purposively recruited working breastfeeding mothers to participate in the study. Out of 10 planned semi-structured, face-to-face interviews, 8 were completed. Participants also completed a demographic survey. Four major themes emerged from the data: 1) other employee’s support, 2) employer infrastructural support, 3) policy perceptions (mothers), and 4) mothers own feelings. Final results and conclusions will be presented at the Undergraduate Research & Creative Achievements Forum.
Optical emission spectroscopy of in-liquid of plasma streamers for the production of hydrogen-rich gas

Aaron Hartfield and Scott Kovaleski

The production of hydrogen gas is an important research topic as hydrogen can be found in multiple applications including fuel cell technology and the remediation of vehicle exhaust gas. Due to the large amount of hydrogen needed for fuel cell powered vehicles, the focus of this research has been centered on electrical discharge plasmas in organic liquids. Reacting plasmas in organic liquids has advantages over other reforming technologies due to its smaller weight, higher conversion efficiencies, and a faster response time. The plasmas streamers in this study are created in an adjustable gap point-plane electrode system where a 20 nF capacitor bank is triggered by a pressurize gas switch to provide ± 12 – 35 kV pulses to induce the reaction. This is reaction is contained in a 300 ml cylindrical aluminum receptacle. This particular analysis utilizes advanced spectroscopic imaging techniques to record the molecular species present during the plasma reaction. Knowing these species will contribute to the understanding of the chemical pathways responsible for the formation of hydrogen, which will in turn lead us to the most efficient techniques for producing a hydrogen-rich gas.
Disconnecting water clarity from organics removal in drinking water

Joshua Hartsock, Annelise Zeltmann, and Enos Inniss

Small community drinking water systems must be in compliance with the Stage 2 of the Disinfectants and Disinfection By-Products rule promulgated by the U.S. Environmental Protection Agency by October 2015. Since disinfection by-products (DBPs) are produced when organics in drinking water react with the disinfectant (typically chlorine) one method for reducing the concentration of DBPs is to decrease the concentration of organics present. For small communities in the State of Missouri, the best approach for reducing these organics may be unclear.

This project is part of an effort by faculty at the University of Missouri to provide technical assistance to select small community drinking water systems to help them determine the best approach to DBP compliance. Raw and partially treated drinking water from various treatment facilities in Missouri is collected and brought to MU. Variations in the amount and type of chemicals added (mainly in coagulants) are tested to determine effectiveness of treatment. The tests involve a simulation of the treatment process, namely the stages of coagulation, flocculation, and sedimentation. Effectiveness is determined by measuring turbidity, Spectral Absorption coefficient (UV-254), pH, Dissolved Organic Carbon (DOC), and chlorine residual.

The ultimate goal is to find the right recipe of coagulants, additives, and concentrations to produce the cleanest, cheapest, and most efficient method of treatment without changing the physical design of the facility from which the water is being collected. However, as part of the project we are finding that expectations based on the clarity of the water do not always translate to optimal organics removal. We will present our data and findings on the differences between observed clarity (turbidity) and optimal organics removal at the Forum.
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Reproducibility of global summation using multithreading on multi-core CPU and the Xeon Phi Coprocessor

Mateusz Haruza and Michela Becchi

Floating point numbers are broadly used in many scientific applications, such as molecular dynamics and physics simulations. Since floating point numbers are an approximation of real numbers, applications based on them are prone to accuracy errors: for example, decimal values such as 0.1 are not perfectly representable in floating point format. Small accuracy errors can be accumulated in large and long running computations such as molecular dynamics simulations. This error propagation produces results that are inaccurate and not reproducible, and the error may be worsened by running the application on parallel platforms.

Our work looks into this phenomenon by considering the summation of a set of numbers with an expected result of zero. We construct synthetic workloads for this computation by creating arrays including random values and their negatives and then shuffling the elements in the arrays in order to simulate random data. In addition, we include in our experiments arrays sorted in ascending and descending order as well as arrays sorted by absolute value to see if the order in which the numbers are added affects the accuracy of the summation. We analyze how the computation size and the difference in order of magnitude of the values summed together affect the accuracy of the results. We measure the error using different floating point representations: single, double and composite precision, which decomposes each number into a value and an error field. We examine the accuracy of the results as well as the performance of the computation on a multi-core CPU and a many-core Xeon Phi Coprocessor. After observing the error accumulation on a single thread of execution, we study the effect of increasing the number of threads (i.e., the parallelism of the computation) while also changing the work distribution among threads and the underlying thread scheduling mechanism.
Extracting characteristic temperature for mid-infrared, optically powered lasers

Zach Haverman, Dominic Montoia, and Gregory Triplett

The demand for mid-infrared lasers has rapidly grown in the past years. With more power and thermal stability, these mid-IR lasers could have a profound number of applications, especially in the sensing community; these applications include sensing of organic compounds (such as methane), explosives ordinance, and environmental detection. These lasers also have a strong military application when used for low-altitude radar, or infrared countermeasures when used in an array. However, challenges exist when using 2-4 μm laser applications that must be overcome.

Characteristic temperature is an important quality to consider when creating laser diodes, as it allows one to see how the performance of the laser varies according to the operating temperature. In order to create a higher characteristic temperature, the device must be stable through a wide range of temperatures. However, due to the wide energy bands of most lasers, thermal residuals can cause temperature instability. This project serves to quantify which pulse width, frequency, and duty cycle allows the most thermal stability, while maintaining a high power density.

After numerous fabrication steps, the rectangular laser bar is mounted on a highly conductive copper stage using thermal paste. The copper stage is temperature controlled by a two-stage thermoelectric cooler with a thermistor embedded inside to frequently monitor temperature. This allows for various temperatures above and below room temperature to be maintained (from 293K to 333K). The lasers are optically-pumped using a high-power, single mode laser (1440 nm) coupled through an optical fiber then into three different lenses to reshape and refocus the beam into a rectangle, allowing it to be incident upon approximately 80% of the sample. The light from the laser bar is collected using an optical fiber, detector and lock-in amplifier. Pulses are no longer than two microseconds with frequency varying in each experiment in order to adjust the duty cycle. Lasers pulsed at low-duty-cycles are very useful in diode evaluation and generates less heat. With these parameters identified in this study, it would allow performance optimization of the laser diodes, while maintaining the most temperature stability.
Azelnidipine attenuates alterations of cerebral endothelial functions induced by amyloid-β peptide

Kayla Henderson, Julia Jaques, Tao Teng, and James Lee

The oligomeric Aβs either bind to cell surface receptors or inserting into the plasma membrane of the cell can trigger oxidative and inflammatory pathways, and result in alterations in cell membrane properties, leading to eventual cell apoptosis. Amyloid beta (Aβ) induced NAD(P)H oxidase-mediated reactive oxygen species (ROS) production stimulates the activation of downstream signaling pathways that involve the activation of MAPK (mitogen-activated protein kinase) and ERK1/2 (extracellular-signal-regulated kinase 1/2), and phosphorylation of cPLA2 (calcium dependent phospholipase membrane protein). Azelnidipine is an L-type calcium channel blocker that causes vascular smooth muscle relaxation, and a drug commonly used to treat hypertension. Recent studies have suggested evidence proposing the drug promotes an anti-inflammatory response that reduces levels of superoxides in various types of cells. In the present study we examined if Azelnidipine was capable of attenuating the Aβ- induced cellular pathways of oxidative stress and inflammatory responses shown to alter endothelial functions using immortalized cerebral endothelial cells (bEND.3 cells). Specifically, we tested and found that Azelnidipine has potential uses in Alzheimer's disease (AD) treatment by suppressing Aβ-induced oxidative and inflammatory pathways through the attenuation of ROS production and activation of subsequent pathways. The results suggest that Azelnidipine might have potential application as a therapeutic strategy to treat Alzheimer’s and mediate oxidative stress induced pathogenesis of neurodegenerative diseases such as AD.
Iterative reconstruction of three-dimensional models of human chromosomes

Noelan Hensley, Jackson Nowotny, Sharif Ahmed, Lingfei Xu, and Jianlin Cheng

The entire collection of human genetic information resides within the chromosomes. Such chromosomes have unique 3D structures that control certain functions including gene interaction, gene regulation, and other genome operations. Therefore, knowing the 3D structure of chromosomes is vital in understanding how the human genome functions. The nature of the 3D structure allows for the construction of a model via computational methods by utilizing contact data of the chromosome. In this study we developed a unique computational approach to construct 3D structures of human chromosomes using this contact data.

Our computational method involved using a technique known as growth to build a random initial model followed by the sequential implementation of optimization algorithms that optimize the model by improving its accuracy based on the contact data. The optimization algorithms implemented are known as adaptation, simulated annealing, and genetic algorithm.

Our research group evaluated the resulting models using scoring functions that compared the finished models with the contact data. Analysis of the developed chromosomal structures through the scoring functions demonstrated the effective construction from our unique computational approach. In addition, when compared to the similar MCMC5C method, our method consistently resulted in higher scores for all chromosomes.

The implementation of our computational approach proved effective in constructing 3D chromosome models. Therefore we achieved our goal of creating a tool to help advance knowledge regarding human genome and chromosome structures. Such knowledge will pave the way for further research and knowledge regarding the human genome.
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Socio-scientific issues: An analysis of science reporting in the New York Times

Jordan Henson and Troy Sadler

Science teachers are often advised to use current events as the subject of their lessons. Often, these events consist of socio-scientific issues (SSI), topics that reflect the intersection of science and society. SSI are usually perceived by the general public to be controversial. The inclusion of controversial SSI-related topics in science teaching is often recommended, but little research exists describing how controversial SSI are portrayed in the media. The purpose of this study is to attempt to characterize SSI in the media and analyze the types of controversy included in SSI reporting according to a theoretical framework (Levinson, 2006). This framework categorizes articles into five different kinds of controversy based on the kinds of opposing views and where the point of contention between them lies. A nationally published newspaper was collected for forty days. Articles were collected and analyzed as being either related or unrelated to science, being related or unrelated to SSI, and then classified by types of controversy. A quantitative analysis of these articles is currently being conducted and results will be presented at the research Forum.
Two white men, James P. Alley, cartoonist for the Memphis Commercial Appeal, and O.N. Pruitt, jack-of-all trades photographer, in Columbus, Mississippi, depicted the racially segregated worlds in which they lived in the early twentieth century. With the conceit of “Southern White Mentalities” and cultural love and cultural theft, this research project links images made by these disparate creators.

Alley helped the Memphis morning newspaper win the Pulitzer Prize in 1924 for editorials, news stories and cartoons critical of the Ku Klux Klan. At the same time, Alley penned a cartoon strip “Hambone’s Meditations.” Hambone was an exaggerated depiction of a simple African American ‘philosopher’ whose observations in hyperbolized African American dialect, entertained millions of readers as the cartoon appeared in roughly 200 newspapers.

With images as diverse as river baptisms, car wrecks, studio portraits, legal executions and an illegal lynching, Pruitt documented via photography his postage stamp of Mississippi soil.

This project on race relations in the American South highlights research of Dr. Berkley Hudson and Sophomore Discovery Fellow Ginger R. Hervey in the Missouri School of Journalism. Over the course of two semesters, Hervey has assisted Hudson. What Hervey has learned most is that racial tensions associated with the past still linger today.

Alley’s character of Hambone, essentially blackface minstrelsy in cartoon form, demonstrates what scholar Eric Lott calls cultural love, cultural theft. This theme recurred as whites simultaneously suppressed black culture and were fascinated by it.

The Pruitt photographs raise questions about nostalgia for the past and shame for the racial atrocities committed in this small Mississippi town. The Pruitt project is part of a National Endowment for Humanities planning grant to design traveling exhibitions and symposia at the University of Missouri, University of North Carolina at Chapel Hill, and in Columbus, Mississippi where the photographs were made.
3D data mapping and real-time experiment control and visualization in brain slices

Jaime V. K. Hibbard, Michael E. Miller, Marco A. Navarro, Tyler W. Nivin, and Lorin S. Milescu

Brain slices are invaluable preparations for neuroscientists, where molecules and individual cells can be studied in the broader context of functional neuronal networks and circuits. We are developing a computer program that streamlines experiments in brain slices and enhances data collection and analysis. The program constructs a 3D virtual workspace, where the equipment, the preparation, and the data are visualized. The user can control the operation and positioning of the instruments relative to the sample, with real-time visual feedback. Specific cells can be bookmarked and linked to optical and electrical recordings, and the entire 3D workspace can be saved for later viewing and data analysis. We are using this software platform to explore cellular and network interactions in the neuronal respiratory pacemaker. This program provides a unified approach for combining electrophysiology with structural and functional imaging.
Sinful curiosity in Chaucer’s *Canterbury Tales*

Maria Hill and Johanna Kramer

Geoffrey Chaucer is known as “the father of English poetry.” His most famous work, the *Canterbury Tales*, provides important insight about medieval religion and society. Filled with Biblical references, the tales invite allegorical readings, and one such allegory evoked in many tales is the Fall of Man. In this paper, I expand this literary context to Chaucer’s *Squire’s Tale* and I argue that this tale should be read as an allegory of the Fall of Man and, within this context, that the knight figure represents Satan and Canace represents Eve.

The Middle Ages was a time of change and instability for society. As a consequence, the construction of knowledge became a point of contention; new ideas challenged traditional Christian thought, setting the stage for debates regarding spirituality. An influential ecclesiastical figure in these debates was Bernard of Clairvaux, writing *The Steps of Humility* in the 1120s. Bernard uses the Fall of Man to demonstrate that curiosity is the first step of pride. His conception of sinful curiosity usefully serves to analyze Chaucer’s *Canterbury Tales*, because pilgrimage — a traditionally spiritual institution that became vulnerable under such challenges — was denounced as an outlet for curiosity, and thus sin, in the later Middle Ages.

In a comparative reading of Bernard’s articulation of the Fall of Man narrative and the *Squire’s Tale*, clear parallels emerge. Specifically, Bernard’s descriptions of Satan and Eve parallel the tale’s central characters, the knight and Canace: like the serpent, the knight tempts King Cambuscan’s kingdom, especially Canace, with forbidden knowledge; Canace, the only female character substantially presented, parallels Eve by surrendering to temptation first. Reading the *Squire’s Tale* in light of Bernard of Clairvaux’s philosophy on sinful curiosity illuminates Chaucer’s conservatively traditional religiosity, placing him on the side of denouncing pilgrimage in the debate about knowledge formation.

*This project was completed to fulfill a Capstone requirement.*
Missouri possesses a wide variety of soil types. The diversity of the soils has tremendous impact on crop yields. Corn yields from 44 counties were detrended and indexed for each year from 1993-2013. In each of the 44 counties the top five soil types that make up the area of each county were chosen for a comparative analysis. The purpose of the comparative analysis is to examine if the soil’s productivity index is an accurate reflection of yields in the county. The Business Environmental Risk Management tool (BERM), created by the University of Missouri, provides each soil’s productivity index (PI) number. Each soil was weighted relative to acres of the soils evaluated and total acres of soil in each county. The PI number for each soil is multiplied by the weighted acres of each soil’s share in the county and provides a weighted average productivity index number for each county. Regression analysis will help further explain where the differences may occur between the weighted average PI numbers and indexed yields for each county. Theoretically, the coefficient on each share variable should be 1 if the productivity index is perfectly correlated to yield. Regression coefficients above and below that value outside a statistical confidence interval would indicate that a particular’s soil’s productivity index overstates or understates its contribution to actual yield.
Preparation of metal oxide coating on carbon nanotubes for battery applications

Sam Hoff and Yangchuan Xing

The search for higher performing battery cells is an important issue society is facing today. The implications of improved energy density in electrochemical cells range from needing to charge a phone battery less frequently to running cars entirely on electrical power and leading the shift away from fossil fuels. A promising area of research in this topic involves the use of carbon nanotubes (CNTs) for their unique electrochemical properties on the nanoscale and their light weight. Coating the CNTs with metal oxides such as TiO2 increases the electrochemical capacity of the nanotubes and could lead to energy densities that greatly surpass that of commonly used battery systems. One of the biggest issues facing this technology is the aggregation of metal oxide nanoparticles on the surface of the nanotubes. The use of ultrasonic baths during the preparation for doping the CNTs has previously been documented to mitigate the aggregation of the metal oxides but the issue still exists and limits the potential of these electrochemical cells. The goal of this project is to develop additional techniques for use during the coating process of the CNTs that yield a more uniform dispersion of the metal oxides on the surface of the CNTs.
Young children reauthoring postmodern picture books

Grace Hofheins, Jaimie Engelken, Lenny Sanchez, and Angie Zapata

Postmodern picture books are a specific genre of picture book that reaches out to the reader and requires participation. Postmodern picture books deviate from normal texts in the way the story is conveyed and are thought to be more complex through their use of metafictive devices. Some of the most prevalent metafictive devices found in postmodern picture books are as follows: narrators jumping out and addressing the reader, characters communicating with the narrator, characters giving commentary, more than one narrator, stories within stories, disruptions of time and space, non-linear structure, intertextuality, parody, unique arrangements of text, illustrations, or book layout, and metalepsis (Pantaleo, 2014).

Our research focuses on how five three and four year-old children responded to postmodern picture books in the context of a teacher’s thoughtful mediations. In a two-week time period, researchers Lenny Sàncchez and Angie Zapata collaborated with a classroom teacher to create a series of invitations to introduce and support young children’s responses to postmodern picture books. This was done through well-planned immersion experiences with the literature and interactive read alouds of select postmodern picture books.

We analyzed the data for emerging themes and patterns in the way children reauthor the postmodern picture books. We define reauthoring as the ways in which children interact with and influence the narrative beyond the authority of the physical text. We believe that reauthoring allows children to mold the text into their own creation (Sanchez & Zapata, 2014). We identified two salient patterns in students’ reauthoring: verbal reauthoring and performed reauthoring.

It is necessary to understand the ways children respond to this interaction in order to comprehend how young children can digest or interpret these complicated texts. 21st century readers are encouraged by postmodern picture books to deeply engage with the text in a level not previously recognized.
Crash report analysis for highway safety manual calibration

Kristin Hofstetter, Christian Brooks, Katie Haberberger, and Carlos Sun

The Highway Safety Manual (HSM) provides transportation specialists a way to quantitatively assess the safety of different highway facilities; it uses the technical analysis of different aspects of highway design so that safety can be tested and ultimately improved. Also, the HSM provides predictions on the crash frequency and severity of common highway facilities, such as interchanges. Crashes at interchanges often relate to the geometry of the entrance and exit ramps on a highway, including the interchange signals. The combination of changing lanes, abiding by traffic signals, and changing speeds at an interchange can all have effects on safety. In order to calibrate the HSM, crash reports are reviewed and assigned to proper highway facilities. Completing a crash report consists of compiling information regarding the circumstances of a roadway accident. This is generally performed by a police officer, but there are often inconsistencies in the reports. A tutorial for analyzing these crash reports written by police officers was developed in the ZouTrans transportation laboratory at the University of Missouri. This tutorial describes the process of assigning a collision to a specific terminal at an interchange. HSM calibration helps to improve the accuracy of the Highway Safety Manual by identifying sites that could use improvement in safety, determining the conditions that are posing issues at the site, recognizing possible solutions, programming these solutions, and finally evaluating the reduction of crashes from the changes.
A potential role for anxiety in formation of dominant and subordinate social status in crayfish

Mark Holder, Miranda Cundiff, Desire’ Buckley and Mark Kirk

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
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Funding Source: McNair Scholars Program

The effects of prescribed fire on the diet diversity of Southern red-backed salamanders

Lauren N. Hollins, Katherine M. O’Donnell, and Raymond D. Semlitsch

Amphibians serve as excellent ecological indicators due to their sensitivity to minute changes in the environment. In deciduous forests, terrestrial salamanders are one of the most abundant vertebrates; however, their exact role in the ecosystem remains unclear. Davic et al. (2004) acknowledged salamanders serve as keystone predators by regulating the amount of soil invertebrates within leaf litter. More research is needed on the extent to which fire indirectly affects wildlife, particularly terrestrial salamanders. Prescribed burns serve as a regulatory method for minimizing overgrowth and increasing biodiversity within forests. However, this process decreases the amount of leaf litter available for shelter and affects local soil invertebrate populations, which influence amphibian growth and survival rate (Pilliod et al. 2003). Salamanders may escape direct mortality by retreating into burrows during fires, but the availability and diversity of their food source may be reduced. In fall 2013 and spring 2014, we collected gut-content samples from Southern red-backed salamanders (Plethodon serratus) in the Sinkin Experimental Forest located in the Mark Twain NF in southeastern Missouri. In order to explore the indirect effects of prescribed fire on wildlife using an amphibian model, we surveyed ten plots that were either untouched or prescription burned in December 2012. Salamanders were obtained through racking of leaf litter and overturning natural cover objects. Overall, we found 121 salamanders and collected 110 gut-content samples. Out of the total, 56 gut contents were from salamanders found in control plots while 54 were from burned plots. Further information on results and conclusion will be presented at the Undergraduate Research and Creative Achievements Forum.

This project was completed to fulfill a Capstone requirement.
An examination of vocal fry in the context of peer bonding, authority, and ambition

Rebecca Honeyball and Matthew Gordon

Vocal fry is a common speech variation, typically characterized by phrase-final irregular voicing in the form of slowed pulses of the vocal folds (Thomas, 2011). In popular culture, it is commonly associated with young women as an affectation or indication of insecurity. This study examines how college students use vocal fry when speaking with different interlocutors. Gender and personality have been taken into account through the use of several standard psychological inventories, as well as the recording of cross- and same-sex conversations. Individuals are hypothesized to show an increase in vocal fry while conversing with a peer, as a function of in-group bonding. In contrast, vocal fry is hypothesized to decrease when the conversation is with an authority figure in an attempt to preserve social distance.

The primary objectives of this study are: (1) to determine in what contexts an individual employs vocal fry in his or her speech (whether frying increases when speaking with a male or female peer, and whether frying decreases when speaking with an authority figure); (2) to gain insight into the effects of an individual’s competitiveness and desire to be authoritative on his or her use of vocal fry (whether frying increases in individuals who rate themselves as more competitive and display more confidence or whether frying decreases in individuals who rate themselves as less competitive and display less confidence); and (3) to verify or dispute existing assertions about the effect of gender on frequency of use (whether or not vocal fry is more prevalent in female speakers than male speakers). Because this study is currently being conducted, results and conclusions will be presented at the Undergraduate Research & Creative Achievements Forum.
Electromechanical properties of carbon nanotube fuzzy fibers

Rachel Hough and Matt Maschmann

Carbon Nanotubes (CNTs) are a developing technology that have applications in multi-functional composites because of their conductivity and strength. This study hopes to elucidate the electrical and mechanical properties of CNTs grown on both planar substrates of silicon and glass fibers. Both have a 10 nm coating of aluminum oxide. The CNTs are grown using chemical vapor deposition of a xylene and ferrocene solution that is slowly injected into a furnace heated to approximately 750 °C. Using a puck that is wired to a digital multi-meter (DMM), the electro-mechanical properties of the CNTs on the glass fibers are compared to the response of the similar arrays grown on planar silicon substrates. The DMM will output a voltage to a computer program, ExcelLinks, which can then be used to evaluate the resistance of the nanotubes. The nanoindenter indents the substrates using a given force, typically around 15 mN. Each indentation point has the force and displacement into the surface recorded. This can be used to calculate the stress on the nanotubes. The force versus displacement curve also indicates the elastic or plastic response of the nanotubes. To further this research many more nanotube forests need to be grown simultaneously on planar and silicon substrates which can then be tested. Once more data has been compiled the planar and glass substrates can be compared and conclusions about the structural and electrical properties of nanotubes can be made.
Determining the feasibility of drone usage for last mile delivery

Michael Huber, Adithyan Babu, Dominic Vollmar, and Cerry Klein

This research focuses on determining the feasibility of using drones to facilitate last mile delivery of goods. This was inspired by the recent push for drone delivery by companies such as Amazon. Some benefits of drone usage would include same day delivery, environmentally friendly energy usage compared to gas powered trucks, and reduced amount of missed deliveries due to customers not being home. A drone delivery system would be almost completely automated, limiting the amount of labor needed to complete deliveries from warehouses to customers. Therefore, if there was added revenue due to the advantages listed, in addition to any decrease in operating costs compared to the current delivery system, it would be feasible for companies to look at using drones for last mile delivery of goods.
In vertebrates, reticulospinal (RS) neurons in the brain project to and activate spinal locomotor networks to initiate locomotor behavior. Following spinal cord injury (SCI) in lower vertebrates, such as the lamprey, the injured descending axons of RS neurons regenerate and locomotor behavior recovers, while this does not occur in higher vertebrates, including humans. Following SCI in the lamprey there is a reduction in calcium influx in RS neurons, which may be important for axonal regeneration. We are using calcium imaging, in which Calcium Green is introduced into RS neurons to monitor intracellular calcium levels, which increase during electrical activity-induced calcium influx. At present, we perform calcium imaging using three separate computer programs, which require multiple manual steps, to acquire and analyze calcium imaging data. To analyze the acquired calcium imaging data more quickly and to customize the imaging analysis, a computer program using Matrix Laboratory (MatLab) was created and tested. The new program acquires a ten-second video file of imaged Calcium Green-labeled neurons, during which imaged neurons are stimulated to induce calcium influx. The video file is separated into individual video frames (images), and the program uses these images to determine the change in fluorescence (dF/F) versus time during the ten-second period, before, during, and after the stimulation. An increase in fluorescence (dF/F) in the graph during the imaging sequence indicates that intracellular calcium had increased, presumably due to calcium influx. This computer program was tested with ten different video files during development, was found to work, and has subsequently been used in our laboratory on fifty video files. The MatLab program efficiently reduces the analysis time to a fraction of what originally was required, and the program is currently being refined to acquire and analyze calcium imaging data in real time.
Faculty Mentor: Dr. Shramik Sengupta, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option

Quantitative assessment of reflux in commercially available needleless IV connectors

Garret Hull and Shramik Sengupta

In collaboration with Nexus Medical LLC, the goal of this research project is to quantitatively study the efficacy of needleless IV connectors to prevent reflux when the IV line is not clamped. Theoretical maxima for amount of reflux will be based on analysis of SolidWorks models provided. Conversely, experimental values will be attained through a model that simulates the average pressure created by the venous system. This will elucidate any potential relationships between the designs of the main types of IV connectors (positive displacement, negative displacement, neutral displacement, and pressure-activated valves) and their efficiency in prevention of reflux.

The proposed work involves design of experiments and statistical analysis to evaluate performance. These are engineering concepts, whose applicability cuts across multiple disciplines of engineering. It is particularly relevant to biomedical systems that are often influenced by a wide variety of human factors. For example, the structural analysis of objects through SolidWorks requires both technical knowledge of the program and mathematical proficiency. Additionally, the creation of a method to which a patient’s accessed cardiovascular system can be statically simulated demonstrates an understanding of the underlying principles of fluid mechanics that drive blood reflux.
Exploring agency in school: Finding ways to make learning student-centered

Kylie Hushion and Lenny Sanchez

This project explores agency to better understand how young children make sense of the relationship between themselves and the social structures that impact their lives. Agency within the classroom creates an opportunity for students to examine their identities and gain a greater sense of culture and community. It involves teachers listening closely to children’s ideas and concerns and using children’s epistemic knowledge to impact what is taught in the classroom. As pointed out by Crane (2001), “Schools cannot learn how to become better places for learning without asking the students” (p.54). Giving students the opportunity to share in the curriculum-making process, for instance, increases self-esteem and self-efficacy and provides a prospect for children to share important and unique insights that other may not have.

This project draws on an existing research partnership between researchers at University of Missouri and University of Western Cape and a primary school in Cape Town, South Africa. More specifically, this project examines children’s participation in an adult-led leadership profile activity and an after-school student-led leadership meeting. Through videos of these activities, we were able to observe children’s perceptions of issues they witnessed in their communities and their questions/ideas for addressing these issues. For example, during the leadership-profile activity, a student suggested that they want to “stop crime in the community”. Through thematic analysis, we documented what was important to the students and their desired changes for themselves and their community as well as how they engaged in practices such as self-critical reflection, which is an essential component in developing agency (Berg, Coman, & Schensul 2009). This study showcases how students are invested in personal and community betterment and how they can use their different life experiences to form pursuits of change.
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Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

Optical scattering of airy beam and gaussian beam through turbid media

Romanus Hutchins and Ping Yu

Cancer is a disease caused by an uncontrolled division of abnormal cells in a part of the body. Because the average lifetime risk of developing cancer has increased over time, there has been a great effort to find ways to detect cancer. One way to detect cancer is by using biomedical optical imaging technology. A possible way to perform biomedical optical imaging is to use Airy beam, a new type of laser beam that has the capabilities to improve current methods of biomedical imaging. Airy beams have an exceptional depth of field, a self-healing property, a flexible main lobe structure, and a propagating trajectory. To use Airy beams in biological imaging, it is important to understand the scattering properties of Airy beam in a turbid medium. Our work starts from the scattering of Gaussian beam since the scattering properties of Gaussian beam are fully understood. In this study, the scattering of the Airy beam and the Gaussian beam through polystyrene beams and milk are compared. We use a He-Ne laser that is expanded to about 20 mm by using a spatial filter, and use a combination of a LCD panel and wave-plates. The Airy beam and Gaussian beam were generated simultaneously using the LCD panel in the Fourier plane of the imaging lens, which is due to the quantity of the phase modulation. The function of the LCD panel is to provide a phase modulation pattern in the light beam. We measured the speckle size of the Airy beam and the Gaussian beam in a fixed scattering angle using an autocorrelation function. Further analysis on the Airy beam is needed before it can be used in biomedical imaging methods for cancer detection. If the Airy beam's optical properties prove to be useful for biomedical imaging, cancer detection can become more efficient.
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Faculty Mentor: Dr. Stephen Whitney, Educational, School, and Counseling Psychology

Teacher characteristics and the achievement gap

Courtney Isaak, Olivia Barfield, and Stephen Whitney

This research explores different teacher characteristics to determine which contribute to the reading achievement gap of students from different racial and income backgrounds. The Achievement Gap refers to the difference in standardized test scores based on race and socioeconomic status. The participants of the study included all students from the ECLS k-8 data set in the eighth grade wave (n=4,549). The ECLS k-8 data set is a nationally representative longitudinal secondary study focusing on administrators, teachers and students from kindergarten to the eighth grade. Participants were grouped based upon four race categories (White, Black, Hispanic, and Asian) and three of the five quintiles of SES (upper class, middle class and poor). The teachers’ characteristics included Teacher efficacy, Teacher burn-out, Satisfied with Teaching, Positive working environment, and Culturally competent teachers. Analysis were conducted using a general linear model (GLM) controlling for age and biological sex. Only teacher burn out was a significant factor of the reading achievement gap between the different races and income groups. Black poor and Black middle class had the highest rates of teacher burn-out and Asian upper class had the lowest. The non-significant findings were unexpected but may be due to problem of restricted range. For example, all teachers rated high on self-efficacy. The findings indicate that support for burn-out teachers may be a promising approach to reducing the racial an income achievement gap in reading within the eighth grade.
RNA binding: Determining strong RNA binding libraries

Nicholas Jackson and Frank Schmidt

Scale-free networks are characterized by a specific distribution function, where most species interact with very few partners, while a few, termed hubs, interact with many more than the average number of partners. Scale-free networks characterize biological systems at multiple levels. The RNA World hypothesis states that self-replicating ribonucleic acid was a precursor to today’s genetic systems. RNA stored both genetic information and catalyzed the chemical reactions in primitive cells. Our research lab studies how the RNA world could be structured. We identify RNA sequences that are able to recognize other RNAs using combinatorial biochemistry. The current research project examines the ability of RNA motifs to form scale-free networks, a hallmark of biological organization. Three different loop sequences, GAGA, UUCG, and UGAGAU were placed at the end of a sequence of double-stranded RNA. Each RNA motif was used as bait to identify other RNAs that could bind them. The hypothesis is that GAGA will bind RNA libraries more frequently of the three because it is found most frequently in the database of all contemporary RNA structures. Deep sequencing identified binding RNAs. We will describe the initial analysis of the properties of the population of binding RNAs.
Cranial joints mediate feeding-generated forces while forming linkages between the different bones of the skull. The mandibular symphysis, the joint at the chin, is particularly important for understanding feeding function. Alligators and other crocodilians evolved a derived mandibular symphysis adapted to withstand significant forces during feeding behavior. These adaptations include various shapes and sizes of sutural ligaments, Meckel’s cartilage and their corresponding osteological correlates. Few studies have quantified patterns of sutural complexity in vertebrate skulls and the crocodylian symphysis provides exemplary material to test patterns of form and function. Using CT data from an ontogenetic sequence of alligators as well as other extant species of crocodilians, we measured parameters describing the complexity of the suture in order to determine patterns of scaling and disparity. The interdigitation index, number of interdigitations and surface area all scaled with isometry in alligators. Symphyses of crocodiles maintain homogenous patterns of suture shape along the length of the joint. Meckel’s cartilage is long and rodlike in longirostrine crocodilids whereas it is short and spatulate in alligatorids. These findings suggest the sutural ligament of crocodylian mandibular symphyses forms a strong linkage between mandibles. These new data enable more accurate interpretations of joint and feeding function in fossil crocodilians as well as histological studies of skeletal tissue growth and adaptive plasticity.
Characterization of botulinum neurotoxin (BoNT)-membrane interactions

