The MU Office of Undergraduate Research Presents

The Undergraduate Research &
Creative Achievements Forum

Schedule of Events

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Tuesday, April 22nd

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 23rd

12:00 p.m. — Student & Mentor Recognition Ceremony, McQuinn Atrium

Abstract Book Prepared by:

Office of Undergraduate Research

Director: Dr. Linda Blockus
Assistant Director: Brittney Goo
Program Coordinator: Brian Booton
Administrative Assistant: Pam Cooper
Student Assistants: Michelle Leone and Cade Cleavelin
2013 Award for Excellence Recipients & Honorable Mentions

**Arts & Humanities**

**Honorable Mention:** Kelsey Clark, Psychology, Richardson, TX; Dr. Cheryl Black, Theatre; Looking through glass: The role of research in performing Laura Wingfield in Tennessee Williams' The Glass Menagerie

**Honorable Mention:** Caleb Shannon, Music Performance, Bowling Green, MO; Chad Tucker, Music Performance, Ava, MO; Dr. Leo Saguiguit, Music; Duo Kratos: World Saxophone Congress Recital

**Award for Excellence:** Sarah Cleveland, English, Danville, IL; Dr. April C. E. Langley, English and Black Studies; Harriet Jacobs and the New Black Female Virtue

**Social & Behavioral Sciences**

**Honorable Mention:** Sanli Brandmeyer, Communication Science & Disorders, New Baden, IL; Lauren Ruzicka, Communication Science & Disorders, St. Louis, MO; Dr. Stacy Wagovich, Communication Science & Disorders; Correspondence of “First Time-Spoken” Word Analysis to established lexical measures

**Award for Excellence:** Caitlyn Yana, Political Science, West Lafayette, IN; Dr. William T. Horner, Political Science; State legislative term limits and responsiveness: A comparative study

**Life Sciences**

**Honorable Mention:** Mekka Garcia, Biochemistry, Centralia, MO; Dr. Charlotte Phillips, Biochemistry; Characterization of the bone phenotype in a mouse model of Mucopolysaccharidosis Type I (Hurler Syndrome)

**Honorable Mention:** Andrew Huber, Biological Sciences, Doniphan, MO; Dr. Stefan G. Sarafianos, Molecular Microbiology & Immunology; SAMHD1 enzymatic activities affect the inhibitory potential of NRTIs

**Award for Excellence:** Caitlin Vore, Plant Sciences, Auxvasse, MO; Dr. Heidi Appel, Plant Sciences; Sniffing Danger: Variation in volatile profiles of insect herbivory on Arabidopsis thaliana

**Physical Sciences & Engineering**

**Honorable Mention:** Dakota Botts, Chemical Engineering, Lee’s Summit, MO; Dr. Thomas Marrero, Chemical Engineering; Modern methods for pelletization and agglomeration of green biomass-A review

**Honorable Mention** Kyle East, Mechanical Engineering, Lee’s Summit, MO; Dr. Gary Solbrekken, Mechanical & Aerospace Engineering; Using an optical laser deflection measurement system to analyze flow induced deflection and vibration

**Honorable Mention** Emily O’Brien, Biological Engineering, St. Louis, MO; Dr. Heather K. Hunt, Biological Engineering; Detection of Campylobacter jejuni using whispering gallery mode optical biosensors in an aqueous environment

**Honorable Mention** Akia Parks, Biological Engineering, Richton Park, IL; Dr. John A. Viator, Biological Engineering; Photoacoustic detection of Escherichia coli bacteria cells for screening of septicemia

**Award for Excellence** James Winkelmann, Biological Engineering, St. Louis, MO; Dr. John A. Viator, Biological Engineering; Cultivation of a metastatic cancer cell after capture using a photoacoustic flowmetry detection system

**Outstanding Undergraduate Research Mentor Awards**

<table>
<thead>
<tr>
<th>Dr. Matthew Bernards</th>
<th>Dr. J. Chris Pires</th>
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<td>Chemical Engineering</td>
<td>Biological Sciences</td>
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2014 Undergraduate Research & Creative Achievements Forum

Student Abstracts
Listed in Alphabetical Order
A new mouse model of presbyphagia and the effect of menthol  
Danarae Aleman, Laura K. Powell, Sabrina Braun, Ryan Brooks, and Teresa E. Lever

**Purpose:** Presbyphagia is an age-related swallow dysfunction found in healthy adults over the age of 65. The primary purpose of this study was to establish a mouse model of presbyphagia suitable for translational research to humans. Additionally, the treatment effect of orally ingested menthol on the swallow function of presbyphagic mice was investigated.

**Methods:** Lick rate was measured in healthy C57BL/6 mice (n=47) between 2 to 24 months of age, divided into 4 age groups: 2-6 months, 7-11 months, 12-16 months, and 17-24 months. Two solutions were tested: water and menthol (0.175 mM), both at room temperature and presented in a counterbalanced order.

**Result(s):** Elderly mice (>17 months of age) licked significantly slower than younger mice ($p<0.05$). Menthol had an excitatory effect (faster licking) only on mice >17 months of age ($p<0.05$); menthol had no effect (faster or slower licking) on mice < 17 months of age.

**Conclusion(s):** The lick rate of C57BL/6 mice significantly declines with advanced age (>17 months) and is immediately improved by oral ingestion of menthol. Impaired licking corresponds with Stage 1 transport (oral preparatory) dysfunction. Therefore, this study provides novel evidence of presbyphagia in otherwise healthy, elderly C57BL/6 mice. We are currently characterizing the underlying mechanisms driving presbyphagia and the positive treatment effect of menthol using a combination of videofluoroscopic, electrophysiologic, histologic, and molecular biology methods with this mouse strain. This research demonstrates the utility of studying mice to better understand swallowing dysfunction in people.
Pretreatment of lignocellulosic biomass with supercritical carbon dioxide explosion
Andrew Allee, William Jacoby, and William Folk

In an era of dwindling fossil fuels, biomass is fast becoming our only carbon resource. For relatively low-value products, like energy, the carbon source must be abundantly available and inexpensive. A present challenge in bioenergy is that common feedstocks, like corn and sugar cane, are already integral parts of the human and animal food supply chain. Lignocellulosic materials such as corn stover, wood, and switchgrass are available in excess and contain sizeable quantities of cellulose (38-50 % w/w). The biggest challenge in lignocellulosic biofuels is the hydrolysis of this cellulose to yield glucose subunits. A protective sheath of lignin and the strong crystalline structure of cellulose in lignocellulose make it notoriously hard to break down into fermentable sugars. Thus, this material must be pretreated to prepare it for enzymatic hydrolysis. Supercritical fluids are known for their exceptionally high diffusivities and low viscosities. These properties allow supercritical CO$_2$ (scCO$_2$) to effuse through the lignocellulosic material. Soaking the biomass in a high-pressure batch reactor saturates the material with scCO$_2$. A subsequent rapid depressurization (“explosion”) causes the scCO$_2$ to violently escape from the biomass. This weakens the cell wall structure and increases exposed surface area. We are studying the effect of this treatment on enzymatic hydrolysis. We have found that the supercriticality of the fluid is vital to the success of this method, and that pretreatment of pure cellulose with subcritical CO$_2$ is significantly less effective than treatment with supercritical CO$_2$. These results indicate that more intense temperature and pressure conditions result in better cellulose destabilization and higher glucose yields. Further experimentation will analyze the maximum pretreatment temperature that can be employed before sugar degradation begins.
Advantages of iohexol as an oral contrast agent for videofluoroscopy in freely behaving animals: Implications for translational research to humans
Mitchell Allen, Vanessa Gaiser, Elizabeth Bearce, and Teresa Lever

Purpose: The purpose of this study was to formulate recipes that animals will readily consume during a videofluoroscopic swallow study (VFSS), without behavioral conditioning. This step is necessary to facilitate translational dysphagia research for debilitating human conditions, such as amyotrophic lateral sclerosis (ALS), oculopharyngeal muscular dystrophy (OPMD), Batten disease, and aging.

Methods: Approximately 60 mice and 40 dogs participated in recipe development of various consistencies using either barium sulfate or iohexol. Mice were from our ALS, OPMD, and presbyphagia colonies. Healthy dogs and those with ALS or Batten disease were from existing colonies or the local community. The following properties of each recipe were investigated: palatability, rheologic characteristics, visibility during VFSS, and adverse effects.

Result(s): Despite exhaustive attempts at flavor enhancement, mice refused all barium-containing recipes and eagerly consumed only one iohexol-containing recipe; no adverse effects occurred. Dogs consistently preferred iohexol-containing recipes over barium, and the only adverse effect from iohexol was mild diarrhea. The most promising thin liquid iohexol recipe was 1.2 cP, which is closer to water (1.0 cP) than Varibar thin liquid barium (4 cP). All barium- and iohexol-containing recipes were readily visible during VFSS.

Conclusion(s): This study highlights an important advantage of iohexol: the aversive flavor can be masked without significantly altering the rheologic properties of foods and liquids. Additional recipe development using iohexol is underway for animals and humans.
Potential rescue of sex-specific stress characteristics in socially deprived mice using supplemental DHA

Lauren Anderson, Eldin Jašarević, Patrick Hecht, David Q. Beversdorf, and Rocío M. Rivera

Chronic social deprivation is a model for depression due to underlying behavioral and neurochemical similarities in rodent models and clinical populations. Chronic social isolation is associated with increased anxiety-like behavior and anhedonia (inability to experience pleasure) as well as dysregulation of the mesolimbic pathway, which encompasses the ventral tegmental area (VTA) and nucleus accumbens (NAc) and plays a key role in reward and motivation. The data are limited comparing sex differences in socially deprived animals, despite the disproportionately higher risk for depression in human females. This discrepancy does not address the many sex differences that are a result of social deprivation stress in terms of mesolimbic dopamine pathway dysregulation, and the present study is an attempt to close the gap. The omega-3 fatty acid, docosahexaenoic acid (DHA), is a major component of neural membrane phospholipids and has been shown to have an influence on mesolimbic pathway function. Recent studies show that omega-3 supplementation can mitigate stress effects on anxiety and cognition by partial reinstatement of gene expression and control of neurotransmission. The present study seeks to assess DHA-dependent rescue of sex-specific stress characteristics in mice exposed to chronic social deprivation. This will be evaluated by focusing on both behavioral changes in the mice, as well as gene expression changes related to neuroplasticity and reward motivated behavior in the VTA-NAc pathway. The genes chosen for this study are Creb, Bdnf, and Dyn due to their sensitivity to diet, sex, and social deprivation. Two experimental groups receiving different concentrations of DHA (0.1% and 1.0% DHA/kg feed weight) in their diet during social deprivation will be compared to a control group receiving a typical diet (a ‘western typical’ 10:1 omega 6:omega 3 ratio). In addition, the males and females within a group will be compared to each other.
Towards the detection of the bacteria *Helicobacter pylori* using Whispering Gallery Mode biosensors
Mark Anderson, Emily Grayek, Emily O'Brien, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Person hierarchies and agreement in Kisongo Massai
Mark Ashmore and Vicki Carstens

In Maa sentences with intransitive verbs, agreement is straightforward and unambiguously identifies each person, number combination of the subject (with the exception only of 3rd person singular versus plural in certain tenses).

(1) A. a-urör-i
   1SG-fall-FUT/PRS
   ‘I will fall.’ or ‘I fall.’

   B. i-urör-i
   2SG-fall-FUT/PRS
   ‘You will fall.’ or ‘You fall.’

   C. 3-ürör-i
   3SG-fall-FUT/PRS
   ‘He/She will fall.’ or ‘He/She falls.’

   D. ki-urör-i
   1PL-fall-FUT/PRS
   ‘We will fall.’ or ‘We fall.’

   E. i-urör-i
   2PL-fall-FUT/PRS
   ‘You all will fall.’ or ‘You all fall.’

   F. 3-ürör-i
   3PL-fall-FUT/PRS
   ‘They will fall.’ or ‘They fall.’

In transitive clauses with pronominal objects, however, this orderly pattern disappears in many cases. Subject and object phi-features are combined in a single morpheme and there is massive ambiguity mainly resulting for the use of [ki-] in a large number of cases and with the use of [aa] in an even further restricted set of cases.

(2) A. ki-ta-du-à
   2SG>1SG-PRF-see-PST
   me.ACC
   ‘You saw me’

   B. ki-ta-du-à
   3SG>2SG-PRF-see-PST
   you.ACC
   ‘He saw you’

   C. aa-ta-du-à
   3SG>1SG-PRF-see-PST
   me.ACC
   ‘He saw me’

   D. aa-ta-du-à
   3PL>1SG-PRF-see-PST
   me.ACC
   ‘They saw me’

A complete morphological profile of Maa person agreement affixes is shown in table (3), with those morphemes encoding for the phi-features of the object rather than the subject bolded.

(3)

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In this paper I argue for a hierarchy of person features. I propose that [ki-] is the default marker used whenever the person features of the object outrank the person features of the subject by a single degree and that [aa] is the marker used when the subject features are outranked by two degrees by the object features:

(4) The proposed Maa person feature hierarchy is: 1>2>3.
I also propose that there is a single agreement probe in Maa. Therefore subject and object features cannot be encoded in distinct morphemes at the same time; thus, resulting in what I term inverse morphemes.

This project was completed to fulfill a Capstone requirement.
Spinal Muscular Atrophy (SMA) is a devastating genetic neurodegenerative disease that mostly affects young children. It is caused by the loss of a single gene, and though it is rare the carrier frequency is 1 in 60 to 1 in 40. SMA is caused by insufficient amounts of the SMN protein. Thus, a mouse model that is missing SMN shows signs of SMA including: muscle wasting, necrosis of the extremities, and decreased motor function.

Previously we have established a therapy in which we introduce DNA of our choice into mice using a biologically engineered virus. Here we detail molecular cloning, mutagenesis, viral preparation and therapeutic delivery involved in this method. When we inject affected mice with a virus that will encode SMN, the protein can be effectively delivered back to the affected mice. This improves SMA symptoms and mice have a normal lifespan.

In this project we seek to identify which regions of the SMN protein are important for preventing disease onset. We hypothesize that we can remove certain unnecessary regions and this "skeleton" protein should still improve SMA symptoms. SMN naturally has 8 distinct regions and based on previous research we believe regions 2, 3, and 6 are the most important. Therefore, we constructed a virus that encodes only these regions and we call it SMN236.

The results show that injecting SMN236 significantly improved the average lifespan of the mice, although it was considerably less effective than the full SMN with all 8 regions intact. This result is very exciting for two reasons: we have established an extremely bare protein that produces a positive effect in a living system, and we can see that regions previously thought to be unimportant have functions in SMA.
The Achievement Gap: Factors that lead to success
Maris Ayers, Codi Mouser, and Stephen Whitney

The Achievement Gap refers to the difference in standardized test scores based on race and socioeconomic status. This research seeks to determine constructs and covariates that contribute to the reading achievement of black and white eighth grade students of the lowest, middle, and highest socioeconomic status. The constructs and covariates include four categories: measures of the Individual, Parents, Teachers, and Schools. Data was taken from the ECLS-K nationally representative longitudinal secondary data set; it was gathered from the 2006-2007 eighth grade wave and then an exploratory factor analysis was conducted to reduce data into the independent construct categories. Preliminary findings indicate important differences in school quality, teacher quality, parental, and student factors in reading achievement in the eighth grade. These findings also indicate areas to invest limited resources in order to help reduce and eliminate the Achievement Gap.
Marcos Barcellona  
St. Louis, MO

Sophomore  
Bioengineering

Faculty Mentor: Dr. Matthew Bernards, Chemical Engineering  
Funding Source: Life Sciences Undergraduate Research Opportunity Program

Development of a nonfouling biofilter for elimination of circulating tumor cells  
Marcos Barcellona, Qinyi Wang, and Matthew Bernards

Metastasis is one of the most common causes of cancer treatment failure. In fact, the majority of yearly cancer deaths in the United States are associated with metastasis. Metastasis occurs when cancerous cells spread from the original location of a malignant tumor to new places in the body. These cancerous cells, called circulating tumor cells (CTCs), enter the blood stream where they are propelled by regular blood flow and settle in new sites. By eliminating CTCs from the blood stream, metastasis could be drastically reduced if not eliminated altogether. The objective of this project is to develop a biofilter whose characteristics would allow it to remove CTCs from the blood stream while allowing for the return of clean blood to the patient. This filter is composed of a nonfouling polyampholyte copolymer which can be functionalized to facilitate the attachment of specific antibodies to it to target CTCs. Because of its nonfouling properties, the filter will be able to come into contact with blood without inducing blood clotting or restricting blood flow. This filter is made by polymerizing two charged monomers and then electrospinning the resulting polymer to create a web of nanofibers. We have developed a procedure to simultaneously electrospin and cross-link the polymer resulting in a water insoluble, nonfouling copolymer. We are currently investigating the nonspecific protein adsorption and protein conjugation capacities of this system. The translational application of this filter in cancer patients could lead to a significant reduction in metastasis-caused deaths worldwide.
Mapping the *Carbon partitioning defective* 6 gene of maize

Brady Barron, Kristen Leach, and David Braun

Plants assimilate carbon dioxide into sucrose during photosynthesis in the leaves, and subsequently load the sucrose into the phloem for transport to non-photosynthetic sink tissues for utilization in growth and development. In the presence of impaired sucrose transport out of the leaf, excess starch accumulation can occur in the chloroplasts and lead to leaf chlorosis, anthocyanin accumulation, and/or necrosis. In our lab, we have identified a class of maize (*Zea mays* L.) mutants that show excessive starch accumulation and the consequent leaf phenotypes. These mutants are collectively known as the *carbon partitioning defective* (*cpd*) mutants. *cpd6* is one such mutant displaying significant starch and anthocyanin accumulation in the leaves, and was mapped near the centromeric region of chromosome 5 based on bulk segregate analysis. Continued fine mapping has subsequently placed the gene within a 1.5-Mbp region containing ~28 genes, including a sucrose synthase protein. To identify and clone the *Cpd6* gene, we will continue to use molecular mapping methods to fine map its genomic location using the primers IDP6893 and IDP5933. Recently, we have started to perform seed chipping and subsequent DNA extractions to allow the more efficient screening of recombinant individuals. Bright-field and florescent studies have also revealed differences in the wild-type and *cpd6* mutant vascular tissue. Identification of this gene could contribute to the elucidation of the genetic pathways controlling sucrose flux throughout the plant.
Effects of propranolol on self-report anxiety and socioemotional functioning in autism spectrum disorder
Jonathan L. Baumstark, Rachel M. Zamzow, Bradley J. Ferguson, and David Q. Beversdorf

Autism spectrum disorder (ASD) is characterized by repetitive behaviors and impaired social communication, and individuals with ASD experience dysregulated autonomic activity. The nonselective beta-adrenergic antagonist, propranolol, has previously been shown to improve problem-solving abilities, verbal fluency, and working memory in ASD. The present study explored additional potential effects of propranolol, such as on self-reported anxiety and socioemotional functioning in individuals with ASD. Additionally, we sought to determine if sympathetic reactivity was able to predict how an individual responds to propranolol. We expected self-report anxiety to be lower in the propranolol condition, as compared to the placebo condition. We also hypothesized that those with greater sympathetic reactivity would show greater improvement in socioemotional task scores with propranolol. A sample of 20 high-functioning individuals with ASD completed two study sessions, during which they were administered placebo or propranolol (40mg) in a counterbalanced, double-blinded manner. After a 60 minute waiting period, participants were given a series of tasks. To assess anxiety, participants were given the Semantic Differential Feeling and Mood Scales (SDFMS) and the Beck Anxiety Inventory (BAI). Sympathetic reactivity was measured by galvanic skin response (GSR) and heart-rate variability (HRV) during a socioemotional task, a component of the General Social Outcome Measure (GSOM). We compared scores between drug conditions, and explored the relationship between drug response for each score and sympathetic reactivity. We found that GSR during the GSOM task was significantly higher in the placebo condition, as compared to the propranolol condition [$t(3) = 3.741, p = .033$]. There was no drug effect on the self-report anxiety measures. These results indicate that propranolol may influence sympathetic reactivity when participants are engaged in a socioemotional task. Further analyses with larger sample sizes are needed to determine if propranolol also influences socioemotional abilities.
“Waste not, want not”: Understanding and addressing the problem of food waste
Andrew Beckerle, Jackson Hambrick, Mary “Emmie” Harcourt, Henry Hellmuth, Lauren McDermott, Nicole Ripperda, Mary Schneier, Luke Welsh, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
Faculty Mentor: Dr. Andrew McClellan, Biological Sciences  
Funding Source: Life Sciences Undergraduate Research Opportunity Program

**Axonal regeneration of lamprey reticulospinal neurons in organ culture**

Sean Bennett and Andrew McClellan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Assessing the phylogenetic utility of ITS regions

Kevin Bird, Pat Edger, Michelle Tang, Dustin Mayfield, Gavin Conant, Klaus Mummenhoff, Marcus Koch, and J. Chris Pires

The internal transcribed spacers of the nuclear ribosomal RNA gene cluster, termed ITS1 and ITS2, are the most frequently utilized nuclear markers for phylogenetic analyses across many eukaryotic groups including most plant families. The reasons for the popularity of these markers include: 1. Ease of amplification due to high copy number of the gene clusters, 2. Available cost effective methods and highly conserved primers, 3. Rapidly evolving markers (i.e. variable between closely related species), and 4. The assumption (and/or treatment) that these sequences are non-functional, neutrally evolving phylogenetic markers. Here, our analyses of ITS1 and ITS2 for 50 species suggest that both sequences are instead under selective constraints to preserve proper secondary structure, likely to maintain complete self-splicing functions, and thus are not neutrally evolving phylogenetic markers. Our results indicate the majority of sequence sites are co-evolving with other positions to form proper secondary structure, which has implications for phylogenetic inference. We also found that the lowest energy state and total number of possible alternate secondary structures are highly significantly different between ITS regions and random sequences with an identical overall length and Guanine-Cytosine (GC) content variation. Lastly, we review recent evidence highlighting some additional problematic issues with utilizing these regions as phylogenetic markers, and thus strongly recommend alternate markers and cost-effective approaches for future studies to estimate phylogenetic relationships.
Faculty Mentor: Dr. Gang Yao, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option

**Motion processing using the Arduino microcontroller platform**
Nathan Birenbaum, Nicholas Roberts, and Gang Yao

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Neuromodulation within the amygdaloid fear-learning circuit and dopamine reward system
Christopher Blasius, Feng Feng, Yankang Chen, 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 and striatum 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. The studies described so far deal with cellular phenomena and models. In a parallel project, striatal dopamine D1 and D2 receptor cascades in the cytoplasm are being modeled using kinetics and differential equations in NEURON, to investigate the sub-cellular processes that cause the intrinsic and synaptic changes in neuronal excitability for the amygdala and striatum.
Lauren Bond
St. Louis, MO

Senior Biochemistry

Faculty Mentor: Dr. Antje Heese, Biochemistry
Funding Source: Monsanto Undergraduate Research Fellowship

**Novel role of an Arabidopsis ENTH-domain protein in flg22-signaling responses**
Lauren Bond, Carina Collins, Dan Salamango, John Smith, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Identification of novel antivirals targeting the hepatitis B virus ribonuclease H

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Biochar is made from taking leftover crop residue, mainly from corn and bean harvests, and charring it to make charcoal. This charcoal can then be applied to fields to increase agricultural production and reduce the amount of fertilizer needed. Fertilizers such as ammonia are difficult to store, expensive to make, and toxic to aquatic systems when they run off the fields. Making biochar utilizes the leftover biomass from the previous year’s harvest and stores it in the ground, which reduces waste, increases sustainability, and acts as a form of carbon sequestration. Secondly, it acts as a fertilizer that is not toxic to the environment, and it is much cheaper to produce and store than ammonia.

To test the effects of biochar on plant growth, many factors have to be considered. In the lab, we create biochar in 1 lb. batches using an oven heated to around 700 °C. In our experiments, we change the heating rate and residence time at maximum temperature in the oven, as these two variables affect the molecular structure, and thus the quality of the biochar. After finding the correct conditions to make the best biochar, trials regarding the correct biochar to soil ratio can be conducted to find the best conditions necessary for plant growth. These experiments are done using trays with growing compartments containing flowers. Throughout the growing cycle, measurements are taken regarding germination time, size of the plant, and number of buds produced. We plan to do a larger scale experiment with soil plots when the growing season starts.

From research, we have discovered that the addition of biochar to soil can increase the growing potential significantly. Future studies on a larger scale could provide information regarding the carbon sequestration potential, the increase in yield from crop harvests, and the overall production costs on an industrial scale. The potential uses of biochar, however, span a much broader scale than just agricultural applications. Current research at MU has shown that biochar can be a host to a type of bacteria which can alter and potentially improve the flavor of the wine produced from vineyards in Missouri. Carbon nanoparticles recovered from the production process could be used to absorb heavy metal contaminants in soil at old mining or waste disposal sites. The biochar can also be compressed into pellets for use as a fuel in the energy sector of Missouri.
Effect of clamping location on the input mechanical quality factor of a piezoelectric transformer
Michael Bowers, James A. VanGordon, and Scott D. Kovaleski

Piezoelectric transformers (PTs) use the piezoelectric effect to step voltage up or down similar to a ferromagnetic transformer when the input electrical frequency is near the mechanical resonant frequency of the device. Length extensional PTs are traditionally clamped at the vibrational null point and experience externally applied mechanical stress if clamped away from the null point. One measurement of mechanical loss in a vibrating system is the mechanical quality factor (Q-value). The input mechanical Q-value can be approximated as the Q value of the input impedance of the PT. A range of frequencies around resonance were tested and repeated for different clamping locations along the PT to determine the input impedance at each frequency. The mechanical quality factor was determined for each of the different clamping positions. The location with the highest mechanical Q-value corresponded to the lowest mechanical loss factor.
Development and characterization of a novel genipin-AgNP-collagen scaffold
Janae Bradley and Sheila Grant

Effective wound treatments are needed for diabetics with chronic wounds and ulcers. People with diabetes can attribute slow healing rates to pure 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 therefore must undergo crosslinking to increase its stability and resistance to degradation, unfortunately crosslinkers can be toxic. To avoid toxic crosslinkers while increasing stability, silver nanoparticles (AgNPs) were being conjugated to porcine Type 1 collagen via a genipin, a natural crosslinking agent. Using aseptic techniques, AgNP-collagen scaffolds were prepared and characterized. Scanning electron microscopy (SEM), differential scanning calorimetry (DSC), WST-1 cell viability, and antimicrobial studies (using *Staphylococcus aureus*) were performed in order to determine morphology, stability, viability, and resistance to infection respectively. The results demonstrated an open microstructure with AgNPs conjugated to the collagen fibrils. DSC demonstrated increased stability over non-genipin scaffolds. The WST-1 assay indicated that the crosslinking process and the addition of gold and silver nanoparticles were not toxic to the cells. The antimicrobial study demonstrated no significant difference between the control (natural collagen) and the AgNP collagen scaffolds. These findings indicate that the presence of AgNP and the genipin crosslinker will result in a collagen scaffold with high cell viability and stability. This study provides evidence that the collagen scaffolds could be used as effective wound dressings for people with diabetes. The data also illustrates that the amount of AgNPs conjugated to the collagen could be increased in order to help resist bacterial adherence.
Anjaleque Bragg  
Columbia, MO  

Junior  
Biological Sciences

Faculty Mentor: Dr. Pamela Brown, Biological Sciences  
Funding Source: A&S Undergraduate Research Mentorship

Controlling bacterial biofilms using the bacterial predator  
*Bdellovibrio bacteriovorus* and bdellophage  
Anjaleque Bragg, Pamela Brown, and George Smith

Many bacteria secrete extracellular polymers in order to help them attach to surfaces and create biofilms. For bacteria, biofilm formation has a number of advantages including survival in nutrient poor conditions and increased tolerance to antibiotic treatment. However, bacterial biofilms cause numerous challenges for humans. For example, biofilms on the hulls of ships are a problem for the navy, infections in burn wounds are very hard to fight due to bacteria biofilms, and biofilms build up in pipes making them inefficient. In order to limit biofilm formation, we suggest using bacteria that eat other bacteria, such as *Bdellovibrio bacteriovorus*, which will prey upon any Gram-negative bacteria. Since the lysis of Gram-negative bacteria is expected to destabilize even mixed species biofilms method has potential to function in many environments where biofilms are a problem. One concern with this strategy is that *B. bacteriovorus* can also create a biofilm. Thus, it will be necessary to control *B. bacteriovorus* growth after it has removed the bacterial biofilm. We are planning to use bacteriophages, viruses that infect bacteria, to remove *B. bacteriovorus* after the biofilm has been cleared. In order to do this we are first testing the ability of bacteriophages against *B. bacteriovorus* to prevent the formation of biofilms or to remove existing biofilms. We isolated bacteriophages from wastewater samples that can infect *B. bacteriovorus* and are working on amplifying the isolated bacteriophage. The effects of sequential *B. bacteriovorus* and bacteriophage treatments as a biofilm control agents are being tested on *Pseudomonas aeruginosa* biofilms.
Separating material and the effect it plays on battery cell's under sonication
Kent Branson, Ramsey Hilton, and Galen Suppes

This research group has documented that using circulation pumps and sonic waves on the electrolytic solution in battery cells will noticeably decrease the rate of discharge and increased voltage potential of these cells. Using a zinc manganese oxide battery cell I have tested the effects of different materials separating the two electrodes and how they affect the overall performance of the cell. It was found that separators with larger pores are more strongly affected when put under sonication and the performance potential of a battery cell will increase with increasing pore sizes. Given more research it is very possible that sonication and flow cell technology can be applied to create stronger, cheaper, and longer lasting batteries in the foreseeable future.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures
Zachary Brinker, Zachary Treece, Austin Stake, Matthew Jackson, Virginia Trauth, and Sarah Orton

Flat plate reinforced concrete structures have been a common design option for many years. They are popular for a number of reasons including ease of construction, decreased required story height, and lower cost. A flat plate reinforced concrete structure consists of reinforced slabs that are supported directly by the columns. Due to the nature of this design these types of structures are vulnerable to punching shear failures at the slab column connection. When a failure of this type occurs it can lead to the surrounding connections being overloaded in turn causing them to fail in the same manner. This effect is called progressive or disproportionate collapse.

The overall goal of this research is to evaluate the potential of disproportionate collapse in older reinforced concrete flat-plate buildings subjected to the loss of a supporting column. The research program considers testing of isolated slab column connections that represent the connection near the lost supporting column. The goal of the tests is to evaluate the effects of in plane lateral restraint, dynamic loading rate, and post-punching capacity. This poster will provide some background on punching shear failures as well as progressive collapse in structures. It will also present and compare the results of the first two unrestrained isolated slab column tests conducted at reinforcement ratios of 1.0% and 0.5% as well as the plans for future testing involved in this project.
Population genetic structure in the marbled salamander

*Ambystoma opacum*

Emily R. Brocato, Jacob J. Burkhart, Lori S. Eggert, and Raymond D. Semlitsch

Studies linking differences in amphibian genetic structure with ecological characteristics tend to focus on dispersal capabilities of a species. However, due to conclusions of previous studies, we question whether genetic structure differences are caused solely by morphology and behavior traits that influence dispersal. Despite ringed salamanders (*Ambystoma annulatum*) and spotted salamanders (*A. maculatum*) having similar ecological requirements and dispersal ability, ringed salamanders exhibit a distinct genetic structure, whereas spotted salamanders have a panmictic structure with no distinct genetic clusters across the same spatial scale. A major difference between these two species is that the spotted salamander is a spring breeding species, whereas the ringed salamander is a fall breeder. In this study, we examine another fall breeding species of *Ambystoma* to see if this same genetic pattern holds true. We sampled 104 larval and adult marbled salamanders (*A. opacum*) from 11 ponds at Fort Leonard Wood, Missouri to compare patterns of genetic structure to the two previously studied species from the same focal area. As marbled salamanders are fall breeders, we expect them to exhibit multiple genetic clusters, similar to those seen in the ringed salamander, across our focal area. A fall breeding life history strategy may contribute to greater genetic differentiation because of a lower availability of suitable breeding habitat for oviposition of eggs and overwinter survival of larvae. With fewer available ponds on the landscape in the fall, salamanders may return to known successful ponds (i.e. natal ponds) instead of dispersing to a new breeding pond. Marbled salamanders may be even more limited in breeding habitat because they oviposit in dry basins or on the banks of fishless ponds, and rely on the ponds to flood and inundate the eggs whereas spotted salamanders oviposit in filled ponds where courtship and breeding aggregations occur annually.
Rachael Brown
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Senior English

Faculty Mentor: Dr. Elizabeth Chang, English
Funding Source: A&S Undergraduate Research Mentorship

Competition or complementation?: The place and process of neo-Victorian fiction
Rachael Brown and Elizabeth Chang

Since the 1800s, Victorian fiction has fascinated readers, writers, and academics. But its enduring popularity lives in how it has influenced modern literary trends. The self-conscious nature of Victorian fiction and its modern offshoot neo-Victorian fiction highlights the power these products have to construct the present and mediate the past.

Neo-Victorian fiction has risen in prominence, but its definition remains amorphous; books of this nature are often lumped into general historical fiction or viewed as mere rewritings of Victorian texts. What makes these works more than just a borrowing of Victorian novels? More importantly, what is it about neo-Victorian literature that resonates so profoundly with readers and writers over other genres?

The genre of neo-Victorian fiction possesses a set of traits and characteristics that helps to separate these works from others. Neo-Victorian texts succeed by “filling the silences” left by Victorian pieces, which includes stronger presences by minority groups and divergence from literary standards or norms. But similarities also run deep — both Victorian and neo-Victorian texts are influenced by their contexts; these works also share types of content and literary devices used to develop the plot and characters.

A.S. Byatt’s neo-Victorian novel Possession has had a profound impact on establishing this literary genre. Byatt’s work uses both styles of neo-Victorian writing to show the ways they complement and compete with each other for reader attention and interpretation. As Byatt herself said, “We are defined by the lines we choose to cross or to be confined by.” Victorian and neo-Victorian fiction operates under the same principle: the similarities that exist between them firmly cement their status as two parts of a pair; their differences, however, propel neo-Victorian fiction into a place all its own.

This project was completed to fulfill a Capstone requirement.
Murder by insulin: Teaching physiology through crimes
Samantha Browning, Basima Khan, Katherine Meidl, Margaret Urschler, and Mark Milanick

Five patients die from excess insulin in one hospital. Coincidence? Were they murdered by a nurse injecting too much insulin? Or did their bodies produce too much insulin? To solve this real life murder, the forensic experts had to understand the physiology of insulin and C-peptide. Patients with Type 1 Diabetes can also use C-peptide levels to determine remaining pancreatic function, as well as for other clinical applications. We created a lab to teach these concepts in an engaging way. First, we will start off our discussion with a Law and Order clip discussing a murder by insulin case. Next, we will present information regarding types of diabetes, and their physiology in the body. The body makes proinsulin, crosslinks it, and then cuts off the C-peptide, but the pancreas releases both pieces. To illustrate these ideas further, we will have the students do a planned activity that demonstrates how insulin and C-peptides work in normal and diabetic bodies. Following this, we will present a newspaper article that brings the lab back to the original murder case. In the case we designed for the students, there will be a question of whether the person died from low blood sugar naturally or by the hand of their caretaker. The students will learn how C-peptides can be measured to determine if this was a natural death or a murder. They will be given a second activity, in which they will determine if the c-peptide levels of simulated blood samples indicate murder. Lastly, we will give them a worksheet that allows them to critically think about the physiology of insulin and C-peptides, as well as how this physiology can be applied to murder.
The influence of organic chemistry courses on college student self-efficacy
Hayley Burgess and Lloyd Barrow

Educators determine the strength of their teaching instruction and course content through tracking their students’ self-efficacy levels. By uncovering students’ self-efficacy, course sequence, content, and teaching methods can be improved. This quantitative study examines the influence of collegiate organic chemistry courses on college students’ chemistry self-efficacy. A sample of 61 college students enrolled in an on-campus general chemistry class at a Midwestern university was used as the source of this research. The students were administered surveys questions pertaining to 3 subcategories: Cognitive Skills, Psychomotor Skills, and Everyday Application Skills. The subscores from each category were averaged and compared between students who had completed an organic chemistry course and students who had not. We hypothesized that students who had previously taken an organic chemistry course would score higher on the self-efficacy assessments. Results concluded that in our population of students, those who had taken an organic chemistry course showed a higher average GPA and greater values of self-efficacy versus those who had not. In addition, we found an inverse relationship between GPA and self-efficacy values across all 61 students.
Parents can play a supportive role in their students’ transition to college, and college orientation offers key information for both students and parents in their adjustment to college. As colleges and universities continue to develop parent outreach programs and family friendly initiatives on campus, it is important to understand how these programs are serving families and assisting parents in transitioning their students to college. This study examines orientation programming at nearly 200 institutions across the United States. Through online research, much like the parents of these students will do, and by following up with orientation administrators, I gathered data on the duration, cost per parent/family, and the range of topics covered of parent orientation programming. In particular, this research explores whether college orientation programs have a special emphasis the transition needs of parents of first-generation, low-income, and/or students of color. Preliminary findings demonstrate that the high costs of programs and extended time periods may make parent orientation inaccessible to many groups, particularly underrepresented groups. The findings also reveal promising practices at institutions that are incorporating unique sessions and inclusive practices. With these findings, further strategies can be developed to foster and support parents and families.
Faculty Mentor: Dr. Scott Maddux, Pathology & Anatomical Sciences

A geometric morphometric analysis of modern human zygomaxillary suture morphology and its association with craniofacial variation
Casey E. Burns and Scott D. Maddux

Previous research has demonstrated that the zygomaxillary suture plays a passive role during craniofacial development, permitting the deposition of bone between the maxilla and zygomatic during growth displacement. Given that the zygomaxillary suture responds passively to craniofacial growth dynamics, it is possible that variation in zygomaxillary suture morphology reflects ontogenetically patterned variation in overall craniofacial shape. However, previous methodological limitations have prevented accurate quantification of zygomaxillary suture morphology, impeding investigations into its relationship with overall facial morphology. In this study, nine semilandmarks derived from a ridge-curve traced along the external surface of zygomaxillary suture were employed as a proxy for the course of the sutural plane. Twenty-nine standard landmarks were additionally collected from across the facial skeleton. These landmarks were collected on a total of 305 human crania from five geographic regions: Sub-Saharan Africa (n=49), North American Arctic (n=62), Northeast Asia (n=55), aboriginal Australia (n=67), and Europe (n=72). A principal components analysis of zygomaxillary suture shape reveals the greatest degree of variation exists between individuals from the Arctic Circle (straight, orthogonal sutures) and individuals from Africa and Australia (curved, parasagittally-oriented sutures). A subsequent two-block partial least squares analysis (2B-PLS) between the zygomaxillary suture and facial landmarks results in an RV coefficient of 0.34 (p < 0.001) revealing moderate, but significant, co-variation between the face and suture. Specifically, the 2B-PLS results indicate that curved, parasagittally-oriented sutures are associated with prognathic faces, wide nasal apertures, and superior-inferiorly short zygomatic bones, while straight, orthogonal sutures are associated with orthognathic faces, narrow nasal apertures, and tall zygomatic bones. These findings indicate that aspects of overall facial morphology are reflected in the zygomaxillary suture, likely due to the passive role of the suture during craniofacial growth and development. Accordingly, the zygomaxillary suture may be useful in understanding developmental shifts in craniofacial form during human evolution.

