

University of Missouri System

Undergraduate Research Day at the Capitol

April 4, 2017

Lindsay Beachner



Social Skills Instruction to Reduce Bullying Involvement among Middle School Youth

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Lee's Summit, Missouri

Senate District 7 House District 35

Major Special Education

Faculty Mentor Chad Rose

Mentor's Department Special Education



Alicia Brueggemann

Integrating Physical Activity with Numeracy in the Preschool Classroom

Poor math achievement and childhood obesity are topics of national concern. In Missouri, almost 1 in 3 children classified as overweight or obese (CDC, 2015). In 2015, 62% of Missouri fourth graders tested at or below the "basic mathematics level" (NCES, 2015). If short bouts of physical activity can be combined with teaching number knowledge and skills, short- and long-term numeracy and physical health can be favorably influenced. For Phase 1 of this study, we predicted that integrating jumping with an evidence-based number game would produce improvements in preschoolers' math outcomes that are at least equivalent to those from sitting for the game. Phase 1 was completed with 24 preschoolers from the Columbia Public Schools Title I Preschool Program. After obtaining parent permission, children were pre-tested on their number proficiency. Children were then randomly assigned to the intervention conditions: 1) the original seated number game; and, 2) a number game that was played by jumping on a floor mat. Preschoolers in both conditions met with an experimenter for two, 20-minute sessions over two weeks; post-testing occurred one week later. Findings indicate equal improvements over time regardless of intervention condition, supporting our prediction. Further, children who played the jumping game experienced the added benefit of activity. Phase 2 extends Phase 1 with more game playing sessions and two control conditions. We predict that playing the jumping number board game will produce improvements in preschoolers' math that are better than playing a jumping color game or playing no game. Phase 3 will determine if children who participate in the number jumping game accumulate more physical activity during the day than children who do not play the game. Findings will inform Missouri's preschool policies and practices that focus on obesity prevention and early number learning.



Beaufort, Missouri

Senate District 26 House District 61

Major Psychology

Faculty Mentor Sara Gable

Mentor's Department Nutrition and Physiology

Funding Source MU Office of Research, Research Council

Jennifer Buehler



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Manchester, Missouri

Senate District 15 House District 99

Major Special Education

Faculty Mentor Chad Rose

Mentor's Department Special Education

Caroline Dunn



Examining polar growth in Agrobacterium may improve understanding of growth in human pathogens

While antibiotics improved medical outcomes since their discovery, many bacterial infections remain difficult to treat. Tuberculosis requires treatment with multiple drugs over a period of 6-9months and it is becoming resistant to a variety of antibiotics. Brucellosis often requires 6 weeks of antibiotic treatment, after which patients may relapse. One challenge is that not all bacteria respond to all antibiotics in the same way. For example, changes in the structure of the bacterial cell wall can prevent antibiotics from being effective. Little is known about the cell wall synthesis, structure, and integrity of the bacteria that cause diseases like tuberculosis and brucellosis; however, as human pathogens, these bacteria are difficult to study. The Brown lab is using Agrobacterium tumefaciens, a plant pathogen, as a model to better understand cell wall growth in bacteria. Since proteins that build, cut, or maintain the cell wall may be useful targets for antibiotics, these proteins need to be studied. This project investigates a subset of proteins predicted to cut the bacterial cell wall and allow cells to divide. The function of these proteins is currently being investigated. Thus far, we have removed a protein called EnvC and have observed that cells cannot separate properly. The ability of this protein to cut the cell wall and its exact role in cell separation will be studied in more detail. Overall, we expect that understanding cell wall growth in A.tumefaciens will allow us to better understand growth of other clinically important bacteria.



Houston, Missouri

Senate District 33 House District 142

Major Psychology

Faculty Mentor Pamela Brown

Mentor's Department Biological Sciences

Funding Source MU Life Sciences Undergraduate Research Opportunity Program

Morgan Fryman





Steelville, Missouri

Senate District 16 House District 120

Major Mathematics

Faculty Mentor Dix H. Pettey

Mentor's Department Mathematics

> Funding Source National Science Foundation

> > Poster Number 8

Fibonacci: Seeable Mathematics

Fibonacci is a famed sequence of numbers used by some to explain beauty and by others to explain botany. The focus of our project was on the latter. We looked at plants within Missouri to see if Fibonacci was as applicable as it was claimed to be. What we saw was that, in some aspects, Fibonacci lived up to its expectations. In other ways however, the sequence was credited unfairly to what statistics could easily explain. For example, the number of petals on a flower cannot really be credited to Fibonacci, but the way the leaves are placed on a stem of most plants can be. We branched out from strictly flowers and looked at pinecones and pineapples as well. The reason behind this is because of the patterns that are on both of these "pines" have specific numbers of spirals that are theoretically always Fibonacci. The purpose of our project was to not only examine the merit of Fibonacci, but also to get people interested in the field of mathematics. Having a simple sequence and its limit that can be applied to so many everyday things, is a stepping stone to getting people excited about what math actually can mean in the context of their everyday lives. We wanted to reach people who would not consider themselves "math" people, and show them that math is not some abstract concept. It is art, philosophy, psychology, botany, and so much more.