Pari Jafari, Joshua Burns, and Michael Baldwin

The botulinum neurotoxins (BoNTs), secreted by Clostridium botulinum and related species, block release of the neurotransmitter acetylcholine from peripheral neurons, resulting in flaccid paralysis. The seven BoNTs (A - G) are proteins roughly 150 kD in size, and are composed of a light chain and heavy chain that mediate blockage of neurotransmitter release and toxin-membrane binding/translocation, respectively. We have applied a stepwise cloning process in order to generate a catalytically inactive form of the BoNT/A toxin, enabling safer and more efficient examination of BoNT interaction with cellular membranes. The recombinant toxin, which carries two loss-of-function point mutations (R362A and Y365F), was expressed by E. coli (BL21) and purified via a combination of nickel-affinity and size-exclusion chromatography. We have sought to further characterize BoNTRY's interactions with neuronal membranes through immunocytochemistry and liposome-binding assays. In addition, liposome permeabilization assays have provided an intriguing means of gauging the extent to which the recombinant toxin can penetrate lipid bilayers. Finally, tryptophan was substituted for three conserved alanine residues and the permeabilization assays repeated, allowing the assessment of tryptophan's role in toxin-membrane interactions.
Lyme Disease is the most prevalent vector borne disease in the United States, with 300,000 new cases presented every year (CDC 2013). Borrelia burgdorferi (Bb) is the causative agent of Lyme disease and is transmitted via the bite of the Ixodes scapularis tick. Th17 cells, a new subset of T helper cells play a major role in autoimmune tissue injury via the release of the pro-inflammatory cytokine, interleukin-17 (IL-17). In a vaccination and challenge model, IL-17RA has been shown to play an important role in the pathogenesis of Lyme disease. However, this mouse model is not representative of a natural infection therefore we wanted to test the role of IL-17 in a more relevant model of Lyme Borreliosis. To investigate the role of IL-17RA in Lyme Borreliosis, we are going to look at IL-17RA knockout mice and compare the course of its infection to that of the wild type counterparts. We hypothesized that once infected with Bb, IL-17RA knockout mice would show a decrease in disease progression. To our surprise, there was no difference in swelling curves of the ankles between that of IL-17RA deficient knockout mice and the wild-type controls. Characterization of the cellular infiltrate into infected joints was no different between knockouts and wild types. Development of Bb specific antibodies and the clearance of the spirochetes in the tissue were no different in the two mouse strains. Although we found small levels of IL-17 in serum of infected tissue, we did not find IL-17 in infected hearts and joints. Based on these results, we find no evidence of IL-17 playing a role in the pathogenesis of murine experimental Lyme disease. In the future, research measures can be done involving humans because IL-17 has been shown to play a role in Lyme patients. Lyme disease is a significant problem for many Americans and by performing studies on mouse models we might be able to determine what causes disease and find a treatment for it.
Azelnidipine attenuates alterations of cerebral endothelial functions induced by amyloid-β peptide

Julia Jaques, Kayla Henderson, Tao Teng, and James Lee

The oligomeric Aβs either bind to cell surface receptors or inserting into the plasma membrane of the cell can trigger oxidative and inflammatory pathways, and result in alterations in cell membrane properties, leading to eventual cell apoptosis. Amyloid beta (Aβ) induced NAD(P)H oxidase-mediated reactive oxygen species (ROS) production stimulates the activation of downstream signaling pathways that involve the activation of MAPK (mitogen-activated protein kinase) and ERK1/2 (extracellular-signal-regulated kinase 1/2), and phosphorylation of cPLA2 (calcium dependent phospholipase membrane protein). Azelnidipine is an L-type calcium channel blocker that causes vascular smooth muscle relaxation, and a drug commonly used to treat hypertension. Recent studies have suggested evidence proposing the drug promotes an anti-inflammatory response that reduces levels of superoxides in various types of cells. In the present study we examined if Azelnidipine was capable of attenuating the Aβ-induced cellular pathways of oxidative stress and inflammatory responses shown to alter endothelial functions using immortalized cerebral endothelial cells (bEND.3 cells). Specifically, we tested and found that Azelnidipine has potential uses in Alzheimer’s disease (AD) treatment by suppressing Aβ-induced oxidative and inflammatory pathways through the attenuation of ROS production and activation of subsequent pathways. The results suggest that Azelnidipine might have potential application as a therapeutic strategy to treat Alzheimer’s and mediate oxidative stress induced pathogenesis of neurodegenerative diseases such as AD.
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Veterans Transitional Shelter

Alyssa Jensen and Bimal Balakrishnan

For my Capstone Project I will be designing a Veteran Transitional Shelter off of Business Loop in Columbia, Missouri that facilitates growth and rehabilitation for veterans and/or homeless veterans alike. The need for a Veterans shelter is very serious; while there is a VA in Columbia, it does not create a place for Veterans who may not have a stable home to live in. Almost 10% of all Veterans have a physical or mental disorder, and may be trapped in a homeless cycle. The building achieves stabilization amongst its users and facilitates transformation. The Transitional Shelter allows for the Veterans to live and visitors to find a sense of community. With the use of a stable environment and a reliable community there is a stabilization of jobs and lifestyles. The building facilitates self-worth and the use of equality and a dignified atmosphere by creating nodes of privacy. On the streets, the stereotype that follows people without homes create an unhealthy place to live. There isn’t a stable environment, or community that inspires for progress. The building does not deny or inhibit people with any physical or non-visible disability with the use of ADA and legible signage. Rehabilitation and progress can only be successful if the building that it is provides a dignified freedom while also creating common amenities. There will be an opportunity to be part of the community by giving all the same rights as any other citizen has to those who may not have current access to such things as computers, washing/drying machines, support teams, and opportunities to be creative within the community. There will be a strong ambition to surpass stereotypes for veterans and to encourage self-worth with open and open floor plan that allows for congregation and communication. Addicts and users will be treated fairly and be given the same opportunities and will be encouraged to create a different type of community within the Transitional Shelter. Freedom is important along with safety. Learning and communication will give life to those that may visit and live within the building. A healing environment will inspire growth and the attainable success of all of its users with the use of healing gardens and landscaping that allows for relaxation.

This project was completed to fulfill a Capstone requirement.
Protoform summaries of bed sensor data

Tianqi Jiang, Akshay Jain, and James Keller

The MU Eldertech group has been studying and deploying sensor based monitoring of elders for several years. There is a massive amount of data generated. More recently, linguistic summaries of such data have been introduced, showing great promise. However, theoretical and practical issues remain. This project addresses some of those problems.

Motion sensors and an MU developed bed sensor reliably detects several important parameters of residents at night. However, it is difficult for a clinician to spend a lot of time to check this extended raw data stream in order to assess the health condition of the patients. Therefore, it is better to find a solution to transform this raw data in textual summaries, which are natural language expressions that are convenient for clinicians to read. The research group already have methods to produce simple template based summaries like The bed restlessness today is higher than most of the nights in past 2 weeks. In this research we propose to investigate issues concerned with the extended template based summaries of the form Most of the nights with high bed restlessness had high bathroom motion, which convey more information about the data. In order to accomplish this, we plan to use a newly created methodology to determine the “truth” of basic and extended template based summaries.
Asia Minor has experienced occupation by various groups of people and civilizations for millennia. Over the past century archaeologists have excavated and cataloged thousands of artifacts from the sites of Sardis, Ephesus, Pergamon, and many others. All of these sites were centers of production and trade in the Asian subcontinent. Sardis is believed to have been home to an imperial arms factory that produced weapons and other armaments for much of the subcontinent. The purpose of this research was to compare various spearheads, arrowheads, axes, and knives from artifact catalogs. If a large number of comparable weapon heads and tools were found, backed by evidence of production and trade in the area, then it may be concluded that Sardis was in fact a site of weapons production and that these sites traded various metal goods with one another. Previous literature provides evidence of trade and circulation of goods within the Late Roman Empire. One instance is of seventh century copper-alloy vessels from Sardis were found to have comparable vessels in Corinth and Constantinople. Many other finds show Roman metals were exported through Asia Minor and the Empire. These goods were exported via sea routes for it cost efficiency as well as the Royal Road that connected the major cities of Asia Minor. Evidence for this comes from ancient authors like Herodotus as well as modern day researchers. The lack of cataloged finds made it impossible to draw a definitive conclusion that the metals at this site are connected, though there is evidence that the production and trade of goods did exist in the late Roman East.
Reaction of stock prices to attempted acquisition of GrainCorp by Archer Daniels Midland Company and the denial of the Australian government

Cody Jones and Michael Sykuta

We examined how the stock market reacted to both the announcement of ADM’s acquisition of GrainCorp as well as the announcement that the Australian government would not allow the acquisition as well as other related dates from 2012-13. We used stock prices from the Center for Research on Securities Prices (CRSP) as well as from Yahoo! Finance to study the market trends on dates including the market’s first hint of the acquisition, the announced proposal of acquisition, and the Australian Government’s denial of the acquisition. We discovered that the stock price of ADM, decreased when the market believed the acquisition would be carried to completion. This result is similar to what happens in many corporate acquisitions. The stock price of GrainCorp, the company proposed to be acquired increased upon the announcement of acquisition. We also discovered the stock price of both companies decreased when the AU government declined ADM’s Proposal to acquire GrainCorp. These results suggest that shareholders well-being is reduced by actions taken by the Australian government, because the market thought the acquisition would be good for all investors.
The effects of encoding scheme, GPU virtualization, and network conditions on remote MRI viewing

Samuel Jonesi, Eliot Prokop, Jerry Adams, Bradley Hittle, Albert Lai, and Prasad Calyam

My research is on various properties associated with viewing MRIs remotely. Difficulties of viewing MRIs remotely, possibly from hundreds of miles away, include the delay required to send data both ways, restricted bandwidth, and multiple machines viewing an MRI on one Graphics Processing Unit at once.

One variable a doctor or researcher can manipulate in their favor is which encoding scheme their virtual network computing client uses in order to view the MRI. Each encoding scheme has a tradeoff. Some compress the MRI data more, thus making it easier to send over the Internet, at the expense of CPU time and image quality. With others it is the opposite. I have had dozens of subjects look at an MRI using virtual network computing clients. I have taken subjective measures of these subjects both 536 miles away on Mizzou’s campus and in the same building at the Ohio Supercomputer Center. During both tests I have had subjects look at and manipulate the MRI under every encoding scheme the VNC client UltraVNC had available, during both optimal conditions in which the bandwidth is the same as the commercial Internet, and while they have the bandwidth halved.

In addition to taking subjective studies of which encoding scheme users prefer while viewing MRIs, I also took objective measures of how much bandwidth was used by each encoding scheme and how they map to users’ subjective scores during both optimal and degraded network conditions.

Finally, I have looked at how many machines can use on graphics processing unit at once without causing the GPU utilization to reach 100%.
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Faculty Mentor: Dr. William Folk, Biochemistry
Funding Source: PML Consortium grant to W. Folk

Modulation of JCV replication by NF1/CTF transcription factors

Kirtan Joshi, Alexander Kenzior, and William Folk

John Cunningham polyomavirus (JCV) is the etiological agent of progressive multifocal leukoencephalopathy (PML), manifested by lytic infection of oligodendrocytes with demyelination that causes motor deficits, altered consciousness, gait ataxia and visual symptoms. While JCV appears to infect the majority of adults, its replication is suppressed by a healthy immune system and usually becomes a health issue only in individuals with compromised immune systems. Administration of individuals with certain monoclonal antibody therapies developed for multiple sclerosis (such as Natalizumab) and other autoimmune disorders can activate JCV infection; currently there are no means to efficiently and selectively block JCV replication.

We have previously reported that interactions between cellular transcription factor NFI/CTF isotypes, and Pol-primase and the viral initiator protein, T-Ag, modulate replication of BK virus, which shares many properties with JCV (Liang et al; 2012). The in vivo data suggests that NFI/CTF might serve as a therapeutic target by which to block JCV replication. Here we assess whether NFI/CTF also modulates JCV replication, by using a sensitive luciferase reporter assay system in which plasmids containing the polyomavirus origin and adjacent regulatory sequences are transfected into cells together with vectors expressing NF1/CTF isotypes to measure DNA replication. The results of preliminary experiments show dependence of JCV replication upon NFI/CTF, and will be discussed.
Recent studies of clinical patients have identified phosphoglucomutase 1 (PGM1) deficiency as an inherited metabolic disease. Disease presentation can range from mild to life-threatening. Phenotypes of the identified patients include dilated cardiomyopathy, stunted growth, exercise intolerance, and hepatopathy, consistent with the central role the enzyme plays in glucose metabolism. We performed biochemical characterization of 13 missense mutants associated with human PGM1 deficiency. The mutants segregate into two biochemical phenotypes: those with apparent folding defects and those with compromised catalytic function. Problems with protein folding were indicated by a decrease in the amount of soluble protein in solution and aggregation. Our findings were consistent with available in vivo data that showed a reduced amount of protein levels in solution. Missense mutants with catalytic defects were well behaved in solution, but had greatly reduced enzyme activity, with $K_{cat}/K_{m}$ often <1.5% of the wild type. Modest changes in protein conformation and flexibility were sometimes present in the mutants with affected catalytic activity. An example is the G291R mutant with severely compromised activity linked to the inability of a key active site serine to be phosphorylated during catalysis. We have also begun to seek crystallization conditions to study the 3D structure of WT human PGM1 and its kinetic mutants. We were able to crystallize both WT and several kinetic mutants under similar conditions, but X-ray diffraction was modest at ~2.7 angstroms. Efforts are underway to improve diffraction by engineering of residues involved in crystal contacts so that a detailed view of structural changes caused by the missense mutants can be obtained. Studying PGM1 protein structure through X-ray crystallography may provide insight to develop new therapies and pharmaceutical chaperones to promote stability/proper folding in patients with this congenital error in metabolism.
Anna Kalinowski, Hadi Ali Akbarpour, and Kannappan Palaniappan

In the fields of photogrammetry and computer vision, three dimensional (3D) visualizations have become more common, and they have proved to be very useful for a wide array of applications such as urban planning, farming, national defense, etc. Many 3D visualizations are obtained from expensive satellite or aerial sensors such as hyperspectral sensors or LiDAR sensors. In this project, methods to obtain 3D visualizations using inexpensive close-look images captured from a camera on the ground have been studied. Although the images used for this project were taken with a hand-held camera, the same methods can be applied to high altitude aerial or satellite imagery. The first step in the process was to collect the raw metadata along with imagery. Each of the sensors used to acquire the metadata and images (inertial measurement unit, global positioning system, and camera) had its own local coordinate system. In order to reconcile the heterogeneous data from the different sensors, it was necessary to apply coordinate system conversions. After this, several different feature detectors were applied for tie point collection. A linear triangulation method was used to estimate a 3D point for each set of corresponding tie points. This resulted in a sparse point cloud. To reduce noise in this result, bundle adjustment was applied to the point cloud and the camera parameters. There are a variety of applications that can benefit from the methods studied here. Future expansions to this method would be to develop its compatibility with ultra-high resolution images collected from a small unmanned aerial vehicle.
A look into the life of a man with Asperger’s syndrome and how he copes

Shelby Kardell and Brian Kratzer

My dog, Faith is a piece about Eli Miller, who was diagnosed with Asperger’s Syndrome when he was a child. I interviewed Eli about how he copes with the panic attacks he experiences as a result of his Asperger’s, in particular with regards to his dog, Faith, and his multitude of animals.

The piece involved a significant amount of problem solving to be successful, from interviewing techniques (such as talking to Eli about a sensitive and personal topic) to making a cohesive storyline in the editing process. The B-roll, audio, and interview had to flow as one line of thought, which is often difficult to plan and organize when producing a film. I spent a significant amount of time in designing a film that accurately reflected Eli’s thoughts and story, while problem-solving to match visual aesthetics with the audio interview. I believe the story-boarding and design was ultimately successful, as Eli’s thoughts combined with the visuals in a complete project and story.
After facing national criticism for the handling of sexual assault cases and procedures the United States military has worked to address these concerns and issues of the military justice system. The purpose of this research project is to analyze why victims chose not to report sexual assaults, and if the military is implementing programs that address the reasons victims do not report. This paper specifically looks at the Special Victims’ Counsel (SVC), a free legal counsel available to victims of sexual assault in the military, to see if this internal military program has been effective in increasing numbers of sexual assaults reported. An increase in the number of sexual assaults reported does not mean that more sexual assaults are happening, rather that victims feel more comfortable coming forward about sexual assaults committed against them. This project observes the implementation of the SVC program in all branches of the military. This research project concludes that the SVC program has been effective in educating victims about the military justice system and their rights as a victim, providing effective legal services, contributing to an increase in reported sexual assaults, and helping change the culture surrounding reporting of sexual assaults in the military.

This project was completed to fulfill a Capstone requirement.
Determining the efficiency of ethanol extraction in mesoporous silica for use in biomedical implant coatings

Lauren Kesselring, John Lewis, Charissa A. Nowak, and Heather Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Understanding molecular mechanisms controlling trace metal homeostasis in Arabidopsis

Adam Kidwell and David Mendoza

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The relationship between mindfulness and occupational balance

Brianna Kim and Karen Hebert

Occupational balance, the ability to engage in range of desired and meaningful activities, is an important concept in understanding how individuals lead satisfying lives. The purpose of this study is to examine the relationship between emotional regulation, mindfulness, fatigue, and occupational balance. We predict that individuals who rate high in mindfulness and emotional regulation and low in fatigue will have greater occupational balance and overall satisfaction with life. The 140 participants in this study were healthy adults who ranged in ages from 18-65. Participants completed self-report questionnaires including the Chandler Fatigue Scale, Difficulties in Emotion Regulation Scale, Kentucky Inventory of Mindfulness Skills, Life Balance Inventory, Mindful Attention and Awareness Scale, and the Satisfaction with Life Scale. Results show that individuals who are high in mindfulness have less fatigue and greater rates of emotion regulation, satisfaction with life, and occupational balance. Occupational therapists should consider using mindfulness techniques for improving occupational balance and satisfaction with life in clients with a range of physical and emotional impairments.
Too much stuff: Individual motivators of overconsumption

Courtney King and Pamela Norum

Overconsumption is a relatively new trend impacting the lives of American consumers, and has a negative impact not only on the environment, but on the social and environmental integrity of the fashion industry. The fast fashion industry has affected the fast pace of changing trends, and the shortened lifespan of clothing, thereby contributing to the disposal of apparel, a portion of which ends up in the landfill. In order to gain a better understanding of the factors that lead to excessive levels of purchasing, a “closet study” was completed through in-depth interviews with 22 women aged 40-65. The interviews were conducted in the participants’ home, utilizing clothing that was purchased within the past 12 months as a cue. There was further conversation between the participant and the observer related to the price of the item, the retailer it was purchased from, and the intention behind the purchase of the garment. It was found that clothing purchases were made based on price, aesthetics and function. Many women insisted on never paying full price for their clothing, while also having high expectations of quality. Another important factor to these women was the versatility of the clothing, as they did not want to purchase clothing unless it could become a part of their wardrobe worn on a regular basis. Finally, women frequently bought clothing without planning in advance; many of the planned purchases were for work or an event. In all, the research is useful for understanding clothing consumption from both a retailer’s point of view, and a sustainability point of view.
Taking a virus on a leisurely cruise: The agent based modeling of Norwalk virus on a cruise ship

Jeffrey King, Samantha Warren, Dmitry Korkin, and Timothy Matisziw

The Norwalk virus, often referred to as the stomach flu, may not necessarily be a deadly pathogen, but instead is more of a hindering nuisance. The virus can be prevented through various hygienic methods, but cannot normally be treated. In an open environment, it is not common for the Norwalk virus to have an epidemic outbreak. However, in a closed environment such as a cruise ship, the virus is more contained and could be a serious concern for everyone on board if even a single crew member or passenger contracted the virus.

A number of records point to similar outbreaks occurring on dozens of cruise ships, with the most significant outbreaks affecting as much as 20% of passengers. Our goal is to develop computational means to accurately simulate and analyze the potential spread of a pathogenic infection on a cruise ship by integrating stochastic simulation, agent-based modeling, and Geographic Information Systems (GIS). GIS is used to define capturing, managing, analyzing, and displaying all forms of geographically referenced information. Using GIS and a specific program called ArcMap, we are modeling and visualizing the 3D floor plan of a cruise ship, using a combination of line networks and grid-based topology. The floor plan model is then used to define agent movements in an agent-based model by employing a specialized language called MASON. MASON allows GIS integration through its extension called GeoMASON. With a GIS model of the ship, we will be able to accurately model the movement of passengers and crew throughout the ship. This will allow us to better understand how pathogens spread throughout a cruise ship. Additionally, we must understand the methods of infection spread. This can be done using probabilistic models based on known of dose response curves of viral particles. This integration of GIS, agent-based modeling, and biology has not yet been utilized to model infection spread.
Super Bowl advertisements: An analysis to gain insight into cognitive/emotional processes evoked by advertising

Samantha Kintz, Congrong Zheng, Jaimee Zupan, and Paul Bolls

This study tests relationships between biometric, self-report, and behavioral indicators of advertising effectiveness. Participants will be 40 male and female adults aged 23 and over recruited from the Columbia, Missouri community. Participants will view nine advertisements selected based on the USA Today Admeter rankings of 2015 Super Bowl advertising. Ads that are ranked at the top, middle, and bottom of the USA Today Admeter rankings have been selected for this study. Biometric data reflecting attention and emotional response will be recorded during exposure to each advertisement. Self-report measures of attitudes, behavioral intentions, and recall will also be collected. This study will provide insight into cognitive and emotional processes evoked by advertising that underlie traditional indicators of advertising effectiveness. It will also inform the value of less conscious biometric measures in predicting advertising success for clients.
Declining motivation across the transition to middle school: A review of the literature

Clare Klawuhn, Mary Wilsdon, and David Bergin

The purpose of the present research was to review quantitative studies that track motivation over the transition from elementary school to middle school. The measures of motivation studied included academic motivation, achievement goals, attendance, engagement, perception of ability, and self-esteem. The ten articles presented longitudinal studies. Students were within a range of fifth through twelfth grades with an emphasis on fifth through ninth grades. The results indicate that there is a steady decrease in most measures of motivation. For example, one study discussed how self-esteem and perception of ability were negatively affected by the transition from elementary to middle school. Their results indicated that self-esteem scores declined across the transition to junior high (from grade 5 to 6), but increased during 7th grade. Self-concepts of ability for math, English, and social activities declined after transition, but perceptions of social ability increased during 7th grade. There were variations across studies in how steep the decline was, but the overall trend leads to the conclusion that student’s motivation declines over time, especially across the middle school transition.
Long-term criminal and civil suit outcomes among juvenile offenders with histories of family violence

Rachel Kloppe, Benjamin D. Johnides, and Charles Borduin

Family violence, including child physical abuse (PA) and exposure to intimate partner violence (IPV), has been shown to predispose children to antisocial behavior during adolescence. Although research has demonstrated the short-term effects of family violence on adolescent behavior, little is known about the longer-term effects. An investigation of the far reaching effects of family violence on antisocial behavior in adulthood may have implications for the treatment of juvenile offenders. The present study examines the long-term criminal and civil suit outcomes of juvenile offenders with and without histories of childhood PA or exposure to IPV.

Eighty-five adolescents were assessed for histories of offending and family violence and then were followed for 27 years to evaluate their criminality and civil suits in adulthood. The sample was divided into four groups, three of which included juvenile offenders with family histories of (1) only IPV, (2) only PA, or (3) no violence, and (4) one of which included nondelinquent youths with no histories of family violence. Family violence data were obtained from court records, and criminal and civil suit data were obtained via Missouri public records.

The analyses will evaluate whether individuals from groups 1 (IPV) or 2 (PA) (a) are more likely to have committed misdemeanor or felony offenses, (b) have spent more time incarcerated or on probation, and (c) have been involved in more family-related and financial civil suits than have individuals from groups 3 (delinquent/nonviolent) or 4 (nondelinquent/nonviolent).

Juvenile offenders who have experienced family violence may be at increased risk of long-term negative consequences. Although research has focused on children who have experienced PA, children exposed to IPV may be at similar risk for long-term difficulties. The findings may be useful for researchers and service providers in the development and implementation of interventions for juvenile offenders with histories of family violence.

This project was completed to fulfill a Capstone requirement.
Allelopathic properties of Virginia Rye exudate

Cynthia Koehler, Sam Delphin, Elizabeth Del Rosario, David Emerich, and Jason W. Cooley

Virginia Rye has been observed to prevent the growth of several species of moss and algae in both natural and controlled environments. Cyanobacteria can form toxic blooms which devastate ecosystems. Targeted allelopathic substances could be a viable and valuable solution to controlling blooms. Additionally, metabolic pathways of cyanobacteria can be manipulated through exposure to allelopathic substances. If the exudate from Virginia Rye is allelopathic, it could have significant implications for the study of light energy storage and harvesting. The aim of this project is twofold: to determine whether or not the Virginia Rye exudates is allelopathic towards the model cyanobacterial models and to determine optimal concentrations most active in allelopathy so as to be able to use the exudates as a selective influence for studies of metabolic manipulation. Thus far, it has been found that the exudate has not impeded growth in laboratory conditions. Further studies will develop the metabolomics and proteomics of in vivo versus in natura exudates and cellular interactions.
Eric Koenig
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Faculty Mentor: Dr. Enos Inniss, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option

Prediction tools for understanding extent of wall effects in DBP formation in drinking water distribution systems

Eric Koenig and Enos Inniss

Disinfection is a vital part of a drinking water treatment process and chlorine is the most widely used disinfectant in the world. Though known for its effectiveness, usage of chlorine does lead to the formation of carcinogens which are commonly called as Disinfection By-Products (DBPs). The Stage-2 Disinfectant and Disinfection By-Product (D/DBP) regulations under Safe Drinking Water Act (SDWA) of United States force water utilities to be more concerned with their finished and distributed water quality.

Compliance requires a better understanding of reaction kinetics changes and wall effects with different materials (Ductile Iron and PVC) used in the distribution system, which affect the formation of DBPs over time. To validate our results in full scale treatment plant physical conditions, effect of different materials, wall effects, bulk reactions and water movement is analyzed using Simulated Distribution System (SDS) tests, Material Specific Simulated Distribution System (MS-SDS) tests and Pipe Section Reactor (PSR); all built using materials from City of Columbia distribution system. PSR and MS-SDS are used to evaluate the change in water quality from typical operational conditions such as having a high chlorine dosage before entering the distribution system and using a chlorine booster system in the distribution system. These different processes contribute to different rates of DBP formation.

Pipe Effect (PE) values are calculated using DBP results from MS-SDS and PSR relative to the ones from SDS. The results from MS-SDS & PSR show that PE value of PVC pipe is > 1 while Ductile Iron is <1. This indicates that in PVC pipes wall effects lead to net increase in DBP formation while the opposite in Ductile Iron pipes. These PE value differences can now be used to better manage disinfectant residual in the distribution system while still being in compliance for DBP Stage-2 regulations.
Exploring sustainability in textile and apparel through minimal waste cutting and digital textile printing

Kathleen Kowalsky and Jean Parsons

The textile industry is one of the world’s leading sources of chemical and material waste. This research design will explore sustainable solutions, including minimal to zero-waste cutting and digitally engineered textile printing. I will be linking my research to the current research of Dr. Jean Parsons who recently finished a project that entailed designing and constructing patterns that required few seams and one piece of fabric. Her engineered print design was made possible through digital textile printing.

The research garment created was a coat designed entirely with various sizes of rectangles. Because of the manipulation of the shapes, the coat is zero-waste, meaning that no fabric was unused during the cutting and sewing. Being that the shapes used are rectangular, it was important to use darting and pleating in order to create shape for fit.

After the design was created, the digital print needed to be engineered. The two images used are both from trips to New York City. The inspiration was taken from the urban architecture, both exterior and interior. The outer body of the garment uses a rendered photo of the exterior architecture of a dilapidated building. The inner lining was created from a photo taken of the interior ceiling of Javits Center, overlaid with a textural image taken of the inside floor of a taxi cab after a snow storm.

My idea was to create a story of life in Manhattan, from the flowing and artistic yet geometrical elements of the coat to the architecturally structural yet textured print. It provides the spirit of New York through the juxtaposition of the creative yet refined culture.
Range-wide genetic assessment of Ringed Salamanders

Chelsey Kroese, Jacob J. Burkhart, Raymond D. Semlitsch, and Lori S. Eggert

Range-wide studies provide information on the type of habitat that species utilize as well as the locations and relative sizes of populations. When range-wide studies include genetic assessment, important aspects of population dynamics (i.e. bottlenecks, extinction/colonization rates) can be determined and the evolutionary history of species can be examined. We studied the ringed salamander (Ambystoma annulatum), a species endemic to the Ozark and Ouachita Mountains in Missouri, Arkansas and Oklahoma. We sampled 250 individuals from 12 localities spanning the range and genotyped them at 19 microsatellite loci. In our pilot study, we found significant genetic structure across the species’ range. Genetic diversity within this species is structured geographically, indicating that the landscape and habitat have likely influenced the genetic structure and dispersal history of this species. This information is especially important in light of the lower survival rates for ringed salamanders in habitats such as open fields. Our study will allow us to answer the question of whether pristine habitats house ringed salamander populations with higher genetic diversity and to begin to elucidate past distribution patterns, all of which will contribute to well-informed management decisions concerning ringed salamanders.
Creating artificial receptors for organophosphates via molecularly imprinting processes for use with WGM optical microresonator sensor platforms

Jackie R. LaBruzzo, Denise Hammond, Emily C. O’Brien, Sheila A. Grant, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Carlos Sun, Civil & Environmental Engineering
Funding Source: College of Engineering Undergraduate Research Option

**Reviewing Missouri Uniform Crash Reports (MUCR) and Missouri Highway Safety**

Tyler Lacy, AmirHossein Khezerzadeh, Claros Boris, Praveen Edara, and Carlos Sun

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Sufficiency of octopamine in *Drosophila* place-memory

Carissa LaFebere and Troy Zars

Monoamines are critical for memory formation in insects, including *Drosophila melanogaster*. We showed previously that of the three biogenic amines serotonin, octopamine, and dopamine, only serotonin is necessary for place-memory (Sitaraman, et al, 2008). Octopamine has been shown to be important for behavior in many insects. As a trace amine, once thought to be unremarkable, it has recently begun to be investigated with renewed effort due to shared similarities with biogenic amines in vertebrate animals. Octopamine’s role in appetitive olfactory learning prompted an investigation into a potentially similar reward-role in place-memory. While it was recently shown that octopamine is not necessary for proper place memory (Sitaraman et al. 2010), whether octopamine could be sufficient for conditioning place memory is an open question. The recent development of thermogenetic tools allows us to ask this question. Despite evidence that octopamine plays an appetitive role in olfactory learning, our new results argue against a major role for octopamine or tyramine in place learning in *Drosophila* and suggests that place-learning may be controlled by a single aminergic system.

*This project was completed to fulfill a Capstone requirement.*
Analyzing multimodal non-fiction writing of young children: Thinking with poststructural and posthumanist theories

Jiun Lee, Emily Sheeley, Tara Gutshall Rucker, and Candace Kuby

Much research has addressed the topic of writing workshops and multimodal writing. However, more research is needed to explore the social, collaborative aspects of multimodal writing and what happens when teachers follow children’s literacy desires. This study aims to address these gaps by examining a second grade Writers’ Studio. Our research explores children’s use of writing materials for a non-fiction unit when they moved beyond typical two-dimensional writing and instead created 3D models, paintings, or movies. We wondered what might happened in a classroom when the teacher invited children to create non-fiction writing using multimodal formats and a variety of materials.