This project was completed to fulfill a Capstone requirement.
Mumsy: TAM 1200 basic concepts of apparel design
Courtney Buscher and Kerri McBee-Black

Mumsy is a maternity wear line that was created to give expecting mothers a fashionable and functional option. Expecting mothers were contacted and asked questions about what was hard for them to find and what would make their experience shopping for maternity wear more enjoyable. Research was also done online to look at the current fashion and what is available in different maternity clothing lines. It was found that the options that are currently available for expecting mothers is nothing impressive. Maternity wear is a highly underdeveloped and under marketed segment of the retail industry. It was found that a line like Mumsy was greatly needed in the fashion industry. There is a major opening for a maternity wear line to be introduced into the fashion world if it could be done successfully it would be a major hit and something to round the industry out as whole.
Kimberly Butler  
St. Louis, MO  

Junior  
Computer Science  

Faculty Mentor: Dr. Chi-Ren Shyu, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option and National Library of Medicine 5G08LM010711-03  

Designing medication database for in-depth analytics for Lymphedema research  
Kimberly Butler and Chi-Ren Shyu  

The purpose of this research is to design a medication database and analytics tool for the American Lymphedema Framework Project (ALFP). A web application will provide researchers an interface to extract medication information from patients’ records and import the data into the research database. To execute this application, the project will be composed of web development, database creation, data collection, database analysis, and clinical significance understanding through the collaboration with nationwide researchers through ALFP. Applying data mining algorithms, 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.
Correspondence of syntactic measures to stuttering fluctuation in preschool-age children
Alysia Carey and Stacy Wagovich

Preschool-age children who stutter generally fluctuate in their disfluency over time, with many children recovering from stuttering by age 6. However, the language factors related to these fluctuations are not well understood. Children tend to produce more stuttering on longer utterances, which also, in most cases, are more syntactically complex. Therefore, to examine the role of syntactic complexity on stuttering fluctuation, analyses less influenced by length are needed. This study examines two measures of syntactic complexity in children’s spontaneous language. The first, mean length of utterance (MLU), is a widely used measure of morphosyntactic complexity and is sensitive to utterance length. Children with longer utterance lengths will have larger MLUs. The second, Developmental Sentence Scoring (DSS; Lee, 1971) is a procedure for scoring syntactic complexity. Although somewhat impacted by utterance length, scores of this measure do not directly index the amount of language in estimating syntactic complexity. Nine children, ages 2;1 to 4;11 years, contributed 10 monthly play-based language samples. Samples with the most stuttering were compared with samples with the least stuttering, across two time periods: the first five months/sessions and the last five months/sessions of the 10-session study. The children’s syntactic complexity was analyzed using the two measures for each time period. Results indicated that for the later sessions, MLU was significantly longer in sessions with the most stuttering, but DSS did not show this pattern. Moreover, for the earlier sessions, neither measure differed in correspondence with stuttering frequency. Findings suggest length may contribute to a child’s frequency of stuttering, but syntactic complexity does not at this point in development. From a measurement perspective, the findings also suggest that MLU is an imprecise measure of early syntactic skills. The clinical relevance of this finding is that MLU should not be used as a measure of syntactic complexity.
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Faculty Mentor: Dr. Leigh Tenkku, Social Work
Funding Source: McNair Scholars Program

Evaluation of acculturated stress and perceived social support among international students attending a university-based peer partnering program
Brandice Carpenter and Leigh Tenkku

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Evidence suggests that the style of processing sensory information in an individual plays a role in the development of affective disorders. However, most of the research focuses on the relationship between sensory hypersensitivity and internalizing disorders. Using seventy-eight healthy individuals at the University of Missouri, this study analyzed the relationship between sensory processing styles and an externalizing condition, impulsivity. Subjects (age 18-60) completed the Adolescent/Adult Sensory Profile (AASP), the Barratt Impulsivity Scale (BIS-11), and a computerized task that measured response inhibition (Go/No-Go) in one experimental session. The findings indicate a positive correlation between sensation seeking, sensory low registration, and Barratt impulsivity scores. Sensory sensitivity was positively correlated with the number of errors in a response inhibition. These findings suggest that individuals with sensory hyposensitivity are more impulsive and indicate that occupational therapists should utilize knowledge of sensory processing patterns and sensory-based interventions with this population.
Load sensing pumps are an integral component of several hydraulic systems. That being said, load sensing pumps often tend to have nonlinearities that can cause instability at certain ranges creating undesirable variations in margin pressure within the pump. Unstable marginal pressure can lead to significant oscillations in pump displacement and flow, often causing undesirable effects on the operation of machines that utilize the pump. Undesirable oscillations pose a threat to the safety of the machinery and to individuals who operate it. Maintaining the marginal pressure within the system will result in a more energy efficient pump. An experimental procedure has been designed to gather data to validate that the pumps control system performance correlates well with data in specification sheets of particular pumps and other dynamic models. To maintain the marginal pressure and prevent catastrophic oscillations within the system, tests must be performed to make sure that the marginal pressure is maintained over different control pressures. By varying the flow rate and pump speed, the discharge pressure before the load can be compared to the load pressure after the load to generate the marginal pressure of the system. The load pressure can be increased and decreased dynamically at specific time intervals using a data acquisitioning system programmed using SIMULINK. Measuring the discharge pressure at desired load pressures and computing the difference will result in the marginal pressure. This thesis involves comparing the effects on the marginal pressure due to the adjustment of flows through the pump during dynamic changes in load pressure at certain motor speeds ranging from 250 revolutions per minute to 1000 revolutions per minute in equivalent 250 rpm intervals. After trials are completed and data is collected, an extensive examination of the data as a whole will reveal characteristics of the performance in the load sensing pump.
Predicting the relationship between prosocial behavior and academic achievement in European American and Asian American college students
Marnae Chavers and Gustavo Carlo

Prosocial behaviors are actions that benefit others (Kosek, 1995). Such behaviors include the tendency to volunteer, complete community service projects and altruism. Prosocial behaviors are considered an important predictor or correlate of healthy relationships, health outcomes, and academic achievement. For example, prior research demonstrates that prosocial behaviors early in life predicts better academic outcomes in later life (Svetlova, Nichols & Brownell, 2010). Although many of these studies focus on different age groups, research on the links between prosocial behaviors and academic performance is lacking among ethnic minority populations. My particular interest is the evidence that Asian American students tend to exhibit better academic outcomes than European American students. Furthermore, recent research shows the importance of studying different forms of prosocial behaviors (Huber and MacDonald, 2012). Therefore, in addition to examining whether prosocial behaviors are linked to academic outcomes for both ethnic groups, we investigated whether some forms of prosocial behaviors are more strongly related to academic outcomes than others, the six types of prosocial behaviors measured were altruism, dire, compliant, public, anonymous and emotional. The purpose of the present study is to examine the relations of different forms of prosocial behaviors to academic outcomes in a sample of European American and Asian American college students. This study will test the relationship between prosocial behavior and academics in Non-Hispanic whites and Asian American college students. The proposed research will give more insight into the relation between prosocial behaviors and academics in college aged students. More importantly it will give insight understanding social behavioral predictors of academic achievement in majority and minority ethnic populations. Such findings could help inform program intervention and policy development aimed at increasing college academic success.
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Senior
Electrical Engineering

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

Heartbeat detection system using foil sensors
Xiao Chen, Harry Tyrer, and Mengxuan Ma

We have developed an effective method to detect heart beats using two foil-sensors that are placed directly on the skin. Each sensor is made of aluminum foil in two layers with a plastic film to separate them. Using a differential amplifier, our system can amplify the tiny cardiac electric signals and remove the common noise the two input signals may share. The two sensors can capture the heart beat signals with one sensor used as signal sensor and another as reference signal. Experimentally, five different displacements on subjects have been tested, including chest& arm, chest& back, back& back, chest& belly and arms. We can see pulses corresponding to heart beats when an oscilloscope shows the output of the system. We count the heart beats using a MATLAB program. We subtract the average amplitude of noise to reduce the effect of noise. We also use the Fast Fourier Transform to get the frequency domain spectrum to identify the heartbeat component. We collected five sets of heart beat data separately to test the system, and we are able to plot the heart rate. Future use of these sensors may be on wearable material or chars to detect a person’s heart beats continuously.
Emily Cheng
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Chemical Engineering

Faculty Mentor: Dr. Gregory Triplett, Electrical & Computer Engineering
Funding Source: Honors College Discovery Fellowship

Improving semiconductor materials for high powered infrared lasers
Emily Cheng, Charles Meyer, and Gregory Triplett

Current infrared lasers are too weak to meet the growing demand for high-powered, infrared light generation. With increased power and efficiency, infrared lasers could have a profound impact on everyday life; applications for this technology range from creating the ultrafast communications systems of tomorrow to providing a means for diabetes patients to noninvasively test their blood sugar. To increase the power output of these lasers to maximum levels, the semiconductor materials used to build these devices must be improved at the atomic level.

Two important semiconductor materials used for infrared lasers, gallium arsenide (GaAs) and indium arsenide (InAs), are of particular interest for creating the next generation of laser devices. Usually, when InAs is deposited on GaAs to form a laser, the InAs will form quantum dots. Quantum dots are atomically rough structures that can limit the performance of certain laser designs. Our research has found a way to form smooth layers of InAs on GaAs, which opens up the possibility for utilizing InAs in a high powered laser structure. This project served to quantify exactly how smooth these InAs layers are, and to see which deposition parameters produce the highest quality InAs.

Over 20 samples were made by depositing InAs on GaAs under varied conditions in our molecular beam epitaxy reactor. We used a scanning electron microscope and reflection high energy electron diffraction to qualitatively monitor the surface roughness of the samples. We then measured the surface roughness of each sample using an atomic force microscope to determine the correlation between the conditions used for InAs synthesis and the quality of the InAs material produced. The highest quality samples have extremely small surface roughness, while poor quality InAs forms rough surfaces. We found the best material to have a surface roughness of .23nm, which is roughly the diameter of a single atom. By finding the parameters associated with such high quality material, we will be able to incorporate high quality InAs into a unique laser design that could be utilized for ultrafast communications, chemical sensing, or noninvasive blood glucose monitoring.
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Faculty Mentor: Professor William Allen, Science & Agricultural Journalism

“Drone Journalism”: Quadcopters as a media tool
Calder Cleavelin and William Allen

Quadcopters — or multirotors, often colloquially referred to as “drones” — are a class of lightweight R/C aircraft that have attained rapid popularity as video-gathering tools. Quadcopters fit the hobbyist niche of the ultralight aircraft spectrum, but their ability to carry high-definition action cameras and operate reliably in difficult flying situations has earned this class of aircraft favor among flying enthusiasts, and increasingly among journalists and filmmakers.

The goal of The Missouri Drone Journalism Program is to embrace this emergent technology as a viable new tool for journalism, data-gathering and broader surveying efforts pursuant to wildlife conservation. Our efforts to build and test these aircraft serve as a proof-of-concept for their viability as tools for communication and the sciences among non-experts in the world of R/C aircraft.
The Israeli-Palestinian conflict: A mediation case study
David Collier and Amanda Murdie

The existing literature on mediation finds that it effectively creates short-term solutions to crises, but that those solutions are often short lived and can come at the expense of the long-term peace process. It also sub-divides mediation into three styles based on each style’s level of intrusiveness: facilitation, formulation, and manipulation. In this study the authors examine the effects of mediation in the context of the Israeli-Palestinian conflict to observe mediation’s effectiveness in one of the most difficult conflicts in the world. More specifically, the authors examine mediation’s impact on the severity of crises and the relative success of each style of mediation. The findings suggest that mediation can result in short-term solutions and reduce the severity of crises within the Israeli-Palestinian conflict. Those solutions, however, often fail to prevent the re-immersion of crises and hostilities in the conflict in the long run.

This project was completed to fulfill a Capstone requirement.
Involvement in risky sexual behaviors among college students is related to many negative consequences such as unwanted pregnancy and sexually transmitted diseases. This study is to examine the associations between mental health (i.e., depression and self-esteem) and involvement in risky sexual behaviors. We also looked at the prevalence comparison of risky sexual behavior and which gender seems to be more promiscuous. We designed a survey questionnaire to measure our study variables, and, using an online survey, collected data from 50 students at the University of Missouri during the fall 2103 semester as a part of the social work research class research project. Participants reported having a moderate level of risky sexual behaviors (mean=23, actual range=15-33). Significantly more male than female college students engaged in risky sexual behaviors in the sample (mean 24.7 vs. 21.6, p=.006). Consistent with our theory, results showed that depression was positively correlated with risky sexual behaviors, while self-esteem was negatively correlated with such behaviors. By making this subject more widely known we hope to help college students make wiser social decisions and not putting their academic careers in jeopardy. Overall we hope the student health center may consider our findings in helping students become more productive students and have a more positive impact in the working world.
Response of meniscal tissue to inflammation in vitro
Alex Cook, Aaron Stoker, and James Cook

Introduction: By analyzing the biomarkers released to the culture media by meniscus explants over a 21 day period, we sought to evaluate the potential contribution of menisci to the development and progression of OA. We hypothesize that IL-1β stimulation of meniscal explants would result in significant increases in MMP activity and relevant cytokine production in culture compared to controls.

Materials and Methods: Canine meniscal explants (4mm) (n=6/group) were created and placed in supplemented DMEM culture media. Explants were cultured in 2ml of supplemented DMEM culture medium with (POS) or without (NEG) 50ng/ml rcIL-1β treatment for 21 days with media collected and changed every 3 days. Media were analyzed for various MMP concentrations and general MMP activity, ADAMTS 4 activity, GAG, NO, PGE2 and various cytokine/chemokine concentrations using commercially available assays. Explants were tested for proteoglycan (GAG) and collagen content.

Results: Media NO concentration was significantly higher in the POS group. Media PGE2 concentration was significantly higher in the POS group for Days 3 through 6 and Days 15 through 21. The concentrations of MMP-3 and MMP-13 were significantly higher in the POS group. The production of MMP-2 significantly lower in the POS group on days 3 through 15 of culture. ADAMTS4 activity was significantly higher in the POS group on days 6 through 18. General MMP activity was significantly higher in the POS group. GAG concentration in the media was not significantly affected by cytokine treatment. The concentration of IL-6, IL-8, KC, and MCP-1 were all significantly higher in the POS group.

Discussion: After IL-1β exposure, meniscal explants were capable of degradative enzyme synthesis and activity, pro-inflammatory and tissue repair responses, and participation in the inflammatory cascades involved in OA.
The effect of roughness on internal flow control and heat transfer

Keith Coulson and C.L. Chen

A decrease of the friction acting on liquid flowing through microchannels would enable cooling channels to operate in an equivalent fashion using less power. This literature survey provides information and conclusions describing the effect of roughness on internal flow control and heat transfer. As water is propelled through the microchannel, cooling the surface of the channel, gas is formed underneath the liquid. The roughness, acting as a hydrophobic surface and therefore keeping the liquid out of the microchannels, would allow gas to stay trapped underneath the liquid, enabling a Cassie-Baxter state and potentially lessening the friction force on the liquid as it moves through the microchannel. Previously the Cassie-Baxter state was considered exhibit less friction than the Wenzel state, however this theory has come into question and is being investigated further. The implications are far reaching and very useful in the field of liquid-cooled electronics, which would benefit from having to use less power to pump coolant through the microchannels.
Iyas Daghlas
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Faculty Mentor: Dr. Teresa Lever, Otolaryngology
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

**Development of Histological Methods for use in Stereological Analysis**
Iyas Daghlas and Teresa Lever

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Mechanical healing of carbon nanotube forests via capillary action
Benjamin Davis, Evan King, and Matthew Maschmann

Carbon nanotube forests are thermally and electrically conductive materials that offer beneficial properties to applications such as thermal interface materials, physical sensors, filtration membranes, and composite materials. The performance of CNT forests in these and other applications is intimately coupled to the mechanical behavior of the forest. We demonstrate that the sequential introduction and removal of solvents into CNT forests reversibly modulates the forest stiffness by an order of magnitude. In the immersed state, van der Waals forces between CNTs are relaxed, leading to a reduction in forest stiffness and an increase in elastic recovery. Capillary forces arise during solvent evaporation, transversely compressing the forest during the drying process. These transverse forces draw CNTs into close proximity and densify the forest. Solvent densification is retained upon full evaporation of the solvent, increasing the forest stiffness. Further, we demonstrate that plastic deformation of the CNT forests introduced in the dry state may be partially or fully relieved by the re-introduction and subsequent evaporation of solvent. These findings indicate that the mechanical properties of CNT forests may be actively and reversibly modulated to suit a given application environment and that CNT forests demonstrate “healing” of mechanical damage by solvent treatment.
Jeremy Davis
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Junior
Bioengineering

Faculty Mentor: Dr. Anand Chandrasekhar, Biological Sciences
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

Role of alcama and pcdh18a in motor axon guidance in the zebrafish embryo
Jeremy Davis, Suman Gurung, and Anand Chandrasekhar

Axon guidance plays a critical role in the assembly and function of an organism’s nervous system. During the development of a vertebrate embryo, neurons extend axons, tipped by a motile growth cone, to navigate the surrounding tissue and identify their correct target cells. Some of the factors regulating the guidance of branchiomotor neuron axons in the zebrafish hindbrain have been characterized. We are interested in identifying more genes involved in branchiomotor axon guidance. To identify candidate genes, we searched the zebrafish gene expression database (zfin.org) for genes expressed in the pharyngeal arches (axon target regions) during the appropriate period in development (24-48 hours post fertilization, HPF). Candidates were limited to cell surface molecules to focus on genes that would have a direct effect on growth cone movement. Two genes, alcama and pcdh18a, with high levels of expression in the pharyngeal arch area were chosen for further study. The DNA constructs corresponding to these genes were obtained, and we are in the process of generating reagents to monitor (and validate) the expression of these genes at the appropriate place and time consistent with a role in branchiomotor axon guidance. In situ hybridization will be performed for each gene at various developmental stages (18, 24, 36, and 48 HPF) to examine their spatiotemporal expression patterns. After we have defined a potential role for one or both genes in axon guidance, we will knock down their expression using antisense morpholinos and examine the effects on branchiomotor axon guidance.
Evaluation of adobe block walls against blast
James Dawson and Hani Salim

Adobe blocks have been utilized for many years for construction in areas of the world that experience very small amounts of rainfall, and more recently they represent a sustainable material choice for modern societies. Currently, design guides for adobe walls under blast are nonexistent. Therefore, in this project, adobe walls were evaluated at the material, component, and system levels under static loading.

This poster will focus on the evaluation of standard compression tests on small mortar cubes to help understand the stress-strain relationship between mortar blocks which have been exposed to different curing environments. In addition, full scale wall samples were tested under uniform static pressure until failure. A total of 100 mortar cubes at various curing ages and environments, and 6 wall samples were evaluated in this project. Summary of the testing setup, evaluation, and results will be presented.
State legislatures across the United States are pushing to tighten voter identification (ID) laws, requiring voters to present a government-issued photo ID at the polling place before obtaining a ballot. Indiana, Georgia, Tennessee and Kansas have held presidential elections under these new requirements. Republican officials defend the provisions as a preventative measure against voter impersonation. Democratic critics argue that the laws are designed to suppress voter turnout among racial/ethnic minorities, the elderly, and the poor—who are less likely to possess photo IDs and more likely to vote for Democrats. Using aggregate data at the state and county level, this paper tests the popular argument that strict photo ID requirements lowered turnout and Democratic voting in the 2008 and 2012 elections. For the 2008 election, I find no evidence that turnout was affected by voter ID laws on average, and the evidence that less educated, elderly or black voters were uniquely affected is very weak and inconsistent. For the 2012 election, there is a stronger possibility that voter ID laws reduced turnout, but I find no evidence that the racial, socioeconomic, or age composition of counties had any role in the matter. Additionally, the argument that voter ID laws lowered Democratic presidential voting by reducing turnout is not supported. These findings suggest that either (1) the Democratic argument has misunderstood the mechanism or magnitude with which voter ID laws reduce turnout, or (2) the aggregate data under examination may be ill suited to the detect these small effects.

This project was completed to fulfill a Capstone requirement.
Match or mismatch: Are teachers utilizing multimedia in the classroom for its intended purpose?
Patrick Dent, Tiffanie Hancock, Kaitlyn Erehart, Nilay Muslu, and Michelle Klosterman

We conducted a qualitative case study of five Pre-service Elementary Science Teachers’ (PSEST) use of popular media at Forest Elementary (pseudonym), a small rural school in the southeast part of the United States. These five PSEST were in the last semester of their undergraduate program, which emphasized inquiry-based science teaching (NSES, 1996), twenty-first century skills development (P21, 2009), and global awareness. They were assigned the task of developing three distinct lessons on a science topic related to the Amazon rainforest (a thematic focus of Forest Elementary at the time of the study), each lasting 45 minutes. Data for this study included teaching artifacts (e.g., lesson plans, teaching reflections) and three interviews – one before, during and after the instructional sequence. The purpose of the cross case analysis was to determine what media resources the PSEST viewed as most useful for classroom instruction and what factors influenced their choices. Through inductive analyses, we found that while the types and uses of media varied across the five PSEST, engagement was a pervasive rationale for classroom media use. Based on these results, and PSEST definitions of engagement as a means to persuade students to participate in and to display an interest in science, we conducted a comparison of how the engagement instructional strategies of PSEST (mis)aligned with the features of the media they used via a rhetorical analysis approach. We found that PSEST most often use logic to engage students, which matches the media they use. However, when emotion, timeliness, or authority are used as persuasive appeals in media, teachers do not leverage those appeals; PSEST underutilize the potential of media resources. These findings suggest several implications for teacher education programs, media creators, and classroom instruction.
Primary electorate ideology, candidates, and intra-party politics
Mark Denton and Kevin Banda

Why do certain primary candidates win rather than others? There is a lack of clarity in the literature regarding this question. I seek to bridge this gap by clarifying and expanding upon existing theories which describe primary voters as mainly ideologically driven, and that this is a prime influence on the type of candidates who win. In this sense, the candidate becomes foremost a reflective “representative” of the party-based electorate who nominated her. By utilizing a unique new database of candidate ideological points derived from 2010 campaign finance records, I am able to tie over 800 House and Senate candidates to their individual primary electorates in a manner not done before. I show that the ideology of each electorate does drive that of the election’s eventual victor: increased party conservatism produces more conservative candidates. Finally, I proceed in developing a general model for primary election outcomes, with the goal of providing a better understanding of candidates and intra-party politics.

This project was completed to fulfill a Capstone requirement.
Differential gene expression in grape-phylloxera galls based on RNASeq data

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

Insect galls are plant structures whose development is controlled by an insect, which Charles Darwin thought resembled peaches. Our current hypothesis is that galling insects have coopted the reproductive development genes of the plant in forming galls (a feeding structure for developing insects). This study compared the differences between grape leaves that were under attack by an insect, known as phylloxera, creating galls, and grape leaves that had no galls on them. To do this, the transcriptomes of galled leaves and leaves were compared. We found differences in 18 floral whorl development genes in galled leaves as compared to ungalled leaves. This suggests that the insect is inducing the expression of floral development genes within the leaf to develop galls.
Intraguild predation occurs when a species will prey on or attack another species which can occupy and utilize resources in the same niche. Ambystoma opacum has a unique breeding behavior, in which they deposit eggs on dry pond beds before they are inundated by the autumn rains. This can confer a size advantage to their larvae over A. annulatum larvae, which must wait for the ponds to fill before they lay their eggs. Since A. opacum is a gape limited predator and has been shown to prey on smaller spring breeding salamander larvae, it is probable that A. annulatum would be preyed on by A. opacum. It is unknown if A. annulatum larvae demonstrate antipredator behaviors when presented with sensory cues associated with A. opacum. Since A. annulatum have not been studied extensively, it is also unknown what type of cues (visual and/or chemical) that they will respond to. To determine if there is an innate antipredator response to A. opacum, we monitored the activity level of A. annulatum larvae before and after being presented with visual, chemical, or a combination of predator cues from A. opacum larvae and Anax junius (green darner) nymphs as a control, since there is a known behavioral response by A. annulatum to dragonfly nymph cues. Testing is still underway, but I predict A. annulatum larvae will demonstrate antipredator behaviors when presented with cues from marbled salamander larvae. There has been very little research done with the A. annulatum and as an endemic species to the Ozark Plateau, they may be an indicator species for the region. Knowing more about them and their place in the ecosystem will help better understand how to best conserve them and the health of their environment.

This project was completed to fulfill a Capstone requirement.
Christopher Dopuch
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Faculty Mentor: Dr. Matthew Dickinson, Information Technology

Computer vision module for unmanned aerial systems operations
Christopher Dopuch, Adam Faszl, Ryan Haslag, Aaron Scantlin, and Matthew Dickinson

Unmanned Aerial System (UAS) operations are becoming increasingly important in military and civilian applications, and official FAA rulings will soon present new opportunities for domestic and commercial drone use. Drones provide a unique platform for video applications, and computer vision is key to processing and acting on that video data. Our project aims to create a comprehensive computer vision platform for use in UAS drones. Our system will visually identify targets autonomously via a 1080p video uplink from the UAS which is processed on the ground by computer. The system will operate in both the visual light spectrum and the infrared spectrum. Our platform is specifically designed for use with intelligence, surveillance, and reconnaissance (ISR) as well as search and rescue (S&R) operations.

This project was completed to fulfill a Capstone requirement.
Reverse logistics network design
Kyle Dorge, Jason Robke, Jennifer Bergman, Wooseung Jang, Ronald McGarvey, and James Noble

Our research team is working with The Boeing Company to identify potential international component maintenance facility locations in order to minimize cost and time performance with capability, capacity, and mode. In order to determine the most feasible maintenance facility location, we have built a multi-modal cost estimator that estimates the price and time span to repair broken parts of Boeing aircraft for each potential location. The estimator calculates the price for repair for every possible combination of destination-origin pairs and also takes into account consolidation waiting periods for shipping by sea. Through this analysis, we will be able to determine an optimum maintenance facility location overseas to maximize the efficiency of receiving broken parts, repairing the parts, and shipping them back to the necessary base. We plan to explore and evaluate the trade-offs between cost and time performance. Overall, we hope to design a reverse logistics network within a Performance-based Logistics (PBL) environment for a wide range of maintenance operations and to have the capability to include multiple platforms.
Late-infantile neuronal ceroid lipofuscinosis (LINCL) is an inherited neurodegenerative disease characterized by progressive loss of cognitive and motor functions, seizures, and visual impairment culminating in blindness. These clinical signs are accompanied by brain and retinal atrophy. Dachshunds with hereditary LINCL develop progressive neurologic signs and exhibit brain and retinal degeneration similar to those in children with LINCL. LINCL in both children and dogs is caused by mutations in the \textit{TPP1} gene that encodes the soluble lysosomal enzyme tripeptidyl peptidase-I (TPP1). We found that administration of recombinant TPP1 to the cerebrospinal fluid of affected dogs did not preserve the ability of the retina to respond to light stimuli as measured with electroretinography (ERG) but did in some cases preserve the pupillary light reflex (PLR). Retinal ganglion cells are involved in mediating the PLR but do not contribute to the ERG. It is possible that preservation of the PLR resulted, at least in part, from prevention of disease-related loss of ganglion cells from the retina. However, it was not known whether the retinal degeneration that occurs in LINCL includes loss of retinal ganglion cells. A study was therefore conducted to determine whether retinal ganglion cell loss occurs in canine LINCL. The axons of the ganglion cells make up the optic nerve and each ganglion cell has a single axon. Therefore, the total numbers of ganglion cells in the retinas of affected (n=5) and normal (n=5) Dachshunds were determined by counting the axons in the optic nerves. Optic nerves were collected from affected dogs at end-stage disease (10-11 months of age) and from normal dogs at the same ages.

To collect the optic nerve, following euthanasia, the eyes were enucleated and a 10 to 15 mm long segment of the optic nerve was dissected from behind the globe and fixed in a mixed aldehyde solution. Approximately 3-4 mm long segments of the optic nerves were post-fixed and embedded in epoxy resin. Cross sections of the optic nerves were cut at a thickness of 0.4 \( \mu m \), mounted on slides, and stained with toluidine blue. Composite high-resolution images of the entire cross section of each optic nerve were obtained and analyzed using Photoshop. Each axon was manually counted and separated into two size classes: larger and smaller than 7.8 \( \mu m \). Metamorph image analysis software was then used to analyze the counts.

No significant differences in total axon numbers or in axon size distribution were observed between affected and normal dogs. Therefore, the preservation of the PLR in dogs treated with recombinant TPP1 cannot be attributed to prevention of ganglion cell loss and is more likely due to preservation of brain and spinal cord neurons involved in the PLR neural pathway.
The number of English language learners (ELLs) in American schools continues to increase. In fact, ELLs are the fastest growing segment of U.S. students. Along with this change in the student population, schools are facing significant changes as the school mathematics curriculum shifts to align with the Common Core State Standards. In light of these factors, it is crucial that preservice teacher programs address effective mathematics teaching strategies for ELLs. In this study we examined the ways in which 5 preservice elementary teachers conceived of and enacted supports for ELLs as they implemented worthwhile mathematics tasks. The primary sources of data included surveys, interviews, and observations. We administered a survey and conducted an interview with each of the preservice teachers prior to their work with the ELL students to gather information on their beliefs. We then observed as the preservice teachers worked with an ELL student one-on-one on a series of four mathematical tasks. The preservice teachers then participated in a group interview as they watched the recording of their initial meeting with their ELL and discussed what they saw and how their thoughts about appropriate supports may, or may not, have changed. We used the constant comparative method (Corbin & Strauss, 2008) to analyze the data. The initial findings suggest that although preservice teachers discussed supports for ELLs that aligned with suggestions from mathematics education literature, they had difficulty enacting these supports when working with their ELL students. Further, the preservice teachers often accepted superficial or unclear explanations from their ELL students due to their perceptions of the students’ abilities. These findings suggest that preservice teachers would benefit from a focused field experience that provided further supports in aiding the preservice teachers to implement worthwhile tasks with ELLs.
National Park funding and its impact on the health of the park service
Eric Dude and William Horner

National Parks have been an integral part of the American life since 1916. In fact, the idea of protected public recreation land is a uniquely American one. Because of this, many people have been concerned with the idea of the National Park Service’s vulnerability during the era of expanded government budget cuts. I researched the history of the federal government’s funding of the Department of the Interior to find out why public outcry has been so fervent recently. What I expected to find was a clear and steady decline of funding over recent years, but what the data shows is much more interesting. The data from the Office of Management and Budget tells us that funding for the DOI, and the NPS has never been higher. The issue, then, is no longer one of exploring why the government might want to cut National Park funding, but rather why the NPS and its interest groups currently feel so threatened in spite of recently generous budget allocations. A number of factors contribute, but a common theme is the delicate balance between increasing pressure for environmental stewardship, and the need for a balanced federal budget.

This project was completed to fulfill a Capstone requirement.
Purpose: To identify reasons for college students’ texting and driving, and to assess the associations between those motives and behavior in the past month.

Methods: College students (n=151) were approached in public locations on the University of Missouri campus and invited to complete a paper-based survey. Items asked about frequency and perceived danger of texting while driving, and reasons for texting while driving. A set of thematic categories was identified, and responses were coded into those categories. Regression analysis was used to assess the relationship between attitudes and frequency of texting while driving.

Results: Among respondents who drive, a majority (79.3%) reported texting while driving in the past 30 days. The frequency of texting while driving did not differ by gender (males=5.8, females=4.8) or age (r = .09, p = .29). Over 80% of students agreed that, “Texting while driving is extremely dangerous,” with 51.3% selecting “strongly agree.” Perceived risk did not vary by gender or age. In open-ended responses, justifications reported for texting while driving were task completion (50.4% of respondents), having high personal control (44.2%), texting out of habit (10.6%), and a need for social interaction (9.7%). Regression analysis indicated that texting and driving was predicted by a combination of low perceived danger score and justifying doing so for task completion, out of habit, or to achieve social interaction.

Conclusions: Despite acknowledging the danger, most students in our sample reported texting and driving. Many respondents cited ways that they attempt to minimize the risks, such as only texting when at a stoplight or using a talk-to-text program. Justifications associated with high levels of texting while driving were the need to complete tasks, feeling an urge or desire for social interaction, and texting out of habit.
Utilizing the vibration analysis of a fuel plate in air versus water to find an appropriate dampening coefficient
Kyle East and Gary Solbrekken

As part of the Global Threat Reduction Initiative (GTRI), the University of Missouri Research Reactor (MURR) is investigating a new low enriched uranium (LEU) fuel to replace the high enriched uranium (HEU) fuel currently in use. In order to reach the lower enrichment target without suffering degradation in performance, the structure of the proposed LEU fuel plates has been significantly altered. Due to the high velocity water coolant necessary to remove heat from the fuel plates, the new design may be prone to flow induced deflection. There is a need to address the potential for fuel plate deflection, as excessive motion may result in failure of the fuel plates. To understand the amount of deflection and limits of stress for the new design, experiments are currently being conducted on aluminum plates under similar flow conditions to those in the reactor. These experiments are unique in that the plate deflections are measured using an optical laser deflection system, allowing for non-intrusive measurement of plate motion under flow conditions.

To conduct a vibration analysis, strain gages are placed on each corner of the aluminum fuel plate utilized in the lab. By clamping down the fuel plate using a sturdy structure, the vibration of the plate can be analyzed by striking one end of the plate with a small-sized hammer. At each strain gage, soldered wires connect the strain measurement outputs to the data acquisition system in order to observe the effects of each hammer strike. This experimentation will be conducted for the plate in air, as well as for the plate in water. Following the collection of data for both scenarios, a dampening coefficient can be found from observing how the plate vibrates differently in air versus water.
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Junior
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Faculty Mentor: Dr. Marci Major, Music Education

Building identity in mid-level collegiate choirs: The student’s perspective
Lauren Eggering, Jacob Dakon, and Marci Major

This study identifies which aspects of individual and group identity are most influential to members of mid-level choirs. The data was gathered through use of surveys written by researchers that asked participants about their college/high school experiences and what they value most about being a member of their ensemble. The ensembles researchers surveyed were mid-level choirs, labeled as such by their directors.

Data showed that participants enjoy the musical self-expression their choirs provide, and highly value the sense of community within the ensemble. Respondents also value a director who is fully dedicated and enthusiastic about the choir and its members. Participants who indicated they would stay in their current ensemble said they would do so because of intrinsic factors (for example, wanting to better themselves as musicians). Those who wished to audition into a different choir were most influenced by the top ensemble’s prestige factor. Nearly half (Approximately 40%) of participants were interested in remaining in their current ensemble, and the other half (approximately 45%) wished to audition into a different ensemble. There were also students who were undecided, no longer participating in choir, or graduating. These students accounted for approximately 15% of the respondents.
Understanding and assessing the craving criterion for diagnosing Alcohol Use Disorders in the DSM-5

Olivia Elam, Calandria Frazier, and Kenneth Sher

The introduction of the Diagnostic Statistical Manual 5 (DSM-5) (APA, 2013) changes diagnostic procedures for Alcohol Use Disorders (AUDs) from the approach used in the Diagnostic and Statistical Manual IV (DSM-IV) (APA, 1994). It eliminates abuse and dependence categories (introduced in the Diagnostic and Statistical Manual III (DSM-III) (APA, 1980) and it creates a continuum of mild, moderate, and severe AUDs. The ‘legal problems’ criterion is also eliminated and “craving” added. Studies have assessed whether the addition of ‘craving’ significantly increases the prevalence of AUDs or differentiates between mild, moderate, and severe cases. Results range from no substantial contribution (Agrawal et al. 2011; Casey et al., 2012; Cherpitel et al., 2010; and Hasin et al., 2012) to significant increases in diagnoses or severity of diagnoses (Dawson et al., 2013; Keyes et al., 2011; and Mewton et al., 2010). Diverse definitions for craving may explain discrepancies between studies. Some studies indicate potential overlap between craving and other criteria (Mewton et al., 2010; Casey et al., 2012; Cherpitel et al., 2010; and Hasin et al., 2012). This study used a self-report questionnaire administered to college students to determine which craving items best predict AUDs and assesses the extent to which the craving criterion overlaps with other criteria. Participants were selected from students enrolled in the PSYCH1000 course at the University of Missouri and must have been at least 18 years of age and have had at least one drink in their lifetime. Data has been collected. Data is being analyzed using logistic regression to determine the influence of the craving criterion on the prevalence of AUDs, and the McNemar test to identify correlation between “craving” and other criteria. Different definitions of “craving” measured by different “craving” items are expected to differentially impact the overall prevalence and overlap with other criteria.

This project was completed to fulfill a Capstone requirement.
Neuron-vasculature interaction in mouse brain
Steven Elser and Shinghua Ding

Ischemic strokes are a leading neural disorder that cause brain damage and may lead to human death, imposing major damage to its victims. In order to better understand how the brain and body react when ischemia occur, it is necessary to better understand how the neural tissue and vasculature in the brain react. In this project, we have stimulated the hind limb and used a laser Doppler to find the threshold for a change in blood flow in the brain. We found that the response threshold for a typical mouse is around $470 \mu A$ and will use this information for stimulation to evaluate transgenic mice. We will use transgenic mice expressing the Ca$^{2+}$ indicator GCaMP3 in endothelial cells to study the neuron-endothelial cell interaction. Using two-photon imaging and blood flow, the Ca$^{2+}$ change in endothelial cells will be measured after electric and sensory stimulation. In order to expose the brain to attain the clearest photos from two-photon imaging and for accurate measurements on blood flow information from laser speckle flowmetry, open skull surgery will be performed on the mice to remove the skull. The sensory stimulation will be applied to the limbs or through direct stimulation if results of limb stimulation are tough to find.
Multimodal writing workshop: Using poststructural theory to analyze structure and content
Lauren Emerson, Candace Kuby, Tara Gutshall, Amanda Heflin, and Jocelyn Wallinger

In the literature on writing workshop three phases are discussed: mini lesson, individual writing time with teacher conferences, and author’s share time (Ray & Cleaveland, 2004). In this approach children usually compose books with limited paper and writing choices. However, with the proliferation of research on multimodal literacies (Kress, 1997) we wondered how the structure and content of a writing workshop might change when students are introduced to a variety of art materials and encouraged to create multimodally. This study spans four years of research in a second grade classroom. We focused analysis on how one teacher stepped outside the traditional writing workshop structure and looked closely at her language, teaching decisions, and interactions with students. Through a process of pedagogical documentation (Lenz Taguchi, 2010) we collected videos, audio recordings, student made artifacts, interviews, and photographs. We thought with poststructural theory (Jackson & Mazzei, 2012), or plugged in ideas, to analyze data. We used concepts from Deleuze and Guattari’s (1987) rhizomatic theory to think about teaching and learning as unexpected departures, fissures, from the typical ways of writing in early childhood. We specifically focused on the following ideas to analyze data: desire, becoming, smooth and striated spaces, lines of flight, and intra-actions with materials. Insights gained from analysis were: 1) when embracing multimodal writing practices the structure of writing workshop might stay the same but the content of each section changes to respond to students’ literacy desires, 2) students become teacher as they demonstrate their processes in creating with a range of materials to their peers, and 3) as teachers follow students’ literacy desires the curriculum becomes more individualized and expanded. We encourage educators to think of ways to embrace fissures in literacy teaching and learning. When students are not limited in their thinking or materials powerful learning happens.
GPU-accelerated DBMS for massively scaled, high-throughput pattern matching and geospatial data clustering
Matthew England, Kevin Melkowski, and Grant Scott

We have developed extensions to the open source database management system (DBMS) PostgreSQL, which facilitate massive-scale, high-throughput pattern matching via graphics processing units (GPU). A GPU is a computer chip that performs rapid mathematical calculations, primarily for the purpose of image rendering. However, modern GPU are massively parallel processors, with hundreds or thousands of cores, which can perform a wide variety of numerical computations beyond traditional graphics and image processing. Compared to standard central processing units (CPU) found in typical desktop or workstation computers, which have between 2 and 8 cores, GPU have significantly more numerical data processing throughput. We have leveraged these coprocessors to perform massively scalable, high-throughput computational pattern matching. We developed a novel integration of GPUs hardware into an open source database management systems, which facilitates scale-out of large data sets. This scale-out potential allows us to process hundred of gigabytes, or even terabytes, of data through GPU coprocessors on a single modest computer. We have applied this pattern matching technology to generate geospatial data point sets, which include latitude, longitude, and orientation. We then designed and implemented novel geospatial clustering techniques, which discover clusters of points that share spatial proximity as well as orientation and pattern match similarity. We render these clusters in a variety of formats -- such as point-sets or polygons -- using open source web-based mapping libraries to provide a rich visual rendering for users. The benefits of these techniques can be applied to numerous computational data processing domains.
Match or mismatch: Are teachers utilizing multimedia in the classroom for its intended purpose?
Kaitlyn Erehart, Patrick Dent, Tiffanie Hancock, Nilay Muslu, and Michelle Klosterman

We conducted a qualitative case study of five Pre-service Elementary Science Teachers’ (PSEST) use of popular media at Forest Elementary (pseudonym), a small rural school in the southeast part of the United States. These five PSEST were in the last semester of their undergraduate program, which emphasized inquiry-based science teaching (NSES, 1996), twenty-first century skills development (P21, 2009), and global awareness. They were assigned the task of developing three distinct lessons on a science topic related to the Amazon rainforest (a thematic focus of Forest Elementary at the time of the study), each lasting 45 minutes. Data for this study included teaching artifacts (e.g., lesson plans, teaching reflections) and three interviews – one before, during and after the instructional sequence. The purpose of the cross case analysis was to determine what media resources the PSEST viewed as most useful for classroom instruction and what factors influenced their choices. Through inductive analyses, we found that while the types and uses of media varied across the five PSEST, engagement was a pervasive rationale for classroom media use. Based on these results, and PSEST definitions of engagement as a means to persuade students to participate in and to display an interest in science, we conducted a comparison of how the engagement instructional strategies of PSEST (mis)aligned with the features of the media they used via a rhetorical analysis approach. We found that PSEST most often use logic to engage students, which matches the media they use. However, when emotion, timeliness, or authority are used as persuasive appeals in media, teachers do not leverage those appeals; PSEST underutilize the potential of media resources. These findings suggest several implications for teacher education programs, media creators, and classroom instruction.
Helping to remember: Cellular membrane changes form Alzheimer’s disease oxidative stress
Chandler Est and James Lee

The main cytotoxic factor in Alzheimer’s disease is known to be oligomeric amyloid-β peptide (Aβ). However the effects of Aβ on the cell membrane are still not fully understood. In this study, Aβ and NADPH oxidase inhibitor combinations will be evaluated to determine any membrane change of mouse brain cells using fluorescence microscopy of Laurdan. Laurdan is a fluorescent molecule that detects changes in membrane phase properties through its sensitivity to the polarity of the environment in the membrane bilayer. Polarity changes are detected by an increase in Laurdan's emission wavelength, which is determined by calculating the generalized polarization (GP). Through the GP calculations, by comparing the difference in wavelengths, an image of the cellular membrane can be produced pixel by pixel in order to elucidate the changes in the molecular order of the membrane. This will reveal the level of stress on the cell and help further the understanding of the biochemical processes of Alzheimer’s diseases.
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Option

Calibrating safety performance functions for interchanges  
Calvin Fales and Carlos Sun

The Highway Safety Manual (HSM) is a document published in 2010 by the American Association of State Highway and Transportation Officials (AASHTO) that serves as the first ever complete collection of quantitative safety analysis methods. Safety Performance Functions (SPFs) are functions that take into account geometric and operational parameters that influence the rate of crashes relative to the volume serviced by a particular section of roadway. Due to the specificity of the factors involved SPFs, different types of facilities (intersections, road networks, roadway segments, etc.) require separate analysis. This study focused exclusively on calculating SPFs for interchanges, which contain specific parameters for freeway segments associated with interchanges, ramp segments, and ramp terminals. Once calculated, SPFs can be used to identify dangerous roadway configurations and to plan for future roadway improvements. Since the HSM was put together on a national basis, it should be calibrated to suit the specific roadway conditions of Missouri. Furthermore, in doing this calibration it is also possible to examine the effectiveness and relevance of the SPFs put forth by AASHTO as they relate to Missouri roadways. To perform this analysis, a representative sampling of interchanges in Missouri was selected at random. These were then refined to fit into specific categories put forth by AASHTO based on urbanization, signalization, and the size of the intersection. After this was completed the geometric, signalization, and crash data were combined using the Enhanced Interchange Safety Analysis Tool (a spreadsheet developed for this purpose) and calibration factors can be calculated and interpreted.
Civil engineering applications of ground-based interferometric radar
Zachary Fallert and Brent Rosenblad

The work presented here is part of larger effort to analyze the potential of the emerging technology of ground-based interferometric radar with civil engineering applications. A multidisciplinary research team at the University of Missouri has been working with this technology to detect and quantify the movements of earthen dams and rockfall hazard monitoring. These studies include testing the detection limits and accuracy of the equipment and the methods used for data processing. Several dam sites throughout Missouri and Kansas have been monitored over the past two years. A control study on rock movements was performed in Colorado and a rock face is being monitored there. The research team, consisting of professors and students of multiple disciplines, is working to interpret and analyze data collected from these sites. As this work progresses the team will be able to draw conclusions on whether it will be practical for government agencies and/or private enterprises to implement this technology as a useful and reliable tool. Undergraduate researcher responsibilities on this project include data collection and learning to process and interpret the data.
Unmanned Aerial System (UAS) operations are becoming increasingly important in military and civilian applications, and official FAA rulings will soon present new opportunities for domestic and commercial drone use. Drones provide a unique platform for video applications, and computer vision is key to processing and acting on that video data. Our project aims to create a comprehensive computer vision platform for use in UAS drones. Our system will visually identify targets autonomously via a 1080p video uplink from the UAS which is processed on the ground by computer. The system will operate in both the visual light spectrum and the infrared spectrum. Our platform is specifically designed for use with intelligence, surveillance, and reconnaissance (ISR) as well as search and rescue (S&R) operations.