Does capital punishment have a deterrent effect?

Since the reinstatement of capital punishment in 1976 (Gregg v. Georgia), executions have been performed in thirty-four states. The efficacy of the death penalty is often evaluated by its ability to deter crime. We seek to answer the question, "Does the death penalty have a deterrent effect on murder rates?" In this study we use a fixed effects model to examine county-level execution and murder data from 1977 to 2013 in an effort to determine the existence of a deterrent effect. Unlike previous authors, we employ a novel approach using county-level data to recognize the variation of capital punishment within as well as across states. We find a high cost of capital punishment, estimating it would require twenty-eight executions to reduce the number of murders by one. For counties having carried out less than twenty-eight executions, we find no deterrent effect. This finding has legislative ramifications in a post-Gregg era, as it is widely accepted in the field of economics that the literature used to overthrow the death penalty moratorium (Ehrlich 1975) was flawed in its experimental design. These findings are significant in their ability to honestly inform policy concerning the death penalty in a post-Gregg era.



Liberty, Missouri

Senate District 17 House District 17

Major Business Administration, Economics

Faculty Mentor Daniel Turban

Mentor's Department Management

Funding Source McNair Scholars Program

Sarah Gebken





Florissant, Missouri

Senate District 13 House District 68

Major Biological Engineering

> Faculty Mentor Chris Pires

Mentor's Department Biological Sciences

> Funding Source National Science Foundation

Poster Number 20

Preparing a Genetic Engineering Technique to Bring into the Brassica Crop Plants

CRISPR/Cas9 is a genetic engineering tool that is revolutionizing the field of biology and can be helpful in diversifying the agricultural community in Missouri. CRISPR stands for Clustered Regularly Interspaced Palindromic Repeats and it is system that can be used to promote quick, targeted, and inexpensive mutations in many different organisms. CRISPR/Cas9 has several advantages over existing methods of genetic modification, including the capability to target genes specifically instead of blindly attacking genes. In this project, we use this technology to disable three seed storage protein genes (CRU1, CRU2, and CRU3) in Arabidopsis thaliana. The first step in CRISPR is to design guide RNA (gRNA) sequences that can target closely related genes. When a circular strand of DNA called a vector (with the gRNA) is inserted into an organism, the CRISPR/Cas 9 system causes a Double Strand Break (DSB) in the DNA. By designing a vector with two gRNAs to target two places of a gene, I can increase the likelihood of making a complete knockout of the gene. In a second experiment, I am making a DSB in two genes simultaneously with a single gRNA. I have designed one gRNA that is aiming to target bothCRU1 and CRU2. Our project will increase our understanding of the CRISPR/Cas 9 system by allowing us to test various gRNA designs with different target points on the genes. The results of this project will determine what method of gRNA works best for targeting seed protein and other genes in Arabidopsis while also allowing us to look more closely into bringing this method into Brassica crops such as cauliflower, kale, cabbage, and kohlrabi. If we are able to utilize this method with these crop plants there is a possibility of making a crop better suited for Missouri's climate where currently these crops do not easily grow.



Loss of the native plasmid in Desulfovibrio vulgaris Hildenborough does not effect biofilm