The methodological approach of this qualitative study is “thinking with theory”. This research tries not to “center the subject” by finding common themes throughout, but it aims to look at data and theory to “see what newness might be incited” (Jackson & Mazzei, 2012). We based our research on four poststructural concepts of Deleuze and Guattari’s work and four posthumanist concepts of Barad’s work. Poststructural theorists look at places where the structures are broken or fissured. These concepts include rhizomes and lines of flights, assemblages of desires, smooth and striated spaces, and absent presence. Posthumanist scholars think materials and humans intra-act, meaning that materials ←→ discourses are mutually entangled; that humans and language are not privileged in research over materials. Posthumanist concepts include becoming, agency, intra-activity of materials, and entanglement.

We transcribed video recordings from two non-fiction projects that both focused on creating “how to” videos with the iPad (how-to make snowflakes; how-to make recipes). We analyzed the transcriptions based on the eight theoretical ideas described above. In spirit with poststructural and posthumanist assumptions, the focus of our research wasn’t on what these classroom intra-actions meant, but on what the learning-with-materials produced for the young writers.
Among infectious diseases, tuberculosis (TB) is the second leading cause of death worldwide. The silver lining is that provided it is detected early, TB is treatable. Hence, there is significant interest in rapid detection of TB mycobacteria in clinical samples.

The most common diagnostic technique for detection of TB is culture-based detection. Though this method is cheap and reliable, they typically require 7-56 days to yield results since Mycobacterium species are extremely slow growing organisms (doubling time of ~ 24 hrs vs. ~20 min for E. coli). Here, we demonstrate an Electrochemical Impedance Spectroscopy based detection methodology to reduce the time-to-detection (TTD).

In vitro TTD study was done on Mycobacterium bovis (M. bovis) (a non-infectious analog for M. tuberculosis). M bovis was seeded in growth media (Middlebrook 7H9 + GAT) and incubated at 37°C. Periodically an aliquot from the culture was drawn and placed in a microfluidic cassette containing a thin capillary channel with two gold electrodes 1 cm apart. When high frequency AC potential is applied, charges tend to accumulate at the membranes of any living cells in the sample between the electrodes. These accumulated charges contribute to the “bulk capacitance” (Cb) of the suspension (distinct from the electrode/electrolyte interfacial capacitance).

Control samples (with no mycobacteria) do not show any increase in Cb over time. On the other hand, samples containing mycobacteria show a gradual increase in Cb over time, with significant differences from the baseline (time t=0) value seen when concentrations in the suspension reached 10^4-10^5 CFU/ml (as determined from plate counts of aliquots taken at the same time as those used for impedance “scans”). This “threshold concentration” of 10^4-10^5 CFU/ml compares very favorably with those of existing culture based methods (10^7-10^8 CFU/ml), and leads us to significantly shorter TTDs.
Investigation of dendrite in convection batteries

Samuel Lohman, Donald Dornbusch, and Galen Suppes

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The RNA World Hypothesis states that early life used RNA as both the genetic material and as catalyst for chemical reactions. Studying RNA molecules catalyze reactions can help us understand the evolution of early life. To understand how RNA can catalyze reactions parallel to biology, we started by artificially selecting for RNA enzymes that catalyze the phosphorylation of a nucleoside. We are selecting for RNA enzymes, or ribozymes, that will use ATP, GTP, UTP, or CTP among many other phosphoryl donors to phosphorylate the 5’-OH of Guanosine. We expect that this ligation-based selection strategy will leave us with active ribozymes that have the capability to phosphorylate free molecules further providing support for the RNA world hypothesis, giving us better models about origins of functional RNA molecules. We have found that almost 20% of RNA population has evolved to a ligated form.

We also want to understand the application of ribozyme phosphorylation on other RNA function. We want to use artificially selected RNA enzymes to modify other functional RNAs by disrupting their function. The particular ribozyme we selected in lab, R3.2, is a target specific functional ribozyme through complementary base pairing. We have three main target RNAs that we phosphorylated by R3.2: ATP binding aptamer, Mango Aptamer (RNA that fluorescences orange when bound to fluorophore) and a hammerhead ribozyme that is capable of self-cleaving. We observed that the when each were phosphorylated, their main functions were inhibited. Modifications by phosphorylation are important to processes in cells; we show it can be specifically and effectively done by ribozymes. This can relate to phosphorylation in post-transcriptional modifications. These protein modifications play a vital role in cell function and growth. Continuation in this study further demonstrates ribozyme such as ours can be used as devices to alter specific gene expression using covalent modification.
The Type VI secretion system of *Yersinia pestis* influences intracellular survival

Lacey R. Lopez, Miqdad O. Dhariwala, and Deborah Anderson

*Yersinia pestis*, causative agent of the plague, is a bacterium that has been responsible for the death of over 200 million people. The ability of this pathogen to counteract host immune response is due to several virulence factors including, but not limited to, the utilization of secretion systems. The lesser studied type VI secretion system (T6SS), is thought to influence the interactions between *Y. pestis* and the host cell, particularly during phagocytosis. In order to understand how the T6SS of *Yersinia pestis* interacts with eukaryotic host cells, phagocytosis assays were performed to study bacterial uptake and intracellular survival. RAW 264.7 macrophages were infected with a multiplicity of infection (MOI) of 20 using a bacterial mutant that possesses a defective T6SS, EO-84, and its parental strain, CO92 pCD1-. The ability of the bacteria to survive intracellular stresses was then studied at 2, 8, and 24 hours post-infection. Here, we demonstrate that both strains of bacteria declined in intracellular survival over the 24 hour time period. However, the mutant strain had a higher phagocytosis and survival rate than CO92 pCD1-. These data suggest that the activation of the T6SS limits host phagocytosis activity, implicating a role for the T6SS in immune evasion by *Yersinia pestis*. Furthermore, Lactate Dehydrogenase (LDH) assays were performed to determine the cytotoxicity of these strains at 8 and 24 hours post-infection. Preliminary data suggest that the active T6SS evades cell death mechanisms in the eukaryotic cell. Together these data enhance the understanding of the role of the T6SS within *Y. pestis* and its influence in intracellular survival.
The induction of iridoid glycosides in scrophularia species

Briana Lynch, Mollie Siemens, William Folk, and Heidi Appel

Plant secondary metabolites are involved in the ecological function of plants and can be important sources for medicines. Scrophularia lanceolata and S. marilandica, were traditionally used by Native Americans and contain iridoid glycosides which are useful in mitigating inflammation. For iridoid glycosides to be produced economically for medicine, it is essential to have high concentrations of these chemicals in the plant. Some plant species producing iridoid glycosides exhibit increased levels following herbivore damage or abiotic stress. This study focuses on whether increases in iridoid glycosides occur in response to treatment of S. lanceolata and S. marilandica with the caterpillar, Spodoptera exigua, or with methyl jasmonate (MeJA) that replicates induction of plant defense or with other stressors such as drought and intense sunlight. The experimental protocols involved greenhouse experiments with net cages to restrict feeding of caterpillars to the same age leaves to control for developmental variation and treatment of field grown plants with abiotic stressors. Plants were analyzed for their levels of iridoid glycosides using Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC). Results from HPLC tests have revealed harpagoside and harpagide in field samples of leaf, root, stem and rhizome tissues in S. lanceolata and S. marilandica. Iridoid glycoside content in each tissue sample is approximately the same between species; however S. lanceolata leaves contain more harpagoside (0.37-0.48%) than S. marilandica (0.13-0.15%) and the harpagoside content seems to accumulate in the leaves of S. lanceolata during the season. Experimental data from caterpillar and Meja treatments have also detected iridoid glycosides in leaf samples using TLC, and experiments are currently being performed. Both field and greenhouse experiments detect different concentrations of iridoid glycosides in tissue samples. Examination of these experiments will help determine which method works best at affecting the iridoid content in Scrophularia species for pharmaceutical use.

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Faculty Mentor: Dr. Karl Hammond, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

Simulation of hydrogen adsorption and scattering on plasma facing materials for nuclear fusion

Joshua MacGregor and Karl Hammond

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The process of abscission refers to a mechanism by which plants shed their organs in response to developmental or environmental changes. In Arabidopsis thaliana, only floral organs are abscised. Previous research suggests that abscission in Arabidopsis requires the action of two genes: HAESA (HAE) and HAESA-LIKE 2 (HSL2). The hae hsl2 double mutant does not abscise its floral organs. HAE/HSL2 are genetically downstream from INFLORESCENCE DEFICIENT IN ABSCISSION (IDA), which is also necessary for abscission. HAE/HSL2 initiate a phosphorylation cascade that leads to abscission. WRKY transcription factor binding sites are over-represented in the HAE promoter and the promoter of PGAZAT, which encodes a hydrolase involved in abscission. WRKY28, a transcription factor, binds to the HAE promoter in the yeast one-hybrid assay. WRKY28 is itself induced during abscission. To further investigate the role of WRKY28 in abscission, WRKY28 was overexpressed (using the cauliflower mosaic virus 35S promoter) and knocked down (using RNA interference or RNAi). WRKY28-RNAi lines show a delayed abscission phenotype. qRT-PCR shows evidence for decreased HAE expression in WRKY28-RNAi plants, while HAE expression is not changed in 35S-WRKY28 plants.
Differential effects of β-Blockers and a novel AT2R agonist on cardiovascular cells

Abuzar Mahmood and Lakshmi Pulakat

Classic β-blockers Metoprolol and Atenolol, 3rd generation β-blockers Carvedilol and Nebivolol, and Angiotensin II (Ang II) type 1 receptor AT1R blockers (ARBs) are widely used cardiovascular protective drugs. Though activation of Ang II receptor AT2R is known to improve cardiac functions and promote cardiac repair after ischemic injury, effects of AT2R activation on cardiovascular cell survival are not fully understood. Therefore, we investigated electrical impedance response of serum-starved mouse atrial cardiomyocyte HL-1 cells to these drugs with the Xcelligence Real-time Cell Analyzer System (RTCA). RTCA measures area covered by cells at the base of microtitre plates and displays it as a unit-less quantity called Cell Index (CI) which corresponds to cell attachment and growth. Treatment with all β-blockers (3μM) decreased CI readings and Nebivolol and Carvedilol induced a characteristic sudden dip in CI that was different from other drugs (p<0.05). Treatment with Ang II increased CI units and this effect was not blocked by AT1R blocker Losartan (1μM) suggesting that increase in CI units is not mediated via AT1R (p<0.05). AT2R agonists CGP42112A and a novel agonist NP6-A4 (300nM) increased CI units and this effect was blocked by AT2R antagonist PD123319 (p<0.05). Inhibition of JAK2, Phospholipase C (PLC) and β3-adrenoreceptor suppressed CI units. To correlate CI units to cell viability and growth we performed MTS assay of untreated and treated HL-1 cells under identical conditions to that of Impedance assay. Treatment with novel AT2R agonist NP-6A4 resulted in the highest number of viable HL-1 cardiomyocytes. Thus the novel AT2R agonist NP6-A4 is more effective in protecting serum starved mouse cardiomyocytes.
In undergraduate research, we are working on a project related to hydraulic pumps that is rather unique in its fundamental applications. Most hydraulic pumps have a combination of actuators and other control mechanisms that are used to control how the pump behaves. One of the main disadvantages of these controls is the amount of space they take up. This project’s purpose is to experiment with the idea of using an area-control valve as the primary control for a pump, eliminating bulky controls like actuators.

The principal idea is this: using an area control valve, control flow by closing the area of the inlet to the pump and vaporizing part of the hydraulic fluid. The amount of area we close will determine how much fluid is vaporized. The saturated solution then flows through the pump and is condensed. However, the greatest challenge to this experiment is getting the hydraulic oil to evaporate because it has a high latent heat of evaporation. What we anticipate will happen, is that the air contained in the hydraulic oil will separate out and act as part of a saturated solution. Thus, the limiting factor on this experiment is the amount of air contained in the oil. We need to determine how much air is approximately in the oil, and if this is a sustainable process or not. Another challenge is the problem of cavitation. Allowing oil/air to evaporate and then condense will cause cavitation on the pump. We have yet to see to what degree this cavitation will be a problem.
The relation of supervision, stress, and coping to aggression in youths with autism spectrum disorders

Louis Christopher Markovitz, Cynthia E. Brown, and Charles M. Borduin

Approximately 50% of youths with autism spectrum disorders (ASD) engage in aggressive behavior toward other individuals, including caregivers, teachers, and peers (Farmer & Aman, 2011). When one considers that aggressive behavior (e.g., physical violence, verbal hostility) in youths with ASD has been linked with both immediate and longer-term difficulties in key areas of adjustment (e.g., academic and interpersonal functioning), it seems imperative to develop an empirical base regarding risk factors for aggression in this population of youths. Although research has examined the relation of individual level variables (i.e., biological characteristics) to aggressive behavior in youths with ASD, little attention has been given to the possible link between family system variables and aggressive behavior in this clinical population. The current study will investigate the relation between key family-level variables (e.g., caregiver supervision, stress, and coping) and aggressive behaviors in youths with ASD.

Participants will include 120 youths with a confirmed diagnosis of ASD, their caregivers, and their teachers. Measures will assess (a) youth aggressive behavior via caregiver and teacher report (Children’s Scale for Hostility and Aggression: Reactive/Proactive [C-SHARP; Farmer & Aman, 2009], (b) caregiver monitoring via youth and caregiver report (Pittsburgh Youth Study Scales [Loeber et al., 1991), (c) self-reported caregiver stress (Parental Stress Index – Short Form [Abidin, 1990]), and (d) self-reported caregiver coping skills (Brief COPE [Carver, 1997]).

Although research is still being conducted at this time, results from this study will be presented at the undergraduate forum. The results of this study may further our understanding of family system factors related to aggressive behaviors in youths with ASD and may help to elucidate potential targets of intervention for family-based treatments, which have been shown to be effective in reducing aggressive and other disruptive behaviors in neurotypical populations.

This project was completed to fulfill a Capstone requirement.
Lindsey Marschka
Lancaster, PA

Faculty Mentor: Dr. Joanna Hearne, English

**Aotearoa Taonga: Allegories of land and treaty in Maori film**

Lindsey Marschka and Joanna Hearne

In the late twentieth century, digital expression emerged as a core mode by which indigenous peoples articulate political concerns and support their cultural identities, thereby altering the visual landscape of mainstream media. From the 1970s onwards, Maori filmmaking gained prominence alongside dramatic social activism in the fragile post-settler New Zealand nation, transforming the way indigeneity is represented in the landscape.

Landscape is central to the formation of cinematic spaces as they position narratives in a specific spatial and historical context with deeper intentions beyond the surface. In analyzing Maori film, taonga (Maori possessions, including land), appear in the Aotearoa/New Zealand setting and notably characterize indigenous Maori conception of space and time as fluid and continuous.

My research demonstrates how Maori control over taonga implies a kind of guardianship, not only over land and external resources, but also people, specifically children and ancestors whose images appear in films. Following the 1975 Waitangi Tribunal, historic claims of tribes for alienated property were given priority. Yet, in the case of Treaty settlements, social structures become fixed, rigidly defined and hierarchical, subverting identity and offering little agency in the contemporary Maori dynamics of rural and urban landscapes. In the process of reinvigorating traditional roots alongside restitution of property, I argue that implementation of taonga to denote rural spaces and urban landscapes can be viewed as allegories of the Treaty and ongoing conflict over rights to land and other property.

I outline the interplay of these concepts in three Maori fiction films spanning two decades, from the success of Once Were Warriors (Tamahori 1994) to Caro’s Whale Rider (2002) and Waititi’s Boy (2010). The films mobilize key tropes of landscape and treaty allegory in cinema as they bridge ideas of separatism and belonging, continuity and adaptation, hybridity and exclusivity, and interior and exterior space.
Algorithmic analysis of protein transport system via atomic force microscopy

Brendan Marsh, Raghavendar Reddy Sanganna Gari, Linda Randall, and Gavin King

More than 30% of all proteins, in any organism, must be transported from the site of synthesis into or across cellular membranes to acquire proper structure and function. In Escherichia Coli and all eubacteria, the major route of protein export is the general secretory system (Sec system). For the Sec system, the pathway through the cellular membrane is provided by the heterotrimeric SecYEG complex. This complex is highly conserved and has homologs across the kingdoms of life, and has energy provided from ATP hydrolysis by the SecA ATPase. However, despite its key role played in the ubiquitous process of protein export, measurement and characterization of the Sec system remains a significant experimental challenge. Advancements in atomic force microscopy (AFM) have yielded a powerful tool for studying such membrane proteins in near-native conditions and have allowed for the imaging of purified SecYEG and its accessories reconstituted into liposomes. Here I present analysis algorithms developed to detect and differentiate the subtle differences between conformational and oligomeric states of the Sec system as imaged through AFM. Analysis reveals that the system is highly dynamic, monomers and dimers of SecYEG and SecA were found, each with multiple conformational states, as well as some higher order oligomers. In addition, the probability of finding the system in a particular state is found to be significantly dependent on what protein is being transported, hinting that the mechanistic details of the Sec system differ for different proteins. Currently, I am working to confirm the results of the analysis algorithms with established crystal structures of the Sec system. Finally, the presented AFM algorithms are being generalized for the study of not just the Sec system but any membrane protein complex.
Haley Martin  
Olathe, KS  

Junior  
Industrial Engineering  

Faculty Mentor: Dr. Wooseung Jang, Industrial & Manufacturing Systems Engineering  
Funding Source: College of Engineering Undergraduate Research Option, Helmerich & Payne  

Assessing distribution system performance and design alternatives in support of a mobile drilling fleet  

Haley Martin and Wooseung Jang  

Helmerich & Payne Inc. (H&P) currently utilizes a third-party distribution system to supply its fleet of mobile drilling rigs with the stock keeping units (SKU) that are regularly ordered by the individual rig operators. The current distribution system is comprised of many small and independently operated distribution centers (DCs) tasked with delivering supplies to the rigs whose drilling sites change every 15-60 days. The actual efficiency (performance and cost) of the current distribution system is not known. Therefore, H&P would like to better understand the operational characteristics of the existing system in order to identify any inefficiencies that if alleviated, could reduce the cost they incur. To this end, this project is evaluating the performance of the existing system and developing models for identifying optimal (and/or near optimal) distribution system designs and operational characteristics (i.e. routing) to benchmark the performance of the existing system. Additionally, this project is exploring mechanisms for integrating H&P’s current rig servicing trips to augment the distribution system.  

Undergraduate Research Objectives: Identify distribution system designs and associated DC inventory profile that could be used to efficiently supply a fleet of mobile drilling rigs with the SKUs that they regularly request.  

a. Develop mathematical models to optimize distribution system design.  
b. Identify optimal distribution system designs  
c. Develop a MIN/MAX inventory system to support DC operations  
d. Compare identified systems with current distribution system and develop supporting business case.
Increasing cultural competence among pre-service teachers through service

Joy Martin, Samantha Stinson, Bianca Zachary, and Gabrielle Malfatti

This mixed-methods study examines the effects of the Weekenders Initiative on the development of education student’s cultural competence. The purpose of this project is threefold; (1) to generate a contextual definition of cultural competence and its importance for this Weekenders experience; (2) to observe the effect that a cultural immersion experience in urban/high poverty schools on the participant pre-service teacher’s cultural competence; and (3) to examine possible changes in cultural competence over the course of the immersion experience. Educators need the ability to understand their own personal biases and how they may affect their future teaching career and how they approach a culturally diverse classroom to achieve maximum academic achievement. The participants were 28 White females and 2 White males all completing their teacher preparation at the same Midwestern University. The location of the study took place at three different elementary/intermediate schools, two charter schools and one public, in urban/high poverty areas. Participants were monitored and observed during their initial pre-traveling meetings and also received a pre and post-trip electronic survey which asked them specific questions regarding their perception of cultural competency and their expectations for the Weekenders experience. Our initial results indicate that there was a change over the course of the trip in the pre-service teachers cultural competence and awareness of their own cultural bias(es). Participants indicated that their experiences far exceeded their expectations and goals for the trip and that following the Weekenders experience, most could see themselves one day teaching in a culturally diverse, urban/high poverty schools. Implications include the enhancement of pre-service teachers training programs to included culturally relevant immersion experiences and thus increasing the willingness of pre-service teachers to consider teaching in underserved urban school districts.
Educator and community perspectives on English learner and dual language education

Emily McCammon, Emma Clawson, and Lisa Dorner

This research examines community members’ and educators’ beliefs about language education programs. Specifically, Columbia Public Schools (CPS) is considering a Spanish-English dual language (DL) program, which would provide content and literacy instruction to students in two languages within the same classroom. This promotes bilingualism, cultural awareness, and academic achievement for English Learners (ELs) and English-speaking youth (Howard et. al, 2007). However, prior research demonstrates that developing DL policies is a value-laden, political process, where different stakeholders’ beliefs and values can shape program implementation (Dorner, 2011). Thus, our study asked: What is the current model of EL education in CPS? What do parents, teachers, and administrators think about changing to a DL program?

CPS currently has 1,010 EL students who speak 58 different languages, including 26% who speak Spanish. Data was collected through six months of participant observation in one EL-focused elementary school, four interviews of CPS teachers and administrators, and two interviews with parents. Analyses also examined demographic data, four newspaper articles, and letters to the editor about the district’s consideration of a new DL program.

Preliminary findings indicate that while the current approach to EL education is believed to be effective, there are challenges with the model. Specifically, the current EL model has a growing number and diversity of students, which makes it challenging for teachers to fully meet their various needs. Meanwhile, parents believed that DL models could improve education for EL students and offer an additive, bilingual education for native English speakers. At the same time, educators expressed questions about which language community to serve in a DL model, and whether the district could secure the proper funding, teachers, and necessary resources for it. Implications will discuss how the district may move forward with planning given these varieties of beliefs and opinions.
Selective inhibition of matrix metalloproteinase-9 attenuates neurovascular damage resulting from delayed tPA treatment in emboli-induced focal cerebral ischemia in mice

Myah McCrary, Shanyan Chen, Zhenzhou Chen, Victoria A. Engel, Ming Gao, Shahriar Mobashery, Mayland Chang, Jiankun Cui, and Zezong Gu

Ischemic stroke, the most common form of stroke, is caused by clotting in the cerebral arteries leading to brain oxygen deprivation and cerebral infarction. Recombinant human tissue plasminogen activator (tPA) is currently the only FDA-approved specific therapy for ischemic stroke. However delayed tPA treatment can increase the risks of neurovascular impairment including neuronal cell death, blood–brain barrier (BBB) disruption, and hemorrhagic transformation. tPA usage is limited to patients within 3 hours (and up to 4.5 hours in some eligible patients) of the onset of ischemic stroke. A contributing factor to these pathological processes is the activation of matrix metalloproteinases (MMPs), particularly MMP-9.

Focal cerebral ischemia was mimicked to a physiologically relevant mouse model of stroke by insertion of a single emboli (10-mm long with 0.02 mm diameter) to block the right middle cerebral artery. The mice were separated into four different groups—the vehicle, inhibitor only, tPA only, and combination of tPA and inhibitor. We determined that the highly specific thiirane “suicide-type” inhibitor SB-3CT blocks MMP-9 activity including MMP-9-mediated cleavage of extracellular laminin, thus rescuing BBB from disruption and decreasing hemorrhagic transformation after delayed tPA treatment. Through these trials, we also demonstrated that the effects of SB-3CT and tPA combined therapy up to 6 hours was synergistic in rescuing neuronal cells from degeneration.

We conclude that a combined treatment with tPA and SB-3CT should hold great promise for prolonging the therapeutic window for tPA as well as minimizing tPA-induced hemorrhage and neurotoxicity after cerebral ischemia.
Design of a non-antibody based test for HIV


One of the most effective tools for combating HIV is widespread testing in high risk areas. Patients who know their HIV positive status are more likely to take precautions, and are less likely to transmit it to others. Unfortunately, current widely deployable tests aren’t very stable in non-controlled environments, are expensive, or aren’t accurate in the first three months. We are designing a system that would be simple to use, but tests directly for HIV viral particles. Our research looks at the interactions of three proteins, and uses them to activate a signal. HIV GP120 is the glycoprotein used by HIV to gain entry into the target cell. It actively binds CD4, a human immune T-helper cell receptor, during the first stage of entry. This binding causes a conformational change in GP120, allowing it to bind CCR5. In the second stage of entry, GP120 binds CCR5, which causes a conformational change in GP41, another HIV glycoprotein, and pulls the viral particle into the cell. Using the affinities of both human proteins, we are designing a system that will allow for one of these proteins to be a propagator of information. To do this, we designed a chimera of CD4/LacZ. This chimera will cause a color change in solution, but will only remain on the column in the presence of GP120. Using this, a device could be designed that tests directly for HIV, reducing the amount of time between potential infection and accurate testing.
Stereotypes of widowhood: Jane Austen’s Mrs. Norris considered

Grace McNamee and Stephen Karian

Jane Austen’s six novels feature twelve “significant” widows (Gevirtz, 138) with varying economic and social resources. Among the most famous of these is Mrs. Norris, one of the lead characters in Mansfield Park. Mrs. Norris is best known for being miserly, selfish and grasping.

But Mrs. Norris is not the only eighteenth-century literary widow with those character traits. In fact, in writing this character, Austen succumbed to the stereotypes of her day, which dictated that widows are selfish, un-maternal, and more interested in money than emotions.

These stereotypes highlight the community’s fears about widows. Eighteenth-century society felt threatened by these independent women who ran their own households, educated their own daughters, and controlled their own finances. These women were threats because they were outside of the control of a male authority.

My poster will illustrate how these stereotypes are reflected in this specific literary character. I will also include historical information about widows’ legal and social rights and how those rights directly relate to the literary stereotypes invoked in this character. Finally, I will provide information on what was expected of real-life widows to avoid living out the literary stereotypes. These expectations included living in separate communities, now known as “spinster clusters,” and living quiet, private lives.

My poster will lead the audience to understand more about eighteenth-century widows, through the lens of Jane Austen’s Mrs. Norris.

This project was completed to fulfill a Capstone requirement.
3D data mapping and real-time experiment control and visualization in brain slices

Michael E. Miller, Jaime V. K. Hibbard, Marco A. Navarro, Tyler W. Nivin, and Lorin S. Milescu

Brain slices are invaluable preparations for neuroscientists, where molecules and individual cells can be studied in the broader context of functional neuronal networks and circuits. We are developing a computer program that streamlines experiments in brain slices and enhances data collection and analysis. The program constructs a 3D virtual workspace, where the equipment, the preparation, and the data are visualized. The user can control the operation and positioning of the instruments relative to the sample, with real-time visual feedback. Specific cells can be bookmarked and linked to optical and electrical recordings, and the entire 3D workspace can be saved for later viewing and data analysis. We are using this software platform to explore cellular and network interactions in the neuronal respiratory pacemaker. This program provides a unified approach for combining electrophysiology with structural and functional imaging.
On extremals of conformally invariant functionals via rearrangement inequalities

Nicholas Miller and Carlo Morpurgo

In 1990, Eric Carlen and Michael Loss developed a method to optimize functionals with great symmetry properties, namely the method of competing symmetries. This method involves applying a sequence of function rearrangements and conformal transformations to a function and showing that this sequence converges to the extremal function of our functional. Carlen and Loss used this method to provide a proof of the sharp Hardy-Littlewood-Sobolev inequality. We use the method of competing symmetries to prove the existence of extremals of functionals of the form

\[ E[W] = \int_{S^n} \int_{S^n} \Phi \left( W(x)W(y)|x - y|^{\frac{2n}{p}} \right) |x - y|^{-2n} dxdy, \]

where \( W \in L^p(S^n) \) for suitable \( \Phi \). We shall also prove the extremal function of \( E[W] \) is, up to a set of measure zero, simply \( \|W\|_{L^p} \). A condition of \( \Phi \) determines whether this function is a maximizer or minimizer of \( E \). Although we work with a general \( \Phi \), specific \( \Phi \) provide interesting examples and insight such as \( \Phi(t)=t^q \) as \( q \) tends to infinity, which yields a simple extremal result for two-point, weighted conformally invariant energies. The latter extremal problem can be further generalized to \( n \)-point weighted energies, rather than simply two.
Cyberbullying of students with disabilities

Lindsey Mirielli and Chad A. Rose

Cyberbullying has become more prevalent among adolescents due to increases in technology and access to the internet (Lenhart et al., 2011). Schools’ use of technology provides students with access to electronic media where involvement in cyberbullying occurs. To compound this issue, research has demonstrated that students with disabilities experience higher levels of traditional victimization than their peers without disabilities (Rose, 2011). This project directly compares the online victimization rates between students with disabilities and without disabilities.

The current study used a data set that surveyed 14,508 students in grades 6-12. The survey included eight items about each student’s personal experiences with online victimization. The results suggested that certain subgroups of students with disabilities experienced higher rates of online victimization than their peers without disabilities. Students with Specific Learning Disabilities were 1.51 times more likely to experience high online victimization than their peers without disabilities. Students with Intellectual Disabilities were 2.74 times more likely to experience high online victimization than their peers without disabilities. Students with Emotional Behavior Disorder were 2.15 times more likely than their peers without disabilities to experience high online victimization. Lastly, females, regardless of disability status, were 1.81 times more likely to experience high online victimization than their male counterparts.

Long-term exposure to bullying and disability-based harassment, and a failure to systematically attend to this exposure, may be an infringement upon a student’s right to a Free and Appropriate Public Education (Rose, Swearer, & Espelage, 2012). Therefore, devoting resources to cyberbullying issues and online victimization of students with disabilities will provide a better understanding of the characteristics that predict escalated rates of bullying involvement among individuals with disabilities, including cyber-victimization, and inform potential action plans designed to provide a more inclusive learning environment for this population of students.
Dominic Montoia
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Faculty Mentor: Dr. Gregory Triplett, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

Extracting characteristic temperatures for mid-infrared, optically powered lasers

Dominic Montoia, Zach Haverman, and Gregory Triplett

The demand for mid-infrared lasers has rapidly grown in the past years. With more power and thermal stability, these mid-IR lasers could have a profound number of applications, especially in the sensing community; these applications include sensing of organic compounds (such as methane), explosives ordinance, and environmental detection. These lasers also have a strong military application when used for low-altitude radar, or infrared countermeasures when used in an array. However, challenges exist when using 2-4 μm laser applications that must be overcome.

Characteristic temperature is an important quality to consider when creating laser diodes, as it allows one to see how the performance of the laser varies according to the operating temperature. In order to create a higher characteristic temperature, the device must be stable through a wide range of temperatures. However, due to the wide energy bands of most lasers, thermal residuals can cause temperature instability. This project serves to quantify which pulse width, frequency, and duty cycle allows the most thermal stability, while maintaining a high power density.

After numerous fabrication steps, the rectangular laser bar is mounted on a highly conductive copper stage using thermal paste. The copper stage is temperature controlled by a two-stage thermoelectric cooler with a thermistor embedded inside to frequently monitor temperature. This allows for various temperatures above and below room temperature to be maintained (from 293K to 333K). The lasers are optically-pumped using a high-power, single mode laser (1440 nm) coupled through an optical fiber then into three different lenses to reshape and refocus the beam into a rectangle, allowing it to be incident upon approximately 80% of the sample. The light from the laser bar is collected using a optical fiber, detector and lock-in amplifier. Pulses are no longer than two microseconds with frequency varying in each experiment in order to adjust the duty cycle. Lasers pulsed at low-duty-cycles are very useful in diode evaluation and generates less heat. With these parameters identified in this study, it would allow performance optimization of the laser diodes, while maintaining the most temperature stability.
Surface roughness and homogeneity study using atomic force microscopy and x-ray reflectivity


Surface flatness and homogeneity are qualities that are important in fabricating nanoscale features in electronics, mechanical components, and multi-layer constructs. The purpose of this study is to determine the surface roughness of coupon samples fabricated to help determine the conformity and flatness of electrode-insulator interfaces in metal-insulator-metal (MIM) diodes used in our rectenna devices. These rectennae are alternative energy devices used to harvest blackbody radiation; i.e., waste heat, for producing electricity. Characterization of the interfaces helps insure that surfaces remain very smooth in order to maintain stable Fowler-Nordheim tunneling, the principal mechanism for electrical rectification. In this study, we first characterized our silicon (Si) substrate and a dummy diode nickel/nickel oxide/nickel (Ni/NiO/Ni) MIM structure. The driver for this examination is that experimental measurements did not match the theoretical model, and there is a concern that the lack of flatness in the deposited Ni was leading to this deviation. Initial characterization utilized atomic force microscopy (AFM) to help measure flatness. To further develop this study, X-ray Reflectivity was used to characterize the surface. It was found that Ni/NiO had a root mean squared (rms) roughness of 2.5 nm at the interface.