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Brian Silvey, Music  
Funding Source: A&S Undergraduate Research Mentorship

The effect of baton usage on college musicians’ perceptions of ensemble performance  
Logan Felder and Brian Silvey

We tested the effects of baton usage on college musicians’ perceptions of ensemble performance. Two male graduate students majoring in wind conducting, who had been assigned pieces to conduct with an auditioned symphonic band, were chosen as the conducting participants for this study. Each conductor was videotaped while leading a 1-minute excerpt from each of his previously assigned scores. The excerpts selected for use in this study were measures 1-52 of *Pathfinder of Panama* (technical) by John Philip Sousa and measures 28-45 of *Seal Lullaby* (lyrical) by Eric Whitacre. Both excerpts were conducted with and without a baton. Videos were imported into iMovie 10.0.1. The audio that accompanied each video was then replaced and synchronized with audio that had been recorded simultaneously with the video. (This would later allow participants in the audiovisual or audio-only conditions to hear the same recordings). College musicians (*N* = 165) at large university schools of music served as either audiovisual or audio-only evaluators. To help control for order effects, we created four orders such that no music excerpt was heard or conductor shown successively. After watching one of the four presentation orders, participants (*N* = 120; *n* = 30 in each order) evaluated both the ensemble’s expressivity and precision on two, 10-point Likert-type scales anchored by (1) *not expressive* and (10) *very expressive* and (1) *not precise* and (10) *very precise*. An additional set of participants (*N* = 45) served as the control group and listened to the audio-only excerpts. These participants also evaluated the ensemble’s precision and expressivity, but in the absence of any accompanying visual information.
Scott Feldt  
O'Fallon, MO  

Senior  
Civil Engineering

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

Effect of wind speed on the detection of subsurface damage in concrete  
Scott Feldt and Glenn Washer

The goal of this research is to improve the tools available for the condition assessment of highway bridges. The objective of the research is to determine a threshold wind speed for the application of infrared thermography in the field. In this research, the student will develop a test set-up in the laboratory to model environmental conditions at a bridge deck. This experimental design will include the ability to vary the wind speed over the surface of the specimen to assess the effect of wind speed on the detectability of subsurface damage (delamination).
In search of human correlates for lick rate
Mallory Ferguson, Anna Grantham, Alyssa Weatherly, Rachel Lazenby, Rebecca Schneider, and Teresa Lever

Our lab has identified lingual dysfunction as the earliest known biomarker of swallowing impairment in the SOD1-G93A transgenic mouse model of amyotrophic lateral sclerosis (ALS). At weaning (3 weeks), these mice lick significantly slower than age-matched controls. Although licking behaviors in mice and ingestion of liquids by humans appear quite different, they serve a common purpose (oral ingestion) and utilize common neurological components (e.g., hypoglossal nucleus and trigeminal nucleus). Therefore, our finding with mice suggests that people with ALS may develop subclinical lingual dysfunction prior to presentation of clinical symptoms of dysphagia or speech impairment. We hypothesize that utilizing tongue ticking behavior, as well as other noninvasive instruments, can provide diagnostic tools that will aid in subclinical diagnosis in patients with ALS. We have established a protocol to test this hypothesis and data collection is currently in progress with healthy adults across age groups ranging from 20-89 years (n = 140). Digital recordings (via Praat) will be analyzed to quantify the following variables: tongue tick rate, diadochokinetic speech rate, swallow rate, and mastication rate. Tongue strength will be measured using the Iowa Oral Performance Instrument (IOPI). Statistical analyses will be conducted upon completion of data collection. Results will provide normative values for future comparison with patients with ALS. We expect this non-invasive, simple test will aid in disease detection, monitoring of disease progression, and quantification of treatment efficacy.
Kevin Fitzgibbon
Chesterfield, MO
Senior
Chemical Engineering

Faculty Mentor: Dr. Galen Suppes, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

Lithium-Sulfur batteries
Kevin Fitzgibbon and Galen Suppes

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Development of a green labeling scheme for MU Campus Dining meals
Shannon Flanakin and Christine Costello

Agricultural activities in support of the human diet result in significant greenhouse gas (GHG) emissions, which are responsible for climate change. Life Cycle Assessment (LCA) research has shown that GHG emissions vary by food type, and that animal-based food products result in more emissions than plant-based food products. In addition, the variation within those two categories can be significant. The goal of this project is to communicate the effect of consumption behavior and provide information to consumers that will help highlight how diet choices can lead to lower greenhouse gas emissions. Life cycle GHG data were collected for major food categories and applied to several MU Campus Dining meals in order to evaluate their relative GHG emissions. GHG emissions for numerous meals available at campus dining halls, inclusive of a variety of foods, were calculated. The results for each were grouped into five class intervals in order to represent the low to high GHG values observed across meals. The LCA dataset and these class intervals are organized such that new meals can readily be assessed and assigned to one of the five classes automatically. These classes are associated with a labeling scheme in order to identify a meal as having low GHG emissions, i.e., “green”, or relatively high GHG emissions “red”, or in between stages “yellow-green”, “yellow” or “orange”. This work provides a first step toward the creation of an interface that would allow students to determine the GHG intensity associated with their meal choices, similar to the “Zoutrition” program currently available through the campus dining website.
Climate change and treeline advance in the northern Rocky Mountains
Robert Fleet and Grant Elliott

Existing data collected on anthropogenic climate change effects in the Western United States show a steady rise in temperatures throughout the 20th century. Late 20th century warming has been especially pronounced during spring, resulting in sharp snowpack reductions in the northern Rocky Mountains that are unprecedented over the last millennium. Similar climate changes in the Southern Rocky Mountains facilitated an up-slope advance of the upper treeline boundary, which represents the uppermost extent of high-elevation mountain forests. Moreover, previous research suggests that climate-vegetation interactions at upper treeline may be the most sensitive on cooler and wetter north-facing slopes. The purpose of this study is to examine how climate influences upper treeline advance on north-facing slopes in the Lost River Range of East-central Idaho and the Pioneer Mountains of Southwest Montana to determine if similar biogeographic responses to climate are evident in the Northern Rocky Mountains in general and east and west of the Continental Divide in particular. We used dendrochronological techniques to reconstruct the spatial and temporal patterns of tree establishment on the north-facing slopes of Mt. Borah and Sugarloaf Mountain in the two aforementioned mountain ranges. Preliminary results show that an overwhelming majority (87.5%) of trees at or above timberline established since 1970. Additionally, 75% of trees above treeline were established during the 1980’s and 1990’s. These findings support accumulating evidence of how warming during the latter half of the 20th century has initiated widespread ecosystem change within high-elevation forests of the Rocky Mountains.
Micah Fletcher
Columbia, MO

Sophomore
Biological Sciences

Faculty Mentor: Dr. Reginald B. Cocroft, Biological Sciences
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

Competitive signal masking mechanisms in a treehopper mate-searching system
Micah Fletcher and Reginald B. Cocroft

Efficient mate searching is essential to reproductive success in many animal species. Some species engage in ‘duets’ where a mobile male broadcasts his presence, then locates a stationary female by homing in on her responses. If two males are present, both males will produce specialized signals that overlap with those of their rivals. These special signals function to mask (i.e. prevent perception of) the signal of a rival male so that the female is less likely to respond. I’m interested in the mechanism by which these masks affect female perception of the signal.

Unlike the continuous stream of sound used by males of other species, the timing and duration of my study species’ mask is surgically precise; the male consistently targets a specific feature of the other male’s signal.

Male signals consist of a tonal whine followed by a series of higher-pitched pulses. The masking signal is produced during the pulses, and consists of a tone with the same frequency as the whine. Thus far, this study has investigated whether the disruptive signal suppresses the female reply by obscuring either the (1) temporal or (2) spectral (frequency) features that the female uses to trigger her response.

I played back computer-generated stimuli that varied either (1) the depth of modulation (the degree to which the amplitude drops between pulses) on a scale from 100% (where the amplitude drops to zero, as in natural signals) to 0% (where the signal is tonal) or (2) the carrier frequency of the pulses.

I have found that females are less likely to respond to signals with pulses characterized by both (1) lower depth of modulation and (2) lower carrier frequency than natural signals. This supports the hypothesis that male masking signals interfere with female perception of both temporal and spectral features of male signals.
Timothy Foreman
Kearney, MO
Senior
Biological Sciences

Faculty Mentor: Dr. Troy Zars, Biological Sciences

**The effect of sulfa drugs on place memory in Drosophila melanogaster**
Timothy Foreman and Troy Zars

Surprisingly, sulfa drugs can have neurological side effects in humans. How these drugs alter nervous system function is not well understood. We are developing a *Drosophila* model to better understand the mechanisms of sulfa drug action on the brain. Sulfa drugs have been shown to inhibit sepiaterin reductase, an enzyme that is ultimately important in the synthesis of dopamine and serotonin. Previous experiments show that serotonin is critical for place memory in the fly. We are developing genetic tools and feeding protocols to examine the effects of sulfa drugs on place memory levels. Flies were exposed to different amounts of two sulfa drugs, sulfamethoxazole and sulfapyridine, and tested for place memory under several conditions. Furthermore, we generated fly lines with genetically altered levels of sepiaterin reductase. Behavioral analyses from these treatments will be presented.

*This project was completed to fulfill a Capstone requirement.*
Differences in the prevalence of DSM-IV vs. DSM-5: Criteria vs. algorithm
Calandria Frazier, Kenneth Sher, and Gail Raskin

The Diagnostic Statistical Manual, fourth edition (DSM-IV; APA, 1994) was recently revised to the Diagnostic and Statistical Manual, fifth edition (DSM-5; APA, 2013), changing how alcohol use disorders [AUDs] are diagnosed. Agrawal et al. (2011) found that the prevalence of DSM-5 AUDs was 10.8% with the corresponding prevalence of DSM-IV abuse/dependence being 9.7%, implying a modest 11.3% increase. Mewton et al. (2011) found that the prevalence of DSM-5 AUDs increased by 61.7% when compared with DSM-IV diagnosis. This study will compare the prevalence of DSM-IV AUDs’s to DSM-5 AUD’s and examine if the expected change is due to the changes in the specific AUD diagnostic items (i.e., adding craving and deleting repeated legal problems) or due to the change in algorithm (i.e., changing from one or more of the four abuse symptoms and/or three or more of the seven dependence symptoms to two or more of an 11 criteria AUD criteria set). Based on prior research, it is predicated that the DSM-5 will have an overall higher prevalence rate than the DSM-IV.

Undergraduate Psychology 1000 students, who were 18 years old and have had at least one full drink in their lifetime, were selected for this study.

The McNemar’s test will assess the marginal proportions of AUDs in DSM-IV and DSM-5. We will test if the number of participants who diagnosed with DSM-IV AUD diagnosis significantly changed when using the DSM-5 AUD diagnosis. If differences are found, we will examine whether the significant changes are due to the algorithm or the individual criteria change. Specifically, we will compare the marginal proportions of four different types of AUDs: (1) DSM-IV criteria with DSM-IV algorithm, (2) DSM-IV criteria with DSM-5 algorithm, (3) DSM-5 criteria with DSM-5 algorithm, and (4) DSM-5 criteria with DSM-IV algorithm.

This project was completed to fulfill a Capstone requirement.
Amongst the most urgent and high-profile sustainability topics facing businesses today are minimizing greenhouse gas emissions and reducing energy consumption in the supply chain. With the demand for energy increasing worldwide, companies must adapt to more eco-friendly processes and regulations. In an increasingly competitive market, companies now look to transportation and logistics as an area to improve energy efficiency, increase environmental sustainability, and reduce costs. This research paper focuses on how energy impacts the different aspects of the supply chain, and how they have adapted from an energy perspective. Within these areas, solutions have been generated through quantitative models and case studies; allowing companies to get a better understanding of how the subject matter can be applied into an existing supply chain network.
Do voters in orphan counties have lower turnout and higher rolloff?
Marie French and Jeff Milyo

In traditional theories of democracy, informed and engaged citizens are essential to the success of a democratic society. The lack of basic civic and political knowledge by a large number of Americans has been well documented. The lower turnout in non-presidential years at state and local elections has also been documented. This has caused concern among political scientists and a large field of study explores the effect of various informational vehicles on citizen knowledge and engagement. The effects of television news and political advertising have been studied extensively, but one area has not been fully considered. The structure of media markets in the United States means about 10 percent of Americans live in “orphan counties.” These counties are served by media markets that primarily serve other state markets or are split between various states and are less likely to get news about their local races or state government. The differential in exposure to information about state and local political races experienced by residents of orphan counties provides an opportunity to explore the unintended effects of media market structure on American democracy.

Using the survey data available from the 2012 Cooperative Congressional Election Study, the voting and rolloff of individuals living in counties served by out-of-state media markets are examined. Since less information is available about the lower state chamber race because of the focus on a different state in the media market, theories and evidence about voter responses to limited information suggest rolloff or failure to vote in the lower-level races would be higher in these orphan counties. Voters were about 4.4 percent less likely to vote in the presidential election. Rolloff in the lower chamber state election was slightly higher, although not quite at the statistically significant level, for voters in orphan counties.

This project was completed to fulfill a Capstone requirement.
Automated oligomeric analysis of atomic force microscopy images
Nathan Frey and Gavin King

In *Escheria coli*, the Sec system is responsible for translocation of polypeptides across membranes. Atomic Force Microscopy images of the Sec system in near-native conditions were analyzed to determine oligomerization in the sample. An algorithm was developed to identify and classify features of interest. The algorithm studied each feature and computed heights, areas, volumes, and higher order geometric properties of the protein. The height data was used to classify features by protein configuration. A designation of monomer or dimer was assigned to each feature by comparing area and volume measurements to benchmark values. Further tests involved contrasting feature geometry with known geometry suggested by crystal structure. Statistics related to the confidence of the oligomerization results were automatically generated for user inspection. The program incorporated a nearest-neighbor feature density analysis to determine if non-dimerized, proximal Sec proteins operate in pairs. The method was generalized to be adaptive to specific translocated preproteins and to be robust under sample-specific conditions.
Christopher Fulton
Wildwood, MO

Moving target defenses in virtual desktop clouds
Christopher Fulton and Prasad Calyam

As the capabilities and uses of cloud technologies have increased dramatically recently, new application delivery services are emerging in cloud marketplaces. One service that is growing in popularity is the transition from physical distributed desktops to virtual desktop clouds (VDCs), where customers can have on-demand access to Desktop-as-a-service (DaaS) for offline applications (e.g., MS Word) and online applications (e.g., WebEx) at pay-as-you-go rates. The adoption of many cloud-based services have been hampered by the fear of the cloud infrastructure providing a less secure workspace and inconsistent performance resulting in a loss of productivity. We propose incorporating a moving target defense (MTD) capability via a novel algorithm as an effective mechanism to protect media (e.g., audio, video, docs) the VDCs hosted by cloud service providers (CSPs). This MTD includes both proactive and reactive techniques that minimize a hacker’s knowledge of infrastructure and can used to rapidly migrate endangered resources to more secure locations if a threat is detected. We believe that by developing a secure resource migration and utility-based resource allocation method within our MTD algorithm, the fear of insecure and sluggish VDCs can be combated and thereby the adoption of new cloud service models by industry and academia can be maximized.
Fabrication and evaluation of calcium phosphate filled dental composite

Thomas Gagnon, Chris Knoll, Kevin Loeppke, and Hao Li

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The average cost per mile of road is $192,371.60, while this number greatly varies depending on the requirements of the road, terrain and other requirements, it is still a very costly endeavor. This high cost of construction is a deterrent for trying new unproven ideas. Should a new idea prove to be a poor choice for the area it was constructed, it is an expensive mistake, as well the design could prove fatal for users driving on it. A simulator allows for these designs to be tested at a very low cost before construction costs or loss of life can occur.

However human reactions vary and are hard for a computer model to accurately show. By allowing a person to interact with a simulator, their reactions can be recorded giving a more accurate view, assuming the rest of the simulator is an accurate representation of the situation, and the driver feels fully immersed into the situation.

The purpose of the Mizzou Driving Simulator was to create a multi-use simulator that can be easily adapted to fit any model or research approach being taken in transportation research, while creating an educational outreach tool to help further public knowledge on transportation engineering. To this goal various simulation platforms were evaluated and Unity 3D was found to be the best fit. The simulator hardware was custom built and the driving simulator chassis was constructed. A virtual reality headset was integrated into the system, a several mile stretch of Highway 70 was modeled using merge sign behavior, and a development manual for the simulator was developed.
Faculty Mentor: Dr. Michela Becchi, Electrical & Computer Engineering
Funding Source: College of Engineering Undergraduate Research Option

**Profiling dynamic parallelism using classic sorting algorithms**
Eric Gaudiello and Micela Becchi

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Dong Xu, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option

**Plant Protein Phosphorylation Database (P3DB)**  
Huangyi Ge and Dong Xu

In the past few years, Plant Protein Phosphorylation Database (P3DB, http://p3db.org) has become a very useful in vivo data resource for plant phosphoproteomics study. In the new version of P3DB (v3.0), more dimensions of information are provided for the protein, including protein-protein interaction (PPI), gene ontology, protein domains, amino acid properties, tertiary structures, and orthologous sequences, all of which may in turn provide better understanding of the functionality and properties for the phosphorylation. The new P3DB also incorporates multiple network features, such as PPI network, kinase substrate network, phosphatase substrate network, and domain co-occurrence network to help reveal the potential functionality or relationship in proteomics from a system point of view. All of these new features drive the new P3DB to be more comprehensive, systematic, automated and interactive with users.
Characterization and applications of nanothermite microchip initiators
Jordan Geeson and Shubhra Gangopadhyay

Recent advancements in nanotechnology have paved the way for the production of new materials called nanoenergetics. Nanoenergetic materials have been receiving a lot of attention because of their enhanced energy release rates due to increased fuel and oxidizer interfacial contact areas. Due to the high release rates of energy, they make an excellent candidate for micro-actuated initiator systems. A particular nanoenergetic material we are interested in is the nanothermite. Nanothermites have shown combustion wave speeds up to 2,600 m/s, reaction temperatures of approximately 3000 K, and the generation of intense light, sound, and pressures. The most notable feature of nanothermites, however, is the ability to selectively control their compositions, energy responses, densities, and equivalence ratios. In order to properly harness and utilize the energy release of these nanothermites in a controlled manner, microchip initiators have been fabricated using MEMS based device processing.
A new bloc: How globalization, economic stability and legacies of communism have affected Czech and Slovak young adults’ support for democracy
Abigail Geiger and Mary Stegmaier

More than twenty years after the collapse of communism, the question stills stands of how impactful the communist era still is on the new democracies. In the realm of international relations of political science, this research will analyze the support of democracy that young adults (between the ages of 15 and 30) have in the post-communist Czech Republic and Slovakia. Because this young adult cohort is the first to be most strongly involved in the new post-communist democratic powers in Central and Eastern Europe, the effectiveness of the democracy is important to ask of such an impressionable audience. This young cohort, compared to their elders who experienced communism first-hand, is more unpredictable. Through three prisms of theories, how do they support democracy or not? Considering “Satisfaction with Democracy” as the dependent variable, the chosen independent variables influencing Satisfaction with Democracy are Globalization, Economic Stability of both countries and Legacies of Communism (Czech and Slovak 2012 European Social Survey data was used). This research’s hypothesis is that globalization will have the strongest effect of the three on the cohort’s support for democracy. The young age (and other variables) of the cohort would likely factor into a weaker connection between Satisfaction with Democracy and both independent variables Economic Stability and the Legacies of Communism. Growing up in both a new democracy and an expanding and globalizing region, this cohort’s support of democracy will most likely be most affected by Globalization. Preliminary data has supported this contention. The findings and discussion of the results will not only see influencers on democracy support in transitional democracies but also offer questions on the topic for future analysis to help combine cross-cultural understandings of democracy.

This project was completed to fulfill a Capstone requirement.
According to the National Institutes of Health, 66% of individuals with brain cancer die within 5 years of diagnosis [1]. Many of these tumors are treatable but the blood brain barrier (BBB) prevents the delivery of drugs to the brain. Available treatments for tumors – surgery, radiation therapy, chemotherapy - are very invasive and have adverse side effects because healthy cells are affected along with cancer cells. One method of targeted drug delivery is electroporation, the process of making cellular walls temporarily permeable using electric fields. An electroporated cell membrane can transmit nanoparticles through the BBB directly to the cancer cells. The aim of this research is to investigate the use of electroporation for targeted tumor treatment through the BBB with an electroporation pulse generator. The pulsed electric field was created with a transmission line discharge into the test subject using a high voltage coaxial cable and triggered spark gap. Simulation results showed a rectangular voltage pulse can be achieved with pulse duration dictated by cable length, and amplitude dictated by the load resistor. The pulse generator system was used on live sedated mice with brain tumors to determine if the system would reduce tumor size.
Crime scenario based teaching of basic chemistry concepts
Spencer Glazer, Ryan Tegethoff, and Mark Milanick

When somebody is poisoned, forensic chemists have to separate compounds into groups in order to identify the poison. This separation utilizes the differences in solubility, polarity, and fluorescent properties to identify a specific compound out of a mixture. But most poisons are dangerous and not visible; students don’t get any reinforcement for what is happening. Therefore we have designed a simulated crime scene lab that lets students utilize colored grocery store compounds as surrogate poisons. This allows students to experience real-world applications of the concepts of chemistry. In this laboratory exercise, students will identify specific compounds in a mixture by working through oil-water partitioning and solubility shifts through salts or pH level manipulation. In addition, some compounds fluoresce with black light flashlights (available from Amazon). For example: quinine is a water-soluble compound in tonic water that is a bright blue fluorescent color under black light, whereas chlorophyll (from pills or olive oil) is a fluorescent orange oil-soluble compound. For decades, students have had to determine an unknown supplied by the teacher. We think the students will be more engaged if they work in two teams; each team has to construct a crime scene that the other time has to solve. Evaluation would include not only how well the students identified the unknown, but also how they constructed their crime scene. The teams must use the available techniques and materials to create a mixture with an “unknown” poison that the other team can unambiguously answer utilizing the same methods. The students can quantitate the absorbance and also discover that fluorescence is more sensitive than absorbance. The crime scene aspect of the lab will engage the students and the use of multi-colored, fluorescent compounds provides a visual feedback/representation of solubility and polarity.
Emily Grayek
St. Peters, MO

Faculty Mentor: Dr. Heather K. Hunt, Bioengineering
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

A proof of concept optical biosensor for the detection of C. jejuni
Emily Grayek, Emily O'Brien, Mark Anderson, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Dental composite materials have become standard in the offices of dentists across the United States. This is due to the composite’s many advantages over other common dental materials such as silver amalgam and gold. Composite materials provide the most aesthetic restoration as the material ends up looking very similar to the healthy tooth enamel. Dental composites are also minimally invasive, biologically compatible, are easy to repair and handle, while also providing high strength.

The goal of this research is to develop a new, stronger universal composite material than is currently available on the market by adjusting the particle size and filler content of the material. Current results show that the product developed in this research is equivalent in strength to the present standards set by industry leaders, which is around 150 MPa. The end goal for this research is for the newly developed composite material to surpass the strength of industry leaders by 20%, which would put the composite strength around 180 MPa.

The development of the new universal composite material is making good progress, as the strength of the material has tested to match the strength of the universal composite material of the current industries leaders. However, further development is necessary to bring the universal composite up to the 20% increase in current strength standards.
The purpose of this research is to examine driver behavior to assess the effectiveness of alert systems for improving safety at mobile work zones. During the study, two systems were evaluated: the Long Range Acoustic Device (LRAD) and a manual alarm system. The systems were evaluated based on sound levels, frequency of alarms (continuous or manual trigger), and driver behavior (i.e. merging and vehicle speeds). A review of applicable literature was conducted to determine what levels of sound could be harmful or confusing to drivers. The field testing consisted of applying the two alarm systems to mobile work zones in the St. Louis and Kansas City areas. The data collected was analyzed and used to form a recommendation for the Missouri Department of Transportation (MoDOT). Sound levels of both alarm systems were well under the dangerous threshold posed by OSHA and NIOSH. All systems produced improved merging distances of vehicles prior to reaching the work zone. A further investigation of the alarm systems is suggested before full-scale implementation.
Ashley Hackworth  
Wentzville, MO

Senior  
Biological Sciences

Faculty Mentor: Dr. Mark Kirk, Biological Sciences

**Long-term affects on tail posture are produced by chronic nerve cord transection in crayfish**

Ashley Hackworth, Daniel Bristow, Aimee Vanderbeck, and Mark Kirk

The crayfish, Procambarus clarkii, is a useful invertebrate animal model for studying principles of nervous system function. Current research shows that responses that escape tail flips, mediated by non-giant neural pathways that are disrupted after nerve cord transection, can reemerge over time, despite the lack of regeneration across the lesion site. However, little is known about how abdominal postural positioning is affected after CNS lesions; therefore, we tested for changes in tail posture that may be affected by nerve cord transection that could implicate plasticity in abdominal neural circuits. In this set of experiments, crayfish were transected between the last thoracic and first abdominal ganglia. The position of the tail at rest was documented using a double blind study over the course of 2 months. Experiments documenting the tail position of crayfish in water reveal that lesioned crayfish show a bias toward a flexed tail position, while sham-lesioned crayfish exhibit an extended tail position. Experiments documenting tail position while on dry surfaces reveal that lesioned crayfish again show a bias towards tail flexion, but to a lesser degree, while control crayfish show no significant bias toward either a flexed or extended tail position. These results suggest that neural connections associated with tail postural control are affected by transection and could provide deeper insight about CNS plasticity after lesions.
“Waste Not, Want Not”: Understanding and addressing the problem of food waste

Jackson Hambrick, Andrew Beckerle, Mary “Emmie” Harcourt, Henry Hellmuth, Lauren McDermott, Nicole Ripperda, Mary Schneier, Luke Welsh, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted annually worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. With current concerns about the agricultural demands of feeding a growing population, it is important to focus not just on increasing agricultural productivity, but to examine the current inefficiencies of our food system. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
Faculty Mentors: Dr. Qingsong Yu, Mechanical & Aerospace Engineering
Funding Source: College of Engineering Undergraduate Research Option

**Effect of neutral desensitizer EDTA and plasma treatment in enhancing adhesive-dentin interfacial bonding strength**
Han Han and Qingsong Yu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Match or Mismatch: Are teachers utilizing multimedia in the classroom for its intended purpose?
Tiffanie Hancock, Patrick Dent, Kaitlyn Erehart, Nilay Muslu, and Michelle Klosterman

We conducted a qualitative case study of five Pre-service Elementary Science Teachers’ (PSEST) use of popular media at Forest Elementary (pseudonym), a small rural school in the southeast part of the United States. These five PSEST were in the last semester of their undergraduate program, which emphasized inquiry-based science teaching (NSES, 1996), twenty-first century skills development (P21, 2009), and global awareness. They were assigned the task of developing three distinct lessons on a science topic related to the Amazon rainforest (a thematic focus of Forest Elementary at the time of the study), each lasting 45 minutes. Data for this study included teaching artifacts (e.g., lesson plans, teaching reflections) and three interviews – one before, during and after the instructional sequence. The purpose of the cross case analysis was to determine what media resources the PSEST viewed as most useful for classroom instruction and what factors influenced their choices. Through inductive analyses, we found that while the types and uses of media varied across the five PSEST, engagement was a pervasive rationale for classroom media use. Based on these results, and PSEST definitions of engagement as a means to persuade students to participate in and to display an interest in science, we conducted a comparison of how the engagement instructional strategies of PSEST (mis) aligned with the features of the media they used via a rhetorical analysis approach. We found that PSEST most often use logic to engage students, which matches the media they use. However, when emotion, timeliness, or authority are used as persuasive appeals in media, teachers do not leverage those appeals; PSEST underutilize the potential of media resources. These findings suggest several implications for teacher education programs, media creators, and classroom instruction.
Faculty Mentors: Dr. LuAnne Roth, English; Dr. Joseph Dolginow, Agricultural & Applied Economics; Dr. Luis Occeña, Industrial & Manufacturing Systems Engineering; Martha Dragich, JD, School of Law
Funding Source: Mizzou Advantage Undergraduate Research Team

“Waste not, want not”: Understanding and addressing the problem of food waste
Mary “Emmie” Harcourt, Andrew Beckerle, Jackson Hambrick, Henry Hellmuth, Lauren McDermott, Nicole Ripperda, Mary Schneier, Luke Welsh, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted annually worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. With current concerns about the agricultural demands of feeding a growing population, it is important to focus not just on increasing agricultural productivity, but to examine the current inefficiencies of our food system. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
Purpose: Late Infantile Neuronal Ceroid Lipofuscinosis (LINCL) is the most common form of Batten disease in children. Nearly all children with LINCL develop dysphagia that necessitates feeding tube placement. Pneumonia is the most common cause of death, typically occurring by 15 years of age. Despite the prevalence and the devastating outcome of dysphagia in LINCL, limited research exists. The purpose of this study was to characterize dysphagia in LINCL using a spontaneously occurring canine model that develops neurological symptoms ~6 months of age and dies ~10 months of age.

Methods: Eleven dachshunds (6 LINCL-affected and 5 healthy, age-matched controls) were tested using a freely behaving videofluoroscopic swallow study (VFSS) protocol established in our lab. Each dog was tested an average of three times between the ages of 6 and 10 months. VFSS recordings (30 fps) were analyzed to quantify 3 swallow parameters: time to maximal pharyngeal constriction, time to UES closure, and inter-swallow interval. Videos for 10 month old dogs have been analyzed.

Result(s): Compared to age-matched controls, inter-swallow interval was significantly longer for LINCL-affected dogs (p<.05) for all consistencies tested. No significant differences were identified for the other two swallow parameters.

Conclusion: This study provides novel evidence that LINCL-affected dogs develop dysphagia and are therefore suitable for translational dysphagia research to benefit people and dogs. Our ongoing research is focused on elucidating robust biomarkers of dysphagia that can be used to quantify treatment efficacy in clinical trials.
Computer vision module for Unmanned Aerial Systems operations
Ryan Haslag, Christopher Dopuch, Adam Faszl, Ryan Scantlin, and Matthew Dickinson

Unmanned Aerial System (UAS) operations are becoming increasingly important in military and civilian applications, and official FAA rulings will soon present new opportunities for domestic and commercial drone use. Drones provide a unique platform for video applications, and computer vision is key to processing and acting on that video data. Our project aims to create a comprehensive computer vision platform for use in UAS drones. Our system will visually identify targets autonomously via a 1080p video uplink from the UAS which is processed on the ground by computer. The system will operate in both the visual light spectrum and the infrared spectrum. Our platform is specifically designed for use with intelligence, surveillance, and reconnaissance (ISR) as well as search and rescue (S&R) operations.

This project was completed to fulfill a Capstone requirement.
Characterization of solar-cell degradation as electric-propulsion spacecraft pass thru the Van Allen belts

Eric Hayes and Craig Kluever

The purpose of this project is to determine the characterization of solar-cell degradation as electric-propulsion spacecraft pass thru the Van Allen radiation belts. This research will investigate how to efficiently model power loss for various spacecraft orbits. Currently power loss is computed by the Naval Research Lab’s complex code called Solar Cell Radiation Environment Analysis Models (SCREAM). We collaborated with Dr. Scott Messenger (current Physics professor at the University of Maryland-Baltimore County; former scientist at US Naval Research Lab) in using SCREAM to determine power loss from different sources of radiation on spacecraft orbit. We plan to efficiently integrate these power-loss models into Dr. Kluever’s low-thrust trajectory optimization program for electric-propulsion spacecraft. The challenge is to reduce the computational cost associated with running SCREAM for every orbit position as the spacecraft transits from low to high orbits and passes through the radiation belts. The result of integrating these models will produce a new integrated code which will incorporate and benefit both the solar cell and orbital optimization communities.
Multimodal writing workshop: Using poststructural theory to analyze structure and content
Amanda Heflin, Jocelyn Wallinger, Lauren Emerson, Candace Kuby, and Tara Gutshall

In the literature on writing workshop three phases are discussed: mini lesson, individual writing time with teacher conferences, and author’s share time (Ray & Cleaveland, 2004). In this approach children usually compose books with limited paper and writing choices. However, with the proliferation of research on multimodal literacies (Kress, 1997) we wondered how the structure and content of a writing workshop might change when students are introduced to a variety of art materials and encouraged to create multimodally. This study spans four years of research in a second grade classroom. We focused analysis on how one teacher stepped outside the traditional writing workshop structure and looked closely at her language, teaching decisions, and interactions with students. Through a process of pedagogical documentation (Lenz Taguchi, 2010) we collected videos, audio recordings, student made artifacts, interviews, and photographs. We thought with poststructural theory (Jackson & Mazzei, 2012), or plugged in ideas, to analyze data. We used concepts from Deleuze and Guattari’s (1987) rhizomatic theory to think about teaching and learning as unexpected departures, fissures, from the typical ways of writing in early childhood. We specifically focused on the following ideas to analyze data: desire, becoming, smooth and striated spaces, lines of flight, and intra-actions with materials. Insights gained from analysis were: 1) when embracing multimodal writing practices the structure of writing workshop might stay the same but the content of each section changes to respond to students’ literacy desires, 2) students become teacher as they demonstrate their processes in creating with a range of materials to their peers, and 3) as teachers follow students’ literacy desires the curriculum becomes more individualized and expanded. We encourage educators to think of ways to embrace fissures in literacy teaching and learning. When students are not limited in their thinking or materials powerful learning happens.
Dental adhesive fillers
J. Cameron Helmuth and Hao Li

Dental adhesives are responsible for mating dental composites to damaged human teeth. These adhesives are typically composed of dimethacrylate monomer and filler. In the presence of a curing agent, the monomers react and form polymer chains that adhere to both tooth and dental materials. The purpose of this research is to explore the effects of varying fillers and amounts of fillers on the viscosity of an adhesive and its microtensile bonding strength with dentin and dental composites.
Frequency control circuit to maintain a piezoelectric transformer at resonance
Travis Hencey, Peter Norgard, and Scott Kovaleski

Piezoelectric transformers (PT) are currently being applied to generate high voltage for portable x-ray and neutron sources. Resonant frequency drifts over time in the piezoelectric transformers make the device impractical to operate in an unattended mode or by un-trained individuals. To improve overall operating performance, a phase lock loop (PLL) based control circuit was developed. The circuit consists of phase-error detection, error amplification, a voltage controlled oscillator (VCO), and a signal conditioning filter over a continuous loop. Frequency drift was detected by monitoring the phase difference between input voltage and current to generate an error signal. The amplified error signal was used to provide a control voltage to the VCO, thereby driving an output frequency at the desired resonant frequency. This control circuit has been modeled and simulated in LTspice using a circuit model of the PT over a realistic range of operating conditions. Simulation results showed the circuit was capable of providing consistent resonant frequency control over the PT.
Kayla Henderson  
Kansas City, MO  
Junior  
Bioengineering

Faculty Mentor: Dr. James Lee, Bioengineering  
Funding Source: McNair Scholars Program

Azelnidipine attenuate the production of ROS induced by Aβ in bEND3 cell and its relevant signaling pathways  
Kayla Henderson, Tao Teng, Yawen Ni, and James Lee

Alzheimer's disease (AD) is a neurodegenerative disease characterized by loss of cognitive functions that include memory loss and decreased thinking abilities. The most common form of dementia, Alzheimer's is identified as a disease that primarily affects elderly individuals although early onset Alzheimer's has been observed. Although the cause of this disease is not well understood, the presence of amyloid beta (Ab) peptides in the brains of deceased AD individuals has led to studies of the role of the protein in AD. The oligomeric Abs 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 death. In this project, azelnidipine, a commercial drug that blocks calcium channels as a treatment of hypertension, was tested to determine if it could attenuate Ab-induced oxidative and inflammatory pathways in immortalized cerebral endothelial cells (bEND.3 cells). Western blots were performed to gather a relative comparison of the phosphorylation of Erk and cPLA2 between each group. Immunofluorescence microscopy was also employed to detect translocation of NF-kB P65 into the nuclei, and the expression of p-Selectin at the cell surface, and western blot was also performed for a relative comparison of the expression of e-Selectin. We expect to see a significant decrease in the phosphorylation of MAP kinases when cells are treated with drug. We also expect no translocation of NF-kB P65 into the nuclei and relatively low expression of e and p Selectin. The study of the effects of Azelnidipine on Ab pathways should prove to provide important information for the development of new therapeutic strategy for treatment of AD. Analyzing the effects will also allow us to better understand the complex pathways involved in Alzheimer’s disease.
**Intracellular calcium regulates the migration of motor neurons in the zebrafish embryo**

Nicole Herrera, Thao Le, Vinoth Sittaramane, and Anand Chandrasekhar

During vertebrate brain development, newborn neurons migrate from their birthplace to specific locations to form neural circuits and structures. Failure to migrate can lead to motor and cognitive disabilities. We are investigating the role of intracellular calcium ([Ca\(^{2+}\)]\(_i\)) in the migration of Facial Branchiomotor Neurons (FBMNs), which innervate muscles controlling jaw movements, and migrate caudally from rhombomere 4 (r4) to r6/7 in the zebrafish hindbrain between 15-36 hours post fertilization (hpf).

To test intracellular calcium’s role in FBMN migration, we examined the effects of Thapsigargin, a compound that increases [Ca\(^{2+}\)]\(_i\). Neuronal migration was evaluated in transgenic embryos expressing green fluorescent protein (GFP) in motor neurons. We performed dose-response experiments to identify parameters that did not compromise overall development. Following Thapsigargin treatment (18hpf), live embryos were scored for migration phenotypes (36hpf) and immunostained with anti-GFP antibodies. We found [Thapsigargin]>5 µM or exposure times >30 min resulted in necrosis, highlighting the importance of Ca\(^{2+}\) in other metabolic processes. Thapsigargin treatments of 3 µM for 15 min generated FBMN migration defects in 81.5% of treated embryos (n=560). Solvent-treated controls had fewer defects (23.8%, n=93 embryos). Defective migration is characterized by the presence of FBMNs in r4 and r5, creating a columnar phenotype. This suggests [Ca\(^{2+}\)]\(_i\) dynamics are crucial for FBMN migration.

To rule out the possibility that the migration of FBMNs is merely delayed in Thapsigargin treated embryos, we examined the location of FBMNs in treated embryos long after migration ceases (48 hpf). FBMNs remained in r4/5 in the majority of embryos (68.3%, n=287) indicating that the defective phenotype does not reflect a delay in the onset of neuronal migration. To determine whether Thapsigargin directly affects FBMN migration, we are currently examining the development and patterning of hindbrain tissues using various cell markers and in situ probes.

*This project was completed to fulfill a Capstone requirement.*
Robot simulation to support classroom instruction
Zachary Higginbotham and Jeffrey Uhlmann

The objective of this project is to develop a robot simulation system to allow students to experiment with and analyze algorithms for controlling the robots. The intended users of the system will be graduate students who are learning how to use data fusion and filtering algorithms to permit a robot to localize itself within an environment. The system will allow students to implement their algorithms so that the system can simulate the resulting behavior of the robot. By watching the robot’s performance, students can better understand the practical performance of theoretical algorithms. The simulation will be written in the language Octave due to, among other reasons, its high speed mathematical functions and compatibility with MATLAB, which will be useful to the graduate students when developing their virtual robots. As part of the developed toolset, a tool will be provided that will animate the results. All tools and parts of the simulation will be cross platform. The result of this will be an easily mobile toolset that will allow students to concentrate on rapid iteration of their own virtual robot.
Quality of parent-child relationships and the effects on child's romantic relationships
Rebecca Higgins and Nicole Campione-Barr

The purpose of this study was to examine the quality of parent-child relationships and the effects those relationships have on emerging adults’ romantic relationships. The initial sample consisted of 279 first year-college students but after filtering out those not involved in a current romantic relationship, we had 100 participants (38 males and 62 females). Emerging adults reported via online surveys on their positive and negative relationship qualities with their mothers, fathers, and romantic partners. The Network of Relationships Inventory was used to assess positive and negative relationship qualities of both the parent-child and the romantic relationships (Furman & Buhrmester, 1985). Four separate hierarchical regression analyses were utilized in the present study; with emerging adults’ perceptions of their positivity or negativity with romantic partners as the dependent variables and separate analyses for positivity and negativity with both mothers and fathers. Though tested, there were no significant moderations by sex evident in any of the analyses. There were marginally significant associations between positivity with mother and positive romantic relationships ($\beta=.17, p<.10$) and negativity with mother and negative romantic relationships ($\beta=.22, p<.05$). There was no significant association with positive romantic relationships but there was an association between negativity with fathers and negative romantic relationships ($\beta=.26, p<.01$). These findings suggest that the quality of relationships that emerging adult children have with their parents has both positive and negative effects on their romantic relationships.

This project was completed to fulfill a Capstone requirement.
Investigation of silver nanoparticle tissue scaffolds
Katie Hocker, Sarah Smith, and Sheila Grant

In the world of biomaterials, biocompatibility of implanted devices and tissues are of the utmost importance, as they determine the overall viability of the implant. In this project, the feasibility of crosslinking silver nanoparticles to decellularized tissue such as xenografts (porcine diaphragms or pericardium) was investigated. The objective of the study was to determine the optimal nanoparticle concentration in terms of stability and biocompatibility. The thermal stability and denaturation of the scaffolds was analyzed, in addition to biocompatibility and bacterial studies to further characterize the crosslinked tissue.
Got Starch? Decoding the *Carbon partitioning defective4* (Cpd4) mutant gene in maize

Cassandra Hoffner, Heidi M. Chapman, Saadia Bihmidine, Erin M. Finefield, Robert F. Baker, Mark Lubkowitz, and David M. Braun

The process by which carbon is transported from source tissues (photosynthetic leaves and tissues exporting carbon) to sink tissues (carbon-importing tissues) has been characterized at the physiological and biochemical levels; however, the genes responsible for this process have yet to be identified. Knowledge of the genes controlling this pathway could allow the development of new approaches for genetically modifying crops, which could lead to increased crop yield and improved human health.

Optimizing the potential for crop production has benefits in both agriculture (food and cattle management) and biofuel production. To identify these genes, maize plants are first screened in the field for phenotypic indications of carbon accumulation in leaves (chlorosis, anthocyanin accumulation, decreased plant height, etc.) and are then starch stained for confirmation as carbon partitioning defective (Cpd) mutants. Cpd4 is a dominant mutation phenotypically identified in the field by the yellow striping across the leaves caused by excess starch accumulation. To understand the function of the Cpd4 gene, we are cloning it using a map-based approach. Genomic DNA is isolated from Cpd4 mutants and wild-type individuals, and then analyzed by PCR and High Resolution Melt-curve (HRM) analyses with polymorphic DNA markers in order to identify recombinant individuals. In turn, these recombinant individuals are then used to delineate the chromosomal region where the Cpd4 gene is located. By examining the DNA sequence in this interval, candidate genes will be identified and sequenced to determine which one is responsible for the Cpd4 mutant phenotype. Once the Cpd4 gene is identified, it can be manipulated with the goal of increasing carbon partitioning in the plant and therefore increasing sucrose and starch concentrations in the sink tissues for increased yield and biomass.
Will mitochondria biogenesis increase in the nucleus accumbens, hippocampus, and lateral hypothalamus in the brain after 5 weeks of voluntary wheel running in selectively bred low voluntary running and high voluntary running female Wistar rats?

John Hofheins and Frank Booth

The goal of the project is to determine whether voluntary running causes an increase in mitochondrial density in brain cells, which could be a major contributor to exercise-associated health benefits. If Wistar rats exercise through voluntary wheel running for a period of 5 weeks it will result in an increase in the biogenesis of mitochondria in their nucleus accumbens, hippocampus, and lateral hypothalamus. It has previously been established in mice that treadmill exercise increases the amount of mitochondria in skeletal muscle tissue, which results in resistance to fatigue as well as many other exercise-associated health benefits. Recently, several papers have been published which state that exercise causes the biogenesis of mitochondria in the brain through analysis of markers of mitochondrial biogenesis. The correlation between the biogenesis of mitochondria in the nucleus accumbens, hippocampus, and lateral hypothalamus and exercise has not been thoroughly explored yet in HVR and LVR Wistar rats. The data I obtain will be useful in advancing current knowledge on this topic due to the fact that most published information does not focus on specific areas of the brain. 28-day-old HVR and LVR female Wistar rats will be randomly separated into two groups. One group will be the voluntary running group, which is composed of 16 rats who will be provided with a voluntary running wheel and the other, the sedentary group, will be composed of 16 rats without a running wheel. Each day, I will measure and record the nightly running distance and time of the voluntary running group. Every week, I will measure the weight of the food consumed as well as the body weight of both voluntary running and sedentary rats. At the end of the 5-week period the rats will be sacrificed and the nucleus accumbens, hippocampus, and lateral hypothalamus will be extracted from the brain. I will also extract and weigh the soleus, gastrocnemius, and the plantaris muscles for other investigations. At the end of the experiment and once all the desired tissues have been extracted we will analyze the levels of proteins associated with mitochondrial dynamics through western blotting. If time permits I will also perform the experiment with LVR Wistar rats.

Current topics addressed by study:

- Poor health caused by inactivity
- Obesity
- Benefits of exercise
- Alzheimer’s prevention
- Increased endurance due to resistance to fatigue
- Various central nervous system diseases
- Various diseases caused by old age

This project was completed to fulfill a Capstone requirement.
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Faculty Mentor: Dr. Raymond Semlitsch, Biological Sciences  
Funding Source: IMSD EXPRESS

The effects of prescribed fire on prey availability and diet diversity of Southern red-backed salamanders

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

In many forests, prescription burns are a means to manage overgrowth and increase biodiversity within the ecosystem. Due to their sensitivity to changes in the environment, amphibians serve as excellent ecological indicators. Despite the benefits of managed fires, this process decreases the amount of leaf litter available for cover and affects the local soil invertebrate populations, which influence amphibian growth and their survival rate (Pilliod et al. 2003). Terrestrial salamanders are one of the most abundant vertebrates in deciduous forests; however, their exact role in the ecosystem remains unclear. Salamanders may escape direct mortality by retreating into burrows during fires, but the availability and diversity of their food source may be reduced. Davic et al. (2004) acknowledged salamanders as keystone predators that regulate the amount of soil invertebrate numbers within leaf litter. In spring 2013, we gathered gut-content samples from Southern red-backed salamanders (*Plethodon serratus*) in the Sinkin Experimental Forest located in the Mark Twain National Forest in southeastern Missouri. We surveyed ten plots that were either untouched or prescription burned in December 2012. Salamanders were obtained through searches of leaf litter and under other natural cover objects. Overall, we found 75 salamanders and collected 65 gut-content samples. Out of the total, 33 gut contents were from salamanders found in control plots while 32 were from burned plots. Our study explores the effects of prescribed fire and seasonality on invertebrate prey availability using the nutritional intake of terrestrial salamanders, which will help us understand the indirect effects of prescribed fire on amphibians.
Animal assisted activity (AAA) programs offer widespread physiological, social and emotional benefits to recipient populations, specifically older adults. While AAA is common in nursing homes, it is less common in retirement residences where individuals are often suffering from the stress of relocating and transitioning to a more dependent lifestyle. PAWSitive Visits (PV) is a weekly AAA visitation program conducted in a group-setting at a Midwestern retirement residence that brings an array of domestic and exotic animal species for the residents to interact with. The PV program includes educational experiences to enhance the residents’ knowledge and curiosity. A pilot study of the PV program was conducted with a small sample of residents to determine the extent to which older adult attendees bonded with an animal visitor. We also posed research questions addressing the extent to which personal characteristics such as age, and previous pet ownership were associated with bonding and a visitor. Residents (N=13) at TigerPlace who regularly participated in the PV program were asked to complete a brief demographic questionnaire about themselves and the Center for the Study of Animal Wellness Pet Bonding Scale (CSAWPBS) after engaging in a one-hour visit with a dog. It was found that older adults who participated in the PV program formed a bond with the visitor animals. Findings also showed that residents of a younger age group (80-89 years) exhibited a stronger bond with the visitor animals, than the older adult age group (90+ years) who also participated in the program, but this was not statistically significant based on an independent samples t-test. PV is a unique and successful program, coordinated in a manner that ensures the health and safety of both animal and human counterparts, while at the same time providing residents with experiences that enhance their well-being.
Ahad Hosseini  
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Industrial & Manufacturing Systems Engineering

Faculty Mentor: Dr. David Brune, Agricultural Systems Management  
Funding Source: College of Engineering Undergraduate Research Option

Quantifying capital lost due to inefficient inter-research communication at the University of Missouri
Ahad Hosseini, Haley Martin, Cerry Klein, and David Brune

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Ryan Hough
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Senior
Biological Sciences

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

**Contribution of propriospinal neurons to locomotor function following spinal cord injury in the larval lamprey**
Ryan Hough, Katie Benthall, and Andrew McClellan

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Laser based measurements for characterization of flat plate, parallel flow experiment geometry
Robert Humphry and Gary Solbrekken

The University of Missouri Research Reactor (MURR) utilizes thin fuel plates with coolant flow channels separating each plate. To assist in characterizing the fluid structure interaction of a proposed low-enriched uranium (LEU) fuel, an experimental study of the flow induced deflection of a surrogate, aluminum flat plate is underway. The primary goals of this study are to evaluate velocity profiles, pressure distributions, and plate deflection in the experiment. These experiment results will be used to validate numeric models. In order to better characterize the experiment, a technique has been developed for mapping the thickness of the fluid channels using a pair of laser based deflection sensors.
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Electrical Engineering  

Faculty Mentor: Dr. Robert O'Connell, Electrical & Computer Engineering  
Funding Source: College of Engineering Undergraduate Research Option  

Smart Power Distribution System with distributed generators  
Mingxin Huo and Robert O'Connell  

The project is focusing on the analysis of the smart power distribution system with distributed generators. The Smart grid is an inevitable trend that is in progress in the electrical industry. In order to build up a more secure, sustainable, reliable power grid, generations of electrical engineers are working on the improvement with joint effort. Smart Power Distribution System is an essential component in that work. With the assistance of multiple distributed generators and the Fast Non-dominanted Sorting Guided Genetic Algorithm, we are seeking a way to reconfigure the distribution system to find the optimal network configuration in order to achieve less power loss, better voltage profile, and no branch overloading. We are doing simulations on a widely used 32-bus system, and our outcome shows good performance on both normal operation and fault operation. By improving the distribution system, we will be able to bring a more reliable, effective and efficient power grid to society.
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Biochemistry and Physics

Faculty Mentor: Dr. Shi-Jie Chen, Physics and Biochemistry  
Funding Source: Life Sciences Undergraduate Research Opportunity Program

**Incorporating experimental SHAPE with RNA structure modeling**  
Travis Hurst, Peinan Zhao, Xiaojun Xu, and Shi-Jie Chen

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Specific speed analysis for centrifugal pump
Bilal Hussain and Ahmed El-Gizawy

Centrifugal pumps are a sub-class of dynamic axisymmetric work-absorbing turbo machinery. Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. The rotational energy typically comes from an engine or electric motor. The fluid enters the pump impeller along or near to the rotating axis and is accelerated by the impeller, flowing radially outward into a diffuser or volute chamber (casing), from where it exits. The goal of this research is to produce an easy way to modify impellers on the centrifugal pumps. Using the specific speed of the pump which is a (dimensionless quantity) the efficiency was calculated. The specific speed being dimensionless quantity will provide a guide line for choosing an impeller, as the size of the impeller will not affect the efficiency of the pump, only the shape of the impeller will be the main factor. The experiments were conducted using as system of tank with almost 550 gallons of oil running into the pump. Sensors were installed to measure the pressure input and the output of the system, flow rate, vibration of the pump, and the temperature both inside the pump and in the pipe system. The results were obtained using LabView software and translated into Matlab for analysis. The whole system is simulated in SolidWorks and CFD analysis were made to compare the experimental results with the simulated results.
Mohammed Hussain
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Senior
Civil & Environmental Engineering

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

Development of activated carbon fabric baffle walls
Mohammed Hussain and Enos Inniss

Disinfection by-products (DBPs) form when organics and minerals present in water react with chemical addition used for disinfecting water. DBPs are present in most drinking water supplies. Exposure to DBPs in drinking water has been associated with human cancers and some adverse birth defects. One treatment option to reduce DBPs in drinking water is to employ activated carbon. Activated carbon is useful in drinking water treatment because it acts as an adsorbent, and can effectively remove particles, organics, and DBPs from water. The goal of this research is to develop activated carbon baffle walls for water treatment systems. The experimental design first considers interactions between fabric materials and various forms of activated carbon by comparing percent removal of TOC and UV254. Then appropriate placement of the baffle walls is tested by passing water taken from various locations (namely from the effluent of the Missouri river) in the treatment process through fabric baffle walls. Isotherm studies have so far shown that several carbon products currently on the market perform better at absorbing organic DBP precursors. However, higher concentrations (up to 50 mg/L) of these products make their use as a simple additive to the process cost-prohibitive. The next phase of the effort is to determine the best way of immobilizing the carbons that are currently available to smaller community drinking water treatment systems (which are primarily coal or wood-based).
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures
Matthew Jackson, Austin Stake, Zachary Brinker, Virginia Trauth, Zachary Treece, and Sarah Orton

Flat plate reinforced concrete structures have been a common design option for many years. They are popular for a number of reasons including ease of construction, decreased required story height, and lower cost. A flat plate reinforced concrete structure consists of reinforced slabs that are supported directly by the columns. Due to the nature of this design these types of structures are vulnerable to punching shear failures at the slab column connection. When a failure of this type occurs it can lead to the surrounding connections being overloaded in turn causing them to fail in the same manner. This effect is called progressive or disproportionate collapse.

The overall goal of this research is to evaluate the potential of disproportionate collapse in older reinforced concrete flat-plate buildings subjected to the loss of a supporting column. The research program considers testing of isolated slab column connections that represent the connection near the lost supporting column. The goal of the tests is to evaluate the effects of in plane lateral restraint, dynamic loading rate, and post-punching capacity. The results of the isolated slab tests will be presented as well and explanation of future work.
Deborah Jacquin  
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Senior  
Civil Engineering

Faculty Mentor: Dr. Enos Inniss, Civil and Environmental Engineering  
Funding Source: College of Engineering Undergraduate Research Option

**Blow it out of the water: Aeration to reduce DBPs**  
Deborah Jacquin and Enos Inniss

Drinking Water Treatment processes include a disinfection step to eliminate pathogens, particulate matter and other harmful pollutants from our water. A negative consequence of the disinfection process is the formation of disinfection by-products (DBPs), including trihalomethanes (THMs) and haloacetic acids (HAAs). Chloroform (CHCl₃) is a common THM that is formed from interactions between chlorine residual and organic matter in the distribution system. With the promulgation of Stage 2 of the Disinfectants and Disinfection By-Products Rule requiring Location Running Annual Average (LRAA), compliance creates more stress for small community drinking water treatment systems. The University of Missouri Drinking Water Research Team (UMDWRT) is studying the formation of DBPs and ways to reduce it in our water to help these treatment plants stay in compliance. In many of the systems studied the dominant form the DBPs is chloroform, which is volatile and therefore can be easily transferred to air from water resulting in overall DBPs reduction.

The purpose of the project is to determine the conditions where aeration is the most effective for chloroform reduction in a clearwell. Determination of the effectiveness of this process requires several steps. The first step is to determine the chloroform percentage of DBPs for the communities. Next, bench scale testing determines which aeration scheme yields better results. Concurrent with this effort is the design and construction of a pilot-scale unit to test the effectiveness of the aeration strategy in the field. We found that the average percentage of chloroform in the water of our partner communities is 70%, with the low being 33% and the high being 92%. The pilot scale unit was therefore designed to aerate the water to allow the relatively high concentrations of chloroform to volatilize into the air bubbles using commercially available materials.
Over time, many political scientists have begun to entertain the idea that the Supreme Court – the most sacred and nonpolitical branch of the United States government – is becoming gradually more public with the media. One of the most comprehensive forms of media that has been used since the founding of our country is the newspaper. From the development of different types of print media to today’s technologically published articles, individual Supreme Court justices have been mentioned in newspaper articles in a variety of different ways – both objectively and subjectively. From an observation like this arises a question about the nature of the relationship between the Supreme Court and the media. Have justices on the Supreme Court really been mentioned more and more over time as numerous media outlets have been introduced and the media becoming more complex? Do public approval ratings play a role in any of this over time? In my study, I analyzed results from searching the number of times each justice was mentioned in a headline of The New York Times since the start of its existence in 1851. Though I hypothesized the number of times each justice was mentioned to increase as time went on, I reached a null finding, only to further delve into the ways in which the top ten and bottom ten justices mentioned in headlines were discussed in the newspaper. Throughout my analysis of the top ten mentioned justices, I compared the content of the news stories mentioning him or her to what the public approval of the Supreme Court is during their time on the bench to see if there was a possible relationship between the content and approval ratings.

*This project was completed to fulfill a Capstone requirement.*
Examine the collaborative thinking: Shared work environments
Alyssa Jensen, Lindsay Webb, and Bimal Balakrishnan

In the fall, we researched how technology and shared environments facilitate group design decisions and communication. We oversaw a group of students work to solve an ill-structured architectural problem while using different technologies to solve the problems. A comparison was made in how group decision-making processes change when in different shared environments. We analyzed the use of shared workspace, freehand sketching, keystroke patterns and how well teams work with current technology and software.

Previous studies on this topic laid a solid foundation for creative convergence network studies. However, prior research did not incorporate sketching as a form of communication in the collaborative process. Because of recent technologies, the Architectural Studies department now has the ability to incorporate freehand sketching into the collaborative process. Sketching is a vital step in the design process; it allows different representations to take place quickly. In the digital age, sharing and communicating early ideation stages is an important step because it can help foster new ideas.

The technologies analyzed were those commonly used on collaborative team projects: Cintiq tablets, and either flash drives, Tidebreak’s TeamSpot, or TeamViewer were all studied. The goal of this research was to examine how technology changes the approach to team design and how it aids the creative decision-making process. After analyzing the varying degrees of technologies, it is safe to say the shared workspaces helped facilitate design.

The benefit of this research is two-fold. First, contributions to the existing research of team psychology and how collaborative work environments aid the design process were made. In addition, an analysis is made on how communication through sketches helps ease the design process. Conducting this research also helps professionals understand different approaches to creative thinking and architecture, while providing the opportunity for researchers to gain invaluable experience in conducting guided academic research.
Faculty Mentor: Dr. Dong Xu, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

Big data clustering and display for protein expressions
Zhongrong Jian, Qiuming Yau, and Dong Xu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Variation in cell size can be caused by both genetic and environmental conditions, in a variety of organisms across taxa. In animals cellular dimensions may help determine physiology and anatomy, which could lead to changes in behavior of the organism. One environmental factor, larval density, is known to affect body size of many anurans at metamorphosis, which is a key factor in juvenile survivorship. While body size and cell size are often correlated, the relationship between density and cell size has not been investigated. My experiment tested to see whether the rearing density of tadpoles affected the cell size of the tadpoles. My hypothesis was that tadpoles raised in higher densities would have smaller cells while tadpoles raised in lower densities would have larger cells. I raised tadpoles in densities of 1, 10, and 20 tadpoles per 473ml of water. Tissue samples from the tadpoles' tails were taken at two points during development: when tadpoles grew their back legs and again when they had both back and front legs. I measured overall length of the samples, body length, and tail length. Preliminary results indicate samples with original densities of 1 or 10 have a longer overall length and a longer tail length. These environmental effects on cell size may facilitate evolution in different environments, although we will need to determine whether cell size differences are maintained into adulthood.

This project was completed to fulfill a Capstone requirement.
Ashley Jones  
Columbia, MO  
Senior  
Language Arts Education

Faculty Mentor: Dr. Jennifer Clifton, Learning, Teaching, & Curriculum  
Funding Source: Missouri Writing Project

**Developing a pedagogy of empathy: Exploring identity, differences, and values through collaborative inquiry, dramatic monologues, and public dialogue**  
Ashley Jones, Kameo Miller, and Jennifer Clifton

In the spring of 2013, our undergraduate English education class chose to engage in a collaborative inquiry around an overarching question, “How do young people experience diversity within the high school English classroom?” Through interviewing students, compiling and performing monologues from student responses, and holding a public forum on issues raised during the performance, we interrogated our personal assumptions and recognized the complexity of issues in students’ everyday lives. We collaborated with youth in a deeper exploration into questions of difference, drawing on their experiences as resources. Through interviewing a range of participants and compiling our monologues with our classmates, we considered a variety of experiences and perspectives. The juxtaposition of these perspectives worked to explode generalizations and binaries, revealing how complex and varied individual perspectives and social concerns can be. Through performing the monologues live for an audience, we called immediate attention to present and vivid concerns of adolescents in the English classroom. We also chose to hold a public forum for discussion in order to extend our complex exploration of diversity to a wider audience- exploring the “and now what?” Throughout the process we further developed our level of empathy with students’ unique concerns in the English classroom.
Samuel Jonesi  
Grain Valley, MO  
Senior  
Computer Science

Faculty Mentor: Dr. Prasad Calyam, Computer Science  
Funding Source: College of Engineering Undergraduate Research  
Option

**Improving remote MRI processing through a better encoding selection scheme**

Samuel Jonesi and Prasad Calyam

I am researching using virtual network computing in order to improve the viewing of MRI images. Ordinarily, they are processed on-site at a hospital, but thanks to the improved bandwidth of the Internet, they can now be processed remotely and viewed on a consumer-grade laptop or other similar computers without the need for specialized hardware. There is a lot of data that needs to be transferred over the Internet, and doing so in a timely manner requires a certain encoding scheme be used to compress a certain number of bits to a smaller number and thus save time and bandwidth. There are many different encoding schemes available. Some work better than others for different network conditions. The goal of my experiments this semester was to find the best encoding scheme at three different bandwidth levels. To minimize the number of comparisons I would have to make, I took the 10 encoding schemes available on the open-source VNC client UltraVNC and arranged a tournament to find the best one. I then compared that with the default that UltraVNC selected for that bandwidth level. I did this six times total. Three tournaments were held at three different bandwidths and used a purely subjective comparison between two encoding schemes while three other tournaments used an objective measurement between the different encoding schemes. Of the six total tournaments, two selected an encoding scheme that performed better than the default encoding selection scheme chosen by UltraVNC.
Optimization of orthopedic interference screw geometry subjected to pullout force for improved resultant stresses
Adam Joyce, Craig Wilkins, and Hao Li

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Conditioned place preference (CPP) is a model of how environmental cues influence drug use and involves pairing a drug (cocaine) with a neutral stimulus. After conditioning, mice display a preference for the area paired with cocaine. Cocaine’s affinity for \( \sigma_1 \) and \( \sigma_2 \) sigma receptors contributes to its conditioned-rewarding effects. Sigma receptor antagonists have been shown to reduce or prevent cocaine-induced CPP. Here, the ability of the sigma receptor ligand PD-144418 to affect cocaine-induced CPP was determined. PD-144418 has high affinity and is very selective for the \( \sigma_1 \) over the \( \sigma_2 \) sigma receptor subtype. PD-144418’s ability to produce CPP and to influence the induction and expression of cocaine-induced CPP was determined in mice. Rotarod and zero-maze procedures were conducted to determine PD-144418’s effect on learned motor skill and influence on anxiety-like behavior. The results showed that a high dose of PD-144418 enhanced the induction of cocaine CPP; however, PD-144418 showed no effect in the other measures. Overall, these results indicate a role for the \( \sigma_1 \) sigma receptor in the conditioned-rewarding properties of cocaine and that PD-144418 may behave as a \( \sigma_1 \) receptor agonist. These results further reinforce the theory that sigma receptors are important in the behavioral effects of cocaine.

*This project was completed to fulfill a Capstone requirement.*
Murder by insulin: Teaching physiology through crimes
Basima Khan, Samantha Browning, Katherine Meidl, Margaret Urschler, and Mark Milanick

Five patients die from excess insulin in one hospital. Coincidence? Were they murdered by a nurse injecting too much insulin? Or did their bodies produce too much insulin? To solve this real life murder, the forensic experts had to understand the physiology of insulin and C-peptide. Patients with Type 1 Diabetes can also use C-peptide levels to determine remaining pancreatic function, as well as for other clinical applications. We created a lab to teach these concepts in an engaging way. First, we will start off our discussion with a Law and Order clip discussing a murder by insulin case. Next, we will present information regarding types of diabetes, and their physiology in the body. The body makes proinsulin, crosslinks it, and then cuts off the C-peptide, but the pancreas releases both pieces. To illustrate these ideas further, we will have the students do a planned activity that demonstrates how insulin and C-peptides work in normal and diabetic bodies. Following this, we will present a newspaper article that brings the lab back to the original murder case. In the case we designed for the students, there will be a question of whether the person died from low blood sugar naturally or by the hand of their caretaker. The students will learn how C-peptides can be measured to determine if this was a natural death or a murder. They will be given a second activity, in which they will determine if the c-peptide levels of simulated blood samples indicate murder. Lastly, we will give them a worksheet that allows them to critically think about the physiology of insulin and C-peptides, as well as how this physiology can be applied to murder.
Evan King  
Columbia, MO  
Senior  
Mechanical & Aerospace Engineering

Faculty Mentor: Dr. Matthew Maschmann, Mechanical & Aerospace Engineering  
Funding Source: College of Engineering Undergraduate Research Option  

Mechanical healing of carbon nanotube forests via capillary action  
Evan King, Benjamin Davis, and Matthew Maschmann

Carbon nanotube forests are thermally and electrically conductive materials that offer beneficial properties to applications such as thermal interface materials, physical sensors, filtration membranes, and composite materials. The performance of CNT forests in these and other applications is intimately coupled to the mechanical behavior of the forest. We demonstrate that the sequential introduction and removal of solvents into CNT forests reversibly modulates the forest stiffness by an order of magnitude. In the immersed state, van der Waals forces between CNTs are relaxed, leading to a reduction in forest stiffness and an increase in elastic recovery. Capillary forces arise during solvent evaporation, transversely compressing the forest during the drying process. These transverse forces draw CNTs into close proximity and densify the forest. Solvent densification is retained upon full evaporation of the solvent, increasing the forest stiffness. Further, we demonstrate that plastic deformation of the CNT forests introduced in the dry state may be partially or fully relieved by the re-introduction and subsequent evaporation of solvent. These findings indicate that the mechanical properties of CNT forests may be actively and reversibly modulated to suit a given application environment and that CNT forests demonstrate “healing” of mechanical damage by solvent treatment.
Pregnancy-associated glycoproteins (PAGs) are produced abundantly by giant trophoblast binucleate cells of the ruminant placenta, which can enter the maternal circulation as well as milk and urine. Consequently, the measurement of PAGs can serve as the basis for pregnancy detection in ruminants and begin to appear in maternal blood around day 25 of pregnancy in cattle; increasing steadily throughout gestation and peak at parturition. The current work focused on measuring PAGs in placental extracts. The hypothesis was changes in PAG expression by the placenta would subsequently be reflected in the maternal circulation. Placental cotyledons (n=44) representing all stages of pregnancy, were homogenized and dialyzed. Total protein concentration (µg/mL) was measured using the bicinchoninic acid protein assay with bovine albumin as the standard. Total PAG concentration was approximated using two different sandwich enzyme-linked immunosorbant assays (ELISA) developed to measure PAGs. PAG amounts were normalized based on total protein in the extracts and results were graphed to permit comparisons. These indicated both monoclonal and polyclonal ELISAs displayed different PAG protein profiles. The monoclonal-based assay showed a significant increase in total PAG concentration from day 35-day 50, then a decrease in the rest of the first trimester. The polyclonal-based assay revealed PAG concentrations were not statistically different during the first trimester. The amount of measured PAG also differed between the two assays, with the monoclonal assay typically displaying 2-3 times more PAG than the polyclonal assay. In the present study, the hypothesis was not supported by the given data as PAG concentrations in the placenta extracts peaked at day 50, while PAGs in maternal blood peaked prior to that, around day 35. Future work, based on the present study, will investigate changes in PAG glycosylation status throughout pregnancy and the continued evaluation of different assay platforms.
Evidence for VP in VSO Kisongo Maasai
Rebecca Kirkle and Vicki Carstens

1. Introduction. In VSO Kisongo Maasai (KM), ellipsis and other tests provide evidence for the existence of an underlying verb phrase constituent, supporting an account of KM word order patterns consistent with the hypothesis of a universal base.

2. Simple tenses. In simple sentences, main verbs raise to the left of the subject. When two TPs sharing a transitive predicate are conjoined, VP-ellipsis in the second TP is possible but strands the verb. This suggests V-to-T movement, with the verb moving from its original position in the vP across the subject to T, leaving any objects alone in the vP for potential ellipsis.

(1) a. etadwa Luka Maria n-etadwa si-nine Jonas (Maria) PST.see Luca Mary and-PST.see also-3SG John Mary ‘Luca saw Mary and John did too’

b. …[TP V-v-T … [VP <V> OB]] VP-ellipsis affects only the direct object because V has vacated VP

3. Adding auxiliaries. When an auxiliary occupies T in this type of construction, the main verb surfaces in the vP left-adjacent to its object. The resulting Aux-SVO word order allows the verb to elide from the second TP along with the object.

(2) a. edipa Luka ana eda n-edipa si-nine engera (ana enda) PRF Luca eat food and-PRF also-3SG child eat food ‘Luca has eaten food and the child has (eaten food) too’

b. …[TP AUX-T … [VP V OB]] VP-ellipsis affects both V and its object because V has not raised

This project was completed to fulfill a Capstone requirement.
Chris Knoll  
Arnold, MO  
Sophomore  
Mechanical Engineering  

Faculty Mentor: Dr. Hao Li, Mechanical & Aerospace Engineering  
Funding Source: College of Engineering Undergraduate Research  
Option  

**Fabrication and evaluation of calcium phosphate filled dental composite**  
Chris Knoll, Thomas Gagnon, Kevin Loeppke, and Hao Li  

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
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 are allelopathic towards the model cyanobacterial models and to determine optimal concentrations most active in allelopathy so as to be able to use as a selective influence for studies of metabolic manipulation.
A reliability method for estimating soil water characteristic curves
B. Ray Koenig and John J. Bowders

Electromagnetic (EM) wave propagation is a popular geophysical technique to determine characteristics of the subsoil without disturbing it (non-destructive-test, NDT). EM techniques have been used to detect subsurface hazardous waste, locate pipeline leaks and buried utilities, locate groundwater, seepage through dams and levees, and define soil stratification. The propagation and attenuation of EM waves through a soil are directly related to the soil’s dielectric constant. Expressions to predict the dielectric constant of soils have been developed. For soils, the dielectric constant is a function of the volumetric water content, $\theta$, and matric suction, $\psi$, of the soil. The volumetric water content of a soil is a relatively easy measurement; however, the matric suction is not so.

The objective of this project was to develop a method to estimate, at a known reliability, the range of matric suctions for a soil at given water contents. The matric suctions can then be used to predict the dielectric constant for a soil and subsequently quantify the ability of an EM wave to propagate through the soil.

The soil water characteristic curve (SWCC) describes the relationship between a soil’s volumetric water content, $\theta$, and the matric suction, $\psi$, that soil exerts on the pore water. The SWCC depends on the type of soil. In a clay, the water is held primarily by its electromagnetic attraction to the soil particles, whereas in a sand it is held by the capillary forces which are weaker in comparison. Consequently, matric suctions in clayey soils tend to be much higher than in sands. In this project, SWCCs for several soils from McBaine, Missouri were measured using three different techniques: pressure plate extractor, Hyprop®, and Tempe cell. The data from the measurements were compiled and a statistical method for finding the average, coefficient of variation and standard deviation of the SWCC of the soils was developed. The method allows for the prediction of the matric suction of the soil with a known reliability for a given water content. The predicted matric suction is then used in the expressions to predict dielectric constant of a soil which in turn is used to estimate the propagation and attenuation of the EM wave through the soil.
Sam Kreter
Jefferson City, MO

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

Parallel programming with GPUs
Sam Kreter and Michela Becchi

My current research has been primarily learning and understanding the many components that go along with parallel programming and GPU processing. I have spent the majority of my time on reading through the CUDA documentation and understanding the architecture of GPUs. Using this I have been working on a C to C compiler that takes in standard C code with specialized key words then complies it into standard C code. These specialized key words will be used to help with the translation of graphing and set algorithms to be parallelized. The research will allow for fast and easy programing of complex algorithms and data structures with GPU based parallel programming.
Plants and humans generate urea by intermediary metabolism. Humans excrete urea as a nitrogenous waste product. Since plants are usually nitrogen (N)-limited, they recycle endogenously generated urea, catalyzing its conversion to ammonia and bicarbonate by action of the enzyme urease. Urease is the only plant enzyme known to contain Ni at its active site, and so Ni is essential for optimal N use efficiency in plants. However, at high concentrations Ni is toxic to plants. Thus, we are seeking soil amendments that allow plants to take up Ni and to utilize it, without suffering from Ni toxicity. We are trying two amendments, Biochar, and the soil and air-born bacterium Methylobacterium spp. (= pink-pigmented facultative methylotrophs, or PPFMs)

Since biochars (pyrolytic products of plant materials) are stable in the soil, and are usually acidic we are testing their ability to sequester Ni, for slow release to plants. Also, biochars can harbor beneficial bacteria. We are selecting PPFM mutants that are resistant to Ni. The aim is to select a mutant line that takes up Ni, and effectively lowers Ni toxicity while still providing Ni to the plant. We will show our selection techniques, and preliminary growth tests of Arabidopsis thaliana (model plant) on variously amended media.
Seasonal changes in the fish assemblages within the runs in Cole Camp Creek
Trevor LaClair and Douglas Noltie

An observational study was conducted near Cole Camp, Missouri, to investigate the seasonal changes in the fish assemblages of three run habitats in Cole Camp Creek. Standardized transect counts (fish visually identified to species, and sizes estimated) were conducted ca. monthly in each of the runs from March 2013 to the present. It was predicted that the census values would increase in the spring and decrease in the fall. Through time, there have indeed been changes in species richness and total abundance. Run A (upstream) contained the highest diversity of fish; substrates here were largest, and the riparian zone was the most fully developed. Sunfish have been observed spawning in Run A in late spring. Run B (middle) contained the lowest diversity of fish and a modest riparian zone. Fish observed in this run were often seen moving upstream, suggesting that Run B may be more of a transition zone. In Run C (downstream), fallen tree branches and steep muddy banks provide structure; numerous fish were seen here during the warmer months. During the late fall and early winter, Cole Camp’s warm-water species generally appear to migrate downstream out of the study site and towards or into the Osage River, after which cool-water species then appear to migrate upstream and into the study site. The cool-water species have been observed most in Run A during the winter, whereas Runs B and C contained few to no fish at this time. Differences through time in the abiotic attributes of each run (temperature, flow, substrate, shelter), coupled with fish growth, recruitment and presumed mortality, and migration, are likely what are impacting assemblage structure at these locations. The research is still in progress and is scheduled to be completed in 2015.
Representing African women in Wole Soyinka's *The Lion and the Jewel*
Jacqueline Land and David Crespy

Wole Soyinka is one of the most influential African playwrights and was awarded the Nobel Prize for Literature in 1986. His work confronts issues of post-colonization in Africa and African diaspora, particularly the tensions between traditional Yoruban culture and modern Western influences in Nigerian society. *The Lion and the Jewel* explores these ideas in a comedic and lighthearted way, setting up an allegorical love triangle that indicates Soyinka’s attitudes about post-colonialism.

One of the major criticisms of this play from a feminist perspective is the sexist treatment of women. However, recent criticism recognizes the innate limitations in traditional feminist theory as it tends to marginalize black or African womanhood by privileging sexual differences over other social issues. These critics have called for wider definitions of feminism that contextualize the interrelated oppressive forces toward women around the world.

I address the aspects of Yoruban culture impacting women that Soyinka illustrates in the play, which require analysis cognizant of interrelated systems of oppression. I propose a production concept using design and direction to emphasize the female character’s agency throughout the play: 1) the casting and performance choices that could reinforce the women’s knowledge of traditional social and cultural customs; 2) the inclusion of chorus members in scenes that illustrate the plurality of African womanhood; and 3) the aesthetic elements such as masks and music that would foreground traditional tribal culture. Ultimately, I aim to provide an interpretation and visual production proposal of *The Lion and the Jewel* in order to help viewers understand Soyinka’s interests and major themes as well as the historical systems of oppression affecting Yoruban women in a post-colonial setting.
The decennial census and apportionment: Issues of fair representation
Joseph Lasher and Jay Dow

The House of Representatives is the only governmental body of the United States federal government that has its seats apportioned based upon the population of the states. Therefore, it is vitally important that the House be as representative of the actual population as possible. The numbers used to apportion the seats for the House come from the decennial census. This study will be examining two drawbacks to the decennial census. First, there is the issue of differential undercount. This can lead to inaccurate census results that would cause unrepresentative apportionment. The second drawback to the decennial census is its periodicity. It only occurs every ten years, and within that time the population could potentially geographically shift greatly. This would cause the elections closer to the next decennial census to be less representative of the actually population. These issues will be examined from their political and legal histories in depth. The possibility of using other census figures other than the decennial census for purposes of apportionment will also be explored. Primarily these figures will come from using other Census Bureau publications such as the American Community Survey and Population Estimates. In this analysis it is found that the differential undercount and periodicity of the census do affect the representativeness of the apportionment process. It is also found that the study's proposed improvements to the apportionment process may be legally possible under current statutes and legal precedents.