ZCAN refers to a metal surface composed of Zirconium, Copper, Aluminum, and Nickel. It has been proposed that ZCAN may provide a smoother interface onto which we can deposit the Ni/NiO/Ni MIM diode. A study was conducted on ZCAN using AFM to measure the rms for different areas. Rms values for the largest area measured, 75.95 μm², were slightly smaller than that of the 9 μm² and 1 μm² areas. These values were 0.713, 0.792, and 0.805 nm respectively. Rms values ranged from 0.1045 nm for the smallest area of 1 nm² to 0.805 nm for the 1 μm² area.
Total monomeric anthocyanin content and total phenolic anthocyanin content of various elderberry extracts

Matthew Mosior, Mitch Johnson, and Michael Greenlief

This study sought to determine the polyphenolic and anthocyanin concentrations in elderberry juice for three specific cultivars. Solid phase extraction was used to separate anthocyanins from the matrix of the elderberry juice. Then, the total phenolic (TP) content of various raw elderberry extracts from several different cultivars by utilizing the Folin-Ciocalteu method. The total monomeric anthocyanin (TMA) content of the raw juice was also determined using the pH differential method. UPLC-MS/MS utilizing multiple reaction monitoring was used to quantify individual anthocyanins in elderberry juice. Elderberry juice from the different cultivars possessed different TP, TMA, and individual anthocyanin content (p<0.05).
James Mrkvicka
St. Joseph, MO

Faculty Mentor: Dr. Troy Zars, Biological Sciences
Funding Source: A&S Undergraduate Research Mentorship Program

Genetics of learning, memory, and thermotolerance in *Drosophila*

James Mrkvicka, Anna Perinchery, Libby King, and Troy Zars

To explore how genetic architecture influences behavior, we examined how different *Drosophila melanogaster* strains learn from and tolerate extreme temperatures. We hypothesized that natural variants of these small poikliotherms would emphasize learning or thermotolerance. We used a unique and powerful genetic mapping population, the *Drosophila* Synthetic Population Resource (DSPR). The DSPR is a panel of more than 1500 recombinant inbred lines (RIL) that have been generated from an eight-way, 50-generation cross. Results show a shallow but significant negative correlation between learning to avoid and tolerating extreme temperatures. Moreover, a QTL analysis has implicated novel genomic regions in fly learning, memory, and thermotolerance.

*This project was completed to fulfill a Capstone requirement.*
Flow separation control in horizontal-axis wind turbines using plasma actuators

Moiz Munir and Chung-Lung Chen

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Musicians in motion: The effects of kinesthetic training on university-level classical musicians

Haley Myers and Paola Savvidou

The purpose of this qualitative study was to explore whether somatic education affects university level classical musicians in terms of their kinesthetic awareness, how they value movement training, and their perception of its role in their musical lives. The study was conducted in conjunction with a new course at a mid-sized public university in the Midwest entitled “Movement and Wellness for Musicians,” which surveyed various somatic techniques over the course of a sixteen-week semester. Three students participated in the research study. Data collection included weekly journals, interviews with three participants, a mid-term project, and interviews with the participants’ applied instructors. Researchers used open coding to independently code the data and then agreed on common themes for the analysis. Results showed that through the course participants increased their kinesthetic awareness and focus, found relief of tension, and reached new and helpful conclusions about movement as a communicative component of music-making. All participants expressed a belief that wellness education is a crucial component of maintaining a long-lasting career in the arts. In addition, results reveal a lack of knowledge and terminology which students and applied instructors may draw from when discussing and exploring new techniques in lessons. These findings suggest that it may be beneficial to introduce classes on somatic training into university-level music education.
The Shine-Dalgarno sequence is a ribosomal binding site in prokaryotic mRNA that initiates protein synthesis by aligning the 30S small subunit of the ribosome with the start codon (usually AUG). Distance between the Shine-Dalgarno sequence and the start codon is known to affect efficiency of translation significantly. Optimal distance between the Shine-Dalgarno sequence and the start codon is estimated to be around 8 base pairs. Furthermore, the intrinsic strength of the Shine Dalgarno/Ribosome interaction contributes to the efficiency of initiation and provides a simple way to regulate protein synthesis. Intrinsic strength can be increased through additional base pairing between the Shine Dalgarno Sequence and the 3’ 16S rRNA. We are using bacterial protein expression to produce Reverse Transcriptase (RT), a protein heterodimer comprising of a p66 subunit and a p51 subunit. RT is translated as a part of a larger gag-pol polyprotein and processed into p66/51 heterodimers by HIV protease during viral maturation. Increasing the translational efficiency of RT is important in efforts to purify the protein for inhibition studies to develop new antivirals. The RT expressing plasmid is currently producing much more p51 than p66, significantly reducing the yield of RT protein heterodimers after purification. The distance between the Shine-Dalgarno sequence of p66 and its start codon is 17 nucleotides. The optimization of RT translation in an expression plasmid is being conducted by changing Shine-Dalgarno to AUG spacing within the plasmid as well as intrinsic strength. I am testing whether decreasing the 17 nucleotide spacing will increase p66 protein expression in this plasmid. Furthermore, I am testing whether increasing the intrinsic strength of the SD/rRNA interaction through additional base pairing will increase p66 protein expression. Fourteen plasmids have been cloned with different spacing variants and Shine-Dalgarno sequences to determine optimum spacing for RT protein expression as well as the effects of intrinsic strength on protein expression. Data evaluating these plasmids by protein synthesis will be presented.
Epigenetic mechanisms lead to parallel cellular resistance to Bisphenol A and detergent

Emily Nelson, William Swatson, and Stephen Alexander

Dictyostelium discoideum is a well established genetic model for investigating the mechanism of drug action and human disease. We used this system to ask if the compound Bisphenol A (BPA) has pharmacological effects beyond those attributed to it being an endocrine hormone mimetic. BPA is toxic to D. discoideum in a dose dependent manner and kills cells quickly. Spontaneous mutants that are resistant to BPA are isolated at a frequency of 1 in 105 cells. Remarkably these clonally derived strains can grow in the presence of BPA indefinitely, but rapidly loose their resistance if grown in the absence of BPA. This type of phenotypic switching has never been previously reported and is clearly epigenetic. The underlying molecular mechanism is unknown, but is not due to DNA methylation. Remarkably, cells growing on BPA also show a strong resistance to non-ionic detergent suggesting that the plasma membrane of these cells is altered. Revertant cells that are no longer BPA resistant are not detergent resistant. Studies of Triclosan (TCS) - a compound that has a structure similar to BPA - indicate that it inhibits growth of D. discoideum but does not kill the cells. Isolation of strains that are TCS resistant, also loose their resistance when grown in the absence of TCS. However, TCS resistant cells are not resistant to detergent. These studies reveal a novel epigenetic mechanism and provide important insight to previously unknown mechanisms of action of BPA and membrane structure and function.

This project was completed to fulfill a Capstone requirement.
Effects of SB-3CT inhibitor on neurodegenerative function of matrix metalloproteinase-9 in a mouse model

Rasheeq Nizam and Zezong Gu

Traumatic brain injury (TBI) is a prevalent civilian injury seen in car accidents, sport activities and active-duty soldiers in warzones. After the initial impact of TBI, biochemical processes often lead to a second stage of injury considered to be the cause of many neurological dysfunctions observed after the initial trauma. Biochemical, metabolic and cellular changes observed during secondary brain injury are frequently associated with disruption of the blood-brain barrier, inflammatory responses and infiltration of blood-derived macrophages, edema, and cell death. Studies in our laboratory and others suggest that irregular signaling events seen after a TBI can lead to the activation of enzymes called matrix metalloproteinases (MMPs) which can digest the extracellular matrix basal lamina and tight junction molecules and cause axonal degeneration, resulting in edema, hemorrhage and brain damage. Among the 25 known human MMPs, MMP-9 (gelatinase B) in particular has emerged as a culprit in many neurological diseases including TBI. Presence of MMP-9 is correlated with neuroinflammation and white matter damage in the brain. SB-3CT is an MMP-9 inhibitor that has been shown to effectively and specifically reduce the impact of MMP-9 after a TBI in mice. However, the specifics of its function and the extent of its effectiveness are still unclear. If a mouse undergoes a cortical controlled impact (CCI) for a TBI model and is subsequently treated with the SB-3CT inhibitor or a vehicle injection containing no inhibitor at 2 or 4 hours after the impact, the images of its brain sections as well as behavior tests will indicate the extent to which SB-3CT is effective at inhibiting MMP-9 activity. The aim of this project is to develop a thorough understanding of the mechanism and effectiveness of SB-3CT through analysis of its physiological and behavioral effects. The previous studies in our lab and numerous others indicate that SB-3CT is an effective, even benchmark, MMP-9 inhibitor in mice. The results of this study give further support to the effectiveness of SB-3CT.
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Faculty Mentor: Dr. Heather K. Hunt, Bioengineering 
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

**Studying the dissolution of MgF\textsubscript{2} thin films with quantum tunneling photoacoustic spectroscopy**

Charissa A. Nowak, Anna M. Rudy, Benjamin S. Goldschmidt, and Heather K. Hunt

MgF\textsubscript{2} thin films are frequently used as antireflective coatings on lenses and other optics, many of which may come into contact with aqueous environments. In these applications, accurately knowing both the refractive index and film thickness is of vital importance. Additionally, knowing the dissolution rate of MgF\textsubscript{2} is necessary to determine the lifetime of the coating in a working environment. Ellipsometry is currently used as the standard characterization technique for measuring refractive index and film thickness. However, ellipsometry requires highly reflective films and relies on empirical models that can be imprecise at certain wavelengths. Quantum Tunneling Photoacoustic Spectroscopy (QTPAS) has been shown to determine refractive index and thin film thickness of optically transparent materials without needing empirical formulas or polishing the film surface. In this work, we will demonstrate QTPAS’s ability to track the dissolution of standard MgF\textsubscript{2} thin films in aqueous solution by dissolving small amounts of the MgF\textsubscript{2} film away over time and monitoring the change in film thickness and refractive index with both ellipsometry and QTPAS. From this study, we anticipate QTPAS to have the ability to monitor film thickness and refractive index in dissolution experiments without the use of empirical formulas and for a film with a low optical absorbance.
Jackson Nowotny, Sharif Ahmed, Noelan Hensley, Lingfei Xu, and Jianlin Cheng

The entire collection of human genetic information resides within the chromosomes. Such chromosomes have unique 3D structures that control certain functions including gene interaction, gene regulation, and other genome operations. Therefore, knowing the 3D structure of chromosomes is vital in understanding how the human genome functions. The nature of the 3D structure allows for the construction of a model via computational methods by utilizing contact data of the chromosome. In this study we developed a unique computational approach to construct 3D structures of human chromosomes using this contact data.

Our computational method involved using a technique known as growth to build a random initial model followed by the sequential implementation of optimization algorithms that optimize the model by improving its accuracy based on the contact data. The optimization algorithms implemented are known as adaptation, simulated annealing, and genetic algorithm.

Our research group evaluated the resulting models using scoring functions that compared the finished models with the contact data. Analysis of the developed chromosomal structures through the scoring functions demonstrated the effective construction from our unique computational approach. In addition, when compared to the similar MCMC5C method, our method consistently resulted in higher scores for all chromosomes.

The implementation of our computational approach proved effective in constructing 3D chromosome models. Therefore we achieved our goal of creating a tool to help advance knowledge regarding human genome and chromosome structures. Such knowledge will pave the way for further research and knowledge regarding the human genome.
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Faculty Mentor: Dr. Karl Hammond, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

Visualizations of plasma-facing materials

Gabriel Ort and Karl Hammond

Exposure to helium plasma causes the formation of fuzz like processes on the surface of irradiated materials. This project focuses on tungsten surfaces, such as the ones that will be used in the diverter of the ITER fusion reactor. Long scale observations of this phenomenon can be obtained through the use of molecular dynamics simulations by implanting helium atoms into the tungsten system. Visualization of these simulations is an important step toward processing and interpreting the data, a task that proves increasingly difficult with the increasing scale of the simulation. For example, running a simulation that of reactions that would occur over just a few picoseconds would take hours or days, and running a simulation that would occur over a period of seconds is unrealistic. Therein lies the problem; we would like to obtain data on these interactions over a longer period of time than is realistically possible given the current abilities of computers. The goal of this project is to create a process of visualization of larger-scale simulations, which will illuminate the more intimate details of the “fuzz” formation.
Improving road striping operations through system optimization for MoDOT

Alec Page, James Noble, Timothy Matisziw, and Ronald McGarvey

Painting road lines represent a significant portion of maintenance activities for the Missouri Department of Transportation (MoDOT). Each year, MoDOT striping crews stripe around 33,500 miles of roads across the state of Missouri. This is equivalent to striping around the equator over one and a third times annually. Currently, factors such as annual average daily traffic and carrying capacity restrict striping schedules for road-striping crews. As a result, “deadhead miles” on segments of road that road-striping crews must travel while not actively striping roads create inefficiencies in the form of unnecessary travel, wasted time, and vehicle wear. The purpose of our research was to determine a striping schedule that increased the efficiency of striping operations in the Central District of Missouri for 2015. Additionally, we seek to develop a tool to utilize optimization models that may be used by MoDOT to increase the efficiency of striping operations on an annual basis.

To investigate road-striping operations, we analyzed information regarding road segments such as distance, number of lanes, and striping frequency. This information was used to determine a preliminary schedule to stripe the necessary roads for Maries County. As the number of counties and roads increased, the time required to calculate a schedule increased exponentially. Therefore, we created a simplified model to calculate a schedule to compare to the optimized schedule for Maries County. By finding a simplified model that closely approximated an optimal solution for Maries County, we created a tool to quickly approximate an optimal striping schedule for all of the eighteen counties in the Central District of Missouri. The creation of a striping schedule will reduce operational costs for MoDOT through the minimization of “deadhead miles” traveled by road-striping crews and decrease the time needed to stripe roads.
Mice exposed to predator threat display protracted sleep disruptions

Amit Patel, Rishi Sharma, and Mahesh Thakkar

Background: Post-traumatic stress disorder (PTSD) is a severe debilitating disorder which develops after an individual experiences a life threatening event. Although several animal models have been developed and used, most models involve physical pain and discomfort. In contrast, the predator threat (odor) model is considered highly relevant since it does not involve pain or discomfort rather. Rodents exposed to predator odor display several symptoms of PTSD including fear and anxiety. Although sleep disturbance are considered to be hallmarks of PTSD, sleep has never been examined in the predator threat model. This study was designed to examine the effects of predator threat on sleep-wakefulness in C57BL/6J mice.

Methods: Using standard surgical procedure, mice were instrumented to record hippocampal EEG and EMG to examine sleep-wakefulness. Mice were exposed to contextual conditioning by replacing their recording cages with contextual cages. PTSD mice were exposed to predator threat by spreading soiled cat litter in their (contextual) cages. Controls were exposed to clean/unused cat litter. After 90 minutes, contextual cages were replaced with original recording cages and mice were left undisturbed for 4 days. Fear learning was verified on day 5 by housing the animals in contextual cages.

Results: As compared to controls, PTSD mice exposed to predator threat displayed a significant and a protracted increase in the wakefulness along with a concomitant reduction in sleep. These results support the relevancy of predator threat model in mimicking human PTSD.

Conclusions: A single exposure to predator threat results in severe and protracted sleep disruptions.

This project was completed to fulfill a Capstone requirement.
Improved enhancement from nano-structured plasmonic gratings

Samiullah Pathan, Sangho Bok, Aaron Wood, and Shubhra Gangopadhyay

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Karen Patterson
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Faculty Mentor: Dr. Carl Gerhardt, Biological Sciences
Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

**Preliminary exploration of cellular and nuclear size as it relates to gene expression and ploidy**

Karen Patterson, Mitch Tucker, and Carl Gerhardt

Polyploidy (full chromosome duplication) has contributed significantly to the evolutionary history of many organisms, although the mechanisms by which it does so are unclear. Polyploidy occurs frequently in plants and lower vertebrates, and is often associated with novelty. One potential explanation lies in the myriad of genetic and epigenetic alterations, which occur both in natural and synthetic polyploids. Another possible factor contributing to phenotypic novelty is the increase in cell size that typically accompanies polyploidy. A previous study investigating the phenotypic effects of synthetic polyploidy on treefrog behavior suggested a link between cell size and behavioral change. Polyploid treefrogs were produced from diploid parents; most males produced advertisement-calls with slower pulse-rates than their diploid siblings. However, four males that were polyploid produced calls with diploid-like pulse-rates and also had diploid-like cell size, suggesting that cell size per se caused the slower pulse rates. In addition to increased cell size through polyploidy, cell size is also influenced by a variety of environmental conditions, namely temperature, nutrition, and density of individuals. Specifically, development occurring in lower temperatures is often associated with an increase in cell size. In order to assess how developmental temperature influences the cell size and behavior of treefrogs, we raised treefrogs to sexual maturity in two temperatures. We measured red blood cells as a proxy for global cell size, using an Olympus Vanox AHBT3 microscope. Preliminary analysis has been consistent with previous findings: cooler temperatures result in larger cells. Future directions include evaluating the behavioral phenotypes of these treefrogs – the pulse-rate of males’ calls, and pulse-rate preferences of females. Continued investigations on the effects of developmental temperature on cell size and behavior will provide insight to the mechanisms by which polyploidy produces phenotypic novelty.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Andrew Pelikan, Carmen Aboytes, Katy Beyer, Andrew Briedwell, Matt Fleissner, Virginia Trauth, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
The influence of appearance and health contingencies of self-worth on goal strategies and impression formation

Riann Pena and Jamie Arndt

People hold varying contingencies of self-worth (Crocker & Wolfe, 2001). These contingencies may provide a roadmap to the feelings of value that can help people to manage their awareness of mortality (Pyszczynski et al., 2004). This study focuses on appearance-related and health-related self-esteem contingencies to address three areas of interest: the extent to which self-esteem contingencies influence the goal strategies that people think about pursuing, the impressions people form of others who share their values, and whether such effects are amplified by factors that motivate self-esteem striving, particularly the awareness of mortality.

Procedure: Female introductory psychology students (approximate target N = 150; N to date = 60) who previously completed a screening survey measuring appearance and health contingencies of self-worth will be randomly assigned to be primed with either thoughts of death or dental pain, based on traditional manipulations of mortality salience (Rosenblatt et al., 1989). Building from previous research (Arndt et al., 2002; Kopetz et al., 2011), participants will then complete a lexical decision task that will measure their endorsement and accessibility of behaviors that are relevant to attractiveness and health, along with an evaluation of two Facebook pages, one of a woman who values being healthy and one of a woman who values being attractive.

Predicted Results: Multiple regression analyses are predicted to reveal that participants high in health and appearance contingencies of self-worth more strongly endorse (and show greater accessibility) of health and appearance goal strategies, respectively. In addition, esteem contingencies are hypothesized to predict more positive evaluations of Facebook pages of others who share their respective value of health or appearance. Furthermore, we predict that these effects will be amplified in the mortality salience condition.

Conclusions and Implications: We may find that self-esteem contingencies influence accessibility of goal strategies related to health and appearance, predicting that these goal strategies become more relevant and accessible to participants. These health and appearance contingencies of self-worth may also influence the way people evaluate others who share their values. Lastly, our results can inform the effects of existential concerns on these processes, finding whether or not these contingency effects are amplified by a motivational factor that enhances self-esteem striving.

This project was completed to fulfill a Capstone requirement.
Functional genomic analysis of the mitochondrial dihydrolipoyl acetyltransferases

Chris Peritore, Elizabeth Hoyos, Allysa Moran, Ján Miernyk, and Douglas Randall

Basic research is aimed at improving our understanding of plant metabolism at the molecular level. A better understanding will allow development of improved agricultural crops to feed the rapidly growing world population. The pyruvate dehydrogenase complex (PDC) is a multi-enzyme structure that occupies the intersection among multiple metabolic pathways, and is subject to several layers of regulation. The PDC converts pyruvate to acetyl-CoA plus CO2. In mitochondria, the acetyl-CoA enters the Krebs cycle in support of cellular respiration. By contrast, plastidial PDC produces acetyl-CoA and NADH for de novo fatty acid biosynthesis. A minimum PDC includes multiple copies of three catalytic components; pyruvate dehydrogenase (E1), dihydrolipoyl acetyltransferase (E2), and dihydrolipoamide dehydrogenase (E3). Sixty E2 subunits form a pentagonal dodecahedron with icosahedral symmetry in eukaryotic PDC’s. The purpose of this project is to determine why there are three genes encoding slightly variant forms of mtE2 in plants: E2IA, E2IB and E2II? We propose that mutation to any of the E2IA, E2IB, or E2II proteins will have a direct effect on the activity of mtPDC, plant growth rate, phenotype, and reproductive success. We have already characterized T-DNA insertion lines for each of the E2 genes in Arabidopsis thaliana by genotyping the homozygous knockout (KO) lines. Our results were confirmed with RT-PCR, where no E2 transcript was present for each of the individual KO lines. The mutant plants were analyzed phenotypically and striking differences were noted: The E2IA KO-line developed faster than the WT; the E2IB (the most catalytically active subunit) KO-plants were smaller than WT, and E2II KO-seeds had a significantly lower rate of germination. We are using quantitative PCR (qPCR) with primers for the E1 and E3 components of mtPDC to test for differences in expression of the other PDC genes in the E2 KO lines. Initial results suggest that there might be pleiotropic changes in expression of the PDC subunit genes in response to changes in expression of individual E2 genes. Results from these analyses will help us better understand the bases for multiplicity of E2’s.
Effects of realistic previews on combat training exercises in an ROTC population

Marjorie Perkins and Victoria Shaffer

Stress has a negative impact on the active duty population of the U.S. Military. It leads to decreased job satisfaction, increased rates of attrition, and higher rates of mental health issues than in the civilian population. Research on narratives has demonstrated that realistic previews of difficult experiences can increase satisfaction with medical decision-making. In this study, we will examine whether this principle can be applied to combat simulation exercises by testing whether realistic previews about combat simulation training exercises affect predictions and experiences of participants in an ROTC training exercise.

Participants (first-year ROTC members at the University of Missouri) will be asked to make predictions about their experiences with an ROTC training exercise and then report their actual experiences after completing the training exercise. Participants will be randomly assigned to either the realistic preview condition where participants will read a story about the training exercise from an upperclassman or the control group, which will receive a basic description of the event.

We hypothesize that participants in the realistic preview condition will make more accurate forecasts about the level of stress they will experience during the training exercise. To test these hypotheses, we will employ a mixed ANOVA model with one between-subjects-factor (control and narrative group) and one within-subjects factor (pre and post-test regarding predicted challenges and stressors).

This work has implications for the training methods used in our active duty populations. If providing realistic previews about training or combat experiences can reduce stress, methods employing realistic previews could decrease mental health issues among veterans and active duty members and improve retention in military careers.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Chi-Ren Shyu, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option

A study on the frequency and location of palindromic DNA across 41 mammalian genomes

Devin Petersohn and Chi-Ren Shyu

Palindromes are words that are read the same both forwards and backwards. However, in DNA, the term palindrome is used to refer to nucleotide sequences that are equal to their reverse compliment. A reverse compliment occurs when DNA is read the same in the 5’-3’ direction on both strands. Palindromic DNA has been shown to have many interesting and functional properties in DNA. These properties include the ability to form unique structures, such as hairpin, cruciform, and slipped strand structures. Palindromes also serve important roles in binding sites, enzyme activity, and have a strong effect on mutation rates within themselves. In addition, palindromes have been identified frequently in proteins, but the role they play in the function of proteins is not well established. The identification and study of palindromic DNA is essential to the progression of our understanding of its functions.

Despite the interesting properties already associated with palindromic DNA, relatively little is known about what their role in evolution is and what their specific function is in certain locations. We present a study in which all publicly available mammalian genomes are analyzed for palindromes of a minimum length 10. We focus our work on the frequency and location (with respect to specific genes) of palindromes and compare the results across the entire dataset, identifying patterns and associations between palindromic DNA and location. By using a Big Data ecosystem, we are able to identify and compare the palindromes of genomes on a larger scale than any previous study has accomplished. Because the scale of this study is unprecedented, the results can offer new insight into the roles of palindromes and how they evolve with the genes they are associated with.
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Faculty Mentor: Dr. Stefan Sarafianos, Molecular Microbiology & Immunology and Biochemistry
Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

**Discovery of novel hepatitis B virus antivirals targeting viral capsid assembly**

Dallas Pineda, Kelsey N. Boschert, Maritza N. Puray-Chavez, Dandan Liu, Andrew D. Huber, Zhengqiang Wang, and Stefan G. Sarafianos

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Investigation of the impact of film thickness on the photoluminescence of microporous silicalite-1 (MFI)

Alexis Planells, Jiayi You, Gregory Triplett, and Heather K. Hunt

Optical material systems have the opportunity to impact the design, fabrication and performance metrics of micro- and nano-scale optical devices and systems. Zeolites are nanostructured materials with a crystalline pore structure, which gives them the ability to selectively absorb molecules based on their shape and size. Due to zeolites’ unique relationships among structure and function, they have potentially interesting optical properties that may be leveraged for integrated optical systems. By manipulating zeolite self-assembly, structure, and composition, we can impact optical properties. Here, we demonstrate the synthesis of silicalite-1 (MFI) zeolite thin films via in situ crystallization for various synthetic parameters, and characterize the resulting structural and optical properties, including the photoluminescence of the calcined samples. The thicknesses of the samples range from 100-200 um, and the photoluminescence spectra exhibit emission peaks at ~ 650 nm and ~ 803 nm. Here, we explore how we can manipulate these emission peaks with small changes to the synthetic parameters, and we evaluate the results using the statistical analysis program JMP. These results will allow us to potentially predict optical properties based on known variations in synthesis protocols.
Biomechanical evaluation of posterior cruciate ligament transection and repair in the human knee

Andrew J. Polk, Laura Evans, James L. Cook, Pat Smith, James P. Stannard, Mauricio Kfuri, Matthew Mooberry, and Ferris M. Pfeiffer

Isolated injury of the Posterior Cruciate Ligament (PCL), and compound multi-ligament injuries involving the PCL contribute to a large number of clinical orthopedic trauma cases. It is well known that these injuries contribute to anterior-posterior instability of the knee, and if left untreated, can lead to early arthritis of the knee. Numerous surgical repair techniques currently exist to treat PCL injuries, however the relative efficacy of each technique is debated.

The objective of this project is to examine the biomechanical effects of isolated PCL injury on anterior-posterior (A-P) stability of the knee, and to evaluate the effectiveness of various surgical repair techniques in restoring stability. This project will provide clinicians with a better understanding of the biomechanical function of the PCL, and will lead to improved clinical treatment of PCL injuries. We hypothesized that an isolated PCL injury will significantly destabilize the human knee joint in the A-P direction, and that reconstruction of the injury using one of three repair techniques will restore function to within 80% of the intact state.

Based on the results of this study, we conclude that posterior cruciate ligament attachment significantly contributes to knee joint stability in A-P shear. We also conclude that the method used for PCL reconstruction can significantly affect stability of the surgically repaired human knee in A-P shear.
Electron beam diode tailored to piezoelectric transformer power supply

Zachary Porter, Brady Gall, and Scott Kovaleski

Conventional x-ray systems typically contain large, immobile high voltage power supplies to generate the x-rays necessary for imaging. While this is satisfactory for most uses, certain applications such as medical, industrial, and security would greatly benefit from a more compact, lightweight option, which is primarily hindered by the size of the power supply. Research at the University of Missouri is leading the development of new compact high voltage sources powered by piezoelectric transformers. These piezoelectric sources have demonstrated output voltages up to 120 kilovolts, which is sufficient for x-ray production. A compact electron beam diode is presented to extract energy from the piezoelectric transformer and produce x-rays. To complement the compact form factor of the piezoelectric transformer, the diode is small, measuring 20 centimeters long with a diameter of 1.4 centimeters. The compact electron beam diode design consists of a thermionic diode for electron emission, and a quartz tube to contain the beam. To test the electron beam the tube was applied a high voltage and x-ray spectra were measured using a solid-state MCA detector.
Monitoring the orientation of α-helices in lipophilic environments

Christopher Powers, Anahita Zare, and Renee Jiji

It is known that a membrane protein’s environment influence the structure, and thus function, of the protein but the extent of this influence has yet to be fully investigated. Circular dichroism (CD) is often used for the characterization of protein secondary structure, but can also be used to provide more information using oriented circular dichroism (OCD). OCD is an optical spectroscopy technique for investigating a protein’s orientation with respect to the membrane it is embedded in. Many factors influence the interaction between membrane protein and membrane, including hydrophobic matching and preparation of the OCD sample. Treatment of a combination of model leucine-alanine α-helices and phospholipids and hydrophobic matching between the peptide and membrane were varied allowing for changes in the peptide’s orientation to be observed.
Use of filler words by preschool-age children who stutter

Brooke Prigge and Stacy Wagovich

Children and adults with and without fluency disorders use filler words (e.g., um, uh) in conversational speech, as well as in response to questions (e.g., What is this?). Several explanations for filler word use have emerged. Clark and Fox Tree (2002) have suggested that speakers use them to signal to the listener that there will be a delay in completing the message. In typically fluent speakers, the use of uh signals a relatively shorter delay, and um signals a longer delay. Thus, according to this account, these filler words serve a specific pragmatic function. The frequency and duration of filler words has not been systematically investigated in individuals who stutter. If differences were observed, this could point to a broader pragmatic function of these words for people who stutter, relative to those who are typically fluent. The purpose of this preliminary study is to compare the frequency and duration of filler words in children who stutter (CWS) and children who do not stutter (CWNS). Twenty children in each group, ages 3;0 to 6;6, participated in a structured picture labeling test. Responses to test items were analyzed for frequency and duration. Results indicated that for the CWNS there is some degree of correspondence between language ability and the use of um versus uh, and the length of um. However, these patterns were not observed in the CWS. Our findings are important because they can guide future work, identifying the role of fillers in the speech of CWS, and addressing the question of whether filler words are simply an aspect of the fluency disorder for CWS or serve a specific pragmatic function.
Finding the correlation between one's human perception stress and performance

Nolan Rackers and Jung Kim

Many jobs and careers these days require people to be able to perform multiple cognitive functions well at a single time. This research is intended to find and analyze the correlation between the human perception stress level and their performance in these multi-task jobs. To do so, eye and head tracking devices will be used to gather as much data as possible from the participants as they go through the experiment. The key measurement taken will be the constant monitoring of the pupil size for each of the participants. All these measurements will be taken while the participant is monitoring an oil and gas refinery pump terminal. To increase the cognitive strain, along with the fact that most control operators in oil and gas refineries have other work activities and responsibilities, in addition to monitoring the pumps, an additional task will be required by the participants to try to replicate this experience. The second task will be a Multi-Attribute Task Battery (MATB). These MATB tasks require the participant to keep a healthy system by resetting the abnormal states and by using pumps to maintain the fluid level in the key tanks. To measure the mental workload from both of the task, the NASA Task Load Index will be used. It is hypothesized that the arousal and stress are believed to play a significant role in performance for detecting the process deviation in the dual-task environment. Different patterns of the pupil dilation movement will be looked for and these patterns will show linkages between the imposed mental stress levels and the different dimensions of performance in the given task. This experiment is significant in the fact that a user-centered design for process monitoring display is important for supportive, proactive monitoring by console operators as they help prevent critical mistakes.
How do tadpoles and larval salamanders influence zooplankton communities?

Madelyn Rawlings, Freya Rowland, Annelies Brock, and Raymond D. Semlitsch

Little is known about how amphibians influence zooplankton in wetlands. Salamander larvae feed directly on zooplankton, but tadpoles are omnivorous, so they can affect zooplankton through direct (consumption) or indirect (nutrient recycling) pathways. Zooplankton are an important part of the ecosystem because they provide a food source for many animals and they also filter particles out of the water column. We evaluated the effects of light, nutrients, and amphibians on zooplankton community over the course of three months in 60 experimental ponds. We tested four amphibian communities: tadpoles (Southern Leopard Frog; Lithobates sphenocephalus), salamanders (Spotted Salamander; Ambystoma maculatum), frogs and salamanders (each replicated four times), or neither (controls, replicated three times). Shadecloth altered light to high or low levels. All ponds received an initial leaf litter packet of 0.5 kg, and high nutrient ponds received additional dissolved nitrogen and phosphorus three times per week. Three zooplankton samples from each pond were enumerated to capture temporal trends. Preliminary results suggest that the zooplankton community had a major shift in the number and size of cladocerans. The first samples had numerous large cladocerans but by the middle of the experiment most of the large cladocerans were generally replaced by small cladocerans and copepods. This study is one of the first to look at the effect of amphibians on pond systems. Our results give insight into the role of amphibians in structuring food webs and how their presence or absence affects ecosystem processes.
Stability of C-dots in aqueous suspensions: Implications on the environment

Chloe Rees, Michael A. Zambrana, and Maria M. Fidalgo

Carbon dots are a class of carbon-based spherical nanomaterial with emission properties in the visible range. Their lower cost, comparable stability and biocompatibility make them an excellent material for environmental sensors. As their field of use grows and more C-dots are being manufactured, the probability of them reaching the environment as a contaminant also increases. The goal of this research project is to assess the behavior of C-dots in natural waters, in order to estimate their implications on the environment. C-dots are known as hydrophilic, very stable nanoparticles. However, when suspended in complex water matrices, i.e. natural waters, nanoparticle stability may be compromised by changes in ionic strength, dissolved organic matter, or natural colloidal particles such as clay or mineral particles.