This project was completed to fulfill a Capstone requirement.
Point cloud visualization for 3D microscopy image analysis
Dan Lasker, Joshua Fraser, Jacob Sewell, and Filiz Bunyak

Point cloud visualizations are becoming increasingly important for interpreting images, and they have strong application in the analysis of biomedical imaging. Given the complexity of these data visualizations, improving upon existing methods of thresholding is necessary for more precise renderings. We are currently working on an existing point cloud visualization software with the goal of implementing a functional thresholding option that can be applied to the point depth, and we are using existing tools including OpenGL, Qt Creator, and Visual Studio.
In search of human correlates for lick rate
Rachel Lazenby, Mallory Ferguson, Alyssa Weatherly, Rebecca Schneider, and Teresa Lever

Our lab has identified lingual dysfunction as the earliest known biomarker of swallowing impairment in the SOD1-G93A transgenic mouse model of amyotrophic lateral sclerosis (ALS). At weaning (3 weeks), these mice lick significantly slower than age-matched controls. Although licking behaviors in mice and ingestion of liquids by humans appear quite different, they serve a common purpose (oral ingestion) and utilize common neurological components (e.g., hypoglossal nucleus and trigeminal nucleus). Therefore, our finding with mice suggests that people with ALS may develop subclinical lingual dysfunction prior to presentation of clinical symptoms of dysphagia or speech impairment. We hypothesize that utilizing tongue ticking behavior, as well as other noninvasive instruments, can provide diagnostic tools that will aid in subclinical diagnosis in patients with ALS. We have established a protocol to test this hypothesis and data collection is currently in progress with healthy adults across age groups ranging from 20-89 years (n = 140). Digital recordings (via Praat) will be analyzed to quantify the following variables: tongue tick rate, diadochokinetic speech rate, swallow rate, and mastication rate. Tongue strength will be measured using the Iowa Oral Performance Instrument (IOPI). Statistical analyses will be conducted upon completion of data collection. Results will provide normative values for future comparison with patients with ALS. We expect this non-invasive, simple test will aid in disease detection, monitoring of disease progression, and quantification of treatment efficacy.
Membrane compaction is a normal phenomenon that exists in the initial hours during membrane filtration process. Nanofiltration (NF) membranes, are often regarded as a nanoporous media. Based on the previous research, pore size is a crucial parameter in evaluating and modeling the flux and rejection profiles of the membrane filtration. However, at the initial hours of operation, hydraulic pressures added perpendicular to the membrane surface will lead to the pore collapse and cause a variation in the water permeate and the retention of the solutes. In this research, we developed a time-dependent model based on the classic pore model equations. NF-90 and NF-270 commercial membranes are investigated in the study. Milli-Q water, Glucose solution and NaCl solution are interpreted to characterize the membrane properties, such as the pore size, thickness to porosity ratio, as a function of time.
Michael Leahy  
Linn Creek, MO  

Faculty Mentor: Dr. William Horner, Political Science  

The existence and effect of profit bias: A comparison of public and private online news  
Michael Leahy and William T. Horner  

With the rise of online news media over the past several years, new customer markets have been opened for news outlets and advertisers alike. This study has worked to examine the influence that profit has on online news sources and whether content is affected differently based on whether a news site is privately or publicly funded. To achieve this, the websites of the New York Times (NYT) and the British Broadcasting Corporation (BBC) were compared due to their equivalent status and differing funding sources. In four twenty-four hour tests, screenshots were taken of different elements on the websites’ home pages at varying intervals. The data was hypothesized to prove that the NYT would produce more content in categories of its site intended to appeal to large consumer markets not necessarily tied to hard news (such as sports, entertainment, etc.) so that the site could bring in more customers, and therefore create greater profit. It was also predicted that the publicly funded BBC would have more news that would be considered newsworthy (thereby directly affecting the lives of a large amount of consumers). The results of the tests disproved both hypotheses, however. Instead this project has shown that the necessity to make profit has caused the NYT to focus more on its core audience by providing greater depth and newsworthiness in its coverage of certain news areas rather than trying to appeal to a larger number of markets. Conversely, the BBC has focused on the width of its coverage by producing greater amounts of content across all of its diverse categories so it can work as the public resource it is intended to be.  

This project was completed to fulfill a Capstone requirement.
**Loren Littrell**  
Mexico, MO  
**Senior**  
Communication Science & Disorders

Faculty Mentor: Dr. Teresa Lever, Otolaryngology  
Funding Source: Mizzou Advantage Undergraduate Research Team

**Characterization of dysphagia in a canine model of Late Infantile Neuronal Ceroid Lipofuscinosis (LINCL)**  
Loren Littrell, Rebecca Harris, Vanessa Gaiser, Mitchell Allen, Mollie Ulsas, and Teresa Lever

**Purpose:** Late Infantile Neuronal Ceroid Lipofuscinosis (LINCL) is the most common form of Batten disease in children. Nearly all children with LINCL develop dysphagia that necessitates feeding tube placement. Pneumonia is the most common cause of death, typically occurring by 15 years of age. Despite the prevalence and the devastating outcome of dysphagia in LINCL, limited research exists. The purpose of this study was to characterize dysphagia in LINCL using a spontaneously occurring canine model that develops neurological symptoms ~6 months of age and dies ~10 months of age.

**Methods:** Eleven dachshunds (6 LINCL-affected and 5 healthy, age-matched controls) were tested using a freely behaving videofluoroscopic swallow study (VFSS) protocol established in our lab. Each dog was tested an average of three times between the ages of 6 and 10 months. VFSS recordings (30 fps) were analyzed to quantify 3 swallow parameters: time to maximal pharyngeal constriction, time to UES closure, and inter-swallow interval. Videos for 10 month old dogs have been analyzed.

**Result(s):** Compared to age-matched controls, inter-swallow interval was significantly longer for LINCL-affected dogs (p<.05) for all consistencies tested. No significant differences were identified for the other two swallow parameters.

**Conclusion:** This study provides novel evidence that LINCL-affected dogs develop dysphagia and are therefore suitable for translational dysphagia research to benefit people and dogs. Our ongoing research is focused on elucidating robust biomarkers of dysphagia that can be used to quantify treatment efficacy in clinical trials.
Faculty Mentor: Dr. Dong Xu, Computer Science
Funding Source: College of Engineering Undergraduate Research
Option

**WEBLOGO design for protein sequences**
Yuyang Liu and Dong Xu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Hao Li, Mechanical & Aerospace Engineering
Funding Source: College of Engineering Undergraduate Research Option

**Fabrication and evaluation of calcium phosphate filled dental composite**
Kevin Loeppke, Thomas Gagnon, Chris Knoll, and Hao Li

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
This project was to evaluate modes of convection battery operation to eliminate battery failures of lithium metal anodes due to dendrite formation. Dendrite is a branching growth due to the buildup of lithium metal inside the cell, and causes cell failure by puncturing the separator and making the cell short-circuit. To test this, a control was established of a traditional diffusion cell design and its operation that has high failure rate due to dendrite formation. After establishing a procedure for the control, the convection battery was tested under similar conditions with reverse flow patterns that are designed to eliminate dendrite failure, and did so by lowering ion concentration in the separator. SEM imaging was used to confirm this.
Abby Lombardi
St. Louis, MO

Junior
Biological Sciences

Faculty Mentor: Dr. Christian Lorson, Veterinary Pathobiology and Molecular Microbiology & Immunology
Funding Source: MU-HHMI C3 Program - Hughes Research Fellowship

Delivery of morpholino modified antisense oligonucleotides that target the intronic repressor Element1 and increase survival in mouse models of Spinal Muscular Atrophy
Abby Lombardi, Arleigh Atkinson, Erik Osman, and Christian Lorson

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Marginal effects of international experience on human rights speeches in the US Congress
Anne Lotko and Amanda Murdie

There are many different factors that can affect why members of Congress bring up human rights concerns on the congressional floor. Bringing up human rights concerns on the congressional floor gives Congress justification for prompting important individual rights in US relations with foreign governments and their citizens such as, promoting democracy, marketing economies, and freeing people from religious persecutions (Galey, 1998). Ellen Cutrone and Benjamin Fordham (2010) study why Congressional members in the 104th and 105th Congress bring up human rights concerns and why they appear on the American foreign policy agenda. They found that humanitarian interests are a strong motive for bringing up human rights concerns on the congressional floor, but constituent economic interests strongly influences which members of Congress speak out. Finding the reason why US Congress members bring up these concerns on the congressional floor is important to understand because it can, and often does, lead to concrete actions. Issues raised in Congress and in other public settings can influence American foreign relations even when they do not actually make policy (Cutrone and Fordham, 2010). This study adds a new theoretical explanation to Cutrone and Fordham’s study of why congressional members are speaking out about humanitarian concerns. It suggests that if congressional members have any background in international relations, then they are more likely to have a critical speech. Results indicated that although a small number of congressman have an international experience, those that do are far more likely to speak out for human rights, even after accounting for the reasons previously deemed important by Cutrone and Fordham.

This project was completed to fulfill a Capstone requirement.
Mary Beth Luebbe  
Chesterfield, MO  

Senior  
Chemical Engineering  

Faculty Mentor: Dr. Thomas Marrero, Chemical Engineering  
Funding Source: College of Engineering Undergraduate Research Option  

**Use of biochar and Azos for the growth of *Arabidopsis***  
Mary Beth Luebbe and Thomas Marrero  

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Variation in recombination frequency in maize inbred lines
Collin Luebbert and Michael McMullen

Recombination is a genetic phenomenon which shuffles genetic sequences between homologous chromosomes during meiosis. Recombination aids in proper chromosome segregation and creates new combinations of genotypes that can be utilized by plant breeders and genetic researchers. Historic data and analysis of the nested association mapping population indicates large genotypic differences in local and global recombination rates. In this study, we genotyped the progeny from reciprocal crosses of seven different inbred lines of maize and B73. Genotyping was done by next-generation sequencing using a two-enzyme genotype-by-sequencing approach. The sequence reads were then aligned to the B73 reference chromosome and single nucleotide polymorphism determined and used to develop genetic maps. These data were analyzed for differential recombination rates among the different inbreds and between reciprocal crosses. Moving forward, the sequence data created in this experiment as well as the data analysis will be used in the future to study the structural features that affect recombination in maize.
Hongxi Luo  
Wuhan, Hubei Province, China

Junior  
Chemical Engineering

Faculty Mentor: Dr. Sheila Baker, Chemical Engineering  
Funding Source: College of Engineering Undergraduate Research  
Option

Ag doped Fe-N-TiO$_2$ with good photocatalytic performances under visible light  
Hongxi Luo and Sheila Baker

It has been well proven that materials such as Fe-N-TiO$_2$ have good photocatalytic performances under visible light. Furthermore, if noble metal is well deposited on the surface, the performances may improve since noble metal can serve as electron sink thus reducing the electron-hole recombination rate while the metallic plasmon resonance can increase the absorption of visible light. In this work, we investigate sliver-modified Fe-N-TiO$_2$ and its application toward catalytic degradation of environmental pollutants.
The concentrations of harpagoside induced from *Scrophularia lanceolata* when interacting with the dietary generalist caterpillar *Spodoptera exigua*
Briana Lynch, Heidi Appel, and William Folk

Plant metabolites are molecules that are directly or indirectly involved in the development and ecological function of plants and can be important sources of medicines. The southern African plant, *Harpagophytum procumbens* known as the “Devils Claw,” contains secondary metabolites that have analgesic properties and are used as medicine to treat musculoskeletal pain. Important secondary metabolites found in the Devils Claw are the iridoid glycosides, harpagide and harpagoside. However, a concern with *H. procumbens* and many other Southern African plants of medicinal value is they are currently being over harvested by European countries. This has led scientist to search for other plants in the same plant family (Scrophulariaceae) that produce similar levels of harpagoside, such as *Scrophularia lanceolata*. 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 as a defense mechanism. This study focuses on whether increases occur in these iridoid glycosides by treating the plants with feeding by caterpillar, *Spodoptera exigua*, or with an application of the plant hormone methyl jasmonate (MeJA) that replicates induction of plant defense. The experiment uses net cages to restrict feeding of caterpillars on same age leaves to control for developmental variation. I have learned how to expose plants to insects and to extract and analyze harpagoside using HPLC. Results from my first experiment comparing the levels of harpagoside in control plants with levels in those treated with caterpillars and with MeJA will soon be available. Once I have collected this data, I will be able to test my hypothesis that herbivory damage and MeJA can increase the concentrations of harpagoside, and I can further investigate on other variables that influence defense induction.
Joshua MacGregor
Ozark, MO

Faculty Mentor: Dr. Yangchuan Xing, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research Option

The influence of PTFE in the cathode transition layer of an aqueous electrolyte Li-air battery
Josh MacGregor, Yunfeng Li, Kan Huang, and Yangchuan Xing

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Heather K. Hunt, Bioengineering
Funding Source: College of Engineering Undergraduate Research
Option

**Patterning silicalite thin films using Carbon Dioxide laser ablation**
Dylan Macoubrie, Swarnasri Mandal, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Dysphagia is a swallowing disorder that affects almost six percent of the population, especially in the elderly population. Dysphagia can result in serious problems including choking, aspiration leading to pneumonia, and malnutrition. All of these are serious issues that can ultimately be fatal, so in recent years there has been a focus in research to more readily and accurately characterize dysphagia using non-invasive techniques. The popular methods for characterizing dysphagia currently include videofluoroscopy, endoscopy, and cervical auscultation. The first two methods are invasive, and can only take place in a controlled clinical setting. In addition videofluoroscopy, the current gold standard, involves exposure to radiation which should be minimized for safety reasons. Cervical auscultation, on the other hand, involves the monitoring of swallowing sounds using a conventional or digital stethoscope placed on the throat. This approach has the benefits of being non-invasive and potentially portable.

A novel noninvasive technique is being developed in this continuing study where the digital audio signatures from a unidirectional condenser microphone (like in cervical auscultation) is complemented with supporting measurements of digital acceleration histories from three axes, and indirect airflow measurements using piezoelectric gages to more fully monitor and characterize swallowing events using external throat measurements. Companion monitoring of ambient temperature and relative humidity add to the comprehensiveness of data gathered from the swallowing event. Mixed time and frequency domain analysis of waveform data from these swallow measurements, either post-measurement or in real-time will allow identifying swallow disorders as well as treatment efficacies. The portable hardware (using Arduino micro-controller) and companion custom developed software (written in C and LabView) will allow convenient physician led clinical use for real-time diagnostic purposes as well as comprehensive data logging for longer term monitoring in more realistic at-home settings.
Chase Mareth  
Butler, MO  
Senior  
Agribusiness Management  

Faculty Mentor: Dr. Abner Womack, Agricultural Economics  
Funding Source: CAFNR On Campus Research Internship  

Using futures price options as a means to protect against market volatility  
Chase Mareth and Abner Womack  

Increased volatility in world commodity markets has urged U.S. farmers to adopt new marketing strategies for grain crops. Utilizing futures price options as tools, large price swings may be used advantageously to protect against bottom-side prices. A set of hedging price ranges and guidelines developed using the USDA’s WASDE projections and FAPRI baseline data were tested for effectiveness using corn, soybean and wheat prices. To develop these guidelines, world market outlook data was collected using the USDA’s monthly WASDE report as a primary resource. This data was analyzed for trends that would affect decision making in each market. A running history of futures contracts and individual put and call prices was also recorded for each commodity on a weekly basis for two crop seasons. Records were kept for December corn and wheat options and November soybean options. All pertinent data was then summarized and provided in a handout that can be utilized by farmers. The idea is to buy puts with market prices on the high side of the range. As market prices fall, put prices increase and protect the farmer from significant price drops. Calls can be purchased when market prices are on the low end of the range and used to the opposite effect as puts. To analyze the developed guidelines, hedging decisions were made and evaluated using the price ranges and market outlook trends. These decisions were made on a weekly basis while adhering to the guidelines for each specific crop. Following the developed guidelines resulted in potential premium opportunities of $2.50/bushel in corn, $1.50/bushel in soybeans and $2.00/bushel in wheat for the 2011 crop. The 2012 crop has shown the chance to protect bottom-side prices by purchasing December puts. The price ranges and guidelines combined with the FAPRI baseline can be applied by farmers marketing corn, soybean and wheat crops in today’s commodity grain markets.
Quantifying capital lost due to inefficient inter-research communication at the University of Missouri
Haley Martin, Ahad Hosseini, Cerry Klein, and David Brune

Communication in our modern world has allowed advancements to proliferate at an unprecedented rate. Transparency in communication with regard to research has the potential to greatly accelerate results.

Our research goal is to quantify improvements in outcomes as a result of utilizing improved systems or programs supporting cooperative and interdepartmental collaboration. Inspired by the core tenant of Mizzou Advantage, which is to foster interdisciplinary collaboration among faculty, staff, students and external partners to address and solve real-world needs and problem, we believe it is essential to put a value on the financial and human capital that is lost.

We have devised a three-pronged plan to tackle this issue:

1.) Preliminary two-person IMSE research team that will focus on Dr. David Brune’s aquaculture program and quantify the resources lost due to lack of communication.

2.) Expand research team to include research programs representing all sectors of campus.

3.) Work with IT to create a platform for all MU faculty, students, and staff to provide a digital medium to access and evaluate research completed and in progress by peers.

Though we fully understand the enormity of such a task, we believe that it would be feasible to have the research in place to prove to administration how vital interdisciplinary communication is. It is our highest goal to create a future where the research done on this campus will be accelerated by the enormous amount of information readily available. Mizzou could become a model for how to preserve resources while still producing world class research.
Key genes of carbon allocation in galls
Victor Martinez-Cassmeyer, Heidi Appel, and Jack Schultz

Plants are comprised of sink and source tissues that compete for resources. Source tissues, such as mature leaves, are able to fix carbon in excess of their needs, and either store or export the excess. Sink tissues, such as young leaves, roots, and fruits, are unable to fix enough carbon and have to import it as sucrose from source tissues. Galls are tumor-like organs that are induced on plant tissues by many insects. It has long been a mystery how insects cause galls on plants, and our lab has been investigating this using the model system of Phylloxera on grape leaves (Vitis vinifera). Gall formation appears to result from a switch in the developmental program of developing leaf tissue from vegetative to reproductive. The accumulation of carbon is important for the formation and maintenance of galls. I have mined gene expression data to construct a visual expression network of genes known to be responsible for carbon allocation using the online database ATTED-II. In the future, we hope to compare this list of genes to replicated RNA-seq data of galled and ungalled grape tissues from grape. The prevention of carbohydrate accumulation during galling could lower the economic impact in this model as well as of other economically important plant species, such as rice and wheat.
Bullying behavior has been a major concern in America’s schools for more than two decades. Today, one in three students report being bullied, with students with disabilities being two to three times more likely to be bullied than their nondisabled peers. Students who are victimized experience greater psychological and physical distress, which are manifested in a variety of ways, such as poor school performance, stomach aches, headaches, depression, and anger. While bullying may seem like a “normal” aspect to public education, it has legal implications, especially for students with disabilities. In particular, disability-based harassment and long-term bullying may violate a student’s right to a Free and Appropriate Public Education, which is required by the Individuals with Disabilities Education Act.

For our study, we provided the University of Illinois and Wellesley College: Student Behavior Survey to the students of twenty-two public schools in Texas. These public schools included junior highs, middle schools, and high schools, including grades six through twelve. Our population included 14,508 students, of which, 1,183 students had disabilities. In the survey, we used five items to gauge student responses in regards to special education status, sense of school belonging, sibling aggression, bullying behavior, and victimization.

In our study, we wanted to see if a student’s sense of school belonging could moderate participation in the bullying spectrum, especially with students who perpetrate sibling aggression, for students with and without disabilities. We found that students who felt they belonged at school were less likely to participate in bullying behavior than students who had negative feelings toward their school. Also, if students are bullying their siblings at home, they are more likely to be bullies at school.

This research stresses the importance of sense of belonging. Missouri’s House Bill No. 1543 is one of the more highly rated in the nation but it does not address sense of school belonging. In particular, my goal is to see schools provide emotional and psychological support to students who are involved in the bullying spectrum and to include language to support the assessment of school climate. With these necessary components, all students, regardless of disability status, will have access to a Free and Appropriate Public Education.
Biocatalyst immobilization on chemically tailored graphene oxide nanosheets
Richard McCay and Gary Baker

Graphene is the thinnest material that exists in the Universe, consisting of a one-atom-thick honeycomb of carbon atoms. Graphene and its cousin graphene oxide (GO) have emerged as superlative materials for various practical applications due to their remarkable mechanical, electrical, and optoelectronic properties. For example, graphene is the strongest material known, can sustain current densities a million times higher than that of copper, is impermeable to all gases, has a huge specific surface area, and shows record-level thermal conductivity, to name a few features.

Nanosheets of GO are decorated with acid, alcohol, and epoxide groups as well as hydrophobic patches that enable the covalent linkage and adsorption of biomolecules. In this research, we will develop approaches for conjugating enzymes to the surface of GO to develop protocols to better understand their behavior once immobilized. Although a handful of enzymes have been attached to GO in the past year, the biomolecule–GO interactions can result in significant loss of biomolecular structure for reasons not yet understood. This project will involve a systematic manipulation of the chemistry presented at the GO surface as a means for favorably modulating these interactions. Richard’s roles in this project will include performing the enzyme conjugation to the GO surface, leading studies of the structure and activity of GO-bound enzymes, and coordinating with peers in the group to perform imaging and spectroscopic studies of the GO-enzyme nanoconstructs.

The long-term vision for this work is the development of nano-armored enzymes that can operate in challenging and inhospitable environments, leading to future-generation sensors and ultra-efficient catalysts for environmental cleanup and energy conversion.
Nerve regeneration: Identifying and utilizing key proteins to facilitate nerve cell adhesion and axon extension
Daniel McGrath and Matthew Bernards

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Reinventing sewage treatment in the third world
William McNeary, Andrew Miller, Reza Espanani, and William Jacoby

According to the World Health Organization, 2.4 billion people in the world live without access to adequate sanitation facilities. This enables the spread of diseases such as cholera and typhoid fever; it is estimated that diarrheal diseases kill some 2 million people each year, the majority of which are children under 5 years old. This problem is further compounded by the fact that many regions lack the water resources and economic capital required to implement conventional sewage systems. Therefore, it is necessary to examine alternative methods for waste treatment in the developing world.

The Carbon Recycling Center (CRC) at the University of Missouri is investigating the application of supercritical water oxidation (SCWO) in the treatment of sewage sludge as part of the Bill & Melinda Gates Foundation’s “Reinvent the Toilet” Challenge, a program that aims to foster innovation in sanitation by awarding research grants to universities and private firms around the world. SCWO is a high-temperature, high-pressure process that utilizes the unique properties of water beyond its critical point (when it is neither liquid nor gas). It is a powerful heat-producing reaction that effectively destroys germs, thereby producing drinkable water, and, unlike conventional waste incineration, does not emit harmful air pollutants. Our group, along with collaborators at Duke University, is developing a neighborhood-scale unit to meet the sanitation needs of approximately 1,200 people.

The CRC is home to our unique laboratory-scale SCWO unit, which is run continuously in 2-3 hour intervals in order to collect data about the reaction and potential hazards. I am also running experiments in batch reactors with sewage simulant, in order to determine the minimum energy to start the reaction. Collection of results and data analysis is ongoing, but the Duke team is currently using our laboratory data to construct the demonstration unit; the team will conduct field testing at a location in India, Ghana, or South Africa. Our ultimate goal is to work with local officials, residents, and non-governmental organizations to ensure that the technology meets the sanitation needs of these communities in a sustainable and financially profitable manner.
Analysis of GPU acceleration for various pattern matching and geospatial data processing solutions
Kevin Melkowski, Matthew England, and Grant Scott

In this research, we have designed algorithms for pattern matching using graphics processing units (GPU), geospatial aggregation techniques and various terrain silhouette extraction techniques. We conducted performance analysis and algorithm efficiencies studies for the pattern matching algorithms. These studies explored several different pattern sizes and similarity metrics to determine the optimal method for searching through patterns. We also evaluated the algorithms on different sets of hardware with multiple levels of parallelism to determine the best configuration and most efficient method of matching patterns. Furthermore, we performed an analysis on several different similarity metrics and measured its impact on the pattern matching algorithm. In order to visualize the results of the pattern matching algorithms, we used geospatial clustering based on spatial proximity, orientation, and pattern match similarity. Finally, we developed terrain silhouette extraction and encoding techniques to generate large-scale pattern data sets. We ran performance analysis to verify algorithm efficiencies for various pattern data set representations, comparing the tradeoffs of memory usage versus speed. This research included analysis using different computational architectures, such as GPU and central processing units (CPU). We analyzed multiple levels of parallelism to find the expected accelerations using GPU hardware for the various stages.
Improved detection of metastatic melanoma with photoacoustic flow cytometry
Mark J. Messler, Erin N. Bax, Benjamin S. Goldschmidt, and John A. Viator

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Improving semiconductor materials for high powered infrared lasers
Charles Meyer, Emily Cheng, and Gregory Triplett

Current infrared lasers are too weak to meet the growing demand for high-powered, infrared light generation. With increased power and efficiency, infrared lasers could have a profound impact on everyday life; applications for this technology range from creating the ultrafast communications systems of tomorrow to providing a means for diabetes patients to noninvasively test their blood sugar. To increase the power output of these lasers to maximum levels, the semiconductor materials used to build these devices must be improved at the atomic level.

Two important semiconductor materials used for infrared lasers, gallium arsenide (GaAs) and indium arsenide (InAs), are of particular interest for creating the next generation of laser devices. Usually, when InAs is deposited on GaAs to form a laser, the InAs will form quantum dots. Quantum dots are atomically rough structures that can limit the performance of certain laser designs. Our research has found a way to form smooth layers of InAs on GaAs, which opens up the possibility for utilizing InAs in a high powered laser structure. This project served to quantify exactly how smooth these InAs layers are, and to see which deposition parameters produce the highest quality InAs.

Over 20 samples were made by depositing InAs on GaAs under varied conditions in our molecular beam epitaxy reactor. We used a scanning electron microscope and reflection high energy electron diffraction to qualitatively monitor the surface roughness of the samples. We then measured the surface roughness of each sample using an atomic force microscope to determine the correlation between the conditions used for InAs synthesis and the quality of the InAs material produced. The highest quality samples have extremely small surface roughness, while poor quality InAs forms rough surfaces. We found the best material to have a surface roughness of .23nm, which is roughly the diameter of a single atom. By finding the parameters associated with such high quality material, we will be able to incorporate high quality InAs into a unique laser design that could be utilized for ultrafast communications, chemical sensing, or noninvasive blood glucose monitoring.
Unitizing understanding of first grade students
Cassandra Mezines, Lauren Montgomery, John Lannin, and Delinda Van Garderen

Unitizing is essential for understanding place value (Fosnot & Dolk, 2001). A deep understanding of unitizing includes viewing a quantity in two ways simultaneously (e.g., viewing 10 as one ten and ten ones). Using clinical interviews, we examined the numeric development of 63 first grade students. Part of this broader study involved analysis of student understanding of unitizing. These students were asked to look a diagram of 7 bags of marbles with 5 marbles in 6 of the bags and 2 marbles in the remaining bag. Students were asked how many marbles altogether and how many groups of 5 marbles they saw. Through our analysis, we categorized student responses into four levels of understanding: (a) sophisticated, (b) transitioning, (c) single unit, and (d) other. This study has important implications for place value in first grade.
Arguably no other president in United States history has been the subject of repeated debate more so than John F. Kennedy. As history has been able to evaluate his presidency, public approval ratings of John F. Kennedy have continued to remain high. Some scholars, however, maintain that there is a significant gap in how the public perceived as well as currently perceives the Kennedy presidency, to the actual reality of the Kennedy presidency. In particular, there is a significant gap in the perception and reality of John F. Kennedy when examining the Cuban missile crisis of 1962, the civil rights movement in the early 1960s, and his personal health. The two events, in addition to President Kennedy’s personal health, are the central topics of the study. November of 2013 marked the fiftieth anniversary of the assassination of John F. Kennedy. Throughout the study, articles written to commemorate President Kennedy in November of 2013 are used to help explain and verify the extent to which the gap in perception and reality still exists in modern day. Even after fifty years of historical analysis, the myths of yesterday are continued today. Moreover, the study offers an examination of the implications of the gap between perception and reality, particularly as it relates to the personal health of President Kennedy. As a part of the study, a survey was conducted in which Political Science students from the University of Missouri-Columbia were asked basic questions about the health of John F. Kennedy. As expected, some students had little to no knowledge of the health problems. The survey is indicative of how the American myth of John F. Kennedy is still prevalent in modern day.

This project was completed to fulfill a Capstone requirement.
The present study examined similarities in externalizing and internalizing symptoms between siblings when compared at the same point in time versus the same chronological age. We predicted that siblings compared at the same point in time would show a stronger association in both internalizing and externalizing behaviors than siblings compared at the same age, with same-sex dyads having the strongest associations, based on Social Learning Theory tenets. The sample consisted of 82 sibling dyads, ranging in age from eighth grade to freshman in college. Data from a four-year longitudinal study of siblings was used to compare second-born siblings (46% male, 54% female) to first-born siblings (51% male, 49% female) at Time 1, as well as at the same age as first-born siblings at Time 1. The participants were overwhelmingly European-American and middle class.

Bivariate correlation analyses were performed comparing older and younger siblings’ internalizing and externalizing symptoms at the same point in time versus the same chronological age. When comparing older and younger siblings’ internalizing symptoms at both the same point in time and same chronological age, siblings’ ratings were similarly and mildly correlated, suggesting genetic similarities and family environmental factors influence internalizing symptomatology. Externalizing behavior only showed significant similarity between siblings at the same point in time, suggesting that younger siblings model their older siblings’ externalizing problems. Additionally, same-sex sibling dyads were more likely to show similarity across internalizing and externalizing than siblings in mixed-sex dyads.

This project was completed to fulfill a Capstone requirement.
Developing a pedagogy of empathy: Exploring identity, differences, and values through collaborative inquiry, dramatic monologues, and public dialogue

Kameo Miller, Ashley Jones, and Jennifer Clifton

In the spring of 2013, our undergraduate English education class chose to engage in a collaborative inquiry around an overarching question, “How do young people experience diversity within the high school English classroom?” Through interviewing students, compiling and performing monologues from student responses, and holding a public forum on issues raised during the performance, we interrogated our personal assumptions and recognized the complexity of issues in students’ everyday lives. We collaborated with youth in a deeper exploration into questions of difference, drawing on their experiences as resources. Through interviewing a range of participants and compiling our monologues with our classmates, we considered a variety of experiences and perspectives. The juxtaposition of these perspectives worked to explode generalizations and binaries, revealing how complex and varied individual perspectives and social concerns can be. Through performing the monologues live for an audience, we called immediate attention to present and vivid concerns of adolescents in the English classroom. We also chose to hold a public forum for discussion in order to extend our complex exploration of diversity to a wider audience- exploring the “and now what?” Throughout the process we further developed our level of empathy with students’ unique concerns in the English classroom.
Bacillus anthracis sporulates in response to nutrient limitation. The spore form of the bacterium can persist in the environment for long periods of time and is the infectious form of this pathogenic organism. Once the spore is ingested or inhaled by a host, germination begins leading to infection of the disease. The exosporium, the outermost layer of the spore, is believed to be important in regulation of germination and interaction with external environment. In a previous study from our laboratory, a mutant B. anthracis strain with a disruption of an operon carrying BAS0384-0390 genes was found to contain defects in the exosporium layer. To determine if any of the proteins encoded in this gene cluster are structural components of the spore, each gene in the operon was fused to the mCherry fluorescent reporter and introduced into the Sterne control strain and to the operon knockout strain of B. anthracis. Out of the seven proteins encoded in the operon, only three fluorescent fusion proteins localized to the exosporium in the control and operon deleted mutant strains. To study the role of the operon in the spore formation, A number of major exosporium proteins were fused with the fluorescent reporter and then introduced to the operon knockout strain. The transformed bacteria were cultured for sporulation and the spores were harvested and observed under fluorescence microscopy. The level of fluorescent fusion proteins on the spore would be compared between the knockout strain and Sterne control strain. By this approach, the effect of loss of the operon-encoded proteins on exosporium assembly can be evaluated.
Richard Miner
Carthage, MO

Senior
Electrical Engineering

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

Langmuir probe development for characterization of an RF plasma for use in a portable neutron source
Richard Miner, Emily Baxter, and Scott Kovaleski

Portable neutron sources have applications ranging from well logging to radioactive forensics. Portable neutron sources may be made using radioactive materials, which introduce proliferation and health risks, or using electronic generators, which usually contain bulky high voltage electronics. A piezoelectric transformer plasma source (PTPS) was developed as an ion source that will be coupled with an accelerator to create a compact electronic neutron generator. The fundamental characteristics of the plasma generated by the PTPS, specifically electron temperature and plasma density, are presently unknown. A Langmuir probe was designed to measure the current-voltage relationship across the plasma, from which the plasma temperature and density can be determined. An LC (inductive-capacitive) filtering circuit was designed to mitigate the RF signal interference with the measurement of the DC current. The probe length and penetration depth into the plasma, and insertion techniques were taken into account to minimize the interference of the Langmuir probe on the plasma.
Laura Moley
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Senior
Animal Sciences

Faculty Mentor: Dr. Michael Smith, Animal Sciences
Funding Source: CAFNR On Campus Research Internship

Detection and cDNA cloning of pregnancy associated glycoproteins in elk
Laura A. Moley¹, Ky G. Pohler¹, Tina Egen¹, Michael F. Smith¹, Trista A. Strauch¹, William J. Silvia², John T. Hast², C. Hugo Hamilton², Don A. Neuendorff³, Ronald D. Randel³, and Jon A. Green¹
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While pregnancy diagnosis is often performed in cattle and sheep by real-time ultrasonography, this technique can cause increased stress and restraint in captive species. Pregnancy associated glycoproteins (PAGs) comprise a family of approximately 20 proteins in cattle; ten have been described in white-tailed deer (Family: Cervidae; Subfamily: Capreolinae). However, PAGs have yet to be well described in the other major cervid subfamily, the Cervinae (e.g. elk, fallow deer, sambar, Pere David’s deer, barasingha). Elk is a generic term that includes two very closely related species, Eurasian red deer (Cervus elaphus) and Asian/North American wapiti (Cervus canadensis). The first objective of this study was to determine the effectiveness of a commercial PSPB (PAG) ELISA for pregnancy diagnosis in red deer. A second objective was to identify the nucleotide sequence of a specific PAG or PAGs expressed in wapiti. For the first objective, female red deer (n=20) at the Texas A&M AgriLife Research Center (Overton, TX) were exposed to a stag for 75 days. The pregnancy rate, based on real-time ultrasonography, was 95%. Each sample was analyzed in a commercially available bovine PSPB/PAG ELISA (Biopryn; BioTracking LLC, Moscow, ID) and the assay was found to be 95% accurate in determining pregnancy status relative to ultrasonography. Since wapiti and red deer are closely related species, we examined PAG gene expression in wapiti by using RT-PCR. We identified several PAG cDNAs that were orthologous with the known white-tail deer PAGs; some putatively distinct wapiti PAGs were also obtained in the screen. We also performed PCR to amplify PAG genes from genomic DNA from several deer species. Genomic PCR products of the expected size were obtained from: red deer, moose, wapiti, fallow deer, white-tailed deer, barasingha deer, Pere David’s deer and sambar. In summary, PAG genomic fragments could be amplified from multiple deer species and the accumulation of expressed PAG in the maternal circulation can be used to accurately detect pregnancy in red deer.
Unitizing understanding of first grade students
Lauren Montgomery, Cassandra Mezines, John Lannin, and Delinda Van Garderen

Unitizing is essential for understanding place value (Fosnot & Dolk, 2001). A deep understanding of unitizing includes viewing a quantity in two ways simultaneously (e.g., viewing 10 as one ten and ten ones). Using clinical interviews, we examined the numeric development of 63 first grade students. Part of this broader study involved analysis of student understanding of unitizing. These students were asked to look a diagram of 7 bags of marbles with 5 marbles in 6 of the bags and 2 marbles in the remaining bag. Students were asked how many marbles altogether and how many groups of 5 marbles they saw. Through our analysis, we categorized student responses into four levels of understanding: (a) sophisticated, (b) transitioning, (c) single unit, and (d) other. This study has important implications for place value in first grade.
Beckwith-Wiedemann Syndrome (BWS) is a human overgrowth syndrome. Symptoms can include enlarged tongue, enlarged organs, abdominal wall defects, and an increased risk of developing childhood tumors. This syndrome is associated with misregulation of genomic imprinting. Imprinting is an epigenetic mechanism that causes parent specific expression of an allele. The occurrence of BWS is increased in children conceived with assisted reproductive technologies (ART). ART includes infertility treatments such as in vitro fertilization, ovarian hyperstimulation, intracytoplasmic sperm injection, embryo culture, and embryo transfer. Large offspring syndrome (LOS) is a phenotypically similar syndrome in bovine that is also associated with the use of ART. A previous study conducted by our laboratory found loss of methylation of the KvDMR1 region on the maternal chromosome and biallelic expression of the KCNQ1OT1 gene transcript in LOS conceptuses (fetus and placenta). This is consistent with the loss-of-imprinting seen in 50% of individuals with BWS. Therefore, LOS was proposed as an animal model to study BWS. The animals studied were Bos taurus indicus × Bos taurus taurus F1 hybrid conceptuses conceived by ART or artificial insemination (AI; control). Conceptuses above the 97th percentile bodyweight (the criteria used to diagnose BWS) were considered overgrown. Current work in the laboratory is aimed at identifying genome-wide imprinting misregulation in the overgrown F1 conceptuses using RNA-seq data and confirming these results with restriction fragment length polymorphism (RFLP) and polyacrylamide gel electrophoresis (PAGE). RNA-seq data gives the parental expression ratio for the control and test groups. Comparing these expression ratios, possible loss-of-imprinting sites are established. Then restriction enzymes are chosen to cut confirmed single nucleotide polymorphisms (SNPs) so that the maternal and paternal alleles can be separated by PAGE. Based on the RNA-seq results thus far, NNAT, MAGEL2, SGCE, PEG10, and PLAGL1 are genes of interest for which restriction enzymes are being chosen.
Collin Morris  
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Biological Sciences

Faculty Mentor: Dr. Rocío Rivera, Animal Sciences  
Funding Source: F21C Reproductive Biology Cluster, NIH Grant to R. Rivera, University of Missouri Research Board

**Identifying single nucleotide polymorphisms to determine loss-of-imprinting associated with Large Offspring Syndrome (LOS) in ruminants**
Collin Morris, Zhiyuan Chen, and Rocío Rivera

The use of assisted reproductive technologies (ART) has been shown to increase the risk for Beckwith-Wiedemann syndrome (BWS) in humans and LOS in ruminants. Both BWS and LOS are loss-of-imprinting (LOI) overgrowth disorders with similar phenotypic presentations, typically characterized by macrosomia, macroglossia, and abdominal wall defects. Genomic imprinting is the process of epigenetic silencing used to establish parental gene expression. Previous research in our laboratory has shown phenotypic and epigenetic similarities between LOS and BWS and we have proposed the use of LOS for the study of BWS. Current work using RNA deep sequencing has identified further potential loci with loss of imprinted gene expression beyond those previously associated with LOS. The objective of this study is to corroborate, by DNA sequencing, single nucleotide polymorphisms (SNPs) found during RNA deep sequencing analyses at imprinted loci between *Bos taurus taurus* (*B.t.t.*) and *B. t. indicus* (*B.t.i*.). Without first identifying these SNPs, it would be impossible to distinguish parental origin of gene expression in the *B.t.i. x B.t.t.* F1 hybrid individuals due to cattle’s heterozygous nature, much like in humans. For this, PCR primers will be designed to amplify the genomic regions of interest in both *B.t.t.* and *B.t.i.* subspecies of cattle. PCR amplicons will then be resolved by agarose gel electrophoresis, isolated, sequenced, and then aligned to a reference sequence (Bovine reference assembly UMD 3.1) using the MacVector aligning software. Comparing the sequenced amplicons from both subspecies, we will be able to identify any SNPs by the presence of genomic disparity between the two strands. The identification of these SNPs can then be used to assign parental origins to expressed sequences of DNA in the *B.t.i. x B.t.t.* F1 hybrids. Using these methods we have already been able to verify SNPs, and thus parental expression, at *NNAT, MAGEL2, SGCE,* and *PEG10.*
The Achievement Gap: Factors that lead to success
Codi Mouser, Maris Ayers, and Stephen Whitney

The Achievement Gap refers to the difference in standardized test scores based on race and socioeconomic status. This research seeks to determine constructs and covariates that contribute to the reading achievement of black and white eighth grade students of the lowest, middle, and highest socioeconomic status. The constructs and covariates include four categories: measures of the Individual, Parents, Teachers, and Schools. Data was taken from the ECLS-K nationally representative longitudinal secondary data set; it was gathered from the 2006-2007 eighth grade wave and then an exploratory factor analysis was conducted to reduce data into the independent construct categories. Preliminary findings indicate important differences in school quality, teacher quality, parental, and student factors in reading achievement in the eighth grade. These findings also indicate areas to invest limited resources in order to help reduce and eliminate the Achievement Gap.
A software framework for graph generation and analysis
Thomas Nabelek and Michela Becchi

Graph data structures are at the center of many applications, where they are used to model various kinds of relationships among entities. Relevant application domains include biology, chemistry, computer science, engineering, and sociology. Applications from these domains use graphs to model neural networks, chemical structures, discrete event simulations, electrical circuits, social networks, and highway linkages. The purpose of this project is to create an object-oriented software framework that enables the easy development of graph processing applications and that includes a user friendly front-end and a computational back-end. The technicalities of the graph data structure are hidden behind a user-friendly graph definition API. In addition, the front-end API includes support for the generation of random graphs, small-world networks, and scale-free networks, based on user-supplied parameters. These graphs, comprised of vertices and weighted edges, can then be analyzed using well-known algorithms to determine the number of paths of a specified length between all vertices, the depth of each vertex from a given root vertex, the shortest path between two vertices, the characteristic path length of the graph, and the mean clustering coefficient of the graph. The next step in this project will be to implement the graph algorithms using parallel processing for increased efficiency.
Thermodynamics curriculum redesign
Hayley Neebe, Wesley Fitzgibbons, and Mary Myers

It is necessary to adapt the current Thermodynamics I course into a modular structure with a focus on mastery learning, because the current course sequence is overly theoretical, which gives students difficulty visualizing the concepts and their application. The first restructuring of its kind, this modular structure is based off of taking the current course and identifying the core concepts: the Learning Objectives, which will be analyzed and used to make resources which will help students achieve mastery learning and aid in visualizing concepts and applications, making the course both easier to learn and easier to teach. To inspire innovation, the planned course redesign markets Learning Objectives and online resources to add greater flexibility for when and how students engage with the course, with a format to keep students on pace and interactive learning activities to increase student learning. In order to accomplish a greater flexibility with course engagement, the thermodynamics program is being streamlined to more online resources and interactive case studies to immerse the students early in the course. Lessons encourage the use of computer software such as MATLAB in order to teach more advanced problem solving techniques, in addition to the eventual development of a new instructional design program. These applications are being applied to the current Thermodynamics I class, with results being recorded and approaches manipulated, to furnish students with a better academic framework in order to learn thermodynamics. This is accomplished through providing students with greater interaction, instantaneous feedback, and multiple opportunities to recall and repeat exercises so that skills are retained. The instantaneous feedback between professors, research assistants, and classroom is integral to altering the course and assessing performance and effectiveness of this redesign. Thermodynamics is generally considered to be one of the most difficult courses in Chemical Engineering, and will be the first course to change the way a STEM class is taught at the university, potentially being applied to other classes, with hopes of being a marketable “Learn Thermodynamics” teaching module.
Development of nano-alloys via electrodeposition
Sean Noble and Patrick Pinhero

The purpose of this research is to develop Cu-based metamaterials for shifting mid-infrared radiation into low-frequency terahertz surface plasmons intensified at geometric features. We are doing this by electrodeposition of Cu onto a photolithographic pattern in a SU-8 photoresist. In this study we initially deposit copper onto the substrate using physical vapor deposition (PVD). This PVD Cu acts as an electrically conductive electrode for Cu electrodeposition. This pattern contains microscopic trenches that are less than 1 micron deep by less than 500 nanometers wide with a pitch of 500 nanometers. The Cu electrodeposit is ~40 microns thick. Later in our research we will do successive electrodepositions of different metals onto the substrate in different patterns in order to create unique Nano-Alloys.
It has been shown that genome spatial structure largely affects both genome activity and DNA function. Knowing this, many researchers are currently attempting to accurately model genome structure. Despite these increased efforts, there still exists a shortage of tools dedicated to visualizing the genome. Here, we present a desktop application designed to effectively visualize genome tertiary structure at multiple scales so that researchers can better analyze their genomics data.

GMOL was developed based upon our multi-scale approach that allows a user to zoom in or out between six separate levels within the genome. These six scales are: full genome, chromosome, loci, fiber, nucleosome, and nucleotide. In order to store the data of the different scales, a new file format was created. With GMOL, a user can choose any unit at any scale and scale it up or down to visualize its structure and retrieve corresponding genome sequences from either Ensembl or a local database. Users can also interactively manipulate and measure the whole genome structure and extract static images and machine-readable data files in PDB format from the multi-scale structure.

By using GMOL researchers will be able to better understand and analyze genome structure models and their impact on genome activity and DNA function. The multi-scale method can satisfy the users’ requirement to not only visualize genome tertiary structure, but also measure it.
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Senior  
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Faculty Mentor: Dr. Anthony Lupo, Atmospheric Sciences  
Funding Source: CAFNR On Campus Research Internship  

The occurrence of extreme weather in the Midwest USA  
Max Nunes and Anthony Lupo  

The month of March 2012 was extremely warm over the central and eastern USA. In Mid-Missouri, temperatures were over 15° F above the normal. This anomalously warm March was comparable to a similar warm anomaly which occurred in December 1889 which was also felt over a large portion of the United States. Both occurred following a peak in La Niña conditions. Both were characterized by an anomalously deep ridge over the central and eastern USA, and both occurred with noteworthy lack of northern Hemispheric and Pacific Region blocking.

These were not the only two extreme monthly departures found during the period of 1889 – 2014 in the central USA. There were 41 similar months that featured warm or cold anomalies greater than three standard deviations (σ) or greater from their seasonal mean. Thus, summer season departures were smaller than winter departures in general. If these data were normally distributed we would expect only 15 such months in the sample period above. Winter produced the most extreme months (23) and many (17) of these were cold anomalies. Spring, summer, and fall produced comparable numbers (18 total) and most of the summer anomalies (5 of 6) were warm.

Examining these with respect to decadal variability show that there were more of these events in the early and mid-20th century (16 and 13, respectively) and only seven events from 1980 – 2014. There was a strong tendency for winter anomalies to occur in El Niño or neutral years, while during the summer, all occurred in conjunction with neutral tropical Pacific Sea Surface Temperature (SST) anomalies. Very few (four total) occurred in La Niña years.
Introduction

The Patient Protection and Affordable Care Act enacted in 2010 marks one of the largest health-care overhauls in recent history. One of the most notable changes includes the health insurance marketplaces, also known as insurance exchanges, which began enrollment in October 2013. This study looks at the intended purposes of the exchanges of creating affordable, more accessible health insurance to Americans, to estimate the success of the implementation procedures. This study uses descriptive analysis by comparing state enrollment numbers of the State-Run and Federally Facilitated insurance exchanges, while also examining the uninsured rates from the 2010 census. This study also analyses state websites to compare the accessibility of health coverage options between states. Implementation processes are difficult to predict, however this report identifies elements that could give insight into the future outcome of the insurance exchanges created by the Affordable Care Act.

This project was completed to fulfill a Capstone requirement.
Alert systems for mobile work zones
Zachary Osman, Dylan Hackman, Pedro Ruiz Fabian, and Carlos Sun

The purpose of this research is to examine driver behavior to assess the effectiveness of alert systems for improving safety at mobile work zones. During the study, two systems were evaluated: the Long Range Acoustic Device (LRAD) and a manual alarm system. The systems were evaluated based on sound levels, frequency of alarms (continuous or manual trigger), and driver behavior (i.e., merging and vehicle speeds). A review of applicable literature was conducted to determine what levels of sound could be harmful or confusing to drivers. The field testing consisted of applying the two alarm systems to mobile work zones in the St. Louis and Kansas City areas. The data collected was analyzed and used to form a recommendation for the Missouri Department of Transportation (MoDOT).

Sound levels of both alarm systems were well under the dangerous threshold posed by OSHA and NIOSH. All systems produced improved merging distances of vehicles prior to reaching the work zone. A further investigation of the alarm systems is suggested before full-scale implementation.
Analysis of waste management on the University of Missouri campus
Alec Page and Ronald McGarvey

The University of Missouri pays the City of Columbia to provide waste collection services on campus. As part of this contract, the City provides the University with waste containers, recycling containers, and compactors to handle campus waste requirements. An interesting aspect of this contract is that the University is charged according to a fee structure that is different for different types of receptacles. The aim of our research is to analyze the location and utilization of receptacles across the University of Missouri campus in order to identify a strategy that minimizes the operational expenses required to accommodate the demand for waste services. An additional objective is to identify strategies that could eliminate the use of dumpsters and other containers on the Francis Quadrangle area of the campus.
In this paper we present an approach that uses Genetic Programming (GP) to evolve novel feature extraction algorithms for greyscale images. Our motivation is to create an automated method of building new feature extraction algorithms for images that are competitive with commonly used human-engineered features, such as Local Binary Pattern (LBP) and Histogram of Oriented Gradients (HOG). The evolved feature extraction algorithms are functions defined over the image space, and each produce a real-value feature vector of variable length. Each evolved feature extractor breaks up the given image into a set of cells centered on every pixel, performs evolved operations on each cell, and then combines the results of those operations for every cell using an evolved operator. Using this method, the algorithm is flexible enough to reproduce both LBP and HOG features. The dataset we use to train and test our approach consists of a large number of pre-segmented image “chips” taken from a Forward Looking Infrared Imagery (FLIR) camera mounted on the hood of a moving vehicle. The goal is to classify each image chip as either containing or not containing a buried object. To this end, we define the fitness of a candidate solution as the crossfold validation accuracy of the features generated by said candidate solution when used in conjunction with a Support Vector Machine (SVM) classifier. In order to validate our approach, we compare the classification accuracy of an SVM trained using our evolved features with the accuracy of an SVM trained using mainstream feature extraction algorithms, including LBP and HOG.
Developing a prototype system to investigate the laryngeal adductor reflex in mice
Sydney Parriott, Leslie Farmer-Shock, Brandon Gallemore, Elizabeth Bearce, and Teresa Lever

Purpose: The laryngeal adductor reflex (LAR) entails brief closure of the vocal folds to prevent foreign material from entering the airway. In neurologic diseases, the LAR becomes impaired and contributes to dysphagia. Studying the LAR in mouse models of neurologic diseases may lead to novel therapeutic approaches for dysphagia. The purpose of this study was to develop a nonsurgical approach for longitudinal investigation of the LAR in mice.

Methods: Fifty-two healthy C57BL/6 mice (8-14 months of age) were used during the design and construction of a prototype LAR system consisting of an air pulse delivery device, respiratory strain gauge, multi-adjusting test platform, endoscope micromanipulator, speculum, and speculum micromanipulator. Air pulses of calibrated, adjustable pressures and durations were delivered via luer lock tubing through the working channel of a 1.9 mm diameter endoscope (Storz). Micromanipulators permitted precise control of the anatomical location for delivery of each air pulse at the laryngeal entrance. Air pulses were synchronized with rate and phase of the respiratory cycle.

Result(s): We have successfully used our prototype system to evoke and record LAR responses in healthy C57BL/6 mice under light anesthesia (see figure). Unilateral or bilateral responses were consistently observed, depending on where each air pulse was aimed along the laryngeal entrance.

Conclusion(s): This study provides novel evidence that mice have an LAR similar to humans. We are currently using our prototype system to establish translational biomarkers of LAR pathology in mouse models of human neurological diseases.
Nano-structure preservation of PMSSQ gratings with APTES aminosilane
Sami Pathan, Sangho Bok, Aaron Wood, and Shubhra Gangopadhyay

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Amanda Pelletier  
St. Charles, MO

Faculty Mentor: Dr. Stefan Sarafianos, Molecular Microbiology and Immunology  
Funding Source: MU-HHMI C3 Program - Hughes Research Apprenticeship

Identification of novel antivirals targeting the hepatitis B virus ribonuclease H  

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Fei Peng
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Senior
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Faculty Mentor: Dr. Dong Xu, Computer Science
Funding Source: College of Engineering Undergraduate Research Option

Website and app development of plant protein phosphorylation database
Fei Peng and Dong Xu

The plant phosphorylation database (P3DB: p3db.org) has been extended as a large data set based cross platform web service.

I'm developing the core display part for the website, which is used to display Protein, Phosphorylation Site, and Peptide data in proper ways; a file system API which is used to manage files in the website; and a gene enrichment system, which is used to find enrichment information base on either protein list or protein networks.

Under a standardized designed interface between interface and the back end platform, we extend the system to iOS web services. This application will help the researchers to communicate and search data on the fly.

This project was completed to fulfill a Capstone requirement.
User location update service for Android application
Zeshan Peng and Yi Shang

Nowadays, it’s common to see that an app in a mobile device wants information of user’s current location or places visited during a specific time. However, it is not easy to find the most efficient way to update an accurate location while consuming acceptable battery power. In our project, we want to find a strategy of location updates for an app which needs to run in background for more than sixteen hours a day. Our purpose is to find the fit most strategy that balances power consumption and accuracy of location updating. We have run several experiments for each different method. Some of the methods compromise the accuracy by using less power while others provide a more accurate location on the basis of consuming more power. We conclude that there is no general approach applied to every application. The solution depends on the environment and requirement of the problem.
A large proportion of the world population is inadequately nourished. Research aimed at developing strategies to improve agricultural production of food, feed, and industrial starting materials is equally aimed at decreasing malnourishment. 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. A minimum PDC includes multiple copies of three catalytic components; pyruvate dehydrogenase (E1), dihydrolipoamide S-acetyltransferase (E2), and dihydrolipoamide dehydrogenase (E3). The E2 subunits form the multi-subunit core of the PDC. In plants the E2 core forms a 60-mer pentagonal dodecahedron with icosahedral symmetry. The purpose of this project is to determine why there are multiple genes encoding E2s of the mtPDC: E2IA, E2IB and E2II. Homozygous T-DNA insertion lines for each of the E2 genes will be determined by genotyping. Transcript profiling will be performed to verify absence of the transcript. Total proteins from the homozygous lines will be analyzed by SDS-PAGE and Western Blotting. Phenotypes associated with each mutation will be determined. Bimolecular fluorescence complementation will be used to determine the interaction between the different E2 subunits. We were able to isolate homozygous KO lines for each of the E2 subunits through genotyping. No transcripts were present for any of the E2 subunits when RT-PCR was performed. We have the vectors assembled and transformed and we are in the final stages of testing fluorescence before analyzing the protein-protein interactions with flow cytometry. In plants, the PDC converts pyruvate into acetyl-CoA plus CO₂. The acetyl-CoA is the entry point for carbon into the Krebs cycle in support of cellular respiration. Results from similar research have led us to believe that a mutation in any of the subunits will have a direct effect on the function of the mtPDC, and the whole plant.
Identifying long ultra similar elements in genomes using texture co-occurrence matrix in a Big Data Ecosystem

Devin Petersohn and Chi-Ren Shyu

Identifying the Long Ultra Similar Elements (LUSEs) in genomes can yield a myriad of new information regarding the result of a genetically and evolutionarily significant mutation. However, current methods of identifying LUSEs cannot capture every possible mutation (insertion, deletion, and base pair substitution) without an exhaustive pair-wise comparison using the Levenshtein Similarity measurement. Alignment algorithms attempt to solve this problem, but can only calculate the maximum consecutively similar elements in a string of base pairs. We have developed an image-based method of identifying LUSEs in genomes that has a strong correlation to the Levenshtein Similarity measurement. Our approach first converts a sequence into a 10x10 grayscale image. Then, using existing co-occurrence matrix based texture feature metrics, we generate a unique feature vector for each sequence by which other sequences can be compared. These feature vectors can then be plotted and, using a clustering algorithm, we will then be able to identify clusters of sequences that share a Levenshtein Similarity greater than 90% (or another threshold of our choosing). Because of the correlation between clusters and the Levenshtein Similarity measurement, we can avoid pair-wise comparisons altogether. Because there are no pairwise comparisons, these algorithms can run in parallel using a MapReduce function in a Big Data Ecosystem (Hadoop), offering a suitable solution to this Big Data problem that is scalable to the amount of hardware available. The final product will be a hash function that can return all clustered LUSEs very quickly for biology researchers to access in real time.
Endometriosis is a gynecological disorder, which affects 10-15% of menstruating women, causing debilitating pain and infertility. It occurs when the lining of the uterus (endometrium) sheds and grows outside of the uterus. The endometrium can implant on the surface of various organs in the abdominal area. Currently, the cause for endometriosis-associated subfertility is unknown. Our recent studies using a well-established model for endometriosis have found anomalies with ovarian function and embryo development. After implantation at ectopic sites, these endometriotic lesions produce tissue inhibitors of matrix metalloproteinases (TIMPs), which localize in ovarian follicles and eventually block ovulation. This also disrupts the normal balance between matrix metalloproteinases (MMPs) and tissue inhibitors of matrix metalloproteinases in order for normal and pathological tissue remodeling of the extracellular matrix (ECM) to occur.

Due to ethical limitations of ovarian research in women, we use a model for endometriosis developed in rats. Models include rats with surgically induced endometriosis (Endo) and control rats (Sham). We hypothesize that the levels of extracellular matrix components, specifically collagen IV (COL IV), laminin (LN), and fibronectin (FN), will be higher in the ovaries of rats with (Endo, n=12) compared to controls (Sham, n=12). Four weeks after surgery, the ovaries were collected and homogenized to extract proteins. The ovarian proteins were separated by polyacrylamide gel electrophoresis. Western blot analyses was performed with antibodies specific to COL IV, LN, and FN. Protein bands were measured by densitometry. Significantly, more COL IV (p=0.017) and LN (p=0.041) were found in Endo rat ovaries compared to Sham. Analyses of fibronectin are still ongoing. To date, the data supports our hypothesis that levels of ECM components are higher in Endo rats compared to Sham rats. Increased levels of ECM components around ovarian follicles, in conjunction with excess TIMP production, contribute to the inability of ovulation to occur.

This project was completed to fulfill a Capstone requirement.
Using phage display to genetically engineer antibody KD-247 for improved efficiency against HIV-1

Dallas Pineda, Dandan Liu, Yee Tsuey Ong, Karen Kirby, George Smith, Shuzo Matsushita, and Stefan Sarafianos

HIV-1, a retrovirus that leads to AIDS, has infected around 34 million people worldwide. Of the multiple clades, clade B is frequent in North America, Europe and Australia while the remaining clades (referred to as non-clade B) account for the vast majority of HIV-1 infection worldwide.

KD-247 is a humanized monoclonal antibody that targets the third variable (V3) loop on the envelope glycoprotein of clade B HIV-1. To expand the specificity of KD-247, we used phage display to genetically engineer the complementary determining regions (CDRs) on the light and heavy chains of the antibody. A library of variants was generated for CDR1 of KD-247 light chain and 58 different clones were tested for binding activity to V3 loop peptides using phage capture enzyme linked immunosorbent assays. At least four clones bind well to both clade B and non-clade B V3 loop peptides. The current focus is to express and purify these clones for further analyses of the HIV-1 neutralizing activity using cell-based HIV-1 pseudotyped virus neutralization assays. The results from this study will help generate a second generation antibody with improved neutralizing profiles to broadly neutralize multiple HIV-1 clades.
Evaluation of the role of the medial meniscus attachment in human knee biomechanics
Andrew Polk and Ferris Pfeiffer

The goal of this project was to evaluate knee biomechanics of ACL-intact and ACL-deficient knees with concomitant peripheral medial meniscus tears or medial meniscotibial insufficiency. Peripheral tear of the medial meniscus and meniscotibial ligament insufficiency are both common clinical problems, especially in sports medicine, and are thought to place additional stress on the ACL. The intent of this study was to determine the effect of such injuries on ACL biomechanics, and evaluate the effectiveness of current surgical repair techniques. This project will provide for a better understanding of the biomechanical interactions between these components of the knee, and will lead to improved clinical assessment.
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Sophomore
Plant Sciences

Faculty Mentor: Dr. Melissa Mitchum, Plant Sciences
Funding Source: Monsanto Undergraduate Research Fellowship

Genome-wide forward genetic screen identifies new soybean genes with a role in resistance to soybean cyst nematode
Elizabeth Prenger and Melissa Mitchum

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Faculty Mentor: Dr. Allen Thompson, Bioengineering
Funding Source: College of Engineering Undergraduate Research
Option

**Evaluation of a subsurface material for irrigation in soils**
Ryan Prsha and Allen Thompson

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Effects of propranolol on social and cognitive functioning in autism spectrum disorder
Lexi Ragsdale, Rachel M. Zamzow, Bradley J. Ferguson, and David Q. Beversdorf

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by impaired social communication and restricted, repetitive behaviors. Propranolol, a known anxiolytic, is a nonselective beta-adrenergic antagonist. It has been shown that propranolol can improve cognitive and language abilities in individuals with upregulated sympathetic reactivity due to stress. As it has been reported that individuals with ASD have increased baseline levels of stress, propranolol may provide benefits for this population. In previous studies from our lab, propranolol has been shown to improve semantic fluency and working memory in individuals with ASD. For the present study, we sought to explore what other domains are affected by propranolol in ASD and which individuals respond best to propranolol, establishing a potential treatment response marker. Twenty participants with ASD completed two study sessions lasting approximately 3 hours each. Baseline sympathetic reactivity was measured via electrocardiogram and galvanic skin response at the start of each study session. Propranolol (40 mg) or placebo was then administered in a double-blinded, counterbalanced manner. Following a one hour wait time, participants completed a series of cognitive and social tasks. Preliminary analyses indicate that task performance was significantly improved in the propranolol condition, as compared to the placebo condition, for the social task and two language tasks. In addition, higher baseline sympathetic activity was related to greater response to propranolol on these tasks. Further study will provide a better understanding of the benefits of propranolol as well as establish a foundation for future studies on pharmacotherapeutic intervention for individuals with ASD.

This project was completed to fulfill a Capstone requirement.
Spatial beam profiling of a compact ion source
Sijie Ran and Scott Kovaleski

At the University of Missouri, a compact system for generating neutrons is currently under development. A primary component of this system is a custom-built ion source called the Piezoelectric Transformer Plasma Source (PTPS). Ions are extracted from the PTPS, forming a beam and impinging on a target. To accurately characterize the neutron source, ion flux on target must be determined. Presented in this research is a system to profile the ion beam flux distribution of the PTPS to verify computer ray-tracing simulations and estimate neutron source yield. To accomplish this, a current collecting anode and a capacitive current diagnostic were used to measure the current from the ion beam. The anode was mounted on a motorized platform and moved through the beam, measuring the ion flux at discrete points. Using this method, the spatial distribution of the PTPS ion source beams was determined.
Quality of marital relationships and its impact on different kinds of parental control used
Suzanne Redington and Nicole Campione-Barr

It has been established through various studies that the quality of a marital relationship can have lasting effects on children (Shamir, Schudlich & Cummings 2001; Davies & Cummings 1994). Some researchers have begun to explore how the marital relationship is associated with levels of control exerted over children. Yu & Gamble (2008) found that parents who used high control over children tend to have more marital conflict. What is not known is if the marital relationship impacts different forms of control used on children. We hypothesized if the marital relationship is rated more negatively then parents will use more psychological control with their children and if marital quality was positive, then more behavioral control will be used. The sample consisted of 109 intact two-parent families with adolescents in 8th, 10th or 12th grade. Mothers, fathers and teens reported through online questionnaires their perceptions of parental behavioral control and psychological control (Child Report Parenting Behavior Inventory; CRPBI; Schaefer, 1965), and mothers and fathers reported positive and negative qualities in their marriage (Network of Relationships Inventory; NRI; Furman & Buhrmester 1985). Mothers’ reports of marital negativity were significantly related to their use of psychological control, as well as significantly related to their teen’s perception of psychological control used by their mother. Additionally, when mothers reported more marital positivity, teens perceived less psychological control from their mothers. Fathers’ marital relationship reports did not impact parental control. Thus, marital quality appears to impact mothers’ parenting more than fathers.

This project was completed to fulfill a Capstone requirement.
Faculty Mentors: Dr. Elizabeth Chang, English; Professor Nathan Boyer, Art

**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.

By May of 2014 a Beta version of the app will be available on the App Store. It is intended to be a learning tool for college age individuals and academics with an interest in storytelling and digital humanities.
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.
The Political Celebrity: The effects of celebrity endorsement, social media, and their implications on voting outcomes of the 2012 presidential election
Taylor Rickard and William Horner

With the fast-moving advancement of the social-media centered culture we live in, politicians have increasingly relied on the substantial influence that celebrities have on our society to gain votes and positive name recognition. Celebrities can access the masses at the drop of a hat with the ease of social media site usage through channels such as Facebook, Twitter, and YouTube. Politicians have learned to use this relationship to their own personal benefit by targeting these influential celebrities to publicly display their opinions on social media sites in order to capture votes from an otherwise untapped group of voters. This paper seeks to highlight the history and development of the “political celebrity” over time, and shed light onto several successful trends being observed, particularly observed in the 2012 election with Barack Obama’s significant social media victories. I use the results of a survey I conducted along with post-election data from the American National Election Studies database to create a correlational analysis focusing in on trends visible in the 18-25 age demographic to understand the linkages between celebrity social media campaigning, age, and ultimately their impacts on the way voters voted in the 2012 presidential election.

This project was completed to fulfill a Capstone requirement.
River regulation has altered flows and temperature which may affect native fish reproduction. We compared larval fish assemblages in a free flowing and regulated tributary of the Lower Missouri River. Drift net larval sampling was conducted weekly from March 20 to July 3, 2013 at one transect 14.5 river kilometers (rkm) from the Missouri River confluence in the Osage River and 3.2 rkm from the Missouri River confluence in the Gasconade River. Osage River river regulation may have increased the contribution of reservoir species and limited the reproduction of species that depend on natural discharge and temperature (i.e., catostomids and percids). The three most abundant families from the Osage River (i.e., centrarchids, clupeids, and percids) exhibited maximum CPUE on the same day when the Osage River experienced its lowest discharge (314 cms) and oddly when the Gasconade River was at its greatest discharge (640 cms). Clupeids (gizzard shad *Dorosoma cepedianum*) in the Osage River had the greatest CPUE of any family (65,049 fish/m$^3$) and contributed 64 times the second most contributed family (percids) from the Osage River. Our results suggest river regulation may affect the timing and abundance of larval fishes, but this relationship may differ by taxa.

*This project was completed to fulfill a Capstone requirement.*
A candidate therapy to prevent infection by the tumor causing plant pathogen, *Agrobacterium tumefaciens*
Jeanette Rimbey, George Smith, and Pamela Brown

Plant disease is a growing problem in the agriculture industry both at a national and world wide level. The bacterium *Agrobacterium tumefaciens* causes crown gall disease in many flowering plants which cause tumors to form on roots and stems. Crown gall is frequently diagnosed on the roots of apple, peach, and walnut trees, as well as blackberry bushes, potentially reducing the yield of these fruits. Presently, there are limited options for the prevention and treatment of crown gall disease. Furthermore, bacterial resistance to antibiotics is a growing threat in our world. Thus, we propose that bacteriophages might serve as an alternative therapeutic tool.

Bacteriophages are viruses that can infect bacterial cells, but have no effect on animals or humans. These viruses are specific to one or a limited number of bacteria. Due to this specificity, bacteriophages which infect *Agrobacterium tumefaciens* should have minimal negative effects on other bacteria in the environment. The long-term goal of our project is to determine if pre-treatment with a combination of bacteriophages will act as a biocontrol agent to limit plant infection by *A. tumefaciens*.

Because *A. tumefaciens* are common soil dwelling bacteria, we expect to find bacteriophages in similar environments, including soils and water sources. Using standard techniques we have amplified bacteriophage capable of infecting *A. tumefaciens*. After amplification, bacteriophages were isolated from plaques which formed on a petri dish containing a lawn of *A. tumefaciens*. Finally, we sub-cloned the phage from one selected plaque in order to ensure its purification and to concentrate it. As a result we have found a bacteriophage, called AP2 that originated from waste-water of the local Columbia, Missouri treatment plant. Future work will focus on understanding how AP2 interacts with *A. tumefaciens*, testing this bacteriophage to determine if they can be used to prevent or treat crown gall disease, and finally continuing to isolate additional bacteriophages.

*This project was completed to fulfill a Capstone requirement.*
The relationship between emotion dysregulation and impulsivity in predicting substance use in borderline personality

Katerina Rios and Timothy Trull

Research indicates that emotion dysregulation and impulsivity are associated with substance use and substance use disorders. Borderline personality disorder is characterized by emotion dysregulation and impulsivity, and those with this disorder often use and abuse substances. Therefore, it is believed that emotion dysregulation and impulsivity in borderline personality disordered persons are the primary psychological processes that lead to the use and abuse of substances. Research has analyzed how emotion dysregulation and impulsivity affect substance use, separately, but has not examined how these psychological processes may interact, leading to greater risk for substance use and abuse.

In this study, we investigated this gap in the literature by assessing the influence of emotion dysregulation and of impulsivity, separately and together, on substance use and abuse in individuals who endorse elevated levels of borderline personality disorder features. The participants in this study consist of undergraduate students at the University of Missouri – Columbia enrolled in an introductory psychology course. The participants consist of individuals who endorse elevated features of borderline personality disorder as well as individuals who do not. The participants completed proctored surveys consisting of scales analyzing borderline personality features, emotion regulation, impulsivity, alcohol use and attitudes, drug use and attitudes, emotional clarity, and emotion differentiation. We expect to find positive correlations between emotion dysregulation and impulsivity, separately and together, and substance use in individuals in both the control and high endorsement of borderline personality features groups.
Nicole Ripperda  
Breese, IL  
Sophomore  
Industrial Engineering

Faculty Mentors: Dr. LuAnne Roth, English; Dr. Joseph Dolginow, Agricultural & Applied Economics; Dr. Luis Occeña, Industrial & Manufacturing Systems Engineering; Martha Dragich, JD, School of Law  
Funding Source: Mizzou Advantage Undergraduate Research Team

“Waste not, want not”: Understanding and addressing the problem of food waste
Nicole Ripperda, Andrew Beckerle, Jackson Hambrick, Mary “Emmie” Harcourt, Henry Hellmuth, Lauren McDermott, Mary Schneier, Luke Welsh, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
The University of Missouri Hospitality program is amongst the leading hospitality programs nationwide. With the continued growth of the hospitality job market, the program continues to expand to keep up with the global demand for hospitality managers.

Collegiate programs across the country, including Mizzou, have expanded outside the realm of the traditional classroom delivery. These expansions have employed a variety of delivery methods to create a virtual classroom experiences on a national level. Research shows these concepts are proven and effective means of information delivery. The question many universities face in deciding if they will offer an online program relate to their desire to maintain the same high quality learning experience. The purpose of this study is to explore the effectiveness of using online education in the hospitality industry, as measured by student’s knowledge retention of service management concepts. Using pretest/posttest scores, students from both the online and traditional course sections were analyzed. Demographics including major, gender, and academic standing (junior, senior) were also explored for relationships with performance and knowledge retention.
Cale Roberts  
Excelsior Springs, MO  
Senior  
Biological Sciences

Faculty Mentor: Dr. Timothy Domeier, Medical Pharmacology & Physiology  
Funding Source: Life Sciences Undergraduate Research Opportunity Program

**TRPV4 and cardiomyocyte contraction in the aged murine heart**  
Cale Roberts and Timothy Domeier

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Nicholas Roberts
Princeton, MO

Sophomore
Bioengineering

Faculty Mentor: Dr. Gang Yao, Bioengineering
Funding Source: College of Engineering Undergraduate Research Option

Motion processing using the Arduino microcontroller platform
Nicholas Roberts, Nathan Birenbaum, and Gang Yao

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Elucidating *RbohD*-dependent requirements of *flg22*-signaling responses in a *Dynamin* mutant
Samuel Robinson, John Smith, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Reverse logistics network design in a PBL environment
Jason Robke, Jennifer Bergman, Kyle Dorge, Wooseung Jang, Ronald McGarvey, and James Noble

When a product is moved, there are two portions of this movement: 1) the initial shipment to the customer and 2) reverse logistics, or the movement of containers back to the original facility. Moving shipment containers back to the original warehouse, or to another warehouse that will reuse the container to ship another item, can become very costly if proper analysis is not done to keep cost to a minimum. This project focused on the development of a program to analyze the cost for various modes of transportation for spare parts. A mathematical model of the problem is formulated and the model can be run for many different locations, as well as different modes of transport, whether it be ocean, air, or truck. The initial pilot analysis indicated that considering different distribution center locations, as well as consolidated shipping, has the potential for significant cost savings.
Roles of a callose synthase in plant immune signaling and development
Sean W. Rogers, Michelle E. Leslie, and Antje Heese

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Landon J. Rohowetz, John P. Hegarty II, Bradley J. Ferguson, and David Q. Beversdorf

Propranolol is a central and peripheral beta-adrenergic antagonist often used to treat test anxiety. Individuals with autism spectrum disorder (ASD) exhibit greater improvements in working memory after the administration of propranolol than typically-developing individuals, which may be due to larger changes in functional connectivity, or the correlation between spatially remote neurophysiological events. This proposed functional connectivity response difference between groups may be caused, in part, by autonomic nervous system imbalance, a characteristic symptom of ASD. Assessing the relationship between autonomic tone and the functional connectivity and cognitive effects experienced in healthy individuals after the administration of propranolol may help explain these differences. We hypothesize that, after administration of propranolol, typically-developing individuals manifesting the highest levels of autonomic nervous system imbalance will experience the greatest increase in functional connectivity between brain regions important for working memory, along with the greatest corresponding improvements in working memory performance. Those with little or no autonomic imbalance will not experience significant effects.

For the present study, resting electrocardiogram was collected from 12 typically-developing participants. Participants were then administered propranolol, nadolol (a peripheral-only beta-adrenergic antagonist), or placebo during counterbalanced MRI sessions in which an n-back task, a task widely used to measure working memory, was performed. A preliminary linear regression analysis of this data revealed that individuals manifesting higher levels of parasympathetic activity experience greater working memory benefits after the administration of propranolol. Further analysis of the relationship between working memory benefit, autonomic tone, and functional connectivity will be performed.

This project was completed to fulfill a Capstone requirement.
Faculty Mentor: Dr. Sheila Baker, Chemical Engineering  
Funding Source: College of Engineering Undergraduate Research Option

Novel fluid mixtures
Dick Ross, Jing Wang, and Sheila Baker

Our work focused on the studying properties of novel fluid mixtures involving deep eutectic solvents and ionic liquids. Our fundamental studies will build a knowledge basis for many potential applications of these systems.
Lymphedema (LE) is a chronic, progressive disease that causes swelling of limbs and often starts as a result of cancer treatment. LE typically evolves into a chronic disfiguring condition that can be managed but is not curable and can become life-threatening if an infection in LE areas becomes systemic. With the number of cancer survivors continually increasing, the number of those who then become affected by LE is also increasing. This condition takes both a severe toll on the individual’s quality of life and a great financial impact on the healthcare system.

The American Lymphedema Framework Project has launched a national collaborative initiative lead by recognized experts in the field of LE to develop and evaluate appropriate healthcare services for patients with LE and advance the quality of LE care. By use of this collaborative team, we have gained access to high-quality information concerning treatments for LE and their outcomes. This information comes from various national sites, each with their own type of data formatting that then needs to be transformed using a mapping function that takes information and then consolidates it into a standard format to be maintained as a minimum data set (MDS). i2b2 (Informatics for Integrating Biology and the Bedside), a National Institutes of Health funded open-source informatics framework, will store the MDS. Association rule mining will be used to discover relationships among the MDS; as well as temporal mining to discover patterns in limb volume changes and how they influence an individual’s chance of developing LE. Since i2b2 is open-source, we are able to then create customized data mining tools to further analyze the MDS. We aim to build a reputable knowledge base for researchers to discover and compare findings that will provide better disease control for those affected by and at risk of developing LE.
Investigating the changed responses to PAMPs in transgenic Arabidopsis lines
Shawna Rowe, Kinsey Hilliard, Sarah Wieskamp, Ying Wan, and Scott Peck

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 only found in microbes that are essential for survival, such as bacterial elongation factor Tu (EF-Tu) which is required for protein synthesis. 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, which is 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 knock down transcript levels from entire families of related genes, including TPK 72-1-D and TPK 72-3-D. Through the process of a growth inhibition assay using EF-Tu, it was observed that the transgenic lines demonstrated an altered phenotype in response to this PAMP. Additionally, by using quantitative PCR (qPCR), we were able to determine that nine genes had effectively been targeted by the amiRNA, and their transcript levels were reduced. I am currently investigating additional molecular markers to determine the extent of altered responses to EF-Tu. This research has potentially revealed novel components in defense responses of plants to microbial pathogens and aims to provide future direction for additional investigation of these genes.
Joe Rowles  O’Fallon, MO
Junior Biochemistry and Nutritional Sciences

Faculty Mentors: Dr. Ulus Atasoy, Surgery and Molecular Microbiology & Immunology; Dr. Joseph Magee, Surgery and Molecular Microbiology & Immunology
Funding Source: IMSD EXPRESS

The posttranscriptional regulation of IL-2 mRNA by HuR
Joe Rowles, Patsharaporn Techasintana, Joseph Magee, and Ulus Atasoy

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Determining the optical properties of mesoporous silica via Total Internal Reflection Photoacoustic Spectroscopy for future use as optical waveguides
Anna Rudy, Swarnasri Mandal, Ben S. Goldschmidt, John A. Viator, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Endometriosis is a benign gynecologic disorder characterized by the presence of endometriotic lesions outside of the uterus, most commonly on the pelvic peritoneum. Endometriosis is capable of causing pain and sub-fertility, but may also show no symptoms. Angiogenesis is the formation of blood vessels from preexisting blood vessels. Since the blood supply is critical for ovarian follicle development and health, vascularization is important in determining the fate of the follicle. The angiogenic abilities of endometriosis may be influenced by levels of certain genes. VEGFα, Col18 and TGFβ have been previously proven to be associated with angiogenesis.

To investigate the role these genes play in endometriosis, QPCR was performed to quantify the gene levels present in the ovaries of rats. Quantification of each gene included cDNA isolated from homogenized whole ovarian tissue from three different groups of rats: rats with surgically induced endometriosis (Endo), a surgical sham (Sham), and a no surgery control (Control). The frequency of the target gene expressed was compared to a common housekeeping gene in each group. Presence of the target gene is expressed as fluorescence and quantified by a cycle threshold value (CT). Using a one-way analysis of variance, there was no significant difference in target gene levels between the three groups of rats. These results suggest there are no differences in the gene transcript levels for VEGFα, Col18 and TGFβ in the ovary from a rat model of endometriosis. However, this does not exclude the possibility that the proteins levels are not different, as the proteins may originate from a non-ovarian site. Future studies using follicles dissected from the ovaries compared to the multiple cell types in the whole ovary may provide more information about the effects of these genes specifically on follicle development and health.
Alert systems for mobile work zones
Pedro Ruiz Fabian, Dylan Hackman, Zachary Osman, and Carlos Sun

The purpose of this research is to examine driver behavior to assess the effectiveness of alert systems for improving safety at mobile work zones. During the study, two systems were evaluated: the Long Range Acoustic Device (LRAD) and a manual alarm system. The systems were evaluated based on sound levels, frequency of alarms (continuous or manual trigger), and driver behavior (i.e. merging and vehicle speeds). A review of applicable literature was conducted to determine what levels of sound could be harmful or confusing to drivers. The field testing consisted of applying the two alarm systems to mobile work zones in the St. Louis and Kansas City areas. The data collected was analyzed and used to form a recommendation for the Missouri Department of Transportation (MoDOT).

Sound levels of both alarm systems were well under the dangerous threshold posed by OSHA and NIOSH. All systems produced improved merging distances of vehicles prior to reaching the work zone. A further investigation of the alarm systems is suggested before full-scale implementation.
The Geosynthetic Reinforced Soil (GRS) Integrated Bridge System (IBS) is an innovative bridge technology for small bridges that incorporates a reinforced abutment foundation constructed using geotextile fabric in multiple soil layers. The GRS-IBS design eliminates the need for conventional bridge foundation elements (e.g., driven piles), which are often expensive and time-consuming to construct. In addition, the relatively uniform stiffness of the GRS-IBS reduces the occurrence of the “bump at the end of the bridge” often associated with conventional bridge foundations. This project involves instrumenting and monitoring the performance of a small bridge to be constructed outside of Columbia, Missouri to provide further evidence the relatively young technology is a safe and effective way for departments of transportation to reduce costs and shorten construction timelines for small bridge.

Structural and geotechnical performance measures will be monitored for two years through several different types of instruments. Vibrating wire earth pressure cells will be used to monitor the load from the bridge, which is of particular interest since the bridge spans a creek that is prone to flooding. Tensiometers will be used to measure pore water pressure in the reinforced soil. Vertical telltale devices will be fabricated and installed to monitor settlement within the backfill, and 24 survey markers will be placed on the bridge abutments (12 on each wall face) to provide an additional measure of bridge movement. Construction of the bridge is anticipated for July 2014.
Earthquake detection near the Central Anatolian Fault Zone: Understanding seismicity and its impact on Central Turkey
Joshua Russell and Eric Sandvol

The Anatolian tectonic plate, located in Turkey, contains one of the largest strike slip faults in the world, making it an important region for both scientific study and understanding earthquake hazards. This project is part of the Continental Dynamics: Central Anatolian Tectonics (CD-CAT) experiment, a large collaborative project lasting 5 years (2011–16) and dedicated to investigating the Anatolian tectonic plate. Anatolia is of great interest because it is actively undergoing tectonic escape where it is being rotated westward due to forces in the east, providing an opportunity to learn more about the fundamental dynamics of tectonic plate motions. The CD-CAT 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 over 5 months of continuous seismic data recorded from this network to detect and locate earthquakes occurring in the CAFZ and surrounding region. Computer programs are used to identify earthquakes in the data, resulting in over 950 potential earthquakes. From this data, arrival times of P and S wave seismic phases are hand-picked for each of the detected earthquakes and entered into a double difference algorithm used for accurately locating earthquake hypocenters within the seismic array. These earthquake hypocenter locations will help describe deformation patterns within the crust and possibly deeper. Additionally, knowledge of precisely when and where these earthquakes occur will provide a way to quantify activity along the faults in the region. This work could have a significant societal impact for the densely populated areas of Turkey near active fault zones where these risks are not well documented. Furthermore, 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.
Performance testing of a variable displacement hydraulic pump under quasi-steady state conditions
Jacob Rusteberg and Roger Fales

Nonlinearities in hydraulic systems, such as those that include load-sensing pumps, can cause changes in the marginal pressure, which decreases the overall system efficiency. In addition, these nonlinearities can cause sustained oscillations in the marginal pressure as well, which is a large risk to the mechanical system and those who might be operating it, such as in the case of large machinery used in construction settings. Numerically simulation studies are being done in order to gain an understanding of how to minimize these oscillations and the effects of the nonlinearities. Obtaining data in order to validate these numerical theses are crucial. Testing the variable displacement hydraulic pump under quasi-steady state conditions can give this such data. In order to do this, the pump speed and flow restriction valve in the system can be used to adjust the flow into the pressure relieving valve in the system, which will be adjusted for a range of flows at pump speed intervals ranging from 250 RPM to 1000 RPM. The load pressure will also be increased and decreased electronically using a pressure reducing valve in the hydraulic system, so that the effects of different load pressures on the marginal pressure can be compared. The marginal pressure can be calculated by taking the difference between the discharge pressure and the load pressure, which is referred to as the pressure drop of the system. No results or conclusions of the data have been made at this point. However, when the full scale of testing has been completed, trends of the effects on the marginal pressure due to operation at these different conditions will be made.
Faculty Mentor: Dr. Kevin Gillis, Bioengineering
Funding Source: IMSD EXPRESS

Comparison among chromaffin cell amperometric spikes produced by the effects of various exocytosis stimulants
Alexander A. Salinas and Kevin Gillis

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Debiasing affective forecasting errors in common medical experiences
Melana Salisbury, Elizabeth Focella, and Victoria Shaffer

People typically overestimate the unpleasantness of medical experiences and may avoid important screenings (Dillard et al., 2010) or medical procedures with long-term health benefits (Angott et al., 2013). The purpose of this research is to determine whether narratives can reduce these mispredictions, or ‘affective forecasting errors.’ In Study 1, 197 Introductory Psychology students completed an online questionnaire rating either their experiences with or predictions about having a Pap smear and donating blood. Participants who had a Pap smear or donated blood rated their overall experience on a 6-point Likert scale. Participants without prior experience predicted what it would be like using the same scale. Participants who made predictions were then randomly assigned to the control condition (no-narratives) or the narrative condition, reading 4 narratives describing experiences with a Pap smear or blood donation before making their predictions. Results show significant differences in participants’ ratings of experiences with Pap smear, $F(2, 140)=11.66, p < .001$, and blood donation, $F(2, 194)=9.21, p < .001$. Participants without prior experience predicted the experiences would be more unpleasant than were reported by participants with direct experience, replicating other affective forecasting literature. However, narratives were not effective at reducing affective forecasting errors, and these errors were more extreme for the narrative-prediction condition. Study 2 will test whether providing participants will numerical ratings in addition to narratives will help to debias the forecasting errors present in Study 1. 150 women will complete an online questionnaire, similar to Study 1. Participants without prior experience will be randomly placed in one of three conditions: narratives, numerical ratings, or narratives with numerical ratings. We hypothesized that participants’ predictions in the narratives with numerical ratings condition will be significantly closer to the ratings of participants with actual experience.
Computer vision module for unmanned aerial systems operations
Aaron Scantlin, Ryan Haslag, Christopher Dopuch, Adam Faszl, and Matthew Dickinson

Unmanned Aerial System (UAS) operations are becoming increasingly important in military and civilian applications, and official FAA rulings will soon present new opportunities for domestic and commercial drone use. Drones provide a unique platform for video applications, and computer vision is key to processing and acting on that video data. Our project aims to create a comprehensive computer vision platform for use in UAS drones. Our system will visually identify targets autonomously via a 1080p video uplink from the UAS which is processed on the ground by computer. The system will operate in both the visual light spectrum and the infrared spectrum. Our platform is specifically designed for use with intelligence, surveillance, and reconnaissance (ISR) as well as search and rescue (S&R) operations.