Two common salts that appear in natural water are CaCl$_2$ and NaCl. In order to understand the behavior of C-dots in their presence, suspensions including these salts were prepared. The size and surface charge of the C-dots were measured as a function of pH and ionic strength for both. Another substance in natural water is organic material. Humic acid can be used to mimic this organic matter. C-dots were again tested to see if they were affected. Testing the stability of the C-dots requires both sizing and finding their zeta potential, as an indirect measurement of surface charge, while including these common substances in the solutions. The results were modeled by the Derjaguin and Landau, Verwey and Overbeek (DLVO) theory of colloidal stability.

Our results indicated that CaCl$_2$ and NaCl have affected the size and zeta potential of the C-dots but not in a drastic enough manner to make a difference. More tests must still be done including both of those salts and also humic acid to have a more complete view of the characteristics of the C-dots.
Adventures of a Hack: Revitalizing Victorian literature through a mobile application

Hannah Reese, Elizabeth Chang, and Nathan Boyer

Adventures of a Hack is a triumph of interdisciplinary research and cooperation because it explores digital humanities, an area largely shied away from. With the immense popularity of apps and the forgotten but vast world of Victorian short fiction, an app is an ideal way to bring relevance and attention back to literature that is significant but ignored.

Adventures of a Hack creates a mobile application that uses Victorian short fiction in an immersive creative game. It builds on new practices of game design to introduce players to both the richness of the literature and to concepts of analysis. Gameplay leads players through the process of modifying a story from a database of texts tagged by content and form, while also presenting Victorian visuals that shift in response to user choices. Modifications will use established academic language but also invite creative variation, encouraging transformations of key story elements and eventually allowing crowd-sourced tags to add to the story database. Rather than focus on memorization of analytical terms, we propose that we can embed a curiosity about literary practice by allowing transformation of the text via these terms. This project shows the interest and relevance of these century-old texts and images and encourages the public to play and think freely with materials of the past without diminishing their meaning.

My work focuses on choosing and preparing stories for use. I have coded 11 stories for gender, history and interiority. These codes allow players to change genders of characters, time period of the stories and the amount of internal reflection the characters engage in. I have also been involved in creating the systems of coding. I have also written much of the story and gameplay that the characters use to interact.

This project is intended to be a learning tool for college age individuals and academics with an interest in storytelling and digital humanities.
Multilevel parallel geospatial data processing with CUDA

Michael Reinig and Grant Scott

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Exploration of rhomboid proteolysis

Eric Renne, Mia Brown, and Jason Cooley

The Rhomboids are a class of proteases which cleave their substrates within the membrane. These proteases are involved in a wide variety of cellular functions, such as cell signaling, bacterial quorum sensing, mitochondrial homeostasis, and parasitic adhesion. They are implicated in various diseases, including Parkinson’s disease, parasitic invasion, malaria, and even type two diabetes. Escherichia coli rhomboid protease, GlpG, serves as the archetypal model protein for the study of this class of intramembrane-cleaving proteases. In order to better understand intramembrane proteolysis, we have asked the question of to what extent the substrate structural dynamics help to dictate specificity for the cleavage reaction. Specifically, we monitored the cleavage reaction of GlpG using deep UV resonance Raman (DUVRR) spectroscopy. DUVRR is used to monitor protein secondary structure and the hydration environment of the proteins backbone, and will report on any structural and environmental changes of the substrate during proteolysis. To differentiate changes that occur during cleavage vs. those that occur during binding, an inactive form of the protease was incubated with native and mutated substrate sequences revealing that cleavage site choice is governed by substrate dynamics at the active site (Kcat) and are independent of substrate binding affinity (Km).
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Faculty Mentor: Dr. Andrew McClellan, Biological Sciences

Calcium imaging of lamprey reticulospinal neurons following spinal cord injury

Leigh Rettenmaier and Andrew McClellan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Phases of the mole: A simulated crime scene

Marissa Rettig, Brendan Steele, and Mark Milanick

Some aspects of science appear irrelevant or boring to some students. A solution is to make a fun and engaging activity such as a crime scene. The concept of moles is foreign to many students and they often are troubled understanding how one determines how molecules in a solution interact.

For example, here’s an engaging initial scenario:

A man is found dead in his downtown apartment. The medical examiner has determined that he was poisoned. The doorman at the apartment building remembers a few people coming in that day to visit him, but he just cannot remember which one came last because there are a lot of people that go in and out during the day. The poison is a powder that was put into the man’s drink. The police found various powders that could be the poison in the houses of the 3 suspects. We used powders and liquids available from the local grocery or hardware store: table sugar (sucrose), table salt (sodium chloride) and fertilizer (ammonium sulfate). When these powders are mixed with water, isopropyl alcohol or propylene glycol (food grade) the results vary. The students test the 3 separate powders in mixtures of different solutions, and identify one as the “poison.” The different results stimulate a discussion of why the 2 phase separation as well as molarity and solubility. This activity would provide students with a fun scenario that relates these concepts to real life and also serves as an easy way to remember concepts of molarity and molecular interactions.
The nematode effector protein 30D08 may alter gene expression by targeting an auxiliary spliceosome component

Amir Richardson, Anju Verma, and Melissa Mitchum

The soybean cyst nematode (SCN), Heterodera glycines, is a sedentary, root-based endoparasite that is responsible for billions of dollars of damage to the soybean industry. SCN manipulates the root cells of a host plant to form a feeding site, known as a syncytium. The syncytium not only works as a command center for the nematode, but also saps nutrients from the plant, which causes a loss of yield for farmers with infected crops. In order to facilitate infection, SCN injects a collection of effector proteins into a target plant cell that have a variety of different functions, including cell wall digestion, immune system suppression, and plant protein mimicry. We previously determined that the novel effector protein known as 30D08 targets the plant protein SMU2, a homologue of the human RED protein family, an auxiliary splicing factor. Here we tested whether or not 30D08 is altering plant gene expression via its interaction with SMU2. For this, 30D08 was expressed in wild type Arabidopsis plants under the control of the SMU2 promoter. Plant gene expression was compared between wild type and SMU2p:30D08 lines by RNA-seq analysis. From this analysis, 243 genes were found to be differentially expressed. A high percentage of these genes were involved in cell wall modification, metabolism, host defense, and iron transport. Quantitative Real-Time Polymerase Chain Reaction analysis validated the RNA-seq results. A comparison between wild type and smu2 mutant plants determined that several of the differentially expressed genes were regulated by SMU2. These data suggest that 30D08 may target the host protein SMU2 in order to differentially regulate genes important for syncytium maintenance and host immune suppression.
Morphometric analysis of the petiole gall on the narrow-leaf cottonwood, *Populus angustifolia*

Ryan Richardson, Melanie Body, Michele Warmund, Jack Schultz, and Heidi Appel

A gall is an abnormal outgrowth on plant tissues, often highly organized and specific to each insect. The insect induces a differentiation of tissues with features and functions of a novel organ. These tissues provide protection to the galling insect from natural enemies and microenvironmental stresses and also provide adequate nutrition. In this study, we characterized how the gall-inducing insect *Pemphigus betae* (Hemiptera: Aphididae) reshapes the leaf morphology of the narrow-leaf cottonwood *Populus angustifolia* (Salicaceae). Galled leaves and ungalled leaf controls were fixed and stained for light microscopy with Toluidine-blue to highlight the general features of gall morphology. Leaf tissue on one side of the midvein bends towards the center of the leaf and then back to create a fold on the abaxial side of the leaf. The fold then grows abaxially through periclinal and anticlinal divisions, effectively eliminating lacunae from the spongy mesophyll. Cells on the adaxial surface were more numerous and smaller than cells near the abaxial surface, creating the large fold that surrounds the insect, similar in morphology to an auxin induced bend. Other samples were prepared for transmission electron microscopy. Cell counts and morphometric analysis of the micrographs using ImageJ software revealed a strong alteration of cells within the gall. In galled tissues, cells were generally smaller, while organelle shape, size, and number were also changed compared to ungalled tissue. The galling insect has a major impact on leaf organization and development to provide protection from the environment and a replenishing food source.

*This project was completed to fulfill a Capstone requirement.*
Is the curse real? Professional athletes on video game covers and declines in their performance

Zachary Ricketts, Braden Curd, Kristin Halford, and KangJae Jerry Lee

This study investigated professional athletes’ performance before and after the appearance on the cover of video games. Rumors suggest that athletes selected for the cover experience substantial declines in their performance. Although it has been widely recognized as a curse or jinx, no scientific investigation has been conducted on this controversial topic. This study examined if athletes indeed demonstrate worse performance after the cover appearance by examining most recent video games from 1999 to 2015.

We used various indicators to evaluate athletes’ performance. The performance information from the year before athletes were on the cover and the year when they were on the cover were collected from sports-reference.com. The data consisted of 50 cases. Athletes were categorized into three groups based on the average percentage change in performance: -1 = more than 20% decrease, 0 = percentage change within -20% to +20%, and 1 = more than 20% increase. The numbers of athletes in each category were 27, 21, and 7, respectively. A paired sample t-test was performed on the number of games played and assists. The number of games played by athletes significantly decreased from the year before the cover appearance (M = 67.96, SE = 6.69) to the year of cover appearance (M = 59.74, SE = 7.15), t(49) = 2.393, p <.05, r = .10. The number of assists also decreased from the year before the cover appearance (M = 155.03, SE = 33.22) to the year of cover appearance (M = 143.65, SE = 41.03). However, this difference was not significant t(25) = .54, p >.05, r = .01. We are currently expanding our analytic approach by collecting more data from the cover athletes on Sports Illustrated. The future study is expect to draw a stronger and more generalizable conclusion about the jinx.
Jeanette Rimbey, Hedieh Attai, George Smith, and Pamela Brown

Agrobacterium tumefaciens causes crown gall disease in many flowering plants. Crown gall results in the formation of tumors on roots or stems reducing the yield of fruits including apple and peach. Presently, there are limited options for prevention and treatment of crown gall disease. The long-term goal of this project is to determine if pre-treatment with combination of bacteriophages will limit plant infection by A. tumefaciens.

Since A. tumefaciens are common soil dwelling bacteria, we expected to isolate bacteriophages from similar environments. Thus far, we have isolated three lytic bacteriophages, AP2, AP3, and AP4 from waste-water. Following phage isolation, we used growth curve analyses to determine the ability of the phage to induce host cell lysis upon infection. Next, using electron microscopy we determined the morphology of the bacteriophages. Finally, we completed a restriction pattern analysis of phage DNAs to determine the relatedness of each phage.

Future work will focus on genomic characterization of the phage DNAs following sequencing analysis using the Illumina MiSeq platform. Each bacteriophage genome will be inspected for the presence of phage lysis motifs (endolysin, holins, and lysis accessory proteins) and the absence of indicators of lysogeny (repressor and anti-repressor proteins). Lastly, we have begun to test the ability of each bacteriophage to prevent A. tumefaciens infection using a potato disk assay. These results should indicate if bacteriophage treatments are a viable option for controlling growth of crown gall disease.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Gang Yao, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option

Exploring the canine model of muscular dystrophy using 6-axis inertial measurement unit data

Nicholas Roberts, Nathan Birenbaum, and Gang Yao

Motion processing technology is embedded in a variety of consumer electronics, medical devices, and scientific applications. Using 6-axis inertial measurement unit data, it is possible to determine the acceleration and angular speed of the any object that these sensors are attached to. In this setup, an Arduino microcontroller is used to read, process, and send 6-axis data from the inertial measurement unit to a computer via Bluetooth for further processing and visualization in MATLAB.

Previous muscular dystrophy studies have compared the gait of normal dogs with dogs affected by golden retriever muscular dystrophy as a model to explore Duchenne muscular dystrophy in humans. These gait studies have historically used video recordings alone to determine gait, but 3-axis accelerometry data has recently emerged as an alternative, more efficiently quantifiable method for determining the gait of dogs. By including measurements of rotational velocity, the 6-axis inertial measurement data allows for the detection of additional gait patterns absent from 3-axis accelerometry data. Through the inclusion of additional gait patterns shown by the 6-axis inertial measurement unit data, it is hoped that the differences in gait in dogs affected by muscular dystrophy can be more completely understood.
Repair prioritization and inventory allocation

When a part fails, the failed part is inducted into the repair system while a spare part is sent out to fulfill the immediate need. When the failed part is repaired, it is returned back into the population as a spare that can be distributed out as needed. In order to properly manage inventory, forecasted inductions are typically utilized to set inventory levels. However, when multiple failed parts begin to come in, how should the repairs be prioritized? And if one part is prioritized over another, what is the effect of that decision on the network as a whole? Our project looks to examine these tradeoffs in a case study with a major aerospace company.
The effect of sulfate on stable carbon isotopic composition of methane in freshwater lakes

Allison Roebuck and Cheryl Kelley

The biogenic formation of methane has been the subject of increased attention, especially in light of current efforts to understand its contribution to the greenhouse effect. Methanogens create methane using two general pathways: CO₂ reduction (CO₂ + 4H₂ → CH₄ + 2H₂O), which produces stable carbon isotope values for methane (δ¹³C(CH₄)) of about -60 to -100‰, and acetate fermentation (CH₃COOH → CH₄ + CO₂), which produces δ¹³C(CH₄) values of about -50 to -70‰. The presence of sulfate and sulfate-reducing bacteria may affect which pathway methanogens use and the δ¹³C values of CH₄ and CO₂ produced. Since sulfate-reducing bacteria out-compete methanogens for H₂ and acetate, methane is produced only when sulfate concentrations are depleted. We hypothesize that methanogens in sulfate-poor lakes will use the acetate fermentation pathway, since methanogens do not have to compete against sulfate-reducing bacteria for labile organic matter. In contrast, methanogens from sulfate-rich lakes will use the CO₂ reduction pathway to produce methane. Water samples (for sulfate concentrations) and CH₄-rich bubbles (for δ¹³C analyses of CH₄ and CO₂) were collected from four lakes and one spring near Columbia, Missouri: two lakes with low (<25 µM) sulfate concentrations and two lakes and the spring with elevated (0.4-2.2 mM) sulfate concentrations. Lakes with elevated sulfate concentrations are located in the Rocky Fork Lakes Conservation Area, where past coal mining operations produced sulfate-rich waters through pyrite oxidation. The δ¹³C values ranged from -70.1 to -63.2‰ for CH₄ and -25.3 to -18.1‰ for CO₂ in sulfate-rich lakes. In sulfate-poor lakes, the δ¹³C values ranged from -57.4 to -52.8‰ for CH₄ and -16.3 to -13.4‰ for CO₂. Although our findings of methanogenic pathway preference are inconclusive, both CH₄ and CO₂ from sulfate-rich lakes are ¹³C-depleted relative to those gases from sulfate-poor lakes. More results and conclusions will be presented at the Forum.
Rooted in sacred ground: Examining the mentor-mentee relationship

Colleen Roetemeyer, Amy Ruopp, and Kathy Unrath

This study examines the complexities and dynamics of a positive, multigenerational mentor-mentee relationship between three women: an associate professor, a fourth year doctoral student, and an undergraduate student, all of whom are within the art education program at the University of Missouri. A series of three interviews were conducted using the “Interpretive Biographies” method, which were then analyzed in subsequent collaborative meetings with all three participants. The purpose of these interactions was to create a visual representation of the dynamic that existed between the three participants. The follow-up meetings in which that representation took form were recorded as documentation of the collaborative process and the evolution of thought as the schematic was realized. Through this organic process of documenting the reciprocal relationships between the three participants it became clear that a mentor-mentee relationship is founded in reflective practices and the exchange of personal perspectives. Time and authentic exchanges helped to establish a continually deepening trust and connection between each of the three members.
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Faculty Mentor: Dr. Walter Gassmann, Plant Sciences
Funding Source: Monsanto Undergraduate Research Fellowship

Extent of broad-spectrum disease resistance of Arabidopsis srfr1 mutants

Conner Rogan, Chris Garner, Ellie Nguyen, and Walter Gassmann

Plants have developed a variety of perception mechanisms to detect pathogens enabling them to survive and reproduce in challenging environments. Most pathogens are recognized at the cell surface by detection of common pathogenic structures such as fungal chitin or bacterial flagella causing the plant to produce an immune response called PTI. Pathogens have evolved proteins called effectors to disable these defenses. In response plants have evolved defense proteins to detect these pathogenic effectors and activate an immune response called effector-triggered immunity (ETI). SRFR1 is a plant protein that negatively regulates ETI, so srfr1 mutants exhibit increased immunity to certain effectors. Surprisingly, the srfr1 mutant was subsequently found to be more resistant to pests that are not thought to induce ETI, opening the possibility that SRFR1 has a broader role in determining a set-point of the plant immune system to a broad spectrum of biotic stresses.

To further explore possible pathways not related to ETI regulated by SRFR1, I infected wild type Arabidopsis plants and srfr1 mutants with wild type Pseudomonas syringae and two attenuated strains, one lacking two effectors and the other lacking the ability to use effector proteins altogether. These attenuated strains mainly interrogate the PTI pathway. Plants were inoculated by forcing bacterial suspensions into leaves with a needle-less syringe. Three days after infiltration I measured bacterial replication within the leaves, a measure of plant susceptibility to bacterial pathogens. Although we predicted that the weakened bacteria would replicate less in the srfr1 mutants compared to the wild type, infection levels were similar. This result suggests that SRFR1 is not involved with PTI, because the attenuated strains that activate PTI showed similar infection levels between the two different plants. Our data so far indicate that srfr1 mutant plants are primed for heightened resistance while minimizing unfavorable effects on plant growth.
Inducible artificial micro-RNAs to investigate functional redundancy in the vesicular trafficking genes DRP2A and DRP2B in flagellin-signaling

Sean W. Rogers, Michelle E. Leslie, Gary Baisa, Bret Huisenga, Sebastian Y. Bednarek, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Medical conditions arising from genetic inbreeding in the Amish community

Laura Roider and Caroline Brock

Recently, I researched the increased frequencies of two autosomal recessive diseases within the Old Order Amish Community through an extensive literature review. In particular, I focused on how the frequency of these diseases is affected by Amish traditions that have led to inbreeding and an isolated gene pool. Both of these two diseases, Glutaric Aciduria (GA) Type 1 and Polyhydramnios Megalencephaly and Symptomatic Epilepsy (PMSE), are inherited through an autosomal recessive pattern. Both copies of the alleles must be recessive for the disease to be phenotypically expressed in the patient. The Old Order Amish traditional focus on community requires that the Amish marry within the church and because very few outsiders join the church, this creates a limited genetic pool. In addition, the majority of the Amish can trace their lineage back to a small group of ancestors producing a bottleneck effect. Overall, the research on genetic inbreeding within the Old Order Amish demonstrates that the Hardy Weinberg Equilibrium is violated because non-random mating occurs. Therefore, we observe different frequencies of distinct genetic diseases than the general population. The unique genetic population in the Amish community enabled scientists to identify a point mutation on chromosome 19 that causes the GA-Type 1 disease. This discovery could lead to a potentially successful diagnostic tool benefiting both the Amish and non-Amish population. In summary, because of the limited genetic diversity within the Old Order Amish, scientists have been able to learn about illnesses present in the general population through their research an example is the recent discovery of PMSE led to the discovery of new information about a disease known as TSC (tuberous sclerosis complex).
Domains of sibling conflict in emerging adulthood

Emily Rolan, Anna Lindell, and Nicole Campione-Barr

The most prominent conflict domains in sibling adolescence is the invasion of the personal domain and equality and fairness (Campione-Barr & Smetana, 2010). The proposed study examines conflicts during emerging adulthood and if they remain in the same two domains or vary. Differences by sibling composition variables (birth order and gender composition) were examined also.

The sample contained 260 predominantly White, middle class, first-year college students. The sample contained 53% first-born, 47% second-born, 101 male participants, and 159 female participants. Sibling conflict was assessed using a revised version of the 20-item Sibling Issues Checklist (Campione-Barr & Smetana, 2010) to include items applicable to emerging adults (e.g., car usage). Participants reported how frequently and intensely they engaged in each conflict on a 5-point scale.

An EFA identified two factors. The first factor encompassed Equality and Balance Issues (i.e. going into siblings room) and the second encompassed Other Relationships (i.e. romantic relationships or dating). Participants engaged in Other Relationships conflict more frequently and Equality and Balance conflict more intensely. First-borns reported more frequent and intense conflict overall. Second-borns reported more frequent conflicts over Other Relationships conflicts, and first-borns reported more intense conflicts over Equality and Balance conflicts. Additionally, first-borns reported more frequent conflict over Equality and Balance issues. Second-borns reported more intense conflicts over Other Relationships issues. Same-sex dyads reported more frequent and intense conflict overall, with sister-sister dyads generally reporting more frequent and intense conflicts.

This project was completed to fulfill a Capstone requirement.
Plant survival depends on a plant’s ability to efficiently defend itself against potential microbial pathogens. Resistance occurs through a multi-layered immune system. The first layer involves recognition of an invading pathogen by perception of a PAMP (Pathogen Associated Molecular Pattern). PAMPs are molecules found in microbes that are essential for the pathogen's survival, such as bacterial elongation factor Tu (EF-Tu) which is required for protein synthesis, but which are not present in the host. Recognition of EF-Tu by the EFR receptor triggers a number of molecular events that result in changes aimed at preventing further microbial growth. These events include transcriptional changes, MAPK (Mitogen-Activated Protein Kinase) activation, and Ca2+ signaling. While a lot of information is known about these rapid responses, how these molecular events connect recognition with biological responses is not fully understood. One obstacle that exists in understanding these events is the issue of gene redundancy, or when a specific biochemical function is encoded by more than one gene. Since many genes are often associated with overlapping functions, we designed artificial microRNA (amiRNAs) to target and knock down transcript levels from families of related genes. By screening these amiRNA lines, one line was identified to have an altered growth phenotype in response to EF-Tu. Additionally, qRT-PCR analysis indicated altered molecular responses to PAMPs. Finally, the lines do not have an apparent phenotypical change regarding their ability to restrict pathogen growth, meaning that the altered molecular responses do not translate into changes in resistance. I am currently investigating additional molecular markers to determine the extent of altered responses to EF-Tu. In addition to determining all of the altered phenotypes, the goal is to identify which of the nine successfully targeted and reduced in function genes are responsible for the altered phenotypes. This research has potentially revealed novel components involved in molecular defense responses of plants to microbial pathogens and may help delineate which molecular responses are most associated with resistance.
Novel effects of FGF21 and exercise on brown adipose tissue inflammation

Joe L. Rowles, Justin A. Fletcher, Terese M. Zidon, Rebecca J. Scroggins, Young-Min Park, James W. Perfield, John P. Thyfault, R. Scott Rector, Jaume Padilla, and Victoria J. Vieira-Potter

Fibroblast growth factor 21 (FGF21) is an endocrine hormone known to enhance adipocyte metabolism via “browning” of white adipose tissue (WAT) and activation of brown adipose tissue (BAT). The metabolic importance of BAT is becoming increasingly more appreciated and literature shows that BAT activation improves metabolic function, as does “browning” of white adipose tissue. Exercise (EX) increases BAT activity and WAT browning, and has anti-inflammatory effects in WAT. We investigated the role of FGF21 in AT browning and anti-inflammatory effects of EX hypothesizing that such effects of EX in AT are mediated in part through FGF21; further, absence of FGF21 would associate with BAT “whitening,” indicated by increased lipid and inflammatory genes traditionally up in WAT. Male FGF21 knock-out (KO) and wild-type (WT) mice fed normal chow were trained (EX) or remained sedentary (SED) for 8 wks creating KOSED, KOEX, WTSED, WTEX groups (n=10/group). By EchoMRI, KO increased, and EX reduced, adiposity (genotype and EX main effects, P<0.05). KO increased BAT mass suggestive of “whitening,” while EX reduced BAT (genotype, EX main effects, P<0.05). KO increased, and EX decreased, BAT markers of inflammation/oxidative stress (leptin, MCP-1, TNF-a, and P22Phox; genotype, EX main effects, P<0.05). Macrophage markers (F4/80, CD11c) were also increased in KO and reduced with EX (P<0.05). In both KO and WT, EX reduced Chop and GRP78 suggestive of reduced ER stress. Interestingly, an EX by genotype interaction (P<0.05) was observed such that EX decreased PRDM16 (BAT marker) in KO and increased PRDM16 in WT. These findings reveal a previously unappreciated anti-inflammatory effect of FGF21 in BAT and suggest anti-inflammatory/browning effects of EX are influenced by FGF21.
Application of association rule mining to gain information on co-occurring mental and physical illness

Anna Rudy, Michael Phinney, Sean Lander, and Chi-Ren Shyu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Monitoring a geosynthetic reinforced soil integrated bridge system

Samuel Runge and Andrew Boeckmann

Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) is a bridge construction technology that uses thin layers of coarse aggregate reinforced with geosynthetic to develop a stiff composite material capable of supporting loads from small bridges. Use of GRS-IBS eliminates the need for traditional bridge foundations such as spread footings or driven piles. Elimination of piles simplifies construction and potentially reduces cost, and has been shown to prevent the “bump at the end of the bridge” that develops when an abutment settles more than the piles supporting a bridge. Boone County, with support from the Missouri Department of Transportation (MoDOT) and the Federal Highway Administration, has recently completed construction of one of the first GRS-IBS bridges in the state. This research involves instrumenting and monitoring the bridge to document its performance. The performance data will be useful since the bridge is one of the first full-scale implementations of the technology and since flooding potential and a considerable skew make the project site unique.

Bridge performance is being monitored with 3 telltales to measure settlement, 2 inclinometers to measure horizontal displacement, 6 earth pressure cells to measure soil stress, and 9 piezometers to measure pore pressure. In addition, 24 survey markers installed on the bridge abutment faces will be surveyed routinely as another measure of movement. The measurements will provide valuable data regarding the effectiveness of GRS-IBS, particularly with respect to how the technology performs under extreme circumstances.
The Anatolian tectonic plate contains one of the largest strike slip faults in the world, the North Anatolian Fault (NAF). The potential hazards associated with the NAF and other faults in Turkey make it an important region for both scientific study and understanding societal impacts. The Continental Dynamics: Central Anatolian Tectonics (CD-CAT) experiment is an internationally collaborative project dedicated to investigating the Anatolian tectonic plate. This experiment consists of a dense array of 65 broadband seismometers located near the Central Anatolian Fault Zone (CAFZ) that continuously record ground motion. We use one year of continuous seismic data recorded from this network to detect and locate earthquakes occurring in the CAFZ and surrounding region. With an automated earthquake detection algorithm, over 1700 events are detected from May 6, 2013 - May 19, 2014. From these data, 404 local events are identified and located using a standard double-difference approach. Furthermore, we distinguish between daytime and nighttime events due to frequent quarry blasting during the day (5:00-17:00 GMT). Clustered seismicity is observed along the East Anatolian Fault as well as diffuse seismicity along the NAF and CAFZ. We find ~93% of local earthquakes occur in the upper crust (< 25km depth), suggesting a lower limit to the seismogenic zone, which depends on crustal strength. Furthermore, a faster than expected VPn of ~7.9km/s is estimated for the region. Seismic activity along the CAFZ due to intra-plate deformation has implications for understanding the regional tectonics and force distributions along the plate boundaries. Furthermore, this work could significantly impact densely populated areas of Turkey near active fault zones where these risks are not well documented. A better understanding of the seismic activity in this region may serve to increase awareness for earthquake hazards, potentially reducing the risk to human lives.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Roger Fales, Mechanical & Aerospace Engineering
Funding Source: College of Engineering Undergraduate Research Option

Pump health monitoring leakage testing

Jacob Rusteberg and Roger Fales

For this experiment, the impact that leakages pose upon a system in which the discharge pressure is used for hydraulic cylinders will be studied. This data will be used in order to validate a numerical model. In order to do this, a test set up, which mimics a steering system of a large mobile machine, will be constructed with certain leakage points that can be controlled so that certain leakage situations can be replicated by opening valves and redirecting the pressurized flow back to the reservoir. One leakage situation that will be simulated is the leakage of the pump discharge flow directly back to the reservoir. This will simulate a failure of the pump. Another instance is imposing a leakage in the hoses directly before the main load, which will be the hydraulic cylinders. This imposed leakage would be similar to a situation in which the hoses next to the load bursting from the high pressure. During these situations, the performance response of the cylinders is expected to decrease due to the loss in pressure. This decrease in responsiveness will be measured and analyzed through taking measurements of the cylinder displacement versus time. In addition, there are expected to be changes in the volumetric efficiencies of the pump as well, however, those are yet to be determined. These changes will be measured by analyzing the discharge flow, pressure, swash plate angle, and the angular velocity of the pump itself. Analysis of the data will yield further information on this topic.
An analysis of bullying and suicide in the United States using a non-Gaussian multivariate spatial model

Mary Ryan, Jonathan Bradley, Trevor Oswald, Christopher K. Wikle, and Scott H. Holan

Bullying affects thousands of students across the United States (US) each year, which can lead to mental health problems, and in some cases suicide. Intuitively, rates of bullying and suicide may be correlated, and this relationship may change based on region. Thus, a spatial analysis of bullying and suicide rates could help identify regions where more attention is needed to prevent both bullying and suicide. As such, we develop a non-Gaussian multivariate spatial model to analyze bullying and suicide rates in the US. This model incorporates the right-skewed nature of bullying and suicide rates, and leverages multivariate spatial dependence to improve spatial predictions. We apply our statistical model to data obtained from the Centers for Disease Control and Prevention’s (CDC) Youth Risk Behavior Surveillance (YRBS) program. In particular, we consider YRBS estimates of suicide and (self-reported) bullying rates (per 100 thousand) over the 48 contiguous states. Our model provides accurate spatial predictions for suicide and bullying rates, while giving realistic spatial prediction variances. These results indicate regions that have higher rates of bullying and suicide, which can have implications on policy decisions.
Exchanging the effects of reserpine from individual chromaffin cells

Alexander A. Salinas, Xin Liu, and Kevin Gillis

Reserpine is a drug that is used to treat high blood pressure and has also been used to treat depression and schizophrenia. This drug is responsible for reducing the amount of neurotransmitters that are released from neurons as well as endocrine cells. Cells secrete transmitter signaling molecules through a process called quantal exocytosis. Specialized cells containing vesicles packed with neurotransmitters are driven by a rise in intracellular $\text{Ca}^{2+}$ to have their vesicles fuse with the cell membrane and release their contents into the extracellular space. The transmitters released from individual vesicles can be measured as molecules are oxidized on the surface of an electrochemical microelectrode. As electrons make contact with an electrode, a spike in current will be produced representing secretion of the cells contents. My project uses custom hardware and software to examine the dose-dependence of reserpine’s action on quantal exocytosis. Analysis of the spikes of current produced by quantal exocytosis reveals the time course of vesicle fusion and the amount of transmitter packaged in each vesicle. Cultured chromaffin cells with added reserpine are placed on custom microchips of electrochemical microelectrode arrays. A high $\text{K}^+$ solution is then added to cells triggering exocytosis. As molecules are oxidized on the surface of an electrode, custom software displays the spike in current being produced as quantal exocytosis occurs. Analyzing spike areas presents information about the quantal event such as the total number of transmitters released as well as the time course of each event. Based off of literary review, we expect to see a declining spike area with increased amounts of reserpine. The validation of data gathered can be used as test cases that can improve the way drugs are tested for effectiveness and could also lead to the discovery of new drugs.
An exon-based minimal domain search for the disease-relevant features of SMN

Thalia Sass, Madeline Miller, and Christian Lorson

Spinal Muscular Atrophy (SMA) is a neuromuscular disease that can be classified by the loss of α-motor neurons, resulting in muscle weakness, atrophy, and in some patients death. There are five types of SMA ranging from Type 0, infantile death, to Type 4, adult onset. Deletion of the SMN1 gene is responsible for SMA. While it is clear that SMN1 is the disease-determining gene, the disease-associated function has remained elusive. To this end, my project involves the generation of a series of SMN mutations that lack previously described functional domains. These constructs will be cloned into a viral vector and subsequently delivered to an important mouse model of disease called SMNΔ7. Constructs will be generated through a series of PCR reactions to generate the specific segment of DNA we wish to insert into the scAAV virus. We and others have previously established that full length SMN recues the mouse model, including life span, weight, gross motor function, and NMJ integrity. We hypothesize that exons, such as Δ2b and Δ3, that disrupt the Tudor domain will fail to rescue the mutant mice, while domains such as the proflin-interaction domain will be dispensable. Collectively, this project provides an in vivo approach to examine SMN functions that relate to SMA development.
Quantifying security measures for shared resources in federated domains

Aaron Scantlin and Matthew Dickinson

The advent of cloud computing paradigms such as Infrastructure as a Service (IaaS) has revolutionized the way that research is performed. By utilizing shared resources, researchers can perform computations within a virtualized environment that provides more physical resources than would otherwise be possible or feasible to host locally. IaaS, when used in conjunction with software-defined networking (SDN), makes collaboration between research institutions easier by allowing network administrators to create a de-militarized zone (DMZ) within the network; this “Science DMZ” can have different firewall rules for incoming and outgoing packets than the rest of the network, allowing researchers to fine-tune the network such that research-critical metrics (such as throughput) can be optimized. One of the issues researchers are faced with in a collaborative (federated) environment is adhering to their local institution’s data classification policies: the way that one institution classifies a piece of data may not be in line with how another institution within the federation classifies that piece of data, or the protocols governing how that data can be handled or transmitted may differ between institutions. In order to reconcile this issue, we explore existing methods for quantifying security and highlight their pros and cons. We then take the desirable traits of existing general quantification methods and combine them with application-specific quantification methods to create SecQuPE, a Security Quantification Policy Engine for use in federated research environments. Research is still actively being done on SecQuPE; as such, results and conclusions will be presented in April.
Computational aeroacoustic analysis of passive flow control for rotorcraft blades

Steve Schafer, Zachary Lipira, Junxiang Shi, and C.L. Chen

It has been seen that the use of a passively morphing bump, engineered for the upper surface of a rotorcraft blade, can effectively weaken the shock strength experienced by the blade in the transonic flight regime. By breaking up the strong normal shock into a weaker λ-structural shock, the shock strength, and therefore pressure gradient at the shock, is weakened.