This project was completed to fulfill a Capstone requirement.
Seth Scarborough
Nevada, MO

Faculty Mentor: Dr. Vicki Carstens, English
Funding Source: A&S Undergraduate Research Mentorship

Accounting for null arguments: Pronoun dropping in Maasai
Seth Scarborough and Vicki Carstens

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

This project was completed to fulfill a Capstone requirement.
Sex influences systemic and peripheral blood mononuclear cell production of superoxide in older adults
Jennifer C. Schanzle, Shekhar H. Deo, and Paul J. Fadel

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Lance A. Schell, John D. Brockman, and J. David Robertson

Manganese (Mn) is a trace element essential to the body’s natural processing of cholesterol, management of superoxide radicals generated during mitochondrial oxidative phosphorylation, and in overall growth and development. Human brain autopsy samples previously scored by a neuropathologist on the NIA Reagan Cross-Sectional and CERAD scales for likelihood of symptoms due to dementia or Alzheimer’s disease (AD) were analyzed using instrumental neutron activation analysis. Samples were irradiated for 30 seconds in high-purity quartz vials and decayed for one hour prior to counting on a high-purity germanium detector. Measured Mn concentrations in NIST Bovine Liver SRM 1577 material were 10.4 ± 0.4 µg/g. No observable detector or ambient Mn was encountered. Average Mn tissue concentrations in the anterior putamen, cerebellum, inferior temporal, mid-frontal, and white matter regions were 2.34 µg/g, 2.01 µg/g, 1.24 µg/g, 1.08 µg/g, and 0.79 µg/g, respectively. Limits of detection ranged from 0.06 µg/g for the white matter tissue to 0.16 µg/g for the inferior temporal tissue.

Anterior putamen Mn concentrations were inversely correlated with higher scores on both the NIA Reagan scale (p = 0.008) and the CERAD scale (p = 0.013). Previous reports have linked changes in the size of the putamen to the cognitive decline seen in patients with AD. Diminished Mn concentrations within this region might lead to loss of the anti-apoptotic properties associated with Mn superoxide dismutase, leading to frequent programmed cell death and less total neuron volume. Future epidemiological bioassays might target quantification of Mn levels as part of exploring SNPs in the superoxide dismutase enzymes within this region and their relationship to the prevention of neuronal apoptosis.

This project was completed to fulfill a Capstone requirement.
Evaluation of power efficiency of photonic devices
Aaron Scherer and Gregory Triplett

This project evaluates the power conversion efficiency of vertical cavity surface emitting lasers (VCSELs) photonic devices. VCSELs that emit in the wavelength range of 2.1 microns were constructed using molecular beam epitaxy and are evaluated. A test bench was set up using an infrared spectrometer, a 1.44 micron pump source, a temperature control module, and LabVIEW software.
Functional analysis of desiccation induced transcripts by overexpression in *Physcomitrella patens*

Steven J. Schlarman and Melvin J. Oliver

Many desiccation tolerant plant species have been studied to examine their ability to withstand drought conditions, particularly extremes of water loss. The bryophyte *Tortula ruralis* exhibits this quality, and has previously been used to identify transcripts important in the dehydration response. Specifically, two candidate genes have been chosen, whose transcripts accumulate in response to dehydration of gametophytes. The moss stores these transcripts in dried tissues within messenger RNA particles for translation upon rehydration. The goal of the research is to functionally assess these gene products so as to understand their role in desiccation tolerance. *Physcomitrella patens*, a model organism for genomic studies of plants at the cellular level, is sensitive to dehydration under natural conditions and can serve as a good receptor species for functional testing of genes involved in dehydration tolerance. We are using PEG mediated protoplast transformation to transform *Physcomitrella patens* protoplast cells with the two candidate genes from *Tortula ruralis* and to assess their ability to improve the level of desiccation tolerance in *Physcomitrella*. This will be achieved using equilibration drying assays of transgenic protonemal cultures. Our expectation is to provide proof of concept that this approach can provide a functional assay for the analysis of genes important in dehydration responses in plants. If successful these genes could become the cornerstone of new strategies for crop improvement in drought conditions.
Dysfunction in the hippocampal region is difficult to differentiate and is introduced by a broad range of common neurological conditions such as Alzheimer’s disease and age-dependent memory loss. Several recent studies have further elicited distinct circuits within the hippocampal region, but the full extent of the interdependence between pathways in the hippocampus is still unknown. To assist in the detecting of interdependence between two protein-protein interaction pathways, a framework to locate potential overlap is introduced. This framework presents an automated pipeline that negotiates common pathway identifications such as Kegg and Reactome to generate all candidate-overlapping proteins for comparison to a central protein database. First, the algorithms presented expand the search space by using existing protein-protein interaction data (simulated and experimental) and by predicting missing interactions using an existing network-based framework. Overlap candidates are then refined using pathway-consistent confidence factors such as medical annotation, affinity, and source. Finally, to account for possible errors in naming conventions, a pairwise alignment is conducted on the final overlap candidates to eliminate trivially different proteins. Experiments with RbAp48, a protein implicated in age-dependent memory loss, are performed to identify the extent of undiscovered interdependence between age-dependent memory loss and other pathways related to hippocampal dysfunction. This framework can be used with any two pathways and could be later applied to more accurately assess combinatorial effects of a drug target between multiple pathways.
Testing the effect of the MSL2 protein on dosage compensation
Collin Schlosser and James A. Birchler

For years, it has been proposed that components of the male specific lethal complex, or MSL complex, on the male X chromosome produce the twofold up-regulation needed by male Drosophila, who have only one X chromosome compared to the female’s two, for dosage compensation. Studies conducted in our lab previously have come to the conclusion that the MSL complex does not produce the twofold modulation for dosage compensation directly but offsets any potential overexpression of X-linked genes due to a high level of histone acetylation that is sequestered to the X to mute an otherwise increase of the autosomes. Two components of the MSL complex were tested, which were MOF, a histone acetyltransferase, and MSL2 protein, a male specific component that initiates the complex’s X-chromosome assembly. To expand on our lab’s previous findings, I tested whether increasing the amount of MSL2 protein would increase the amount of the reporter gene product. This required making several crosses of Drosophila that would result in offspring with varying amounts of MSL2 that is targeted to a white-eye color gene reporter. By using the target gene miniwhite, the results could be seen phenotypically by comparing the Drosophila’s eyes side by side. To determine the quantity of mRNA from the white-eye color gene, a molecular analysis was performed using the quantitative polymerase chain reaction (qPCR) technique on three biological repeats. The molecular analysis revealed no significant difference in mRNA levels between Drosophila with one copy of MSL2 and Drosophila with two copies. However, there was a significant difference in the mRNA levels of Drosophila with two copies compared to those with three copies. The increase in mRNA levels does not seem to correspond to an increase in the target gene though, since the increase was not seen in the phenotypes.

This project was completed to fulfill a Capstone requirement.
Lauren Schneider
Kirkwood, MO

Senior Psychology

Faculty Mentor: Dr. Kristy vanMarle, Psychological Sciences

Sand in or sand out: Infants’ ability to reason about substances and objects
Lauren Schneider and Kristy vanMarle

Despite infants’ sophisticated knowledge of objects (Baillargeon & Carey, 2012; Kinzler & Spelke, 2007), their ability to reason about nonsolid substances (e.g., sand, water) appears to be rather limited (Hespos & vanMarle, 2012; Huntely-Fenner, Carey, & Solimando, 2002; vanMarle & Wynn, 2011). Nonetheless, previous research suggests infants have a basic understanding of the properties of at least some nonsolid substances. A study by Hespos, Ferry, & Ripps (2009) found infants hold expectations about liquids and expect them to be non-cohesive and penetrable.

In our study we tested if infants extrapolate their understanding liquid properties to other non-cohesive substances such as sand, and furthermore, whether they can reason about how sand should interact with objects on the basis of the object’s features. Specifically, we asked whether 16-month-old infants can predict whether sand should remain inside a container with solid walls, but fall out of a perforated container.

Infants watched six test events. Each event began when a container (perforated or solid, on alternating trials, with order counterbalanced across infants) was suspended above the stage floor. A screen was then raised to hide all but the top edge of the container, following which sand was poured into the container. The screen was finally removed to reveal the sand either inside the container (sand in condition) or in a pile below the container (sand out condition). Each infant was tested in either the sand in or sand out condition.

A 2 x 2 repeated measures ANOVA on infants’ mean looking times on the perforated and solid trials revealed a significant interaction between condition (sand in or sand out) and trial type (perforated or solid), $F[1,18] = 8.77, p = .008$. This suggests that 16-month-olds can effectively reason about whether a nonsolid substance should remain inside or fall out of a container depending on the surface features of the container.

This project was completed to fulfill a Capstone requirement.
Mary Schneier  
Chesterfield, MO  
Junior  
Food Science

Faculty Mentors: Dr. LuAnne Roth, English; Dr. Joseph Dolginow, Agricultural & Applied Economics; Dr. Luis Occeña, Industrial & Manufacturing Systems Engineering; Martha Dragich, JD, School of Law  
Funding Source: Mizzou Advantage Undergraduate Research Team

“Waste not, want not”: Understanding and addressing the problem of food waste

Mary Schneier, Andrew Beckerle, Jackson Hambrick, Mary “Emmie” Harcourt, Henry Hellmuth, Lauren McDermott, Nicole Ripperda, Luke Welsh, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
Experimental design for the study of curved 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. Therefore, further investigation is needed to understand the effects of hydraulic forces on the fuel plates as a result of the high velocity water used to keep them cool. To collect data on this Fluid Structure Interaction (FSI) problem, a new test section has been developed for use in an existing flow loop. This new test section approximates the actual fuel plates through use of surrogate aluminum plates. Presently, research is focused on designing and instrumenting the experiment. Later, the experiment results will be used for benchmarking of numeric models.
Faculty Mentor: Dr. Matthew Bernards, Chemical Engineering
Funding Source: College of Engineering Undergraduate Research
Option

Investigating polymer based biomaterials for improved medical implant performance
Megan Schroeder and Matthew Bernards

Biomedical devices- such as artificial knees, hip implants, heart stents, and dental implants- can drastically improve patient health; however the human body’s immune response to these devices can be painful. When biomedical implants are introduced into the body, the natural immune response is initiated when proteins, naturally present in bodily fluids, stick to the surface of the device. This process leads to inflammation and a buildup of scar tissue, isolating the implant from the body. This may impact the device functionality. To address this issue, research is being conducted on materials that are “invisible” to the body’s wound healing response. These biomaterials, referred to as “nonfouling materials”, are resistant to protein adsorption and can be used in the construction of biomedical implants. Specifically, we investigate polymeric hydrogels as potential biomaterials to solve this problem. We also take this potential solution a step further, by incorporating specific biological cues within our hydrogel sample to make it more compatible with natural biological processes. It is hypothesized that this will promote tissue reconstruction around and integration with the implanted material.

I have been working to develop a nonfouling hydrogel, which is a hydrated polymer, or a plastic such as a soft contact lens, for this purpose. Our samples exhibited low levels of protein adsorption and therefore, nonfouling characteristics. The next step was to purposefully attach protein to the surface of the hydrogel, to provide specific biological signals. Once there is a layer of protein on the surface of the gel, it is possible to bind cells to the proteins, and the hydrogel becomes a tissue “scaffold.” In our lab, we have demonstrated mouse bone cells adhering to the surface of our sample. This scaffold has the potential for use in future studies to fabricate tissue and for many other biomedical applications.
Economic volatility in Europe: A modern rise of the far-right?
Ryan Schuessler and Laron Williams

Existing literature exploring the economic indicators behind voter support for far-right parties in Europe is extensive. However, there is little modern literature examining the 2008-2013 global financial crisis and whether or not the resulting economic conditions gave rise to far-right support in Europe on a cross-national scale, in real time. I hypothesized that the low GDP growth rates during this time fostered support for these parties, and also that those countries that employ proportional representation electoral systems would see a greater increase in support for these parties. I analyzed the results of 55 national legislative elections between 2000 and 2013 in 17 European OECD countries, observing 18 far-right parties that participated in elections. Using a multiple regression test, I tested the relationship between real GDP growth rate during an election year and vote share for the far-right party participating in that year’s election, while controlling for electoral system, unemployment rate, change in unemployment rate since the year before the election, the proportion of foreign-born residents, previous vote share, as well as the interaction between GDP growth and electoral system. I expect to find that GDP does not have any statistically significant effect on vote share for far-right parties. Rather, the data suggest that previous vote share is what influences current vote share most, where those far-right parties with larger vote shares in the last election will lose more votes in the current election than smaller parties.

This project was completed to fulfill a Capstone requirement.
Catherine Seidu
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Faculty Mentor: Dr. Zezong Gu, Pathology & Anatomical Sciences
Funding Source: Mizzou Advantage Research Grant

Quantification of metalloproteinases in human cerebrospinal fluid after traumatic brain injury
Catherine Seidu, Brittany Tomlinson, Ashley Bartels, Zachary Bowles, Shanyan Chen, Zhe Qu, Jiankun Cui, Robert Calaluce, Stephen L. Barnes, and Zezong Gu

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Determining the genes involved in control of petal detachment

*Kati Seitz and John C. Walker*

Abscission, the process of shedding floral organs, such as leaves, fruit, or petals, is a vital part of the plant life cycle. While abscission may sound abstract, you experience it constantly—you see leaves fall from the trees in autumn, the fruit you eat is dropped from a plant, and you can even see plants lose their leaves if attacked by a pest or disease. As such, understanding how abscission works would be beneficial to controlling when and why crop bearing plants drop their produce. Our lab's main goal is to better understand the process of abscission, how it is controlled, and what genes are involved in the signaling pathway.

We use *Arabidopsis thaliana*, a model organism for plants. This small weed has a much shorter lifespan than most other plants, allowing us to run experiments in a timely manner. The results we produce in Arabidopsis can also be applied to other vegetation. In Arabidopsis, the process of abscission is mediated by two protein kinases HAESA (*HAE*) and HAESA-LIKE 2 (*HSL2*). Kinases add phosphate groups to other proteins, which can activate large chain reactions and control several processes at once. A mutation in both of these genes results in the plant never shedding its petals. The purpose of my experiment was to find other genes involved in the abscission pathway, that are affecting or being affected by *HAE* and *HSL2*. I searched a mutated plant population that already had a mutation in the gene *HSL2*, and found potential mutants that kept their petals. Of those, I chose two plants to study further. To identify the mutations, I first sequenced *HAE* in both plants. There were no new mutations, suggesting *HAE* was not mutated in these plants. I then bred these two plants with a native Columbia (Col-0) plant population and a double mutant (*hae3 hsl2-3*). My breeding results suggested one plant, M1, had a mutant form of *HAE*, while the other plant, M48, did not. To better determine if there was a mutation in the *HAE* gene, I performed quantitative real-time polymerase chain reaction (qRT-PCR) on both plants. This technique allows me measure RNA levels in a plant, which shows how active a gene is. Mutated genes have more or less RNA than a normal version of the gene. By comparing the RNA levels of several abscission-related genes in the mutants with those of a control, I was able to determine that *HAE* is being affected in M1, but not in M48. Determining more genes involved in the abscission process in Arabidopsis would allow us to look for similar genes in crop plants, such as corn or soybeans, and help to control their abscission process. Controlling abscission would mean we controlled when a plant dropped its harvest, and stopping abscission would allow us to prevent crop loss and save more of the harvest. If abscission in these plants were regulated, it would prevent loss of harvest and lead to more food production in Missouri.

*This project was completed to fulfill a Capstone requirement.*
Point cloud visualization for 3D microscopy image analysis
Jacob Sewell, Joshua Fraser, Dan Lasker, and Filiz Bunyak

Point cloud visualizations are becoming increasingly important for interpreting images, and they have strong application in the analysis of biomedical imaging. Given the complexity of these data visualizations, improving upon existing methods of thresholding is necessary for more precise renderings. We are currently working on an existing point cloud visualization software with the goal of implementing a functional thresholding option that can be applied to the point depth, and we are using existing tools including OpenGL, Qt Creator, and Visual Studio.
Effect of propranolol on functional connectivity in individuals with Autism Spectrum Disorder
Emily Shaw, John Hegarty, and David Q. Beversdorf

Autism Spectrum Disorder (ASD) is characterized by impairments in language and communication processing which may be affected by cognitive flexibility, information integration across networks. Cognitive flexibility is impacted by functional connectivity, a pattern of functional relationships among regions of the brain inferred from common changes in activation over time. Functional connectivity may be increased between cortical regions important for language processing by beta-adrenergic antagonists that are able to cross the blood-brain barrier such as propranolol.

We measured the effects of propranolol on the performance of individuals with ASD during two different language tasks (designated “Categories and “Letters”) during which an fMRI scan was taken of the subject’s brain. Nadolol, another beta-adrenergic antagonist but one which does not cross the blood-brain barrier, and a placebo, were used as controls, and typically-developing, age-matched individuals were compared to individuals with ASD as a control group. The order of drug administration was counterbalanced between subjects across the three sessions and the study was double-blinded. In the Categories task, subjects named words that fell under a given category (i.e. “drinks”). In the Letters task, subjects named words that started with a given letter. The quantity of correct words generated within the given time frame was calculated, as well as was the frequency per million words in the English language using the SUBTLEX word corpus (Brysbaert & New 2009), which is a measure of cognitive flexibility.

ASD subjects will be compared within and between groups for drug effects. We hypothesize that functional connectivity will be greater in individuals with ASD with the use of propranolol than with nadolol or the placebo. We also hypothesize that these subjects will generate more correct words and words that are less common when given propranolol. This will be important in the attempt to increase development of language and communication skills of individuals with ASD.
This study sought to determine if younger infants were capable of distinguishing between moral and conventional transgressions. To establish infants' sensitivity to moral transgressions in general, Experiment 1 tested 32 13-month-olds' ability to distinguish between moral and neutral individuals. Infants first watched videos showing a conventional or moral transgression. At test, looking time was measured when a neutral agent preferred either the moral transgressor or a neutral individual.

A one-way repeated measures ANOVA on infants' mean looking times to the two test events (moral and neutral) revealed a marginally significant effect of test event ($F[1,31] = 3.681, p = .06$). Additionally, a planned paired t-test on infants' mean looking times to the test events was significant, $t(31) = 1.92, p=0.32$, 1-tailed]. As a group, infants looked longer when the agent chose the moral transgressor ($M = 19.73, SD = 11.00$) than the neutral individual ($M = 17.14, SD = 8.75$), indicating they discriminated moral transgressors from neutral individuals.

Experiment 2 is ongoing ($n = 13$, planned $n = 32$) and asks whether infants discriminate moral and conventional transgressors. At test, infants are shown (on alternating trials) a neutral agent choosing either the moral or conventional transgressor. Preliminary data suggests that 13-month-olds do not distinguish between moral and conventional transgressions – only 6 of 13 infants look longer at the test event in which the agent chooses the moral transgressor ($p = .50$, 1-tailed binomial test).

Given that 13-month-olds are not making the moral-conventional distinction, we began testing 18-month-olds ($n = 2$) using the same procedure/stimuli as Experiment 2. If infants’ make the moral-conventional distinction at 18 months (Expt. 3), but not 13 months (Expt. 2), it would indicate that this capacity emerges around the same age that infants begin to develop empathy (Thompson, 1998).

This project was completed to fulfill a Capstone requirement.
Over-expression of soybean DOF-type transcription factor increases biomass in Arabidopsis
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. The DOF (DNA binding with one finger) domain protein is plant-specific zinc-finger transcription factor family regulating several biological and physiological processes associated with stress responses, photosynthesis, growth, and development. Here, we report that over-expression of a soybean GmDOF gene increases shoot and root biomass in Arabidopsis plants. Phenotypic analysis of several independent homozygous transgenic Arabidopsis plants was conducted. Most of the lines showed increased seed size and yield. These preliminary results suggest that GmDOF increases biomass by regulating other downstream genes. Additional efforts are also underway to explore the effect of over-expression of GmDOF on downstream genes including the genes for yield and biomass improvement.
Faculty Mentor: Dr. Sheila Baker, Chemical Engineering
Funding Source: Oak Ridge Associated Universities (ORAU) Ralph E. Powe Junior Faculty Enhancement Seed Grant; College of Engineering Undergraduate Research Option

**The capture of CO₂ in electrical utility generating units**
Sonali Siriwardana and Sheila Baker

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
A new mutant with no ears in maize
Taylor Smith and Paula McSteen

The tassel and ear are very important in the development of maize. Normal tassels consist of a main spike with several long branches and the ear shoot develops from the main stalk. Both the tassel and ear are crucial in ensuring crop yield, which is important to the agricultural industry as a whole.

The barren class of mutants is defective in either tassel or ear development. This is because of a lack of the hormone auxin, which plays an important role in plant growth. The barrenstalk1 (ba1) and ba2 mutants are in this class and both lack branches on the tassel and have no ears.

The new mutant that is presented is very similar to the barren class of mutants and has been found to map on chromosome 6. The mutant’s phenotype does not have an ear and has few branches in the tassel. In order to clone the gene I am currently working on mapping the mutant.
Mechanisms that regulate firing synchrony in crab cardiac ganglion
Morgan Spratt, Pranit Samarth, and Satish Nair

The crab heart muscles are controlled by a group of 9 cells of the cardiac ganglion (Ball et al., 2010 and Franklin et al., 2010). The ganglion consists of five large motor cells (LCs) and four small endogenous pacemaker cells (SCs), which are responsible for controlling the rhythmic contractions of the heart muscle. The SC cluster drives the LCs using gap junction as well as chemical synapses. The five LCs are all inter-connected via gap junctions, and innervate the muscles of the crab heart. Even with wide varying intrinsic properties in the 5 LCs of the network (Ransdell et al., 2013), the LCs fire synchronously. Thus far, we have determined the biological parameters of each individual cell and have compiled data from previously developed single cell and 2-cell networks. Using this information, an accurate model of a 9-cell network will be developed. By studying and modeling both single-cell and the 9-cell network characteristics, we will investigate the mechanisms that enable cells with varying conductances to fire synchronously.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures
Austin Stake, Zachary Brinker, Matthew Jackson, Virginia Trauth, Zachary Treece, and Sarah Orton

Flat plate reinforced concrete structures have been a common design option for many years. They are popular for a number of reasons including ease of construction, decreased required story height, and lower cost. A flat plate reinforced concrete structure consists of reinforced slabs that are supported directly by the columns. Due to the nature of this design these types of structures are vulnerable to punching shear failures at the slab column connection. When a failure of this type occurs it can lead to the surrounding connections being overloaded in turn causing them to fail in the same manner. This effect is called progressive or disproportionate collapse.

The overall goal of this research is to evaluate the potential of disproportionate collapse in older reinforced concrete flat-plate buildings subjected to the loss of a supporting column. The research program considers testing of isolated slab column connections that represent the connection near the lost supporting column. The goal of the tests is to evaluate the effects of in plane lateral restraint, dynamic loading rate, and post-punching capacity. The results of the isolated slab tests will be presented as well and explanation of future work.
Student associations and student governments discredit the assumption that young people are not engaged in the political process. Forty-one states have various forms of student associations meant to represent students in government. Many of these student associations have student lobbyists that work to lobby for students in their state legislatures. Very little has been published about college student lobbyists and their effectiveness at the state level. This comparative study will compare a variety of characteristics across four student-lobbying organizations: the Oregon Student Association (OSA), the University of California Student Association (UCSA), the Arizona Student Association (ASA), and the Associated Students of the University of Missouri (ASUM). The goal of this comparison is to start a constructive dialogue between student lobbying organizations and provide them with avenues to increase the effectiveness of their lobbying.

*This project was completed to fulfill a Capstone requirement.*
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 obtaining a vacuum circuit breaker and running field tests.
The influences of physical activity on bone mineral density: A study on the active prevention of osteopenia and osteoporosis
Matthew A. Strope, John P. Thyfault, Peggy Nigh, Melissa I. Carter, Nantian Lin, Jun Jiang, and Pamela Hinton

Background: In addition to the 2 million already diagnosed, it is estimated that more than 12 million American men are at risk for osteoporosis. High-impact exercise has been shown to increase bone mineral density (BMD) for individuals suffering from osteopenia or osteoporosis.

Objective: Our goal is to find a long-term, preventative measure against bone deficiency diseases for at-risk men.

Design: We utilized a cross sectional design to analyze subjects’ questionnaires administered at the initial stages of a related study (Hinton et al.). Subjects’ histories of sports and physical exercise participation were documented and stratified based on age; adolescence was designated as 13-18y, young adulthood as 19-29y, and adulthood as ≥ 30y. Each sport and physical activity was then assigned a score based on the degree of force generated from impact with the ground. Intensity of sport participation and resistance training were also inquired upon.

Results: Higher impact scores during adolescence and young adulthood yielded significantly higher BMD measurements at the total body, hip, and lumbar spine, while higher impact scores from current activity resulted in higher BMD for the hip and lumbar spine only. Likewise, individuals currently involved in sports generating maximal ground reaction forces (GRF’s) had higher BMD for the hip and lumbar spine. The adult time period and resistance training were not significant for any of the areas measured.

Conclusions: Participation in higher impact sports over the lifespan, especially during adolescence and young adulthood, seems to protect normal and at-risk adult men from age-related bone loss.
AAV5 Rep40 is required for efficient packaging of the AAV5 viral genome
Stephanie Stupps and David Pintel

Alternative spliced versions of the prototype adeno-associated virus type 2 (AAV2) P19-generated pre-mRNAs individually generate the small Rep proteins, Rep52 and Rep40, which differ in their carboxyl termini. We have previously shown that AAV5 Rep-encoding P19-generated transcripts are primarily polyadenylated within its central intron and not efficiently spliced; however, surprisingly, AAV5 was found to generate high levels of both Rep52 and a Rep40-like protein. Although precluded from using alternative splicing to generate multiple Rep isoforms, AAV5 ensures the production of a Rep40-like protein by utilizing a novel internal translation initiation event. In contrast to the case with AAV2, the AAV5 Rep40-like protein has the same C-terminus as Rep52. Although it has been shown that the small Rep proteins of AAV2 are involved in packaging of AAV genomes, it is currently unclear whether both proteins are required. Biochemical characterization of AAV5 Rep40-like function indicates that it has helicase activity which unwinds double stranded DNA substrates, a function expected to be required for packaging activity.

We have generated a series of mutants that impact expression of the AAV5 small Rep proteins. Mutant M49-51A, which lacks Rep40 expression, shows a severe defect in viral genome packaging. This defective phenotype can be rescued by the reinsertion, into the M49-51A, of a methionine codon immediately downstream of the parental mutation. These results, combined with our previous observations, strongly suggest that AAV5 Rep40 - which has a different carboxyl terminus status than the prototype AAV2 Rep40 – is required for efficient packaging of viral genome during infection.
Faculty Mentor: Dr. George Stewart, Veterinary Pathobiology
Funding Source: Mizzou Advantage Research Grant

Role of bacteriophage in Diterpenoid A resistant in *Staphylococcus aureus*
Che-Min Su, Hsin-Yeh Hsieh, Chung-Ho Lin, and George C. Stewart

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
High performance monolayer MoS$_2$ transistors
Sheng Chieh “Vincent” Su and Shubhra Gangopadhyay

Two-dimensional materials have become very popular in the many fields recently because of their atomic-scale thickness and several unique properties that make them promising in many applications. Materials such as graphene and MoS$_2$ represent the ultimate limit of material scaling in the vertical dimension. While graphene has drawn much interest due to its massless charged carriers, the lack of an intrinsic band-gap limits its applications in digital electronics and switching devices. MoS$_2$ is a stack of planes where covalently bonded S-Mo-S atoms are closely packed in a hexagonal arrangement, and the adjacent planes are held together by van der Waals interactions. This allows us to achieve multi and monolayer MoS$_2$ with scotch tape. MoS$_2$ transistors might not be good for high-performance applications due to heavier electron effective mass and lower mobility compared to the state-of-art III/V material based transistors, but because it has large band gap and excellent electrostatic integrity inherent in a two-dimensional system, MoS$_2$ is a great alternative for low power applications. In addition, because of its high thermal stability, chemical inertness, transparency, flexibility, and relatively inexpensiveness, MoS$_2$ show promising potential to become next generation electronics.
Matthew Swartz  
Adrian, MO  
Junior  
Biological Sciences

Faculty Mentor: Dr. David Q. Beversdorf, Radiology, Neurology, and Psychological Sciences  
Funding Source: Research Council and Research Board of the University of Missouri and the University of Missouri Research Investment Fund

**Sex-specific effects of DHA enrichment on anxiety-like behavior and anhedonia following chronic social stress**

Matthew Swartz, Eldin Jasarevic, Patrick Hecht, Kevin L. Fritsche, and David Q. Beversdorf

Chronic social stress is believed to be a key contributor in the rapid growth of depression- and anxiety-related disorders in today’s society. Epidemiological studies have observed a strong relationship between plasma omega-3 fatty acid docosahexaenoic acid (DHA) deficiency and depression, suggesting that diet may play an important role in the etiology of depression. Previous work has shown that omega-3 PUFA enrichment decreases the emergence depressive-like behavior following chronic stress, however, these studies have largely focused only on males, despite wide recognition that females are at a higher risk for depression. This discrepancy may underestimate the putative protective role of n-3 PUFAs in females. To address this gap in our knowledge, we will examine the sex-specific effects of DHA enrichment on anxiety-like behavior and anhedonia following chronic social isolation. Animals were placed on one of three diets: a control AIN93G diet with no DHA supplementation, a AIN93G diet supplemented with 0.1% DHA/kg feed weight, or a AING93G diet supplemented with 1.0% DHA/kg feed weight. Following chronic social isolation we will evaluate exploration, anxiety-like behavior and anhedonia (e.g., decreased motivation to seek natural reward) in mice using open field, elevated plus maze, and a two-bottle sucrose preference test, respectively. Data will be analyzed for sex x diet x treatment interactions. Following behavioral testing, plasma levels of DHA will be measured to assess whether sex-specific behavioral differences following social isolation correlate with plasma DHA levels. This study will provide insight regarding the sex-specific role of chronic social isolation in an animal model of depression and whether the maladaptive effects of social isolation could be buffered by a DHA supplemented diet.
This paper examines the role of miracles in texts narrating the conversion of pagans to Christianity by looking at saint’s lives from northwestern Europe and Armenia and Georgia. In these texts, the converting saints perform miracles that paralleled those of Jesus in the Gospel of Mark. The authors of these texts show that miracles convinced royalty to convert to Christianity and encouraged their subjects to follow. Miracles were also used to show how much more powerful the Christian God was compared to the pagan deities. The saint’s miracles parallel Jesus’ miracles and provided the same result of influencing large portions of the population to adopt the new faith. Scholars have pointed out other reasons why Christianity was attractive to the Germanic and Slavic peoples, and after a brief discussion of their theories, I will conclude by offering some reasons why, even though miracle stories are not the only reason people converted, they remained not only a popular literary device, but one seemingly necessary to the construction of a hagiographical text.
Edwardian era literature, defined as English writings of the early 20th Century occurring during the reign of King Edward (1901-1910) is much shorter and more loosely defined canon than its Victorian counterpart. The period seems to represent tensions with traditions of the past and portents of the future, with a lot of carry over from Victorianism but also with the looming threat of WWI and the renewed search for personal and national identity. One of the most well-known and prolific writers of this period was E.M. Forster, who wrote four of his six novels in this decade span, including *A Room with a View* and *Howard’s End*. Aside from *A Passage to India* (1924), Forster didn’t release any other notable works of fiction after this period of time, instead turning his pen to the field of literary criticism.

Forster is notable for the philosophy of liberal humanism that he brings to his fictional works, as spelled out by the famous epigraph to *Howard’s End*—“Only Connect.” It is also worth noting that he frequently contradicted his humanist outlook with what biographer Frank Kermode deemed unforgiving elitism. But Forster’s humanist concern with personal and national identity within his Edwardian works offers a vital perspective of England bracing for World War and modernity, still suffering under the constraints of Victorian society but on the cusp of change.

I wish to focus on the specific historical moment that saw Forster producing two extremely different but potentially linked works: his short story “The Machine Stops” (1909) and his much larger magnum opus *Howard’s End* (1910). “The Machine Stops,” published initially in *The Oxford and Cambridge Review* in November 1909 was a unique departure for Forster, modeled after the Victorian proto-science fiction stories of H.G. Wells. The novella-length story grappled with issues of advancing technology and individualism within a dystopic plot. It is fascinating that this experimental piece arrived just before the publication of *Howard’s End*, a more typical realist drama of English class relations between the three central Schlegel, Wilcox, and Bast families. The central critical issue of the novel is the unanswered question of which family will inherit the titular Howard’s End property, which itself represents the future of England. The fact that both turn of the century texts seem preoccupied with issues of futurism is something I hope to explore further in my writing.

I intend to approach these two key texts primarily through a historicist lens, examining the English culture that could produce and make meaning out of two wildly different pieces of fiction. I also intend to apply a queer reading of Forster’s work as ‘closet fiction or fantasy’ as outlined by Ralph Pordzik and other queer theorists/Forster scholars. Society as depicted by Forster’s characters has more in common with the repressed, patriarchal attitudes readers would associate with the late-Victorian era. But Forster stops short of affirming this type of the society as the ideal, and in works like “The Machine Stops” and *Howard’s End*, he frequently challenges patriarchal values that rigidly police gender, sexuality, and other societal norms. Specifically Forster, as a closeted homosexual, envisions new, natural spaces free from the constraints of civilization that represent patriarchy and sexual repression within his fiction.

*This project was completed to fulfill a Capstone requirement.*
Design of data automation work flows
Liuyan Tan and Dong Xu

The new version of our plant protein phosphorylation database (P3DB: p3db.org) implements multiple module based work flows. One of our most important work flows is the data automation process. The user can upload data by his or her own and instantly see the results of the data structure. This workflow solves the problem that the data set needs to be individually processed by the web site editors. The automation speeds up the data curating process, and give an immediate analysis result, which can be visualized instantly. In the end, the users can automatically generate the customized data repository site and develop their personalized websites for publication purposes.
Objective: The objective of our research is to understand the role of sleep and sleep disruption in the development of post-traumatic stress disorder (PTSD).

Background: PTSD is a severe debilitating disorder with profound socio-economic costs. Hyperarousal, nightmares and sleep disruptions are considered to be the hallmark of PTSD. However, their role in the development of PTSD is unclear. To better understand this, we used the most widely-used and ecologically valid “predator odor trauma” model to mimic human PTSD.

Methods: C57BL/6J mice, implanted with electrodes in the hippocampus and muscles to examine sleep-wakefulness and hippocampal field potentials, were used in a set of experiments as described:

Experiment 1: The experiment was initiated by replacing the animal’s recording cages with contextual cages (aluminum foil wrapped on the bottom and outside half of recording cages) followed by exposure to predator odor (soiled cat litter) 30 minutes later. After 90 minutes of exposure to predator odor, mice were transferred back to their respective recording cages and left undisturbed for 5 days. On Day 5, animals were exposed to objective reminders (contextual cages) for three hours. Sleep-wakefulness and hippocampal field potentials were continuously recorded for all 5 days. Control animals underwent the same protocol except that they were exposed to clean litter.

Experiment 2: Same as experiment 1 except that sleep was disrupted (by gentle auditory tactile and stimuli) for three hours immediately after the trauma.

Results: Mice exposed to predator odor trauma displayed hyperarousal and sleep disruptions. Exposure to objective reminders resulted in “flashbacks” or replication of behaviors observed during original trauma. Three hours of sleep disruption reduced PTSD symptoms.

Conclusions: Our preliminary results suggest 1) mice exposed to predator odor trauma mimic sleep disruptions observed in human PTSD. 2) If sleep is disturbed immediately after trauma, PTSD symptoms are attenuated.

This project was completed to fulfill a Capstone requirement.
Context dependent target detection
Angelique Taylor, Xiaoxiao Du, Chao Chen, and Alina Zare

This project involves analysis of Synthetic Aperture SONAR using fuzzy clustering algorithms. The goal is to autonomously partition input SONAR imagery into different sea-bed types such as sea-grass, sand ripple, rock, and others. In order to be able to partition the imagery, informative texture features are needed. I have been comparing texture features and their parameter settings to find an effective set of features to use to partition input SONAR imagery. The long term goal of this project is to incorporate the clustering result into a target detection system in order to improve detection results and reduce the number of false alarms by adapting the detection parameters based on the sea-bed type.
How red is your blood: Anemia, oxygen saturation and mutations
Ryan M. Tegethoff, Spencer B. Glazer, and Mark A. Milanick

We have designed a laboratory exercise to help some students who don’t fully understand the relationships between hematocrit, oxygen saturation, and how much oxygen is delivered. Oxygen delivery depends upon not only oxygen saturation levels but also the amount of hemoglobin. But mutations that alter the affinity of hemoglobin for oxygen can give abnormal pulse oximeter and hemoglobin readings but normal oxygen delivery. Two such mutations are the KansasHb and HbBrynMawr studies. With HbKansas, the lowered oxygen affinity is attributed to molecular abnormality in the globin, which interfere with normal hemoglobin interactions. The high affinity of HbBryn Mawr for oxygen, results in a decrease in tissue oxygenation and an increase in erythropoietin levels and in red cell synthesis, while intracellular precipitation of Hb, results in a hemolytic anemia and decreased survival of RBCs. Pulse Oximetry is a non-invasive way to determine one’s oxygen saturation levels and heart rate. We have developed a simple apparatus to simulate blood with different pulse oximeter readings. Using our data from multiple tests, we were able to create a lab experiment for high school and undergraduate students. Students will explore oxygen carrying capacities of blood samples provided by the teacher. The students will receive four different blood samples; they must measure the hematocrit and pulse oximeter readings of each individual sample and they have to match the blood sample with the patients’ diagnosis. Students will be given the chance to explain their observations using a physical model and a novel river plot. The physical model through hands on activity will stimulate the student’s comprehension of the mechanism to oxygen binding with hemoglobin. Educating students on the physiology of Pulse Oximetry will ultimately enhance their knowledge and understanding the relationships between hematocrit, oxygen saturation and how much oxygen is delivered.
**Samantha Tellatin**
Springfield, MO

Junior Bioengineering

Faculty Mentor: Dr. Steven Borgelt, Bioengineering  
Funding Source: College of Engineering Undergraduate Research Option

**Eliminating waste through sustainable practices and energy production**  
Samantha Tellatin and Steven Borgelt

The aim of this project is to evaluate the methods, efficiency, and the economic and environmental impacts of converting waste to energy on the University of Missouri campus. A two-week long trash audit of the Agricultural Engineering Building will be performed during the dates of March 31st through April 11th. The side effects and byproducts of the incineration of any non-recyclable, non-compostable waste products will be examined, through written research and potential lab incineration, and the amounts of usable thermal and electrical energy they can provide will be discovered. The processes of gasification and combustion will be explored in order to determine which process is best for the task of converting this waste to energy. In doing this project, I hope to:

1. Understand the quantity and composition of the trash produced by the Agricultural Engineering Building

2. Eliminate, or greatly reduce, the production of waste transferred to landfills in the Agricultural Engineering building, through peer education, better sustainable practices, and waste diversion for other purposes.

3. Explore the potential of using waste as an alternative source of energy and its implications.
State legislatures and the laws that bind them
Matt Tharp and Peverill Squire

By definition, democracy depends on the trust of the people. Consequently, it is imperative citizens believe their legislators are ethically sound individuals who operate outside the influence of financial and policy-based special interests. This influence is exerted through a variety of actions, including gifts to legislators from lobbyists, campaign contributions, and independent expenditure campaigns. Missouri is the only state in the country that both has unlimited lobbyist expenditures and lacks campaign finance limits, a fact that causes many to argue for stricter regulations. However, that begs the question: are ethics regulations in state legislatures even effective? Is is possible to legislate morality? Previous research has used various states as case studies in the examination of ethics yet there is a void of research cross-examining specific behaviors across states during a set time period. This study compares campaign contribution and lobbyist gift behavior in both a low-regulation state (Missouri) and a high-regulation state (Minnesota) from 2004-2012.

This project was completed to fulfill a Capstone requirement.
Peter Thommesen
Ballwin, MO

Faculty Mentor: Dr. Jay Dow, Political Science

Political knowledge and satisfaction with government performance: A comparative perspective
Peter Thommesen and Jay Dow

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

This project was completed to fulfill a Capstone requirement.
It is now generally accepted that democratic states win wars and produce highly effective military forces, especially when pitted against an autocratic foe. Researchers have found that democratic governance consistently provides a nation several systemic advantages which offer greater insight in the initiation of conflict and superior military leadership and quality of soldiers on the field of battle. While democracies have maintained undiscutable success in conventional conflicts over the past century, there are instances in which autocratic regimes have produced far more effective military forces than their democratic rivals. Throughout the Second World War, the German military proved to be a formidable foe that was able to consistently outmatch Allied armies on the field of battle. This qualitative analysis of military literature focuses on finding the underlying reasons why the German military was able to consistently outperform its democratic opponents during the conflict. This study focuses on two important factors in the foundation of German military prowess, the culture of the German military and the unique political position Germany was placed in as a result of the Treaty of Versailles. It is my argument that German military successes are a result of a distinct military culture that placed an emphasis on individual imitative. This culture, combined with the clean slate that Versailles provided the German officers corps, allowed Germany to masterfully implement modern military tactics while mitigating some of the damaging effects of autocratic government that plague similar states. By understanding how Germany was able to perform so well during the conflict we can better understand the unique relationship between government and military effectiveness, as well as provide insight into the challenges of forming a truly effective military in the modern era.

This project was completed to fulfill a Capstone requirement.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures
Virginia Trauth, Austin Stake, Zachary Brinker, Matthew Jackson, Zachary Treece, and Sarah Orton

Flat plate reinforced concrete structures have been a common design option for many years. They are popular for a number of reasons including ease of construction, decreased required story height, and lower cost. A flat plate reinforced concrete structure consists of reinforced slabs that are supported directly by the columns. Due to the nature of this design these types of structures are vulnerable to punching shear failures at the slab column connection. When a failure of this type occurs it can lead to the surrounding connections being overloaded in turn causing them to fail in the same manner. This effect is called progressive or disproportionate collapse.

The overall goal of this research is to evaluate the potential of disproportionate collapse in older reinforced concrete flat-plate buildings subjected to the loss of a supporting column. The research program considers testing of isolated slab column connections that represent the connection near the lost supporting column. The goal of the tests is to evaluate the effects of in plane lateral restraint, dynamic loading rate, and post-punching capacity. The results of the isolated slab tests will be presented as well and explanation of future work.
Evaluation of the progressive collapse potential of flat plate reinforced concrete structures
Zachary Treece, Austin Stake, Zachary Brinker, Matthew Jackson, Virginia Trauth, and Sarah Orton

Flat plate reinforced concrete structures have been a common design option for many years. They are popular for a number of reasons including ease of construction, decreased required story height, and lower cost. A flat plate reinforced concrete structure consists of reinforced slabs that are supported directly by the columns. Due to the nature of this design these types of structures are vulnerable to punching shear failures at the slab column connection. When a failure of this type occurs it can lead to the surrounding connections being overloaded in turn causing them to fail in the same manner. This effect is called progressive or disproportionate collapse.

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Atmospheric plasma spectroscopy for volatile compound identification
Lars Tuveson, Emily Baxter, and Scott Kovaleski

Volatile compound research is becoming more common because of the health risks associated with their long-term exposure to humans. Some presently used identification methods of volatile compounds include solid phase microextraction, gas chromatography, and mass spectroscopy. These methods require high purity samples, extensive sample preparation, and costly containment procedures for accurate analysis. The aim of this research is to identify volatile compounds that are present in environments in which human exposure is common by analyzing the compound’s emission spectrum. Gaseous compounds are ionized through the use of the piezoelectric transformer plasma source (PTPS). In order to deliver the compound to the ionization area and to recreate normal exposure conditions, a carrier gas must be used. Argon was chosen for this experiment because of its well documented emission spectrum, low reactivity, and relatively low cost. Electron excitation and relaxation emits photons at discrete energy levels and wavelengths that can be used to identify the compound. Photon collection and analysis was performed using a spectrometer.
Annette van Swaay  
Creve Coeur, MO  

Junior  
Biological Sciences

Faculty Mentor: Dr. Kristen Taylor, Pathology & Anatomical Sciences  
Funding Source: National Institutes of Health NCI R00 CA132784 (K.H. Taylor)

**Effect of enhancer methylation in Acute Lymphoblastic Leukemia**  
Annette van Swaay, Md Alamamun, Wade Davis, and Kristen Taylor

B-cell acute lymphoblastic leukemia (ALL) is a malignancy characterized by an accumulation of immature precursor B-cells. Progress in identifying mechanisms other than genomic rearrangements that are responsible for the pathogenesis of ALL is lacking and genomic rearrangements alone do not explain all incidences of ALL. Therefore, the identification of key regulatory regions in the genome that may impact the development of ALL is a crucial component to gaining a better understanding of the malignancy.

DNA methylation is a biochemical process, which adds a methyl group to the cytosine of a CpG dinucleotide and is a regulatory factor for gene expression and cellular differentiation during normal human development. Aberrant tissue specific gene regulation may lead to the development of many diseases, including cancer. Genome-wide methylation studies comparing healthy precursor B-cells and ALL patient samples were performed to identify differentially methylated loci. Remarkably, most of the differentially methylated loci were located within intergenic and intronic regions. We hypothesize that there are regulatory elements in these differentially methylated regions that could lead to the development of ALL.

Enhancers are non-coding regulatory regions present in intergenic and intronic regions of the genome. Previous studies have shown that enhancer methylation can affect the expression of neighboring genes. Specific chromatin signatures can be used to identify enhancer like regions. The best predictor of an active enhancer is the co-enrichment of histone-3-lysine-4 mono-methylation (H3K4me1) and histone-3-lysine-27 acetylation (H3K27ac). H3K4me1 and H3K27ac data were obtained from the publically available ENCODE project to identify putative differentially methylated enhancers. We identified 275 differentially methylated regions enriched with H3K4me1 and H3K27ac marks. The neighboring genes surrounding these regions were extracted using the UCSC table browser. An analysis of RNA expression data has shown that enhancer methylation correlates with low levels of expression at neighboring genes.

*This project was completed to fulfill a Capstone requirement.*
Sex-determination mechanism of gray tree frogs: *Hyla versicolor* and *Hyla chrysoscelis*

Amber VanStrien, Carl Gerhardt, and Mitch Tucker

Sex chromosomes control the expression of characteristics that classify an organism as male or female. In many species, including humans, females are considered the homogametic sex because they have two structurally similar X chromosomes. Males have dissimilar X and Y chromosomes, and are considered the heterogametic sex. This system can be reversed in other species; whether a species utilizes male or female heterogamy, is referred to as that species' genetic sex-determining mechanism. The aim of our study is to discover the sex-determining mechanism (male heterogamy XY, or female heterogamy ZW) of two gray treefrog species, *Hyla chrysoscelis* and *H. versicolor*. The experimental treatment used irradiated sperm to fertilize cold-shocked eggs. Ultraviolet radiation destroys DNA but does not harm the sperm cell itself, allowing fertilization and subsequent signaling cascade that initiates development. Cold-shocking of eggs causes the retention of all homologous chromosomes contained in the second polar body. The gynogenetic embryos resulting from fertilization of the cold-shocked eggs with DNA-inactivated sperm possess only maternal DNA. The ratio of male to female gynogenetic individuals indicates which SDM occurs in this species. If the progeny are all female, that species has male heterogamy (XY). If there are male and female progeny in equal ratios, the species has female heterogamy (ZW). Our preliminary results indicate that male heterogamy occurs in both species. Knowing which system is currently used by *H. versicolor* and *H. chrysoscelis* helps us understand the evolutionary pathways of anurans, which are found to have experienced reversals between the XY and ZW systems early in their history.
Previous research has shown that narratives in health news can impact readers’ intentions and behavior related to medication use (Shaffer et al., in prep). Based on previous work, this study investigated whether reading about an adverse reaction to over-the-counter medication would cause people to avoid consuming that medication specifically or to avoid all related medications generally. This experiment was conducted within a two-week period. Seventy-seven participants enrolled in an Introductory Psychology course were surveyed about their past use of common over-the-counter medications and their intent to use these medication in the future on a 5-point Likert scale (0=Not At All Likely, 4=Very Likely). Participants were then randomly assigned to read one of two versions of a New York Times column, Think Like A Doctor, which described a woman’s adverse reaction to an over-the-counter medication. In one condition, the article stated that the adverse reaction was caused by Advil; in the other, the article stated that the adverse reaction was caused by Advil, and a number of other related medications that may also cause the reaction. After reading the article, participants were asked about their intentions to use Advil and related medications. Two weeks later, participants were asked to report their actual use of Advil and the related medications, as well as future intentions to use the medications. There was no significant difference between the Advil and Advil plus related medications conditions in either intentions to use Advil or actual Advil use. However, intentions to use Advil in the future were significantly lower after reading the article than at baseline for both groups, $F (1,75) = 19.18, p < .001$. Further, fewer participants reported using Advil two weeks after reading the article than at baseline, but these differences were not significant.
Variation in volatile emissions of *Arabidopsis thaliana* in response to damage produced by insects with different feeding behaviors

Caitlin Vore, Chung-Ho Lin, Jack Schultz, and Heidi Appel

Plants are very sensitive to changes in their environment and produce airborne chemicals, referred to as volatiles, in response to many different stimuli, including insect herbivory. Plants can produce different suites of volatiles at different concentrations specific to the species of plant and the species of insect causing damage. In this study I determined the composition of volatile profiles released by the plant *Arabidopsis thaliana* in response to physical wounding and herbivory by two species of caterpillars: *Pieris rapae*, a dietary specialist on the Brassicaceae family and *Spodoptera exigua*, a dietary generalist, both of which can be major agricultural pests. We used a volatile collection system with adsorbent traps to capture volatiles and then analyzed them with a gas chromatograph-mass spectrometer (GC-MS). Using available standards, we developed a method to detect and quantify 19 compounds commonly produced by plants. We found treatment-specific responses in volatile profiles associated with both the amount of damage and the type of damage produced. Analysis of the volatiles produced over a time series shows differences in compounds produced at certain time periods, as a result of the different feeding behaviors of the two insects. Sampling volatile emissions can tell us what species of insect is damaging a crop and where the damage is occurring. Using this information, conservationists, farmers, and scientists can work to improve precision agriculture and integrated pest management.
Theoretical models of consanguineous marriage in Bangladesh

Emily Voss and Mary Shenk

Consanguineous marriage, or close kin marriage, has been a common form of marriage historically across cultures. Over time the practice has decreased in many areas of the world, yet it is still present in the Near East and South Asia in countries such as Pakistan, India and Bangladesh. Although the practice is common, the literature examining the socio-cultural determinants is lacking. This paper examines possible determinants through three predictive models based on analysis of the current literature: industrialization, marriage costs, and cultural traditions.

Based on analysis of the current literature, these models have been realized and will be tested across relevant variables. The shift from a landowning agricultural to an industrial society is generally associated with lower rates of consanguineous marriage, although there are many variables associated with this model (such as education, occupation, property and residence patterns). Rates of consanguineous marriage may stay high due to cultural norm of dowry payments and economic benefits of paying a lower (or zero) dowry in consanguineous unions. The third model suggests that separate from external societal changes, consanguineous marriage will occur because of cultural traditions such as religion, parental influence and marriage stability.

These models and their variables will be tested using quantitative data from 944 surveys collected in 2010 from Matlab, Bangladesh. Consanguineous marriage is common in Matlab with 18% marrying a relative and 10% marrying a first cousin. This analysis will show how marriage practice trends in Bangladesh compare to similar, more commonly studied countries such as Pakistan and India as well as the trends around the world.
Ethan Voyles
Wildwood, MO

Junior
Bioengineering

Faculty Mentor: Dr. Allen Thompson, Bioengineering
Funding Source: College of Engineering Undergraduate Research
Option

Evaluating discharge uniformity of semi-permeable tubing material in subsurface irrigation
Ethan Voyles and Allen Thompson

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Sulfur plays a large role across bacterial, animal and plant kingdoms as an essential component of amino acids, lipids, steroids, cofactors and other metabolites. Sulfur is also present in the plant hormone jasmonate (JA), which plays a key role in plant immune responses and development. That of which includes regulation of plant resistance to insects and microbial pathogens, and growth-related processes, such as, senescence, reproductive organ development, germination, root growth, and senescence. JA exists in various forms including, jasmonoyl-L-isoleucine, responsible for many JA-regulated gene expressions, while the role of other JA derivatives is less clear. The sulfated 12-hydroxyjasmonate, 12-HSO₄-JA, accumulates to high levels in damaged tissues. *Arabidopsis thaliana* sulfotransferase 2A (AtST2A, At5g07010), among the 18 sulfotransferases in Arabidopsis, was shown to catalyze the formation of sulfated derivatives of JA *in vitro*. To study the *in vivo* function of the AtST2 genes, T-DNA insertion mutants for AtST2A and its close homolog AtST2B (At5g07000) were isolated. Hormone profiling using Ultra Performance Liquid Chromatography-tandem mass spectrometry during simulated-herbivory showed that AtST2A mutant was significantly reduced in the formation of 12-HSO₄-JA while mutants for AtST2B did not yield obvious changes in hormonal profiles. Consistent with this result, transgenic plants overexpressing AtST2A showed marked increase in the 12-HSO₄-JA level. Comprehensive characterization of these mutants and transgenic plants is currently underway.
Multimodal writing workshop: Using poststructural theory to analyze structure and content

Jocelyn Wallinger, Amanda Heflin, Lauren Emerson, Candace Kuby, and Tara Gutshall

In the literature on writing workshop three phases are discussed: mini lesson, individual writing time with teacher conferences, and author’s share time (Ray & Cleaveland, 2004). In this approach children usually compose books with limited paper and writing choices. However, with the proliferation of research on multimodal literacies (Kress, 1997) we wondered how the structure and content of a writing workshop might change when students are introduced to a variety of art materials and encouraged to create multimodally. This study spans four years of research in a second grade classroom. We focused analysis on how one teacher stepped outside the traditional writing workshop structure and looked closely at her language, teaching decisions, and interactions with students. Through a process of pedagogical documentation (Lenz Taguchi, 2010) we collected videos, audio recordings, student made artifacts, interviews, and photographs. We thought with poststructural theory (Jackson & Mazzei, 2012), or plugged in ideas, to analyze data. We used concepts from Deleuze and Guattari’s (1987) rhizomatic theory to think about teaching and learning as unexpected departures, fissures, from the typical ways of writing in early childhood. We specifically focused on the following ideas to analyze data: desire, becoming, smooth and striated spaces, lines of flight, and intra-actions with materials. Insights gained from analysis were: 1) when embracing multimodal writing practices the structure of writing workshop might stay the same but the content of each section changes to respond to students’ literacy desires, 2) students become teacher as they demonstrate their processes in creating with a range of materials to their peers, and 3) as teachers follow students’ literacy desires the curriculum becomes more individualized and expanded. We encourage educators to think of ways to embrace fissures in literacy teaching and learning. When students are not limited in their thinking or materials powerful learning happens.
Haidong Wang  
Dalian, China

Senior  
Computer Science

Faculty Mentor: Dr. Yi Shang, Computer Science  
Funding Source: College of Engineering Undergraduate Research  
Option

Pop-up charts  
Haidong Wang and Yi Shang

Dynamically add flags on a line chart based on CSV files. When a flag is clicked, pop out another bar chart below the line chart. The data of the bar chart is based on the clicked flag. Multiple bar charts can be shown at the same time to be compared. Clicking a remove button will remove a corresponding chart.
Impact of iron on natural organic matter adsorption onto MIEX during drinking water treatment

Shiyi Wang and Baolin Deng

Natural organic matter (NOM) in raw water is associated with the formation of carcinogenic disinfection by-products upon chlorination of drinking water, and thus removal of NOM is important in drinking water treatment. This study investigated how ferrous iron, which may be present in some ground water at significant concentration, impacts the adsorption of NOM onto magnetic ion exchange resin (MIEX) under different iron concentration and pH. MIEX treatment process is based on the incorporation of magnetized iron oxide particles into anion exchange resins. It is well established that MIEX has a high removal capacity of NOM and other contaminants from waters, under the different pH, temperature, time of mixing, etc. In the experiment, humic acid solution was used as NOM because NOM in groundwater is mainly composed of humic substances. The experiments were performed considering adsorption both in oxic and anoxic conditions because partial or complete ferrous ion oxidation may occur once the groundwater is exposed to air, resulting in formation of ferric iron as solid ferric oxides or soluble Fe$^{3+}$ complexes. The expected result is the higher iron concentration will lead to lower MIEX adsorption efficiency.
High-throughput measurement of drugs that alter quantal transmitter release from single chromaffin cells using an electrochemical microelectrode array microchip
Xi Wang and Kevin Gillis

Neurons and endocrine cells secrete neurotransmitters and hormones in discrete packets through a process called quantal exocytosis. Electrochemical microelectrodes can detect quantal exocytosis in the form of spikes of amperometric current as oxidizable transmitter released from individual vesicles is oxidized on the surface of the electrode. Devices fabricated with these electrochemical microelectrodes can aid in drug discovery and testing. However, most measurements to date have not been carried out in a high-throughput manner. Our device offers the promise of high throughput measurements of transmitter release by using electrode arrays. I have initiated experiments to test the effects of two types of drugs on quantal exocytosis. Control experiments were performed using a high K+ solution to stimulate exocytosis and the resulting amperometric spikes were analyzed to determine the time course and amount of catecholamine released from each vesicle. I next plan to test two kinds of drugs, reserpine and L-DOPA, that are predicted to alter quantal exocytosis. Reserpine is an inhibitor of the vesicular monoamine transporter, therefore I predict that the amount of transmitter released from each vesicle will be reduced. On the other hand, I predict that incubating cells in the dopamine precursor L-DOPA will increase the amount of catecholamine released from each vesicle. Positive results from these experiments will establish “proof of principle” for evaluating drug effects on exocytosis to open the door to screening and discovery of new drugs.
Membrane compaction is a normal phenomenon that exists in the initial hours during membrane filtration process. Nanofiltration (NF) membranes, are often regarded as a nanoporous media. Based on the previous research, pore size is a crucial parameter in evaluating and modeling the flux and rejection profiles of the membrane filtration. However, at the initial hours of operation, hydraulic pressures added perpendicular to the membrane surface will lead to the pore collapse and cause a variation in the water permeate and the retention of the solutes. In this research, we developed a time-dependent model based on the classic pore model equations. NF-90 and NF-270 commercial membranes are investigated in the study. Milli-Q water, Glucose solution and NaCl solution are interpreted to characterize the membrane properties, such as the pore size, thickness to porosity ratio, as a function of time.
Exploring the predictive nature of extracurricular activities in the bullying dynamic for students with and without disabilities

Riley Wartick and Chad Rose

Bullying has become a hot button topic in today’s society. Research suggests that having positive involvement in extra curricular activities can serve as protection against bullying (Rose & Monda-Amaya, 2012). Studies have demonstrated that students enrolled in special education are victimized and perpetrated more in bullying than their general education peers (Rose, Monda-Amaya, & Espelage, 2011). The association between students with disabilities being involved in extracurricular activities and the bullying dynamic has become more relevant with the Dear Colleague Letter, issued on January 25, 2013, which is in reference to the Rehabilitation Act of 1973. This act states that all students should have equal access to sports and activities without discrimination, which is especially beneficial to students with disabilities (Rimmer, Rowland, & Yamaki, 2007). Unfortunately, little is known about the intersection of involvement in extracurricular activities and bullying among students with disabilities.

The purpose of this study is to determine the correlation between involvement in extra curricular activities and involvement in the bullying dynamic. This study involved a survey of 14,508 students, including 1,183 students with disabilities, in grades 6 – 12 from five school districts in Texas. The eight-item University of Illinois Bully Scale (Espelage & Holt, 2001) was used to assess bullying behavior, which includes teasing, social exclusion, name-calling, and rumor spreading. Students indicated how often they have engaged in each behavior in the past 30 days. The 4-item University of Illinois Victimization Scale was also included in the survey. The students indicated in the same manner how often they were called names, made fun of, picked on, or hit and pushed by other students. To assess extracurricular activities participation, students listed the extracurricular activities in which they participated. In total, 28 activities were identified, including, but not limited to, various sports, school-related activities, religious affiliated groups, vocational activities, and leadership groups.

Initial findings suggest that extracurricular involvement does not provide a great protective factor. For students with disabilities, the level of involvement in the bullying dynamic is greater in every extracurricular area compared to students without disabilities. The most surprising finding is that students, regardless of disability status, involved in multiple domains of activities are more highly involved in the bullying dynamic than those who are not involved in activities and especially higher than students involved only in sports. These findings indicate that bullying is still a problem in our school systems regardless of the Dear Colleague Letter. The bullying policy in every state needs to be re-examined to determine if students’ needs are really being met in the school system with this problem occurring.
How parents' marital status affects the association between women's relationships with fathers and romantic partners

Chanell Washington and Nicole Campione-Barr

The quality of the father-daughter relationship could affect young women’s romantic relationships because better father-daughter relationships have been associated with better quality romantic relationships (Scharf & Mayseless, 2008). We hypothesized that the association between negative relationships with fathers and negative relationships with romantic partners would be stronger for women who experienced separation from their fathers than for those who did not; we also hypothesized that the association between positive relationships with fathers and positive relationships with romantic partners would be stronger for women from intact families.

The sample consisted of 62 women (M = 18.43, SD = 0.98) who were enrolled in their first year of college. They were given the Network of Relationships Inventory (Furman & Buhrmester, 1985), a widely used questionnaire that assessed the women’s positive and negative relationship qualities with their fathers and romantic partners.

There was a significant main effect of parents’ marital status. Women from non-two parent homes reported greater romantic negativity than those with married parents ($\beta = 0.25$, $p < 0.05$). There was also a significant main effect of positivity with fathers ($\beta = -0.25$, $p = 0.05$), such that greater positivity in the father-daughter relationship predicted less negativity in romantic relationships, but this effect was qualified by a marginally significant interaction with marital status ($\beta = -1.93$, $p <0.05$). The association between father positivity and romantic negativity was only significant for women from non-intact families (two parent: $r = 0.07$, non-two parent: $r = -0.42$).
Comparing cost-effectiveness and environmental benefits of hand drying methods
Sara Wasinger and Steven Borgelt

In this study, the environmental benefits of using hand dryers in the Agricultural Engineering building are being addressed. Currently, most restrooms in the building have paper towels. Many factors have been taken into account, such as cost, amount of solid waste produced, maintenance, and energy used. In addition, the benefits of composting paper towel waste will be addressed. This study is based on a study done by the University of Nebraska-Lincoln\(^1\). It concluded that hand dryers were both more environmentally efficient and cost-effective in the long run than paper towels. The current quality and quantity of waste in the building is being determined by a trash audit. Quotes from various air dryers and costs of electricity are used to determine whether dryers would be more cost-effective and environmentally beneficial than paper towels.
Examining collaborative thinking: Shared work environments
Lindsay Webb, Alyssa Jensen, and Bimal Balakrishnan

In the fall, we researched how technology and shared environments facilitate group design decisions and communication. We oversaw a group of students work to solve an ill-structured architectural problem while using different technologies to solve the problems. A comparison was made in how group decision-making processes change when in different shared environments. We analyzed the use of shared workspace, freehand sketching, keystroke patterns and how well teams work with current technology and software.

Previous studies on this topic laid a solid foundation for creative convergence network studies. However, prior research did not incorporate sketching as a form of communication in the collaborative process. Because of recent technologies, the Architectural Studies department now has the ability to incorporate freehand sketching into the collaborative process. Sketching is a vital step in the design process; it allows different representations to take place quickly. In the digital age, sharing and communicating early ideation stages is an important step because it can help foster new ideas.

The technologies analyzed were those commonly used on collaborative team projects: Cintiq tablets, and either flash drives, Tidebreak’s TeamSpot, or TeamViewer were all studied. The goal of this research was to examine how technology changes the approach to team design and how it aids the creative decision-making process. After analyzing the varying degrees of technologies, it is safe to say the shared workspaces helped facilitate design.

The benefit of this research is two-fold. First, contributions to the existing research of team psychology and how collaborative work environments aid the design process were made. In addition, an analysis is made on how communication through sketches helps ease the design process. Conducting this research also helps professionals understand different approaches to creative thinking and architecture, while providing the opportunity for researchers to gain invaluable experience in conducting guided academic research.
Avery Wells  
Joplin, MO  
Junior  
Computer Science

Faculty Mentor: Dr. Jianlin Cheng, Computer Science  
Funding Source: College of Engineering Undergraduate Research Option

GMOL: A tool for 3D genome structure visualization  
Avery Wells, Jackson Nowotny, Lingfei Xu, and Jianlin Cheng

It has been shown that genome spatial structure largely affects both genome activity and DNA function. Knowing this, many researchers are currently attempting to accurately model genome structure. Despite these increased efforts, there still exists a shortage of tools dedicated to visualizing the genome. Here, we present a desktop application designed to effectively visualize genome tertiary structure at multiple scales so that researches can better analyze their genomics data.

GMOL was developed based upon our multi-scale approach that allows a user to zoom in or out between six separate levels within the genome. These six scales are: full genome, chromosome, loci, fiber, nucleosome, and nucleotide. In order to store the data of the different scales, a new file format was created. With GMOL, a user can choose any unit at any scale and scale it up or down to visualize its structure and retrieve corresponding genome sequences from either Ensembl or a local database. Users can also interactively manipulate and measure the whole genome structure and extract static images and machine-readable data files in PDB format from the multi-scale structure.

By using GMOL researchers will be able to better understand and analyze genome structure models and their impact on genome activity and DNA function. The multi-scale method can satisfy the users’ requirement to not only visualize genome tertiary structure, but also measure it.
Faculty Mentors: Dr. LuAnne Roth, English; Dr. Joseph Dolginow, Agricultural & Applied Economics; Dr. Luis Occeña, Industrial & Manufacturing Systems Engineering; Martha Dragich, JD, School of Law
Funding Source: Mizzou Advantage Undergraduate Research Team

“Waste not, want not”: Understanding and addressing the problem of food waste
Luke Welsh, Andrew Beckerle, Jackson Hambrick, Mary “Emmie” Harcourt, Henry Hellmuth, Lauren McDermott, Nicole Ripperda, Mary Schneier, Joseph Dolginow, Luis Occeña, Martha Dragich, and LuAnne Roth

Conservative estimates report that 1.3 billion metric tons of food is wasted worldwide (Gustavsson et al. 2011), about one-third of all food fit for human consumption, and that the worldwide economic cost of food waste to be 750 billion dollars (Jan et al. 2013). Wasted food means losing nutritional value as well as the precious environmental resources of land, water, and energy. Recent government reports, nonfiction publications, and movements in local governments have garnered attention and concern for the problem of food waste, however, academic research on the subject is lacking. Funded by Mizzou Advantage, this interdisciplinary undergraduate research team is at the beginning stage of a two-semester project that seeks to understand what constitutes food waste, explores some of the root causes of food waste, determines best methods of measuring food waste and assessing its impact, and identifies ongoing local and regional efforts to address food waste. This semester lays the groundwork by conducting a literature review, going on field trips, and maintaining an ongoing journal of personal food waste and group discussion reflecting on the whole process, whereas next semester will aim at designing an experiment to measure sources of food waste.
Craig Wilkins
St. Louis, MO

Senior
Mechanical Engineering

Faculty Mentor: Dr. Hao Li, Mechanical & Aerospace Engineering
Funding Source: College of Engineering Undergraduate Research
Option

Optimization of orthopedic interference screw geometry subjected
to pullout force for improved resultant stresses
Craig Wilkins, Adam Joyce, and Hao Li

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
The determination of mesoporous silica biocompatibility
Heather L. Williams, Anna M. Rudy, and Heather K. Hunt

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Investigation of process unit parameters for WatPro modeling of select Missouri drinking water treatment plant performance
Dana Willsey and Enos Inniss

Several small Missouri drinking water treatment facilities have partnered with the University of Missouri to investigate options for water quality compliance. As part of this effort, each of the treatment plants need to be modeled so that process modifications can be considered both experimentally and mathematically. WatPro is a leading water treatment simulator for predicting water quality based on specific treatment processes and chemical addition. The software provides a quick and easy way to evaluate the performance of drinking water treatment processes from a microbial and chemical standpoint. One of the main features of this program is its ability to predict the formation of disinfection by-products (DBPs).

The purpose of the project is to determine the most effective way to gain the desired results from each drinking water treatment plant. In order to achieve this goal, many steps must be performed. The first step is to verify what data has already been obtained and what still needs to be found. This effort started with developing an Excel spreadsheet of all the parameters that may be beneficial when constructing drinking water facility models, including both physical and water quality information. Some of this information can be attained by visiting facilities, reviewing engineering plans, and reviewing bench sheets. Next, baseline models for each partner facility were created using WatPro and the available data. Building on these baseline models various treatment options can be considered and then executed using WatPro without consequence to the partner facility in terms of changes to operation. The final step is to compare the model data to the experimental results to figure out what information is mandatory to run the program and to ultimately find the best way to treat the drinking water.
Characterization of 2’-modified RNA Aptamers from Poly-2’ SELEX
Katherine Wilsdon, Khalid Alam, and Donald Burke-Aguero

Recently, our lab has identified 2’ modified RNA aptamers from a novel selection scheme termed Poly-2’ SELEX, in which pre-enriched libraries originally selected with standard RNA were subjected to three additional rounds of in vitro evolution in which the 2’-hydroxyl of pyrimidines were replaced with 2’-amino, fluoro, or O-Methyl functional groups in order to increase stability against blood serum nucleases. Low throughput sequencing using traditional cloning and sequencing revealed several sequences of aptamers that appeared frequently. These candidate aptamers, which are selected to bind HIV reverse transcriptase (HIV RT), were assessed for their ability to inhibit reverse transcriptase (RT) using primer extension assays. Primer extension assays were performed to measure the activity of HIV RT in the presence of poly-2’ aptamers. If these aptamers inhibit, then RT cannot efficiently convert the RNA template into DNA. Data confirms that these newly identified aptamers maintain inhibition of HIV RT, despite introduction of 2’-modifications that alters the backbone chemistry. Recent high-throughput sequencing of these aptamer populations have identified a multitude of other aptamers, which may also inhibit RT and resist degradation from serum nuclease. Here we present several of these candidate aptamers and biochemical data suggesting that they are both stable in serum for several hours and strongly inhibitory of HIV RT.
Zachariah Winkler
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Senior
Anthropology

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What TV says about culture: A pilot database of cross-cultural television
Zachariah Winkler, Amber Cox, and Robert Walker

Television is a product of the modern world and it is an important factor in social globalization, enculturation, and knowledge dissemination. Like films, television programs are embodiments of the cultures in which they are embedded, acting as cultural mediums for ideals, trends, issues, and perceptions. These programs can be a rich source of cultural data for anthropologists. Data can be obtained from television programs that might be advantageous when conducting cultural and comparative analyses. The best way to organize this type of data could be a cross-cultural database, with television programs categorized by the culture to which they belong and by the number of seasons the series were produced.

This feasibility study seeks to develop a prototype of what this cross-cultural television database might consist of and what information and analyses could be conducted within it. Television programs from the United States and South Korea available for viewing online were coded for data such as airing information, main character demographics, family representation, and prominent topical themes. Only live action programs airing episodes within the last ten years were included.

Tentative results show that there may be significant differences regarding television program main character demographics and themes across cultures. Future studies should build on this database and methodology. Shows from various cultures across time periods could be utilized for a variety of interesting studies within cultural anthropology, including trends in culture change over time.
Joshua Witmer
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Funding Source: College of Engineering Undergraduate Research Option

Modeling second harmonic generation for Quantum Cascade Lasers grown on Orientation-Patterned Gallium Arsenide
Joshua Witmer, Justin Grayer, and Gregory Triplett

Quantum cascade lasers (QCLs) are excellent tools for remote sensing and communication through Earth’s atmosphere due to their ability to operate in the mid- to far-infrared spectral range with high optical power output. The use of Orientation-Patterned (OP) nonlinear crystal substrates, such as one built with Gallium Arsenide (GaAs), could further push these capabilities to increase the speed of communications over a longer range as well as even generate signals to disrupt other threatening systems. This stems from the fact that OP substrates polarize incoming electromagnetic waves to allow for second harmonic generation, essentially doubling the frequency of the wave and causing its amplitude to exhibit quadratic growth as the wave passes through the substrate’s orientation planes.

The effectiveness of this theory can be verified by treating OP-GaAs as a photonic crystal and using finite difference time domain and finite element analysis methods to model wave propagation through the substrate. This will enable the creation of complex differential equations describing the behaviors of the magnetic and electric fields pertaining to the beam that would be produced by the QCL.
The suppressor of sessile spikelet loci regulate the production of spikelet pairs in maize
Shelbie Wooten, Andrea Skirpan, Laura Matera, Ronnie LaCombe, Andrea Valdez, Hannah Seberg, Chris Garner, Elizabeth Kellogg, and Paula McSteen

The maize tassel has a main stem and long branches that are covered in pairs of short branches, called spikelets, that bear the florets. The Suppressore of sessile spikelet mutants are semidominant mutants characterized by the production of single instead of paired spikelets leading to gaps between the rows on the ear and a sparse tassel. Sos1 has been fine mapped to a single BAC in bin 4:02 containing three predicted genes. Sos2 has been mapped to a region of chromosome 10:01 containing ~17 predicted genes and Sos3 has been mapped to chromosome 1 between bins 1:06-1:07. Therefore, at least three loci regulate the production of the paired spikelet in maize. Each of the mutants also have defects that indicate additional roles in inflorescence development: Sos1 has a smaller apical inflorescence meristem resulting in a further reduction in row number; Sos2 frequently has an aborted apical inflorescence meristem indicating that it also functions in the apical meristem; and severe Sos3 mutants often have unbranched tassels or tassels with a few very short branches and ears with barren patches indicating that Sos2 plays additional roles in axillary meristems. As the production of paired spikelets is a derived trait found in all 1000 species in the Andropogoneae but absent from more distantly related grasses including rice, barley, and wheat, an understanding of the role of the Sos genes will shed light on the evolution of a novel inflorescence character.
Investigating the effect of the experience-based metacognitive feedback in dynamic decision-making tasks
Hanli Wu and Jung Hyup Kim

In this research, we investigated the effects of Experience-Based (EB) metacognition in dynamic control tasks. The Anti-Air Warfare Coordinator (AAWC) human-in-the-loop test bed was developed to facilitate the experiment (J. Kim, Rothrock, Tharanathan, & Thiruvengada, 2011). It is a radar monitoring simulation. An operator must defend his/her ship against hostile aircraft. Rules are embedded into the simulation so that participants can gradually learn task-specific rules from training exercises. Participants were randomly assigned to the experimental groups (SA level-based feedback group and overall feedback group) and the control group (No feedback group). During the experiment, the simulation was stopped at random times between 10 and 15 minutes after the simulation started. Participants were asked probes to determine their situation awareness (SA) accuracy, called the Situational Awareness Global Assessment Technique (SAGAT). The only difference between the three groups is the way the situation awareness performance are grouped on the feedback screen. After the HITL simulator recorded the correctness of signal detection and reaction time for each signal, our task is to compare these data among three groups by applying ANOVA in Minitab. The objective of this research is to determine whether the Experience-Based metacognitive feedback affects decision making or not and thus to identify the best way to improve the learning performance by feedback in complex command-and-control environments. These results will benefit social and behavioral science in improving the future design and development of training programs in a military Air Traffic Control context.
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Funding Source: College of Engineering Undergraduate Research  
Option

A high-performance and user-friendly protein identification mapping application  
Jizhou Xu and Dong Xu

ID mapping being the one of the most essential and important procedures in protein-related bioinformatics, is highly used by researchers. As one of the most significant in vivo data resources for studying plant phosphoproteomics, P3DB, the Plant Protein Phosphorylation Database, has a high expectation for the ID mapping functionality. Since 2013, I have been working on the design and implementation of a high performance web-based ID mapping tool. The database consisting of 11 most recognized protein ID systems, the premise of my project is to find the core system that contains the largest scale of IDs so that we take it as the transport hub to reach any ID expressions of the others. Toward this end, we substantially analyzed all of the files downloaded from each protein ID system, and finally chose Uniprot-AC and Ensemble Genomes as the two core systems.

With four different types of mapping methods (one-to-one, one-to-many, many-to-many, and find-in-sequences), internal customers get to implement the API according to their needs. The back-end data processing script packs and re-organized the parameters provided by users. The current system supports multiple plant organisms, i.e. arabidopsis, brassicanapus, glycine max, medic ago truncatula, nicotiana tabacum, oryza saliva, solanum tuberosum, vitas vinifera, and zea mays. The user can choose exact mapping or fuzzy mapping as the mapping strategy. The ID mapping result will be eventually displayed as table or dendrogram. The application will be used as a fundamental module in the next generation of the P3DB network.
Abby York
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Junior
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Funding Source: School of Health Professions Undergraduate Research Mentorship

The Role of HuR in the Posttranscriptional Gene Regulation in Asthma
Abby York, Ulus Atasoy, Joseph Magee, and Patsharaporn Techasintana

Research abstract withheld at the request of the faculty mentor for proprietary purposes.
Sorting of complex bacterial mixtures using kinetically-limited differential centrifugation
Yesen Zhou and Shramik Sengupta

Certain bacteria in the gut, such as Segmented Filamentous Bacteria (SFB) have been shown to potentially induce immune responses in mice, and it is hence desired to isolate those bacteria for further research. However, it is not possible to culture these bacteria outside the body, and in samples isolated from the body, they are mixed with many other bacteria.

We propose to isolate our bacteria of interest from mice fecal samples using a method called Kinetically Limited Differential Centrifugation that was developed in our lab. In this method, we load seperands on the top of dense separation buffer and run the separation process for an optimal amount of time. This optimal time is obtained by using mathematical models to predict the rates of sedimentation.

Upon implementing the separation method, various fractions of bacteria will be collected, identified and counted using gram stain (microscopy) and characterized for their specific function.
Characterization of vegetative and reproductive defects in the maize *tassel-less* 4 mutant
Dennis Zhu and Paula McSteen

*Zea mays* (maize) is important both as an agricultural crop and as a genetic model organism. Maize normally produces a male reproductive structure called a tassel and female reproductive structure called an ear. However, *tassel-less* (*tls*) mutants are characterized by an absent or reduced tassel. At least eight *tls* loci have been identified, and two have been cloned. Here we present phenotypic characterization and genetic mapping of the *tls4* mutant. *tls4* mutants either produce a reduced tassel or no tassel at all. Quantification of tassel phenotypes shows that *tls4* mutants produce shorter branches and fewer spikelets than their normal siblings. SEM analysis of immature tassels shows defects in spikelet pair formation. In addition, *tls4* mutants exhibit a number vegetative phenotypes. First, *tls4* mutants are shorter than normal siblings due to shorter internode length. Secondly, *tls4* mutants exhibit a progressive leaf phenotype with narrow and rough leaves that worsen as the plant matures. Lastly, the leaves of *tls4* mutant plants display vasculature defects. Rough mapping using molecular markers indicates that *tls4* maps to bin 4.10 on chromosome 4. Further fine mapping is ongoing to identify the gene mutated in *tls4* plants. We propose that the *tls4* gene plays a fundamental role in vegetative and reproductive development in maize.
Simulation of refractive index distribution in semiconductor devices
Jianshen Zhu and Gregory Triplett

In this research project, I explore the features of the optiFDTD, a device simulation package for the purpose of modeling III-V semiconductor/optical materials. The important metrics include the properties that determine refractive index distribution using a variety of device designs such as vertical cavity surface emitting lasers (VCSELs), thermophotovoltaics (TPV), and infrared detectors.