High Speed Impulsive (HSI) noise is a major contributor of overall helicopter noise. The majority of HSI noise is generated by quadrupole sources, which are generated not by a body in a fluid, but by the effects of the flow field itself. The transonic flow regime studied generates a locally supersonic flow, thus a shock wave is formed. This shock wave represents a large pressure gradient and acts as a quadrupole noise source. As of current, quadrupole noise sources must be calculated using a permeable surface which encloses all of the noise sources generated by the flow field.

Since the main function of the morphing bump is to weaken the strength of the shock, it is intuitive to think that the HSI noise will be reduced as well. Thus, a computational aeroacoustics solver, PSU-WOPWOP, is used to quantify the sound pressure level of the airfoil. A permeable surface, which encapsulates the entire geometry of the shock structure, is used. This ensures that the quadrupole noise generated by the shock wave is taken into account.
Can money buy election results? A new look at the evidence

Megan Schaff and Jonathan Krieckhaus

Since the 1970s, there have been conflicting results in political science surrounding money’s influence on United States congressional election outcomes. Earlier studies initially found a strong case for challenger spending, but a puzzling irrelevant or inverse effect on incumbent spending. More recent and varied research has challenged this assumption and attempted to find an answer by controlling for alternative explanations, simultaneity problems, and measurement error found in previous studies. Furthermore, researchers have entered new domains relating to money and elections, studying how issues such as campaign finance contributions, campaign advertising, strength of challengers, and type of spending affect the outcome of elections. These more recent results regarding challenger and incumbent spending have been mixed, leading to an increasingly cloudy field of research. There has been no definitive answer regarding money’s impact, leading to confusion and futile debate. This study aims to find a comprehensive answer to the long-debated question of money’s influence on election results. Through a theoretical overview and statistical meta-analysis of previous data, I find that money has a direct and causal influence on election results, contrasting previously held notions about elections.

This project was completed to fulfill a Capstone requirement.
Development of livestock antibodies in guinea pigs

Amanda L. Schmelzle, Sarah A. Munzer, Elizabeth A. Benavides, and Duane H. Keisler

The hormonal changes that occur within an animal is that animal’s internal “messaging system” which we can “tap into” to learn many things about that animal and how it is responding to its environment, such as its metabolic efficiency, reproductive status, and, with reasonable accuracy, its future production potential. In order to assess hormonal changes, antibody based assays are used. Unfortunately, antibodies against livestock antigens are becoming more difficult to source and commercially available antibodies have proven to be inadequate. This is a problem because without high-quality specific antibodies, an accurate hormonal profile cannot be determined. Therefore our lab hypothesized that it was possible to generate livestock antigen specific antibodies (Abs) in guinea pigs (Cavia porcellus) for use in livestock radioimmunoassays. To accomplish this, we developed a procedure for immunizing guinea pigs (N=3). Prior to immunizations, a preimmune blood sample was collected from the anterior vena cava. Immediately thereafter, immunizations commenced consisting of an emulsification of de-zinced bovine insulin in Freunds Complete adjuvant given intradermally in the flank. At monthly intervals thereafter, a boost immunization was given in the same manner except Freunds Incomplete adjuvant was used. Blood samples were collected at the time of immunizations and every 1 to 2 weeks thereafter. Collected blood was allowed to clot, then centrifuged and sera (antisera) were stored frozen. Optimum binding range was determined using the predetermined dilution, 125I-Insulin and Sheep-anti-Guinea Pig second antibody. We found that, while there were differences in binding between the guinea pigs, each were able to bind to not only bovine insulin, but also in parallel with ovine, equine, chicken, turkey, and rabbit sera. While there is still variability in binding between guinea pigs, we conclude that it is possible to build working Abs against bovine insulin in guinea pigs.
Conservation and discovery of isolated indigenous tribes in Amazonia using remote sensing.

Bryce Schmidt, Ashley Aissi, Robert Walker, and Dylan Kesler

Amazonia is home to 50-100 isolated indigenous societies that have limited to no contact with the outside world. Remote sensing offers an inexpensive and systematic approach to analyze demographics and land use of isolated villages without the cost and risk of overflights or encounters on the ground. To date, we have located over 30 isolated villages and show that they are commonly located near the tops of watersheds and far from roads and deforestation. Estimates of village population sizes vary from 50 to 300 people. Our research is a first step towards the longitudinal monitoring of population dynamics and movements of isolated peoples through time, and in relation to currently protected territories and encroaching deforestation. The long-term survival of isolated indigenous populations is our primary concern, and our project can help inform policy on ways to mitigate against the external threats to their livelihood.
Missouri e-Filing system: Case processing time study analysis

Caroline Schmidt, Brett Watkins, and Jung Hyup Kim

A time and motion study has traditionally been completed with pencil, paper, and a stopwatch. This method continues to work efficiently as many Industrial Engineering professionals have mastered this technique, but as manufacturing and technology continue to evolve, this method has become tough to use accurately in all situations. Therefore, the study was conducted to investigate new time and motion study methods that could improve the accuracy, stay cost effective, remain feasible for a primary user to learn, and reduce researcher analytical time. The new methods (audio recording, Google Glass, and Leap Motion – gesture recognition time capture) were tested on Missouri court clerical staffs with the Missouri Office of State Court Administrator (OSCA). The time and motion study was conducted to evaluate clerks’ working processes before and after implementation of the new Missouri e-Filing System (MeFS).
Faculty Mentors: Dr. Sheila Grant, Bioengineering; Dr. Shubhra Gangopadhyay, Electrical & Computer Engineering

**Surface and optical characterization of a plasmonic HD DVD grating platform to enhance fluorescence**

Hilary Schmidt, Aaron Wood, Sangho Bok, Sami Pathan, Sam Pautler, Cherian Mathai, Sheila Grant, and Shubhra Gangopadhyay

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Moshe Naveh-Benjamin, Psychological Sciences
Funding Source: A&S Undergraduate Research Mentorship Program

Schematic support in age-related differences in short and long-term associative memory

Nicholas Schmidt, Dwight J. Peterson, and Moshe Naveh-Benjamin

Within short and long-term memory (STM, LTM), older, relative to younger adults exhibit an associative memory deficit (AD) wherein they have trouble binding distinct components to form associations, while memory for these individual components remains intact (Naveh-Benjamin, 2000; Chen & Naveh-Benjamin, 2012). Reduced performance emerges due to high false alarm (FA) rates in older adults. Two factors that could increase FA rates in older adults’ associative memory are an increased reliance on item familiarity and decreased use of recall-to-reject recognition strategies.

Recent work examined these factors by manipulating item familiarity and schematic relatedness. Face-name pairs were presented to younger and older adults. During an associative LTM test these pairs remained intact or were recombined within the same (old-face, old-name) or between two different stimulus categories (old-face, young-name). Half of the items (high-exposure items) were presented prior to the study phase to increase item familiarity. The lowest FA rate was found for pairs containing low-exposure items that had been recombined between-stimulus categories (Fine & Naveh-Benjamin, in preparation).

Extending recent work, here we examined whether the AD can be reduced within STM. Item familiarity was manipulated via a pre-exposure phase prior to a continuous recognition task including STM and LTM retention intervals, older and younger adults were presented with face-name study pairs and intermittently tested on both single items (faces or names) and associations (face-name pairs). During associative tests, face-name pairs were displayed intact or recombined within or between-stimulus categories. For example, a young face-young name pair could be recombined within (same face, new young-name) or between-stimulus category (same face, new old-name). We observed lower FA rates when face-name pairs were recombined between rather than within-stimulus category, reducing the AD for older adults. Increasing access to recall-to-reject recognition strategies facilitates binding of distinct components within both STM and LTM in aging populations.

This project was completed to fulfill a Capstone requirement.
Variation in enamel thickness of the teeth of crocodilians

Brianne Schmiegelow, Kaleb Sellers, and Casey Holliday

The study of fossil teeth is of great importance in determining the lifestyle and behavior of extinct animals. Through examination of both the enamel and the dentine, we are able to make deductions about the evolution of different species and can provide insight into characteristics such as diet, age, and environment. Although we have a reasonably solid understanding of primate enamel and its ecological significance (Kono, 2004; Olejniczak, et al. 2008), we know less about the evolution and ecology of teeth in crocodilians and other vertebrates. Crocodilian lineages evolved numerous feeding adaptations, which we expect to be reflected in the enamel thickness of the teeth. Here I used 3D modeling to determine if enamel thickness varies in age or position in Alligator mississippiensis. These findings were then compared to similar data from fossil crocodilians to find trends in tooth structure, evolution, and feeding behavior.

Following Olejniczak, et al. (2008), we used Avizo 3D Analysis software to segment the enamel and dentin from microCT scans of crocodilian teeth and found the average and relative enamel thickness of the tooth. We measured a set of three teeth each from individuals with a skull length range between 7.3 and 27 cm, taking from each specimen one tooth from each of three regions of the jaw. This allowed us to look for variation not only between different-sized specimens, but also between teeth in different regions in the jaw. Initially I thought the variation would be small because of how often new teeth are regenerated, however, we found a distinct differences in relative enamel thickness among the varying regions of the jaw and among the specimens. Prevailing dogma always suggested enamel was homogenous among crocs, but instead, it seems that crocodilians have an enamel pattern much closer to that of primates than initially hypothesized.
Channel mapping of flat plate with two channel flow for study of nuclear fuel plates

Gerhard Schnieders and Gary Solbrekken

The University of Missouri Research Reactor (MURR) is planning to convert its existing High Enriched Uranium (HEU) dispersion fuel to a novel Low Enriched Uranium (LEU) monolithic fuel. As part of the Global Threat Reduction Initiative (GTRI), there is an ongoing effort to reduce the amount of HEU in use at civilian facilities such as MURR. As a result of the conversion to LEU, the physical structure of the curved fuel plates is changing significantly. Flow loop experiments are run to benchmark numeric models that will be used to understand the Fluid Structure Interaction (FSI) between the nuclear fuel plates and the high velocity water being used to cool them. The fluid channels in the flow loop are mapped so that they can accurately be represented in numeric models. High precision lasers mounted on a two dimensional positioning system are used to take channel gap measurement at a grid of locations.
Design of a non-antibody based test for HIV

Victoria Schutz, Rich McGhee, Holly Campbell, Colin Grace, Jittapun Lachitavongs, Mark Messler, Joseph O’Brien, and Mario Pennella

One of the most effective tools for combating HIV is widespread testing in high-risk areas. Patients who know their HIV positive status are more likely to take precautions, and are less likely to transmit it to others. Unfortunately, current widely deployable tests aren’t very stable in non-controlled environments, are expensive, or aren’t accurate in the first three months. We are designing a system that would be simple to use, but tests directly for HIV viral particles. Our research looks at the interactions of three proteins, and uses them to activate a signal. HIV GP120 is the glycoprotein used by HIV to gain entry into the target cell. It actively binds CD4, a human immune T-helper cell receptor, during the first stage of entry. This binding causes a conformational change in GP120, allowing it to bind CCR5. In the second stage of entry, GP120 binds CCR5, which causes a conformational change in GP41, another HIV glycoprotein, and pulls the viral particle into the cell. Using the affinities of both human proteins, we are designing a system that will allow for one of these proteins to be a propagator of information. To do this, we designed a chimera of CD4/LacZ. This chimera will cause a color change in solution, but will only remain on the column in the presence of GP120. Using this, a device could be designed that tests directly for HIV, reducing the amount of time between potential infection and accurate testing.
The goal of this project is to design and manufacture porous polycaprolactone (PCL) osteochondral tissue scaffolds for use in repair of osteoarthritic articular defects. Metallic hip arthroplasty in humans and animals has a limited lifespan and can induce unwanted effects such as stress shielding and an immune response. PCL is a proven to be a biodegradable polymer with good biocompatibility. Ideally, PCL could be developed to prevent these problems as a biodegradable replacement for tissues that repair over time as the polymer is safely degraded by the body. A further improvement to PCL is the addition of brush polymers or even stem cells that will allow for healthy tissue ingrowth into the PCL scaffold. The addition of these surface modifications, while ultimately relevant to the final application of such a project as this, will not be reviewed as a part of this study.

Production of these PCL scaffolds was conducted with a modified CNC machine using G-code to precisely map out the layers of the scaffolds. Cylindrical 15 mm diameter scaffolds were produced with varying molecular weight PCL. PCL was heated to above its melting point before being extruded to cool as a solid, similar to technology used in 3-D printing. The scaffolds were then milled using a drill press to remove the unevenness at the edges of the scaffold, which occurred as the PCL cooled from liquid to solid.

Porous PCL tissue scaffolds of various types will then be investigated using biomechanical testing (Instron) as well as computational simulations (finite element analysis). Biomechanical testing will be used to determine properties in the following areas: stress-strain analysis, material property determination, static and dynamic loads, failure, and fatigue.
Boron concentration determination in Maize

Nicholas Seidel, Xingyao Wang, and Susan Lever

Purpose: It is known that boron plays an important role in plant reproduction, however its role is not completely understood. In order to gain a better understanding of boron’s role in plant reproduction we use several methods to determine the concentration and distribution of Boron in maize samples. These methods include Neutron Capture Radiography (NCR) and spectrometric determination of boron concentration.

Methods: Our spectrometric determination of boron involves a previously discovered, automated method using Beer’s Law, wavelength absorption from the reaction between azomethine-H and boric acid as a function of boron concentration, to determine boron concentration in our samples. In this procedure we prepare azomethine-H solution, buffer solution, and our boric acid standard solutions from 0ppm-15ppm mixed pipetted together into cuvettes. After two hours from adding the azomethine-H to the buffer and boron solution, UV/Vis spectrometry was used to analyze wavelength absorbance peaks at 410nm using the 0ppm sample as a baseline. These standards are then used for generating a calibration curve in order to determine an unknown boron concentration in dry ashed maize/NIST plant leaf powder solutions.

Our NCR irradiation procedure was done at the MURR. Boron undergoes irradiation, a nuclear reaction with a thermal neutron beam, leaving tracks from emitted alpha particles on a CR-39 plastic detector. These tracks on the plastic detectors can be etched in a 6.25N NaOH bath at 98°C and then analyzed by TASLIMAGE system to count the number of tracks automatically. When attaching a filter paper spiked by different concentrations of H310BO3 solutions on the detector, a linear trend between the number of tracks and the B-10 concentration in the solution of B-10 enriched boric acid can be observed after eliminating any tracks smaller than 5 microns.
Acute Lymphoblastic Leukemia (ALL) is a hematopoietic stem cell derived cancer, predominantly found in children. ALL is characterized by the accumulation of precursor B-lymphocytes in the bone marrow. Approximately 10% of children who are treated for ALL, relapse after complete remission 1 (CR1). We generated DNA methylation profiles using next-generation sequencing for matched samples at diagnosis and relapse in 10 pediatric ALL patients to identify differentially methylated regions (DMR) of the genome. Strikingly of 141,070 total DMRs, 45 regions became hypermethylated at relapse. We focused on these regions because it is well known that hypermethylation in the 5’ regulatory region (promoter, 1st exon) can silence genes by blocking RNA polymerase II and other transcription factors from initiating transcription or by attracting methyl-CpG-binding domain proteins to attract other proteins involved in altering the chromatin into a repressive conformation. A total of 34 genes were associated with the 45 hypermethylated DMRs. Two hypermethylated regions were located within the 5’ regulatory region, four within exons, and the rest of the DMRs were located within introns and intergenic regions. A candidate tumor suppressor gene, IQSEC1 was found to have hypermethylation in its 5’ regulatory region, potentially leading to apoptotic evasion in B-cells. The mechanism through which IQSEC1 participates in apoptosis has yet to be elucidated.
Exploring interaction of MSUD proteins by use of bimolecular fluorescence complementation (BiFC)

Benjamin Shanker, Logan Decker, Erin Boone, Hua Xiao, and Patrick Shiu

Neurospora crassa is a fungus used often in genetics research due to its haploid nature, or the fact that it does not have two copies of each of its chromosomes but rather one. Due to this haploidy, Neurospora expresses every gene on its DNA while growing in a vegetative state (non-sexually), without a “backup” that could be read in the case of mutated or virus-inserted genes. To combat the delicate nature of its genome, Neurospora has developed a “proof-reading” mechanism known as Meiotic Silencing by Unpaired DNA (MSUD). In MSUD, the organism cancels expression of unpaired DNA segments during the production of offspring via specially constructed RNA, the use of which is mediated by a specialized protein “machine” which comes together in the perinuclear region of Neurospora’s cells.

While we know Neurospora uses meiotic silencing, we do not yet understand which proteins work together to make meiotic silencing happen. The Shiu lab attempts to answer this question by “tagging” suspected interacting MSUD genes with protein pieces that fluoresce when they come near each other and are viewed through electron microscopy. My work in facilitating this task is the generation and diagnosis of properly tagged offspring via gel electrophoresis, the crossing of individuals with tags present on specially formulated agar, and the stocking and cataloguing of strains of Neurospora used to generate results in silica gel and glycerol.

My experimentation proved that the genes DCL-1 and SMS-2 were interacting perinuclearly, as were SAD-1 and QIP. It is valuable to build an image of the silencing mechanism through experimentation because many proteins that the Shiu lab is studying are very similar to those found in vertebrates, suggesting meiotic silencing is going on across many levels of organisms and is likely a fundamental part of all meiosis.

This project was completed to fulfill a Capstone requirement.
Viability of a novel pump in hydraulic systems

Zach Sharp and Roger Fales

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Frequently reported symptoms and most effective management techniques of breast cancer survivors with lymphedema

JaLisa Shaw and Jane Armer

Purpose: The purpose of this study is to determine the most frequently reported symptoms that patients with lymphedema report and how these symptoms are managed. While identifying symptom management techniques, this study will also determine if alternative therapies are effective techniques compared to traditional medical approaches including medications.

Significance: Lymphedema affects numerous of breast cancer survivors who have no idea how to treat lymphedema because they are unaware they have lymphedema. It is important to identify which interventions work best for symptom management. This study will help improve the overall well-being of patients by understanding which techniques are most effective.

Methods: This project is a subsample of qualitative data from a longitudinal prospective continuation study. The sample was comprised of 337 pre-op and post-op breast cancer survivors. Data for research project were collected at pre-op, post-op, every three months for one year, and every six months through eighty four months. Symptom and symptom management data were self-reported and collected through surveys and patient interviews. Symptom management data were de-identified then analyzed through editing style content analysis. The research team met regularly to discuss the content analysis, including tallying, labeling, and consolidation of categories. General descriptive statistics were used to summarize the reported frequency of the reviewed symptoms.

Results and Conclusion: After interpreting and analyzing the data, the top reported symptoms were Numbness, Tenderness, Firm/Tightness, Aching, and Swelling. The data revealed that alternative therapies are just as effective as traditional therapies. However, some symptoms were better managed by traditional therapy which included medications. Throughout the data there was an overlapping theme that symptoms are best managed when there is a combination therapy regimen. Therefore, it is recommended that combination therapy is used for patients with breast cancer related lymphedema.
Analyzing multimodal non-fiction writing of young children: Thinking with poststructural and posthumanist theories

Emily Sheeley, Jiun Lee, Tara Gutshall Rucker, and Candace Kuby

Much research has addressed the topic of writing workshops and multimodal writing. However, more research is needed to explore the social, collaborative aspects of multimodal writing and what happens when teachers follow children’s literacy desires. This study aims to address these gaps by examining a second grade Writers’ Studio. Our research explores children’s use of writing materials for a non-fiction unit when they moved beyond typical two-dimensional writing and instead created 3D models, paintings, or movies. We wondered what might happen in a classroom when the teacher invited children to create non-fiction writing using multimodal formats and a variety of materials.

The methodological approach of this qualitative study is “thinking with theory”. This research tries not to “center the subject” by finding common themes throughout, but it aims to look at data and theory to “see what newness might be incited” (Jackson & Mazzei, 2012). We based our research on four poststructural concepts of Deleuze and Guattari’s work and four posthumanist concepts of Barad’s work. Poststructural theorists look at places where the structures are broken or fissured. These concepts include rhizomes and lines of flights, assemblages of desires, smooth and striated spaces, and absent presence. Posthumanist scholars think materials and humans intra-act, meaning that materials ↔ discourses are mutually entangled; that humans and language are not privileged in research over materials. Posthumanist concepts include becoming, agency, intra-activity of materials, and entanglement.

We transcribed video recordings from two non-fiction projects that both focused on creating “how to” videos with the iPad (how-to make snowflakes; how-to make recipes). We analyzed the transcriptions based on the eight theoretical ideas described above. In spirit with poststructural and posthumanist assumptions, the focus of our research wasn't on what these classroom intra-actions meant, but on what the learning-with-materials produced for the young writers.
A comprehensive database of protein subcellular localization

Yihua Shi, Ning Zhang, and Dong Xu

Most proteins will be trans-located to their appropriate destinations after synthesized in cytosol, meanwhile about half of them would need to go through the targeting process in order to get settled at their correct subcellular locations. Since any mistake in the localization process of proteins might result in metabolic disorders or diseases, correct subcellular localization appears crucial to the maintenance of cell organization and function. The capability of identifying the subcellular localization given any protein has long been a challenge and is especially helpful in the study of the underlying mechanisms of protein targeting.

The goal of this research project is to develop a comprehensive database that stores the subcellular localization information for proteins across species, which is expected to be a valuable resource for biological researchers. The database will be utilized for investigation of the localizations as well as functions of different proteins aiming at different levels of users, by allowing users to perform analysis tasks or searches for detailed information related to a specific protein.
Identification and characterization of key transcription factors (TFs) for oil and yield improvement in Soybean (Glycine max L.)

Jacob Shoemake, Gunvant Patil, Babu Valliyodan, Theresa Musket, and Henry T. Nguyen

Soybean, the most important legume crop worldwide, is an essential source of oil and protein for humans as well as livestock and is also considered as a potential source of bio-diesel. Considering the importance of soybean for food, feed and nutritional security, there have been intensive efforts towards increasing soybean production. Previous studies to increase yield and biomass in plants have focused mainly on manipulation of photosynthesis related pathway genes. As an alternative to single pathway genes, transcription factors provide an attractive solution for altering complex traits by regulating several other genes. Our overall goal is to increase soybean yield, biomass and oil content through genetic modulation of candidate genes from soybean and other oil yielding organisms. In the present study, we are targeting major regulatory genes which are involved in lipid biosynthesis. Genes/transcription factors involved in lipid biosynthesis are being over-expressed in a seed specific manner to get the desired phenotype. Due to the usefulness of Arabidopsis thaliana as a model organism, we are using Arabidopsis as an experimental tool to speed up the process of trait discovery. We have observed plants with increased seed size as compared to the wild type, as well as increased plant biomass.
Identification of satellite cell motogens and chemoattractants

Emily Shoesmith, Patrick McAnulty, and Dawn Cornelison

Skeletal muscle can repair and replace damaged muscle fibers due to the presence of a muscle-specific stem cell population known as satellite cells. While satellite cells are quiescent in undamaged muscle, rapidly after damage they are ‘activated’ which allows them to divide into a pool of myogenic precursor cells. If and how satellite cells can be recruited to an injury to make regeneration more efficient is not definitively understood, but such an activity would have implications for repair and prospects for satellite cell-based therapies. It is known that injured muscle releases proteins that will promote both satellite cell chemokinesis (random movement) and chemotaxis (directional movement), but few of these proteins have been identified. As in previous studies, we analyzed crushed muscle extract (CME) to screen for candidate motility factors. We subdivided CME into less complex fractions and compared those fractions for active components. One fraction with high activity was analyzed by mass spectroscopy and among the proteins it contained was Wnt-5b. We tested Wnt-5b alone for its effects on satellite cells, and confirmed that it promotes total and directional satellite cell movement. We also found that it is expressed in nonmuscle cells located between myofibers and in uninjured muscles, which would be consistent with a protein released immediately upon physical trauma. We therefore propose that Wnt-5b is an active component of CME, and speculate that it could act in vivo to enhance muscle repair and regeneration by increasing the number of satellite cells available in the damaged area.

This project was completed to fulfill a Capstone requirement.
Hannah Shultz
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Faculty Mentor: Dr. Bimal Balakrishnan, Architectural Studies
Funding Source: Program for Undergraduate Research Experiences (PURE), College of Human Environmental Sciences

Medical education building

Hannah Shultz and Bimal Balakrishnan

My conceptual idea for a thesis project is to design a clinical simulation and teaching laboratory that would be directly affiliated with the University of Missouri hospital and could coordinate with neighboring hospitals to teach new techniques and hold training exercises. The main goal of this laboratory is to be able to accommodate a range of specialties so that students can work together in varying fields to allow for a more in-depth teaching and learning experience. The laboratory would be designed with a variety of equipment for medical simulations to provide students a place to experience real world scenarios. It would include spaces such as an accurately designed operation room, several emergency and patient rooms that can be set up for primary or critical care, specialized procedure training rooms, a virtual reality suite, and control rooms for simulating the scenarios. Medical students, doctors, and teachers could use the space to enhance their knowledge and hone their skills.

In the research for this project, I want to explore a variety of possibilities for this lab. It should contain spaces for different areas in the medical field such as surgery, nursing, emergency medical simulation, and patient-doctor interaction. Teamwork is very important in these areas, and I want to further pursue how the environment affects the delicate team communication and interaction that is created in these spaces. This building will have areas for students to study, a lounge, and hold class-briefing sessions. These spaces are critical because they are neutral, low stress spaces that allow the students to relax outside of the high stress training scenarios, which strengthen team skills. At completion of the simulation and teaching lab I would gain a greater understanding of how medical spaces function and the importance of simulation training to gain experience for the real world.

This project was completed to fulfill a Capstone requirement.
The induction of iridoid glycosides in scrophularia species

Mollie Siemens, Briana Lynch, Heidi Appel, and William Folk

Plant secondary metabolites are involved in the ecological function of plants and can be important sources for medicines. Scrophularia lanceolata and S. marilandica, were traditionally used by Native Americans and contain iridoid glycosides which are useful in mitigating inflammation. For iridoid glycosides to be produced economically for medicine, it is essential to have high concentrations of these chemicals in the plant. Some plant species producing iridoid glycosides exhibit increased levels following herbivore damage or abiotic stress. This study focuses on whether increases in iridoid glycosides occur in response to treatment of S. lanceolata and S. marilandica with the caterpillar, Spodoptera exigua, or with methyl jasmonate (MeJA) that replicates induction of plant defense or with other stressors such as drought and intense sunlight. The experimental protocols involved greenhouse experiments with net cages to restrict feeding of caterpillars to the same age leaves to control for developmental variation and treatment of field grown plants with abiotic stressors. Plants were analyzed for their levels of iridoid glycosides using Thin Layer Chromatography (TLC) and High Performance Liquid Chromatography (HPLC). Results from HPLC tests have revealed harpagoside and harpagide in field samples of leaf, root, stem and rhizome tissues in S. lanceolata and S. marilandica. Iridoid glycoside content in each tissue sample is approximately the same between species; however S. lanceolata leaves contain more harpagoside (0.37-0.48%) than S. marilandica (0.13-0.15%) and the harpagoside content seems to accumulate in the leaves of S. lanceolata during the season. Experimental data from caterpillar and Meja treatments have also detected iridoid glycosides in leaf samples using TLC, and experiments are currently being performed. Both field and greenhouse experiments detect different concentrations of iridoid glycosides in tissue samples. Examination of these experiments will help determine which method works best at affecting the iridoid content in Scrophularia species for pharmaceutical use.
Determining epigenetic hindrance on embryos using a surgical model for endometriosis

Epiphani Simmons, Briana Evans, Henda Nabli, and Kathy Timms

Introduction: Endometriosis is a disease where endometrial tissue grows outside of the uterine cavity. This debilitating disease affects 10% of females causing pain and subfertility. It is established that women with endometriosis have embryos that are more likely to undergo apoptosis. Evidence suggests endometriosis is familial, yet little data supports the idea of endometriosis being a genetic disease. Animal models suggest epigenetic mechanisms are at play in producing offspring with endometriosis-associated anomalies. We hypothesize DNA methylation is causing alternations in the embryo's genome, ultimately leading to apoptosis and their demise.

Methods: The use of animals is approved by MU’s IACUC. Endometriosis will be induced in rats with regular 4 or 5 day estrous cycles. Endometriosis is induced in 1/2 of founder rats (F0 Endo) by removing one uterine horn and ovary and suturing uterine tissue into mesenteric arteries of the small intestine. The other half of the founder population will undergo a sham surgery excluding the uterine implantation (F0 Sham). LH/RH agonist injection is given to synchronize the rats’ estrous cycles; during proestrus, F0 Endo and Sham rats will be mated following established protocols. Three generations of embryos and offspring will be produced from founder rats. In each generation, ½ of rats will be sacrificed and 8-cell stage embryos collected to analyze DNA methylation and histone acetylation. The remaining rats generate subsequent generations of pups.

Results: We demonstrated significant differences in gene expression between founder F0 Endo and Sham embryos. We predict the difference in expression is due to in utero exposure to the hostel environment produced by endometriosis. By identifying unique epigenetic markers on F1, F2 and F3 embryos, we will for the first time have data to support transgenerational mechanisms in endometriosis.

Significance: By identifying epigenetic markers that contribute to subfertility, greatly needed therapeutic approaches may be designed.
Peptide amphiphiles for targeting micelle vaccines

Josiah Smith and Bret Ulery

Effective and efficient vaccination is important to preventing deadly diseases caused by pathogenic agents. Antigenic peptides such as OVABT induce a host immune response sufficient to produce immunity in the host. By conjugating a model antigenic, hydrophilic peptide to an aliphatic hydrocarbon tail, a peptide amphiphile can be synthesized that undergoes hydrophobically-driven self-assembly in water to form stable micelles. Micelles are unique nanoparticles that concentrate peptide into a nanoparticle via micelles, efficiently displaying the vaccine antigens to antigen presenting cells in the host. Micelles have been shown to induce a stronger immune response than non-conjugated peptides co-delivered with traditional adjuvants. My research has been focused on generating immunogenic micelles using a model antigen (OVABT) and the hydrophobic tail (palmitic acid). The amphiphile concentration necessary to achieve micelle formation termed the critical micelle concentration was determined using a fluorescence assay, and micelle structure was studied using transmission electron microscopy. This information is being utilized to optimize micelle formation for future in vitro and in vivo studies that will probe the immunogenicity of peptide amphiphile micelles.
Ancient and modern perspectives on grammars and grammatical structures

Sorsha Smith and David Schenker

The focus of this research is to understand how ancient and contemporary grammarians perceive and think about language, and the ways they choose to present it. More specifically, I investigate how the methods and approaches of Priscianus (Priscian) Caesariensis compare to those of the contemporary world, as represented by James P.T. Clackson.

Almost all modern approaches divide a grammar into three general categories: phonology, morphology, and syntax. If the ancient and modern approaches turn out to be similar, this could be evidence that people throughout the ages are programmed to think about language in a particular way, supporting the idea of a universal grammar. Since this study tries to assess the idea of language universality over time it therefore focuses only on the study of Latin in an ancient and modern context. If, on the other hand, Priscian’s approaches appear different from those in the contemporary grammar, we can find insights on the degree to which language thought has evolved over time and perhaps find new ways to present topics in a grammar today.

The information used in this study was found in the grammars of Priscian’s Institutiones Grammaticae and Clackson’s contribution to The Ancient Languages of Europe. I considered the three broad categories discussed, the more specific sub-sections in the work, and the length of time spent on each subject by the two authors.

The data show that both authors discuss phonology, morphology, and syntax (in that order), and that there is considerable overlap within the specific topics discussed. Priscian, though, discusses a variety of extra topics not discussed at all in Clackson, in a seemingly scattered manner. This coverage reveals an emphasis on grammatical structures in the ancient learning of Latin that differs from the contemporary emphasis.
Ebola in Sierra Leone: A history of the 2014 outbreak based on national and international reports

Emily Smith and Daniel Domingues

The 2014 Ebola outbreak in West Africa has ravaged the region in a way that goes far beyond physical illness. Sierra Leone, in particular, has been hard hit by the epidemic, causing international panic on a significant scale. There are many components of this panic that have gone overlooked, including government relations on a local, national, and international level, as well as the influence of newspapers, social media and television coverage.

In regards to the epidemic itself, relief agencies such as Doctors Without Borders have played an important role in controlling the disease in Sierra Leone. Additionally, the United States, Europe, and Cuba have aided Ebola-stricken countries by sending healthcare workers, supplies, and military intervention. However, this focused attention on West Africa has left Sierra Leone struck with social implications such as mistrust, embarrassment, and fear. The mass media has contributed to this fear through blatant exaggerations and accusations that have left the world in a state of shock.

This project examines the history of the Ebola outbreak in Sierra Leone based on a variety of resources such as global media coverage, literature on previous epidemics in Africa, and data from public health agencies. It uncovers different facets of the Ebola epidemic in Sierra Leone while providing accurate statistics and resources to paint a broad view of the outbreak. The results show how social components of an epidemiological outbreak can either aid or hinder a country in a time of public health crisis, and how these themes can be applied to future epidemics around the world.
Brendan Steele  
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Faculty Mentor: Dr. Mark Milanick, Medical Pharmacology & Physiology

Phases of the mole: A simulated crime scene

Brendan Steele, Marissa Rettig, and Mark Milanick

Some aspects of science appear irrelevant or boring to some students. A solution is to make a fun and engaging activity such as a crime scene. The concept of moles is foreign to many students and they often are troubled understanding how one determines how molecules in a solution interact.

For example, here's an engaging initial scenario:

A man is found dead in his downtown apartment. The medical examiner has determined that he was poisoned. The doorman at the apartment building remembers a few people coming in that day to visit him, but he just cannot remember which one came last because there are a lot of people that go in and out during the day. The poison is a powder that was put into the man’s drink. The police found various powders that could be the poison in the houses of the 3 suspects. We used powders and liquids available from the local grocery or hardware store: table sugar (sucrose), table salt (sodium chloride) and fertilizer (ammonium sulfate). When these powders are mixed with water, isopropyl alcohol or propylene glycol (food grade) the results vary. The students test the 3 separate powders in mixtures of different solutions, and identify one as the “poison.” The different results stimulate a discussion of why the 2 phase separation as well as molarity and solubility. This activity would provide students with a fun scenario that relates these concepts to real life and also serves as an easy way to remember concepts of molarity and molecular interactions.
Wanga noun tonology

Kenneth Steimel and Michael Marlo

Wanga [lwg] is a Bantu language spoken in Western Kenya. Tone is a contrastive feature in Wanga phonology (e.g. the words for ‘stomach’ (índá) and ‘louse’ (iŋndá) differ only by their tones). The data herein were collected from Alfred Anangwe using a questionnaire created by Michael Marlo. This presentation provides the first description of the tonal system of nouns and noun phrases in Wanga. We have identified at least 8 lexical classes of two-syllable nouns in Wanga. These include a toneless class (omú-koye ‘rope’), a class with H on the stem-initial syllable (omú-khási ‘wife’), a class with final H (iŋgúrwé ‘pig’), and a class with a stem-initial H and a stem-final H (esí-láaró ‘shoe’). Other classes involve H on noun class prefixes: one with H only on the prefix (ómú-kóosó ‘back’), one with a H on the prefix and a final H (líí-tuumá ‘maize’) and a noun tone class in which a level H extends throughout the entire word (índába ‘tobacco’). In addition, we have íŋgókhó ‘chicken’ and omú-yááyi ‘boy’, with H on the prefix and a downstepped high on the following two moras.

H is acquired on the noun class prefix of some cl. 5 and some cl. 10 nouns. Compare cl. 11 olu-sáála ‘stick’ vs. cl. 10 tsí-sáála ‘sticks’, and cl. 6 ama-yíínji ‘arguments’ vs. cl. 5 líí-yíínji ‘argument’.

At the phrasal level, H Tone Anticipation (HTA) spreads H from an adjective to a preceding word (omúú-ndú mú-láyí ‘good person’, cf. omuu-ndu ‘person’). H Tone Insertion (HTI) inserts H onto the final vowel of toneless nouns, which then undergoes HTA in certain other N+modifiers combinations. Modifiers that trigger HTI include demonstratives (omúú-ndú uno ‘this person’), possessives (omú-kóyé ‘kw-áánje ‘my rope’), and ‘another’ (omúú-ndú uundí ‘another person’).
Fluorescence characterization of naturally occurring polyphenolic compounds

Jessica Stengel and Renee JiJi

Polyphenolic compounds are known to disaggregate plaques similar to the protein aggregates found in the brains of patients with Alzheimer disease. These plaques are comprised predominately of a single peptide, commonly referred to as A-Beta (Aβ). Polyphenols are abundant in fruits and vegetables and exhibit both anti-aggregate and antioxidant properties. Thus, they can potentially provide positive health outcomes for Alzheimer's disease. Thioflavin T (ThT) fluorescence assays are a common method to assess the effect of polyphenols on Aβ aggregation. However, the intrinsic fluorescence from the polyphenols can interfere with the ThT assay. Using UV-visible and fluorescence spectroscopy, the polyphenolic compounds were assessed. It was found that ThT fluorescence could be measured in the presence of Nordihydroguaiaretic Acid and Rosmarinic Acid without interference. However, Resveratrol and Curcumin were found to interfere with ThT fluorescence.
Vacuum circuit breaker modeling in EMTP-ATP

Jesse Stever, Mike Lee, and Robert O'Connell

Vacuum circuit breakers, or VCBs, are mainly used in medium voltage switchgear up to 38,000 volts. When a fault is detected, the VCB contacts will open in order to interrupt the current. Immediately after the contacts open, arcing occurs. Due to vacuum as the medium, VCBs have minimal arcing. However, the high transients involved with arcing current can cause damage to circuit elements. My research involves modeling the physics behind a vacuum circuit breaker in a transients program known as EMTP-ATP and testing it when it is attached to a capacitive load. Recent research has been focused on implementing statistics as well as the Transient Recovery Voltage (TRV) in the model.
Increasing cultural competence among pre-service teachers through service

Samantha Stinson, Bianca Zachary, Joy Martin, and Gabrielle Malfatti

This mixed-methods study examines the effects of the Weekenders Initiative on the development of education student’s cultural competence. The purpose of this project is threefold; (1) to generate a contextual definition of cultural competence and its importance for this Weekenders experience; (2) to observe the effect that a cultural immersion experience in urban/high poverty schools on the participant pre-service teacher’s cultural competence; and (3) to examine possible changes in cultural competence over the course of the immersion experience. Educators need the ability to understand their own personal biases and how they may affect their future teaching career and how they approach a culturally diverse classroom to achieve maximum academic achievement. The participants were 28 White females and 2 White males all completing their teacher preparation at the same Midwestern University. The location of the study took place at three different elementary schools, two charter schools and one public, in urban/high poverty areas. Participants were monitored and observed during their initial pre-traveling meetings and also received a pre and post-trip electronic survey which asked them specific questions regarding their perception of cultural competency and their expectations for the Weekenders experience. Our initial results indicate that there was a change over the course of the trip in the pre-service teachers cultural competence and awareness of their own cultural bias(es). Participants indicated that their experiences far exceeded their expectations and goals for the trip and that following the Weekenders experience, most could see themselves one day teaching in a culturally diverse, urban/high poverty schools. Implications include the enhancement of pre-service teachers training programs to included culturally relevant immersion experiences and thus increasing the willingness of pre-service teachers to consider teaching in underserved urban school districts.
Biocompatibility of inductive simple signaling molecules

Jessica Stromsdorfer, Brittany Allen, and Bret Ulery

The long-term goal of the research is to create new solutions for repairing bone that is lost due to osteoporosis or non-union bone defects due to injuries or tumors. The first phase of the project was to establish a bank of progenitor osteoblast MC3T3-E1 cells. After enough cells were generated, they were divided into one control group and eleven experimental groups, adding different concentrations of molecules that have shown preliminary promise as inductive simple signaling molecules. Half of the project investigated calcium and phosphate ions, which can cause stem cells to differentiate into bone cells. Ideally, therapeutic concentrations will also be biocompatible. These studies will hopefully determine what ratio of molecules should be added to the cells to reach the ideal differentiation states. From the findings, additional in vitro studies as well as in vivo experiments will be conducted.

The other half of our project is to determine the optimal concentration of hydrogen peroxide to induce blood vessel formation. MC3T3-E1 cells to a peroxide concentration gradient to determine the highest concentration that does not cause adverse effects. This process is similar to the one described above for calcium and phosphate ions. After the optimal concentration is found, we will integrate it with a polymer that can be used at the nanoscale to deliver the peroxide in order to the target tissues in the body. As a whole, the lab is developing integrated biomaterials systems to promote proper growth of bone tissue in vivo. The problem with current musculoskeletal regeneration models is that they cause all the stem cells to differentiate into osteoblasts and do not take into account that those osteoblasts need neural and vascular networks to survive.
Inducible plasmid-based complementation systems are regulated using inducing compounds at varying concentration; however, precise control of transcription is difficult to achieve. Even in the absence of inducer, gene expression is often still measurable due to the leakiness of the promoter and copy number of the plasmid. In order to overcome this challenge, our goal is to develop a chromosome-based method of complementation for *Agrobacterium tumefaciens*. We have engineered a tn7-based method for inducible control of transcription from an engineered site on the chromosome. In this study, we will compare plasmid- and chromosome-based complementation using the inducible lac promoter. We hypothesize that the chromosome-based complementation strategy will be less prone to leaky transcription. To test this hypothesis, we will monitor the restoration of motility and biofilm phenotypes during complementation of null mutants with both systems. Both motility and biofilm phenotypes are easy to assay and quantitate providing us with a means to validate the chromosomal complementation system. Preliminary results suggest that restoration of motility in a non-motile mutant (Δrem) requires the presence of inducer when a complementing gene is inserted on the chromosome under the control of the lac promoter. We expect that the development and validation of a chromosome-based complementation system for *A. tumefaciens* will improve our ability to genetically manipulate this important bacterial plant pathogen.

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Language attitudes of Mizzou students

Emily Summers and Matthew Gordon

People tend to have strong opinions about language, especially when it comes to what is incorrect or improper. Sociolinguistic research examines these beliefs in order to understand the linguistic choices made by speakers and writers and how those choices affect communication with the people around them. Previous research has connected awareness of prescriptive grammar and linguistic insecurity with general attitudes about language. Many studies have shown that approaching language in terms of correctness promotes negative attitudes about certain varieties of English and their speakers. As negative attitudes persist, further exploration of this topic is necessary because previous research has mostly been interested in the affect of social differences (including gender, geographical region, and age) on language attitudes.

This paper seeks to uncover correlations between the personalities and identities of speakers and their general attitudes about language, a perspective that has yet to be applied to studies of this type. Using a questionnaire methodology that surveys Mizzou students, demographic information (including college major and year in school), political leanings, and answers to the Big Five Personality Test (focusing on the personality trait, ‘openness to experience’) are collected. Next, participants are asked questions regarding general attitudes about language, knowledge of prescriptive grammar, pronunciation tasks, and knowledge and usage of slang. At least 100 participants will be sought in order to represent a wide range of college majors, political leanings, and personality types. Although people with higher levels of education, higher scores in ‘openness to experience’, and more liberal political views should be more tolerant of language variation, other research, including studies at MU, suggest that this will not be the case. I hypothesize that no matter how ‘open’, educated, or liberal a speaker tends to be, language variation will be interpreted as incorrect, rather than different, thus reinforcing negative stigma.

*This project was completed to fulfill a Capstone requirement.*
The emergence of new wealth in the American Industrial Era: Class idealism in Willa Cather's "Paul's Case"

Elizabeth Sweeny and Jeannette Schollaert

In Willa Cather’s short story “Paul’s Case,” Paul exemplifies working class yearning and the unsustainability of American industrial ideals in his wanderings of Pittsburgh and subsequent escape to New York City. Cather captures the changing architecture of Pittsburgh in the midst of the steel boom, yet Paul’s view is limited to the streets. This presentation examines the effect of Pittsburgh’s new wealth and the intersections of class and place in Paul’s attempts to navigate the tension between his working class Pittsburgh reality and the luxurious New York City ideal of his personal American dream.

Combining the disciplines of architectural and cultural history with literary criticism, this presentation explores the representations of urban material culture and class idealism in Cather’s short story. Two presenters will provide research from the aforementioned fields to contribute to one cohesive study of material culture, place, and class in Cather’s work. In terms of architecture and material culture, the presentation will explore the idea of the “street view” and the inaccessibility of industrial era interior architecture, as Paul experiences both the view from the streets and inside the Waldorf-Astoria hotel. The literary analysis will consider Cather’s use of place and descriptions of smell as markers of class. Much of the scholarship on this story concerns art and psychoanalytic readings, whereas cultural materialist readings of the story are lacking. By combining complementary yet diverse perspectives, this presentation offers a multifaceted critical analysis of American Industrial Era material culture as represented in Cather’s urban, pre-”Prairie Trilogy” short story.
Microbial production of 2, 3-Butanediol from lignocellulosic biomass

Taylor Thompson and Caixia Wan

2, 3-butanediol (2,3-BDO) is a precursor for bulk production of various chemicals. Microbial production of 2,3-BDO has attracted increasing interest due to the use of renewable feedstocks and environmental friendliness. In this study, Bacillus licheniformis was used to produce 2, 3-butanediol from switchgrass, a dedicated energy crop, via simultaneous saccharification and fermentation (SSF). 2, 3-BDO, sugars, acetoin and other byproducts produced during the fermentation were analyzed using HPLC or GC. The yield and productivity of 2, 3-butanediol as well as the consumption of sugars in switchgrass were reported.
"Draw a Scientist Test", determining the schema associated with geologists and meteorologist

Evan Thornberry, Tanner Wolf, and Lloyd Barrow

Once a person has a solidified their perspective of a topic, it is hard to change that position. If we know these perspectives The “Draw a Scientist” test is designed to ambiguously have students recreate their idea of what a scientist looks like. The test then grades for the stereotypically associated images portrayed in the drawings. But, does this idea of a stereotypical image transfer to the idea of an Earth scientist? In particular, could the test allow us to understand the different perspectives associated with geologists and meteorologists?

We tested the drawings of college level students going into the research we believed that geologist would be the most stereotypical images of scientists being portrayed. We believed that meteorology would be less stereotypical of a scientist because of the association between meteorologists and weather reporters.

Preliminary results show that the images were scored to be more stereotypical in both upper and lower scores of the Draw-a-Scientist scale. Furthermore, the total scale mean of the geologists was 6.1 points with a standard deviation of 2.1250 points. This is greater than the mean for the meteorologists which was 4.8077 points with a standard deviation of 1.9803 points.
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Faculty Mentor: Dr. Sarah Orton, Civil & Environmental Engineering  
Funding Source: College of Engineering Undergraduate Research Option, National Science Foundation grant to S. Orton

Evaluation of the progressive collapse potential of flat plate reinforced concrete structures

Virginia Trauth, Carmen Aboytes, Katy Beyer, Andrew Briedwell, Matt Fleissner, Andrew Pelikan, and Sarah Orton

A common structural design in the construction industry is the flat plate reinforced concrete design. The reason for the popularity of these structures includes lower cost, relative ease of construction, and decreased required story height. In a flat plate structure, reinforced concrete slabs are supported directly by reinforced concrete columns. The nature of this design leaves the structures vulnerable to punching shear failures at the slab-column connection due to high shear stresses. When a punching shear failure occurs in a flat plate structure with discontinuous reinforcement, the load cannot be distributed to the surrounding columns. If the surrounding columns of the structure are not designed to carry the redistributed load, a progressive or disproportionate collapse will ensue.

The overall purpose of this research is to determine the mechanisms of disproportionate collapse in outdated reinforced concrete buildings subjected to sudden column loss. The research program consists of multi-panel concrete flat-plate structures in conjunction with previously tested isolated slab column connections. Additional areas of interest include the effect of in plane lateral restraints, the effect of post-punching capacity and the effect of loading rate on pre-1971 flat plate construction code.
Crowdsourcing for remote sensing

Huy Trinh, Michael Brooks, Daniel Hanson, and Alina Zare

We are developing a method to collect uncertainly labeled training data for remote sensing using crowdsourcing techniques. Traditional supervised machine learning methods require very accurate and precise training labels from which to learn. Collecting accurate training data is very time consuming and expensive. Multiple-instance learning algorithms relax that requirement and only need positive and negative sets of data points, called “bags.” Positive bags are defined as having at least one of the target points within the bag. Negative bags are defined as having only non-target points within the bag. The solution presented uses the idea of a crowdsourcing web application in order to gather the training data to be used with multiple-instance learning algorithms. The web application has one view for selecting a specific region and a second view that shows the multispectral image corresponding to the selected region. Once the user has selected a region from the first view, they will look at the corresponding multispectral image and then record what features they believe are present in the segment. The features the user selects as being present in the multispectral image will be saved to a database. Since the user data is not guaranteed to be correct, the data qualifies as the uncertainly labeled training data, however, our ongoing research shows that this type of data can be used within multiple-instance learning algorithms.
Womanhood: An analysis of abusive relationships between mother and daughter

Rachel Trout and Hannah Reeves

My body of work examines abusive relationships between mother and daughter. My mother’s mental illness manifests itself as physical and emotional abuse in the context of her parenting. Because the norm of American society is for girls to develop in the shadows of our mothers, I explore through my sculptures the impact of abusive maternal relationships (rooted in mental illness) on the development of femininity.

Mothers are examples of maternity and womanhood. Channeling associations of domesticity, Training Bra is 100% cloth and was sewn in construction. Training Bra, a 6 x 9ft sculpture, symbolizes a milestone of becoming a woman, but also investigates the struggle of exploring femininity independently in the absence of a positive maternal example. Through poor domestic craft, references to promiscuity through cloth type and color, scale, and partnership of dysfunctional hanger, Training Bra emphasizes distortions of a feminine image. By veiling feminine anatomy with the exception of an impregnate womb, and through the imprisoning of the pregnant woman with her own umbilical cord that resembles rope, Mommy’s Here, an 11 x 9in linoleum relief print, illustrates abuse initiating an anxiety of legacy, with special consideration to the hereditary nature of mental illness.

Regarding the act of visual research, I have concluded through my own process of art-making and studying the work and biographies of artists, specifically artists that contribute to the same or similar conversation on which I am commenting (like poets Allen Ginsberg and Anne Sexton), that connecting authentically with art is paralleled by the authenticity of the artist’s explanation. This became a part of a body of work that examines a particular relationship dynamic in the larger world of mental illness.
In 2005, President George W. Bush nominated Judge Samuel Alito to succeed outgoing Supreme Court Justice Sandra Day O’Connor. Critics and politicians quickly criticized Alito, an experienced federal judge, for being a “life-long conservative” and “out of the mainstream of American values.” Soon after his nomination, the media began to use the nickname “Scalito,” indicating that if confirmed by the United States Senate, Justice Alito would replicate the relentless textualism of long-time justice Antonin Scalia. The name appeared frequently in high-profile media outlets in an attempt to link the two judges’ jurisprudences. Justice Alito has now served on the High Court for over nine terms, and it is worth reexamining the ‘Scalito’ comparison. Is Alito simply “little Scalia?” Or is there consistent disagreement in legal philosophy between these two justices?

It is my thesis that Justices Alito and Scalia, though both conservative judges, are independent legal thinkers who use distinct methods to interpret law. To conduct this qualitative study, I began by examining their respective influences and theoretical philosophies. I then conducted an analysis of Supreme Court decisions from 2005-2014 and found the two consistently disagree on several constitutional provisions. I used these areas of disagreement as the data for my project and conducted an interpretive analysis to pinpoint their larger philosophical differences.

*This project was completed to fulfill a Capstone requirement.*
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Faculty Mentors: Dr. Victoria J. Vieira-Potter and Dr. Terese Zidon, Nutrition and Exercise Physiology

Effects of dietary soy extract on metabolic response to ovariectomy in female low capacity running rats

Bridget Upton, Rebecca Welly, Young-Min Park, Katherine Wainright, Rebecca J. Scroggins, Steven L. Britton, Jaume Padilla, Victoria J. Vieira-Potter, and Terese M. Zidon

Menopause (i.e., loss of ovarian hormones such as estrogen) is correlated to weight gain, obesity, metabolic dysfunction (such as dyslipidemia and insulin resistance), reduced energy expenditure in women which all increase the risk of type II diabetes. Soybean isoflavones containing phytoestrogens, which are estrogens that naturally occur in legumes, have proven to reduce some of the side effects related to menopause. For our study we used a special rodent model that is selectively bred for low intrinsic aerobic fitness (i.e., low capacity running, LCR). Rats that have been selectively bred for low aerobic capacity running (n=40, 16 weeks of age at start) were randomly assigned one of the four groups: sham-operated control diet (SHM-C); sham-operated high soy extract diet (SHM-S); ovariectomized control diet (OVX-C); and ovariectomized high soy extract diet (OVX-S). Food intake and body weight was monitored weekly for 26 weeks; OVX and SHM surgeries were preformed when the rats were ~18-20 weeks of age. The measurements that were taken in this study include: weekly body weight gain (in grams), food intake (in grams), energy expenditure (i.e., fat, lean, and bone), spontaneous cage physical activity, regional fat distribution (via weighing individual fat pad depots including subcutaneous and visceral regions), and fasting blood markers (i.e., lipid panel, glucose, insulin, estrogens and inflammatory markers). Some of our conclusions include the OVX rats gaining more weight than the SHM controls which was analyzed using EchoMRI and fat pad weights. From an increase in dietary soy isoflavones, there is a decrease in adiposity and improved insulin sensitivity in both the SHM and OVX LCR female rodents.

This project was completed to fulfill a Capstone requirement.
Changes in crayfish tail posture after nerve cord transection are affected by serotonin and octopamine

Aimee VanDerBeck, Ashley Hackworth, Desire' Buckley, and Mark Kirk

The red swamp crayfish, Procambarus clarkii, is a useful invertebrate model to study principles of neural function due to its relatively simple and easily accessible nervous system. Beginning one week after transection of the ventral nerve cord (VNC) between the thorax and abdomen, an interesting form of neural plasticity occurs. Complete VNC transection disrupts pathways required for expression of non-giant neuron mediated, phasic tail flips. However, this phasic (fast) flexor muscle activity reemerges after about 1 week, in the absence of regeneration across the lesion. This re-expression of non-giant mediated fast flexor activity, in response to weak mechanical stimulation, is known as hyperreflexia. In addition to hyperreflexia, we found that VNC transection has acute and prolonged affects on abdominal posture. The lesion results immediately in an exaggerated postural flexion of the tail, and this flexion bias persists for weeks. However, normal tail posture gradually returned over the course of one to three months. In the present studies, we tested whether the initial flexion bias as well as the return of normal tail posture can be mimicked (or reversed) by injection of the neurohormones serotonin and octopamine. Serotonin and octopamine are known to elicit opposing tail postures in crayfish and lobsters. We injected serotonin or octopamine into the circulatory system of the abdomen near the site of VNC transection. We found that in lesioned crayfish the postural bias towards flexion can be attenuated with octopamine, while exaggerated tail flexion was largely unchanged by serotonin. These affects were observed over a time course that paralleled hyperreflexia. Therefore, we propose that increased serotonin levels, or increased sensitivity to serotonin, contribute to the extreme postural tail flexion after VNC transection and that this postural flexion can be partially reversed by octopamine. Alternatively, reduced octopamine levels after VNC lesion could lead to the flexed tail posture we observed. Exaggerated reflex responses occur after spinal cord injury in vertebrate animals; therefore, the study of hyperreflexia and associated changes in postural responses in the crayfish may provide insight to neural mechanisms that underlie plasticity after CNS injury.

This project was completed to fulfill a Capstone requirement.
Benjamin Vega, Autoosa Salari, and Mirela Milescu

EAST and SeSAME syndrome are two channelopathies that result from a single nucleotide mutation in the inward rectifier channel, Kir4.1. The Kir4.1 channel is important for regulating potassium homeostasis and neuronal excitability. These channelopathies are autosomal recessive diseases characterized by debilitating neurological disorders. The underlying mechanism by which this single nucleotide mutation affects channel function is currently unknown. The single nucleotide mutation causes a single amino acid change in the cytoplasmic domain of the channel adjacent to a putative ATP binding domain. To investigate the structural and functional effects of this mutation we use both computer modeling and electrophysiological recording in *Xenopus laevis* oocytes. Computer modeling was necessary to study the mutation’s effect on the channel’s structure, as there is no crystal structure of Kir4.1 available. The models were generated using Modeller software and other potassium inward rectifier channels with available crystal structures as templates. Models of both wild type and mutant channels were generated to determine the mutation’s effect on the channel’s structure. Modeling did not reveal stark structural differences between the mutant and wild type channel. For expression in *X. laevis* oocytes, we have constructed and optimized a Kir 4.1 plasmid for the wild type channel and are currently engineering the EAST and SeSAME syndrome mutant form of the plasmid. Both channels will be recorded from using the two-electrode voltage-clamp technique in *Xenopus laevis* oocytes.

This project was completed to fulfill a Capstone requirement.
Kv2.1 and its friend AMIGO: an influential relationship

Benjamin Vega, Alissa Becerril, Autoosa Salari, and Mirela Milescu

Voltage-gated potassium channels (Kv) are transmembrane proteins that respond to changes in membrane potential and regulate the flux of potassium ions across the cell membrane. These channels, among other voltage-gated ion channels, form the foundation of electrical signaling in excitable cells. It has long been known that auxiliary proteins that associate with voltage-gated ion channels can modify the channel in a number of ways, including cell-surface expression, voltage-dependent activation and inactivation, and pharmacology. Recent studies identified AMIGO-1 (amphoterin-induced gene and open reading frame) as an auxiliary subunit for Kv2.1 that increases the surface expression of the channel. Moreover, the presence of AMIGO alters the voltage dependency of activation of the channel (Peltola et al, 2011), suggesting a possible interaction site with Kv2.1 voltage sensors. These structural motifs are a well-known target of gating-modifier toxins isolated from venomous animals. Here, we investigate the role of AMIGO on the pharmacology of Kv2.1 expressed in *Xenopus laevis* oocytes using two-electrode voltage clamp technique. We hypothesize that AMIGO forms interactions with the voltage-sensing domains of Kv2.1, and thereby alters the binding affinity of the toxins. AMIGO cDNA was cloned into a vector designed to properly express exogenous RNA in *Xenopus laevis* oocytes and was coexpressed with Kv2.1. We find that the presence of AMIGO causes the channel to open at more hyperpolarized voltages. Moreover, the presence of AMIGO influences the ability for toxins to bind and inhibit the channel. Future experiments will be performed to further investigate the binding interface between Kv2.1 and AMIGO that will provide significant information on the regulation of voltage-gated ion channels by auxiliary proteins.
Dominic Vollmar, Adithyan Babu, Michael Huber, and Cerry Klein

This research focuses on determining the feasibility of using drones to facilitate last mile delivery of goods. This was inspired by the recent push for drone delivery by companies such as Amazon. Some benefits of drone usage would include same day delivery, environmentally friendly energy usage compared to gas powered trucks, and reduced amount of missed deliveries due to customers not being home. A drone delivery system would be almost completely automated, limiting the amount of labor needed to complete deliveries from warehouses to customers. Therefore, if there was added revenue due to the advantages listed, in addition to any decrease in operating costs compared to the current delivery system, it would be feasible for companies to look at using drones for last mile delivery of goods.
Probabilistic risk assessment

Dustin Wagner and Patrick Pinhero

Probabilistic Risk Assessment (PRA) is an analytical technique that examines potential faults or failures in any system or process by examining deterministic factors and stochastic events. It allows engineers to determine what can go wrong, how likely it is for the system to fail, and what the consequences are. My summer research project focused on using PRA techniques to examine potential failures in nuclear systems. PRA on nuclear systems is important because it provides information about lowering the risk probability on nuclear reactor sites. Without this knowledge, nuclear systems are more susceptible to catastrophic events like to ones that happened at Chernobyl, Three Mile Island, and Fukushima-Daichi reactor sites. These monumental events were the result of small problems that escalated into problems that caused either the core to melt or a sudden large release of radioactivity. It was important to analyze every piece of the system to prevent mistakes in my risk assessments. In order to complete a risk assessment on a nuclear system, I first had to master programs that are tailored to PRA. One of the programs, SCALE, is designed to evaluate the neutronics and radioactive decay in nuclear reactor systems. This provides information such as how hot the core gets, which is valuable for the PRA process. Another program that was required for risk assessment was SAPHIRE. SAPHIRE is the actual PRA code used to create a graphical diagram of the system using event trees and fault trees. These trees were composed of all possible events required for a system to fail. SAPHIRE allowed me to investigate the probability of a nuclear system failing at any given moment. SAPHIRE also allowed me to control which events I wanted to analyze by breaking each main event into separate components. Learning these programs allowed me to comprehend the steps of probabilistic risk assessment and preform my skills at the industrial level.
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Analyzing growth on early writing measures: Getting students off to the "write" start

Kate Waidmann, April Byrd, and Erica Lembke

Curriculum-based measurement (CBM) is an efficient, standardized, valid, and reliable tool to examine students’ performance and progress in academic areas. Writing is an area where students continue to struggle and the most recent NAEP data (2011) suggest that a large number of students with and without disabilities are not at the basic proficiency level. There is a need for teachers to use time efficient measures like Curriculum-Based Measures (CBM) in early writing to make data-based decisions about their students’ writing progress. In this study, we investigated the differences in early writing growth between gender, socioeconomic status (SES), and ethnicity in first- through third-grade students in two Midwest schools in one school district. We measured student growth by examining three writing tests given in the fall and spring of one academic year and determined differences between fall and spring scores. The first test, Word Dictation focused on students writing words. The second test, Picture Word, focused on student’s sentence structure. The third test, Story Prompt, focused on student’s paragraph structure.

We separated student data into three subgroups—gender, socioeconomic status (as determined by free and reduced lunch status), and ethnicity, for analysis. To analyze these differences we looked at the data for individual grades (first, second, and third) by themselves, as well as the total population of students in first- through third- grade. Our data suggests that students who are male, receive free or reduced lunch, or identify as African American lag in early writing growth. We chose to look at first through third graders because these are critical years in developing writing skills. Helping students that are struggling at the beginning of their schooling will allow them to get back on track. Our findings provide teachers and principals with information that can be utilized to design plans that support struggling students.
Comparison of synovial and infrapatellar fat pad tissue responses to cytokine stimulation using an in vitro co-culture model

Nicole Walden, Nicole Werner, James Cook, and Aaron Stoker

Introduction: Osteoarthritis (OA) is a debilitating disease associated with loss of functional articular cartilage and is projected to affect 59.4 million Americans by 2020. Inflammatory cytokines, such as IL-1β, have been shown to contribute to the clinical progression of OA. Delineating the potential role of tissues involved in OA pathogenesis can help guide the development of future treatment strategies. We hypothesize that cytokine stimulation will result in characteristic responses from synovial tissue and fat pad in a co-culture model of osteoarthritis.

Materials and Methods: Cartilage, synovial, and infrapatellar fat pad tissues were collected (n=5). Cartilage (6mm) explants (n=6) were co-cultured with either synovial (CS) or fat pad (CF) tissue explants (4mm). Tissues were co-cultured in 2ml of DMEM media supplemented with rcIL-1β at 50, 10, 2, 0.1, or 0 ng/ml (NEG) for 21 days. The media was changed every three days and collected to assess nitric oxide (NO), PGE2, proteoglycan (GAG) concentration, and MMP activity.

Results: Both co-cultured models produced significantly higher MMP activity, PGE2, and NO when treated with 2, 10, and 50 ng/ml of IL-1β compared to the NEG group. The release of GAG was not significantly affected by IL-1β treatment. No consistent significant differences between the CS and CF groups were observed for MMP activity, PGE2, NO, or GAG production.

Discussion: Synovium and infrapatellar fat pad have similar responses to stimulation with IL-1β in vitro. These data suggest a potential role for the IPFP in the pathogenesis and progression of OA development that is similar to the synovium, indicating a need to consider the IPFP during the treatment of OA clinically.
Mother-daughter relationship quality and family structure in the association between sexual attitudes and intentions

Chanell Washington, Sonia Giron, Sarah Killoreen, and Nicole Campione-Barr

Typically, parents worry more about the sexual behaviors of daughters than sons (Perilloux, Fleischman, & Buss, 2008). Thus, daughters are more likely to report sexual discussions (Raffaelli, Bogenschneider, & Flood, 1998). Research has shown that family structure and mother-daughter relationship quality affect girls’ sexual behaviors (Fingerson, 2005). As sexual intercourse is associated with sexual intentions, and sexual intentions are associated with sexual attitudes (Gillmore et al., 2002), the goal of the present study was to examine whether mother-daughter relationship quality and family structure (intact vs. non-intact) moderate the association between adolescent daughters’ sexual attitudes and their sexual intentions.

Fifty-six adolescent sister dyads (n = 112) were recruited from Colorado and Missouri (M = 16.88, SD = 2.30). Surveys were utilized to gauge their sexual intentions (East, 1998), sexual attitudes (Sprecher, McKinney, Walsh, & Anderson, 1988), and maternal acceptance (Schwarz, Barton-Henry, & Pruzinsky, 1985).

There was a significant main effect of sexual attitudes on sexual intentions, such that more conservative sexual attitudes were associated with fewer sexual intentions, and vice versa. There was also a significant main effect of participant birth order on sexual intentions, such older siblings reported greater sexual intentions. Furthermore, there was a significant interaction between sexual attitudes and mother-daughter warmth. The association between sexual attitudes and sexual intentions was only significant for girls who reported low maternal warmth. There was no moderating effect of mothers’ marital status.

This project was completed to fulfill a Capstone requirement.
Faculty Mentor: Dr. Steven Borgelt, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option

Assessing solid waste production to determine environmental advantages of hand drying methods

Sara Wasinger and Steven Borgelt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Missouri e-Filing system: Case processing time study analysis

Brett Watkins, Caroline Schmidt, Anne Janku, Joseph Vradenburg, and Jung Hyup Kim

As society moves into more advanced times, inevitably analytical research must do the same. Time and motion studies have traditionally been completed with pencil, paper, and a stopwatch. This method continues to work efficiently as many Industrial Engineering professionals have mastered this technique, but as manufacturing and technology continue to evolve, this method has become tough to use accurately in all situations. Therefore, this study was conducted to investigate new time and motion study methods that could improve accuracy, stay cost effective, remain feasible for a basic user to learn, and reduce researcher analytical time. The new methods that were tested in this study were audio recording, google glass recording, and leap motion – gesture recognition time capture. The previously stated methods were tested in this experiment on Missouri court clerical staff through a time and motion study that the Missouri Office of State Court Administrator (OSCA) was conducting to assess their newly implemented electronic court filing system. This time and motion study was selected as it was evaluating workload before and after implementation of the new Missouri e-Filing System (MeFS). Results of the study revealed that the most effective new method was capturing time using the Leap Motion Device. This device reduced overall error rate, was economically efficient, had a small learning curve for staff, and improved the analytical process after the time and motion study was complete.
The influence of soil amendments on nutrient fate through a bioretention soil mix

Thomas Welby, Erin Reinkemeyer, Kaley Hensel, Kaili Li, Grace Stojeba, and Enos Inniss

A bioretention cell is one of several vegetated BMPs (best management practices) for reducing the impact of storm water runoff on receiving streams. Bioretention soil columns have been designed and built based on full-scale designs used on the University of Missouri campus and around the City of Columbia, Missouri. Running synthetic storm water through the bioretention soils used in these features resulted in minimal phosphorus removal from the storm water runoff. Due to phosphorous levels contributing to water impairment in several streams throughout the State of Missouri, this issue needs to be addressed before the water reaches the receiving streams.

The focus of this research group’s efforts has been to determine the effects of various amendments on the fate of nitrate and phosphate present in storm water runoff. The amendments include compost, biochar, grog, mulch, as well as ferric, lime, or aluminum drinking water treatment residuals. Source water and effluent nitrate and phosphate, turbidity, and organics content were measured to determine effectiveness of the amendments on water quality after several storm “events.”

We will discuss at the Forum phosphate export from these soils and efforts to reduce that export by modifying the soil composition and, therefore, improving management of the storm water runoff.
Conveying Victorian short fiction in the Twenty-First Century

Brianna Westervelt and Elizabeth Chang

In any English Capstone class, research is a key element towards completion of a project. In this particular English Capstone class, that research was taken to the next level, by going back in time to Nineteenth Century England. Focusing on Victorian short fiction, how could we present these texts for a new, Twenty-First Century audience? The answer to that question was found in the development of an online archive housing various Victorian short stories found in the era’s numerous periodicals, focusing specifically on the unstudied or unanthologized texts and how we can make those more prevalent objects of research. Searching for historical context, author biographies, among many other sources, this research was paired with the original text of the story all on one Wiki page, making it easier for the new, Twenty-First Century audience to navigate to and interact with these diverse Victorian periodicals and texts. Through the development of the Wiki, we want to make relevant these texts with which many people may be unfamiliar.

This project was completed to fulfill a Capstone requirement.
Simulations of Rayleigh-Taylor and Richtmyer-Meshkov instabilities

Justin White and Jacob McFarland

Having began this research during the spring semester, it is in its infancy stages. Therefore, this abstract will present and outline future goals for the coming semesters. Rayleigh-Taylor instabilities occur at an interface of two fluids of different densities. Often times a heavier fluid is resting on a lighter fluid relative to the acceleration vector, such as cold ocean water resting on a large pocket of warm ocean water where the acceleration is created by the Earth’s gravity. The equilibrium that exists between the two is highly unstable and the slightest disturbance in the interface will cause the heavier fluid to accelerate downwards into the lighter fluid and the lighter fluid to move into the region of the heavier fluid. Richtmyer-Meshkov are similar to Rayleigh-Taylor instabilities, but the acceleration is impulsive and almost instantaneous. Such an acceleration is created by a shock wave.

This research is important because these instabilities are present in many high energy natural phenomena and in thermonuclear explosions. RT instabilities can be observed in the formation of supernovas such as in the “fingers” of the crab nebula. Also, understanding and controlling the formation of RM and RT instabilities is fundamental in aiding the progression of inertial confinement fusion. These instabilities are produced during compression and lead to detrimental mixing of hot fuel with cold or inert material decreasing the fusion yield and limiting its viability as a commercial power source.

This research’s first goal is to first use high performance computing to simulate both instabilities through a program called Ares, developed at Lawrence Livermore National Laboratory, which will produce high-resolution simulations of the interface as it grows and mixes. The MU Shock Tube Facilities have the end goal of building a shock tube to run experiments that create Richtmyer-Meshkov instabilities and validate simulations.
Anhueser-Busch logistics

The purpose of this project is to partner with Anhueser-Busch (AB) to reduce distribution cost variability. Currently beer is distributed to wholesalers based on a forecast for demand and a production schedule that must be locked in many weeks in advance of the actual shipping of beer. However, for each particular beer product, the planned amount to be shipped from a brewery to a wholesaler is not always accurate, due to variability in demand and production. These variabilities cause reallocation of beer shipments between breweries and wholesalers, increasing AB’s logistics costs. This project is to identify the extent of variability in the demand forecasts and production plans, and also use optimization models to identify the impact of this variability on distribution costs. Instead of just providing a cost estimate for Anhueser-Busch, this project aims to generate a cost probability to characterize uncertainty in the shipment plan and how it might affect overall cost. Currently the research project is still in progress and results found by the forum will be presented at that time.
Identifying glial cell function in subsets of the nervous system in *Drosophila melanogaster*

Alex Willenbrink, Audrey Wagner, Lovesha Sivanantharajah, and Bing Zhang

In the nervous system there are two types of cells: neurons and glia. Although the vast majority of these cells are glia, modern understanding of glia is quite limited compared to that of neurons. Glia are best known for their roles in sheathing axons to increase neural communication speed. Only recently have new functions of glia start to become apparent such as: delineating and dividing lobes in the brain, serving as the immune system of the brain, and regulating neuronal excitability and synaptic transmission. With this flood of new information, there is a necessity to separate and classify subsets of glia based on functionality. To solve this problem, I have undertaken a “loss of function” approach to describe and classify subsets of glia. The objective of my project encompasses isolating subsets of the brain glia of the model organism *Drosophila melanogaster* (fruit fly) through expression of a toxic protein called Polyglutamine (PolyQ). Instead of expressing PolyQ in all glia, I apply a newly developed ‘intersectional’ method to refine PolyQ expression in subset glia. This method allows unbiased restriction of glia-Gal4 expression upon flippase-mediated repression by a Gal4 inhibitor, Gal80. I then observe and analyze defects in fly walking and climbing when subset glia express PolyQ. Finally, I map the morphology and location of the subset glia to gain insights into their roles in fly locomotion.
The effect of template removal techniques on the biocompatibility of hexagonal mesoporous silica for *in vivo* devices

Heather L. Williams, John W. Lewis, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The Whipping Man

Vincente Williams and Brad Carlson

The Whipping Man takes place shortly after the end of the Civil War and glimpses into the relationships between a Confederate soldier and two of the former slaves of his household. Throughout this play, the characters show just how dramatic a change the end of the war (and the freedom of slaves) was and also brings up problems of the past. I did a light design for the production of The Whipping Man, and with collaboration with the design team and Director of the production, I went with a realistic approach for the design. In this approach I wanted to pull my audience into the set and story to make it feel as though they were sitting on stage and fully immersed into the lives of the three characters as well as the situations they are going through. Throughout the play the light design worked with the actors as they interacted with the set as they lit lantern or wall sconces, to the lightening that happened during the thunder storm. With the design, it also made the play feel like the actors were very comfortable with their surroundings- as though they had been living in the space for years.
HIV’s high mutation rate enables the virus to develop resistance to standard antiretroviral therapeutics. Broad spectrum inhibitors that simultaneously bind to conserved residues of reverse transcriptase (RT) may prevent the emergence of drug resistance and suppress replication, and would therefore make them ideal therapeutic candidates. Nucleic acid aptamers selected against HIV-1 RT bind and inhibit RT by competing with the viral RNA for access to the active site. However, previously characterized aptamers exhibit specificity for the subtype and strain of HIV RT they were selected to bind. Our lab has recently performed a selection process, termed Poly-Target SELEX to identify broad-spectrum inhibitors of RT. RNA libraries that had been pre-enriched for binding to RT from a subtype B strain of HIV were subjected to three additional rounds of selection along independent trajectories that recognize and bind to RT from phylogenetically diverse lentiviral strains. High-throughput sequence analysis of populations from Poly-Target SELEX identified sequences that co-enriched along multiple trajectories. Primer extension assays were performed to test whether candidate aptamers would inhibit a panel of phylogenetically diverse RT. A subset of these candidate aptamers demonstrated broad-spectrum inhibition in vitro. Secondary structure analysis of the broad-spectrum aptamers identified through this process appear to fold into the previously described (6/5)AL motif while having some previously unobserved features. These broad-spectrum aptamers will be further characterized in biological assays to determine the efficacy of inhibiting the replication of HIV. Through these techniques we have identified and characterized broad-spectrum RNA inhibitors of phylogenetically diverse RT that fold into previously unobserved secondary structures.

This project was completed to fulfill a Capstone requirement.
Declining motivation across the transition to middle school: A review of the literature

Mary Wilsdon, Clare Klawuhn, and David Bergin

The purpose of the present research was to review quantitative studies that track motivation over the transition from elementary school to middle school. The measures of motivation studied included academic motivation, achievement goals, attendance, engagement, perception of ability, and self-esteem. The ten articles presented longitudinal studies. Students were within a range of fifth through twelfth grades with an emphasis on fifth through ninth grades. The results indicate that there is a steady decrease in most measures of motivation. For example, one study discussed how self-esteem and perception of ability were negatively affected by the transition from elementary to middle school. Their results indicated that self-esteem scores declined across the transition to junior high (from grade 5 to 6), but increased during 7th grade. Self-concepts of ability for math, English, and social activities declined after transition, but perceptions of social ability increased during 7th grade. There were variations across studies in how steep the decline was, but the overall trend leads to the conclusion that student's motivation declines over time, especially across the middle school transition.
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Faculty Mentor: Dr. Charles Brown, Veterinary Pathobiology
Funding Source: NIH Initiative for Maximizing Student Diversity (IMSD-EXPRESS)

The role of 12/15 lipoxygenase in a murine model of Lyme Disease

Edric Winford, Carmela L. Pratt, Carrie E. Lasky, and Charles Brown

Borrelia burgdorferi (Bb) is the causative agent of Lyme disease and is spread in nature by the bite of the Ixodes scapularis tick. When susceptible mouse strains are infected with Bb, they develop arthritis of the large joints that primarily localizes to the ankles. About one week after the onset of arthritis, carditis will develop. Both manifestations of disease will resolve about 60 days after infection. The immunological mechanisms that drive both the onset and resolution of inflammatory diseases are unknown. Eicosanoids are bioactive lipids that are known to regulate inflammatory processes and have been shown to play critical roles in certain infectious disease models. In addition to their primary pro-inflammatory role, eicosanoids have recently been shown to also have anti-inflammatory properties. The enzyme 12/15 lipoxygenase (LO) is a component of the eicosanoid pathway that is thought to produce primarily anti-inflammatory mediators. Others have reported more severe inflammation in 12/15 LO deficient mice using the K/BxN serum transfer model of arthritis compared to control mice, suggesting an anti-inflammatory role for 12/15 LO in arthritis. Our lab uses a murine model of Lyme arthritis and a role for 12/15 LO in the development of Lyme arthritis or carditis has not been established. We hypothesize that infection of 12/15 LO-deficient mice with B. burgdorferi will lead to exacerbated disease. Arthritis development is monitored by measuring ankle swelling and disease severity assessed on H&E stained histological sections of joints and hearts. Clearance of bacteria from tissues is assessed using quantitative real-time PCR. There was not a significant difference in swelling curves of either arthritis-resistant B6 or -susceptible C3H 12/15 LO-deficient mice compared to their wild type counterparts. Although ankle swelling is not always indicative of underlying tissue damage, cell infiltrates into the ankles determined using flow cytometry was not different between B6 12/15 LO and the wild type controls. Flow analysis of C3H 12/15 LO ankles is pending. Histology heart and ankle severity scores were not significantly different between B6 12/15 LO and their wild type controls. Assessment of the C3H 12/15 LO H&E stained slides are pending a pathologist’s review to determine heart and ankle severity scores. In the future, protein and lipids will be extracted to assess concentrations of pro-inflammatory and anti-inflammatory mediators. A better understanding of this pathway may lead to the development of treatments for Lyme and other inflammatory diseases.
"Draw a Scientist Test", determining the schema associated with Geologists and Astrologists

Tanner Wolf, Evan Thornberry, and Lloyd Barrow

Once a person has a solidified their perspective of a topic, it is hard to change that position. If we know these perspectives The “Draw a Scientist” test is designed to ambiguously have students recreate their idea of what a scientist looks like. The test then grades for the stereotypically associated images portrayed in the drawings. But, does this idea of a stereotypical image transfer to the idea of an Earth scientist? In particular, could the test allow us to understand the different perspectives associated with geologists and astrologists?

We tested the drawings of college level students going into the research we believed that geologist would be the most stereotypical images of scientists being portrayed. We believed that astrologists would be less stereotypical of a scientist.

Preliminary results show that the images were scored to be more stereotypical in both upper and lower scores of the Draw-a-Scientist scale, with the mean of the geologists being 6.1 points with a standard deviation of 2.1250 points. This is greater than the mean for the astrologists which was 4.7692 points with a standard deviation of 1.9663 points.
Trends in the quantity of medications reported by breast cancer survivors

Katherine M. Woodruff, Emily J. Tesar, Bob R. Stewart, and Jane M. Armer

Background: Over 2.8 million breast cancer survivors in the U.S. are at lifetime risk of developing lymphedema, limb or upper body swelling following cancer treatment.

Purpose: Analyze the average number of medications reported by breast cancer survivors at each study visit to determine trends in the number of medications taken by patients during their survivorship. Provide a preliminary foundation for future more sophisticated quantitative studies relating the number and classification of medications to the occurrence of post-breast cancer lymphedema.

Design: Secondary analysis of data from an epidemiological study (N=337) following a longitudinal prospective study design.

Methods: Breast cancer survivors (n=267) self-reported their medications during a nurse interview. Descriptive statistics were used to summarize the average number of medications taken by patients at two time points.

Findings: The participants self-reported a slight increase in the number of medications (5.24 vs 6.67) over the time span of their survivorship, or the time between their first study visit and last visit ("X"=44.06 months).

Conclusions/Clinical reference: As these breast cancer survivors aged, they self-reported a slight increase in number of medications. Future correlational studies will be done to determine if this increase can be linked to an elicitation or exacerbation of lymphedema by analyzing the participant’s self-report of signs and symptoms of lymphedema at each corresponding visit. Eventually, it may be possible to create a medication list that should be monitored or used with caution in breast cancer survivors, as they may be linked to the emergence or exacerbation of lymphedema.
Though we currently reside in an era of fossil fuel dependence, biomass will become our primary carbon resource in the future. Lignocellulose, the predominant component of tough plant materials such as corn stalks, prairie grasses, and wood, is one cheap source of carbon in the form of biomass. Bioethanol is produced via a seven-step process that converts plant matter into liquid fuel. The least efficient step in this process is the breakdown of cellulose to yield sugars that can be fermented into this biofuel. The tightly-bound chemical structure of lignocellulose makes the biomass resistant to breakdown, requiring a pretreatment step to ready it for the production process. Supercritical Carbon Dioxide (scCO2) is a fluid capable of penetrating the lignocellulose. During pretreatment, the biomass is soaked in a high-pressure batch reactor and saturated with scCO2. Then, a rapid pressure release (“explosion”) causes the scCO2 to rush violently from the innermost parts of the tough lignocellulose. The explosion weakens the structure of the plant material and increases the exposed area on its surface, thereby improving the efficiency of the next step in the bioethanol conversion process: enzymatic hydrolysis.

We studied the effect of the scCO2 explosion process on the efficiency of enzymatic hydrolysis. 16 different trials of varying temperature, pressure, and residence time parameters were conducted. The dependent variable for each trial was the glucose yield of subsequent enzymatic hydrolysis. That is, the amount of simple sugars produced from the pretreated biomass that can be carried on to the next phase of bioethanol production. Our findings suggest that scCO2 explosion can indeed be used to pretreat biomass. However, the high temperature and pressure of process operation are difficult to achieve quickly and consistently.
Power loss in smart distribution networks with distributed generator

Xiaowen Xu, Huanyu Chen, and Robert O’Connell

Nowadays, energy is a big issue in the world. Smart distribution networks, which supply electricity directly from the transmission system to end users, will need to undergo significant developments to cope with the decarbonisation of electricity generation, transport and heat. From small to large scale smart distribution networks, power loss should be given a priority in our research work to help solve the energy problem. To decrease the power loss, the distributed generators will be interconnected to the existing distribution networks, which are primarily radial. Distributed generators interconnected into the distribution network are regulated to within certain limits, based on the technical interconnection problems. The next generation smart grid will be required to accommodate increased customer demands and will require distributed generator units to ensure a high power quality and energy efficiency. This project is focused on power loss reduction, including the effects of distributed generators based on a certain network. A direct approach for unbalanced three-phase distribution load flow solutions is using to calculate the power losses for the 32-bus test system in different study cases. A method for placement of distributed generators is considered based on the analysis of power flow continuation and determination of most sensitive buses to voltage collapse. The project results show that proper placement of distributed generators can effectively reduce the power losses and improve the voltage quality. In the case that generators inject both real power and reactive power, reactive power plays a prior role in the power losses.
Increasing cultural competence among pre-service teachers through service

Bianca Zachary, Samantha Stinson, Joy Martin, and Gabrielle Malfatti

This mixed-methods study examines the effects of the Weekenders Initiative on the development of education student’s cultural competence. The purpose of this project is threefold: (1) to generate a contextual definition of cultural competence and its importance for this Weekenders experience; (2) to observe the effect that a cultural immersion experience in urban/high poverty schools on the participant pre-service teacher’s cultural competence; and (3) to examine possible changes in cultural competence over the course of the immersion experience. Educators need the ability to understand their own personal biases and how they may affect their future teaching career and how they approach a culturally diverse classroom to achieve maximum academic achievement. The participants were 28 White females and 2 White males all completing their teacher preparation at the same Midwestern University. The location of the study took place at three different elementary schools, two charter schools and one public, in urban/high poverty areas. Participants were monitored and observed during their initial pre-traveling meetings and also received a pre and post-trip electronic survey which asked them specific questions regarding their perception of cultural competency and their expectations for the Weekenders experience. Our initial results indicate that there was a change over the course of the trip in the pre-service teachers cultural competence and awareness of their own cultural bias(es). Participants indicated that their experiences far exceeded their expectations and goals for the trip and that following the Weekenders experience, most could see themselves one day teaching in a culturally diverse, urban/high poverty schools. Implications include the enhancement of pre-service teachers training programs to included culturally relevant immersion experiences and thus increasing the willingness of Pre-Service teachers to consider teaching in underserved urban school districts.
Fluorescence quenching and stability of biocompatible carbon nanodots

Michael A. Zambrana, Chloe J. Rees, and Maria M. Fidalgo

Photoluminiscent nanomaterials are of interest for environmental sensing due to their high chemical and photo stability. Their small size opens opportunities for nanosensor fabrication. Quantum dots have been extensively explored and present several desirable properties: high quantum yield, ease of fabrication and stability. However, their toxicity and potential impact to environment and biological systems have raised concerns and limited its application. Carbon dots are a class of carbon-based spherical nanomaterial with emission properties in the visible range. Their lower cost, comparable stability and excellent biocompatibility make them an excellent substitution for semiconductor quantum dots.

The objective was to synthesize and characterize carbon nanodots, prepared following a previously published method. Their fluorescence and its changes, specifically quenching, were investigated to assess their use to detect the presence of contaminants such as dinitro toluene (DNT) in natural waters, including surface water and groundwater. In the presence of DNT, the fluorescence was observed to decrease over time thus resulting in the hypothesized quenching effect. The dots are being further characterized to identify quenching patterns with respect to the concentration of DNT. This creates the potential to not only detect the presence of the DNT contaminant but also gain an idea of the concentration. Their pH and ionic stability are being tested to simulate the conditions of the natural water sources that they may be used in.

Emission was observed to decrease with increasing concentration of DNT as tested in the range of concentrations of 1mM to 100mM emission was observed to be stable with time and pH but decreased at higher ionic strengths, which could limit the detection limit of the sensor in seawater and groundwater with high levels of dissolved solids. Despite this potential limitation, research of these carbon nanodots indicates their overwhelming possibility for real world nanosensor technology.
The Belousov-Zhabotinsky oscillating reaction (BZR) is the model oscillating reaction in the field of non-linear chemical dynamics. The BZR consists of the metal-catalyzed bromate oxidation of a dicarboxylic acid in dilute sulfuric acid. We study the bromate oxidation of malonic acid catalyzed by the Ce(III)/Ce(IV) and Fe(II)/Fe(III) couples, and also with these two couples together. Oscillations are visible because of the colors associated with the different oxidation states of the metal species: Colorless Ce(III) versus yellow Ce(IV), red ferroin and blue ferrin. When the two metals are combined in the so-called four-color BZR a periodic progression through four colors is observed: red (both reduced; Fe(II), Ce(III)), blue (oxidized iron; Fe(III), Ce(III)), green (both oxidized; Fe(III), Ce(IV)), and purple (mixed iron II/III and Ce(III)). We have been studying the BZR with experimental measurements, mathematical modeling, and mechanistic analysis. In the laboratory, we found experimental conditions that allowed for the reliable reproduction of BZ reactions with variations of selected parameters (sulfuric acid concentration and pH; relative concentrations of Fe and Ce catalysts) and the video-recording of the reactions. The analysis of the videos involves several layers of mathematical modeling. Color analysis of the video frames as a function of time gives time traces associated with characteristic colors. Extrema analysis of the time traces allowed for the extraction of timing information and, specifically, the period times PT(ti), oxidation times OT(ti), and reduction times RT(ti) over time. The results of the kinetic analysis and studies of key elemental reactions with modern electronic structure theoretical methods have allowed us to refine the mechanistic understanding of the oscillating reactions. We will highlight new results on the oxidation of bromomalonic acid by the high-oxidation-state metal catalyst, the rates of product formation in these oxidations, and on the metal-to-metal charge transfer from Ce(IV) to Fe(II).
Disconnecting water clarity from organics removal in drinking water

Annelise Zeltmann, Joshua Hartsock, and Enos Inniss

Small community drinking water systems must be in compliance with the Stage 2 of the Disinfectants and Disinfection By-Products rule promulgated by the U.S. Environmental Protection Agency by October 2015. Since disinfection by-products (DBPs) are produced when organics in drinking water react with the disinfectant (typically chlorine) one method for reducing the concentration of DBPs is to decrease the concentration of organics present. For small communities in the State of Missouri, the best approach for reducing these organics may be unclear.

This project is part of an effort by faculty at the University of Missouri to provide technical assistance to select small community drinking water systems to help them determine the best approach to DBP compliance. Raw and partially treated drinking water from various treatment facilities in Missouri is collected and brought to MU. Variations in the amount and type of chemicals added (mainly in coagulants) are tested to determine effectiveness of treatment. The tests involve a simulation of the treatment process, namely the stages of coagulation, flocculation, and sedimentation. Effectiveness is determined by measuring turbidity, Spectral Absorption coefficient (UV-254), pH, Dissolved Organic Carbon (DOC), and chlorine residual.

The ultimate goal is to find the right recipe of coagulants, additives, and concentrations to produce the cleanest, cheapest, and most efficient method of treatment without changing the physical design of the facility from which the water is being collected. However, as part of the project we are finding that expectations based on the clarity of the water do not always translate to optimal organics removal. We will present our data and findings on the differences between observed clarity (turbidity) and optimal organics removal at the Forum.
Protein Bioviewer tool update in Soybean Knowledge Base (SoyKB)

Chunyang Zhan, Jiaojiao Wang, Trupti Joshi and Dong Xu

The Soybean Knowledge Base (SoyKB) is a comprehensive database and web resource for soybean genomics. This database provides the storage, analysis and integration of all multi-omics information related to the genes of soybean.

Protein Bioviewer shows the information that coming from the gene of soybean. It shows the protein sequences, secondary structure and other information each soybean may have. As the newer updated versions of soybean reference genome become available, there is a need to update the tools with the latest results and add options for users to utilize information for all versions. In order to achieve this goal my role in the project is to update, analyze and transfer the gene sequence into the models we need. For predicting those information, I use three tools which are tmhmm, PSIPRED and iprscan, to generate predictions and write necessary scripts to ensure those tools work correctly. After this, I would write other scripts to update the database for Bioviewer.
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Faculty Mentor: Dr. Yi Shang, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option

**Hexoskin**

Zening Zhang and Yi Shang

Hexoskin is the first wearable movement, respiration, and heart activity tracker. Hexoskin tracks your health and gives you insights about your activities, your sleep, etc. Using Hexoskin, we can get the heart rate, heart rate variability, breathing rate, breathing rate volume, and sleep properties.

It has 14 or more hours of battery life (multiple trainings), 150 or more hours of standalone recording, and Bluetooth connectivity with iPhone, iPad and Android. The data is validated by independent research labs and the Hexoskin is safe for any kind of activity. The open Data API allows the download of raw data and the use of your own analytics software.

As a computer science junior student, my role in this research is to continue the project from a predecessor who had already gone to work. I utilize the API to download the files from the server and check the update. Also, I need to gather the CSV files together to make it more readable for the user.

After doing the above back-end work, I created a website for our project. The customers told me it must be user-oriented because users cannot do command line work. All the back-end work I did should be transformed to the front-end. Therefore, I make a Hexoskin file management system which can preview the downloading files. The experience sounds like a lot of work, but I really enjoy it. Working not only with people, but also computers, is really exciting.
Super Bowl advertisements: An analysis to gain insight into cognitive/emotional processes evoked by advertising

Congrong Zheng, Jaimee Zupan, Samantha Kintz, and Paul Bolls

This study tests relationships between biometric, self-report, and behavioral indicators of advertising effectiveness. Participants will be 40 male and female adults aged 23 and over recruited from the Columbia, Missouri community. Participants will view nine advertisements selected based on the USA Today Admeter rankings of 2015 Super Bowl advertising. Ads that are ranked at the top, middle, and bottom of the USA Today Admeter rankings have been selected for this study. Biometric data reflecting attention and emotional response will be recorded during exposure to each advertisement. Self-report measures of attitudes, behavioral intentions, and recall will also be collected. This study will provide insight into cognitive and emotional processes evoked by advertising that underlie traditional indicators of advertising effectiveness. It will also inform the value of less conscious biometric measures in predicting advertising success for clients.
Swift language program

Yuxuan Zhou and Dale Musser

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Zeina Ziadé, Kawasi M. Lett, and David J. Schulz

The pyloric network of the crustacean stomatogastric ganglion (STG) is a central pattern generator that requires descending modulation to produce a normal ongoing rhythmic activity. The neuromodulators that affect the STG activity are carried via inputs in the stomatogastric nerve (STN). Following blocking or cutting of the STN (“decentralization”), the activity of the STG is diminished or stops altogether. Previous studies in our lab demonstrated that within 24 hours of removal of STN modulation, there are changes in sensitivity to exogenously applied neuromodulators. In particular, response to the neuropeptide proctolin is enhanced. However, it is not known whether these changes in response to modulation persist over longer time frames post-decentralization. Our hypothesis is that longer time spent devoid of modulation and activity will cause more severe physiological changes to the cells of the STG, and impair their ability to respond to proctolin. After dissecting out the stomatogastric nervous system (STNS) of the crab Cancer borealis and cutting the STN, we cultured the preparation for either 48 or 72 hours. At 48 and 72 hours, we perfused proctolin to the system and studied the change in pyloric burst frequency in the lateral pyloric (LP), pyloric constrictor (PY), and pyloric dilator (PD) cells. Pyloric burst frequencies were derived from the cycle period as determined by the time between two consecutive bursts of PD neurons. We observed a strong response to proctolin at both time points, although effects at 48 were more variable than at 72 hours. Our results indicate that even after decentralization, the system could still produce and maintain an output of the STG, and proctolin enhanced the rhythmicity and synaptic activity even after this time period. These results indicate that this system remains robust in its ability to produce output as a result of exogenously applied neuromodulation, and increase in responses to proctolin persist. This potentially homeostatic increase in neuromodulator sensitivity suggests that critical central pattern generator networks have multiple mechanisms to ensure robust output under changing physiological conditions.

This project was completed to fulfill a Capstone requirement.
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Jaimee Zupan, Samantha Kintz, Congrong Zheng, and Paul Bolls

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