Pipelines corroding and breaking down is a universal problem that is affecting millions, with individual health problems, high costs and the negative effects on the environment. One of the main reasons pipelines are corroding is due to biofilm formation. Biofilm formations is the ability of a cell to stick to a surface, like the goo on your teeth in the morning. This can corrode your teeth if not cleaned the same way they can corrode a pipeline. One of the main bacteria that is responsible for formation of biofilms on pipelines is Desulfovibrio vulgaris Hildenborough (DvH). My research goes in depth on the mechanism of biofilm formation and the genes necessary for biofilm, specifically looking at the plasmid (contains genes unnecessary for cell survival) DvH is a sulfate-reducing bacterium, using sulfate instead of oxygen, as a terminal electron acceptor and producing hydrogen sulfide (a toxic gas). It is commonly found in water dense soil and is known to have negative effects on the environment, such as corrosion of iron and concrete pipelines. This bacterium is commonly found attached as a biofilm and our goal is to determine the mechanisms of biofilm formation in DvH. Previous work with an evolved DvH strain that has lost the native plasmid, suggested that the plasmid was necessary in the formation of biofilm. To test that the plasmid and not an unidentified mutation in the chromosome caused biofilm deficiency, we have deleted pDV1 from our parental strain JWT700. This was done by first introducing a kanamycin-resistance and a uracilphosphoribosyltransferase gene (confers 5-fluorouracil sensitivity) onto the native plasmid. This was followed by electroporation and selection of 5-FU resistance for the loss of the plasmid. This plasmid-less mutant was confirmed through a series of testing, which included a catalase test, growth curves, and multiple PCRs. Analysis of biofilm formation was done in hungate tubes containing glass slides. These indicated that the loss of the plasmid does not affect biofilm formation. This was confirmed in a biofilm chemostat. With these tests, all genes on the plasmid can be eliminated as genes of interest.



Santa Cruz, California

Major Health Sciences

Faculty Mentor Judy Wall

Mentor's Department Biochemistry

Funding Source Missouri EPSCOR

Kaydee Harper





Wentzville, Missouri

Senate District 2 House District 108

Major Biological Sciences/ Psychological Sciences

> Faculty Mentor Lorin Milescu

Mentor's Department Biological Sciences

> Funding Source NIH IMSD Express Fellows Program

> > Poster Number 3

Neural communication and the modulation of voltage-gated sodium channels by FHF1B

Electrical signaling in the brain relies on the production of action potentials, which are brief changes in the electrical potential across the neuronal membrane. Action potentials are produced by specialized membrane proteins called ion channels, which open and close to allow specific ions, such as sodium, to move across the membrane and change the electrical potential. Of particular interest to us are voltage-gated sodium channels, which have specialized structures that sense the membrane voltage, allowing them to open and close with very specific timing. They play the main role in generating action potentials. Once an action potential is fired, these sodium channels inactivate, which enables the neurons to enter a refractory period that is essential for the propagation of the electrical signal across the neuron. Mutations in sodium channels lead to major diseases, such as ataxia, which affects muscle coordination. Multiple auxiliary proteins interact with sodium channels and modulate their function. The fibroblast growth factor-homologous factor (FHF) is an auxiliary protein that binds to a portion of the sodium channel. Previous studies have shown that FHFs make the channel stay inactivated for a longer period, increasing the interval between two consecutive action potentials and affecting electrical communication in the brain. The purpose of my project is to understand how FHFs interact with sodium channels. I carry out this research by expressing channels in frog eggs (oocvtes), alone, or together with the FHF. Specifically, I inject genetic material in the eggs and incubate them to allow them to produce the proteins we want. The expectation is that the oocytes containing channels and FHF will exhibit more inactivated channels, as caused by the FHF. By understanding how FHFs interact with sodium channels, we hope to find new tools for treating neurological diseases caused by mutations in ion channels and auxiliary factors.



3D Computational Modeling Used to Predict Joint Health

Arthritis is a serious condition that causes severe pain, from which about 1.3 million Missourians suffer. Missouri has one of the highest prevalence of arthritis in the United States. It cannot be reversed, but understanding how cartilage slowly degrades over time could lead to earlier diagnosis and treatment, before joint replacement is necessary. The goal of this project is to evaluate the mechanical and biological response of cartilage to variations in loading, using computational methods (3D mathematical modeling). Joint health is affected by the mechanical loading, including less than normal physiologic loading like resting or greater than normal physiological loading like extensive sport activities. Initially, biomechanical testing of cadaver cartilage explants was performed and eventually compared to the computational modeling values. My research utilizes the FEBiO software suite to create customized models and perform optimizations to predict accurate results. With the help of a FEBiO tutorial, I created a compression of biphasic articular cartilage model including my tested experimental values. FEBiO can accurately model the materials that are required. However, once all geometry of the model and boundary conditions are applied, new changes to the geometry cannot be made. Therefore, this method is still not efficient enough to recreate several models for experiments. Also, the optimizations are still being evaluated due to intolerable results. Optimizations are important because it will help predict values for individual cases. There needs to be more research and improvement of computational modeling specifically designed for joint health. The long term goal is to develop natural and tissue engineered biologic joint replacement solutions to repair and/ or replace arthritic joints. Advancing and understanding of how arthritis progresses affects the mechanical properties of the tissue, possibly helping to predict disease progression.



Lee's Summit, Missouri

Senate District 8 House District 34

Major Bioengineering

Faculty Mentor Ferris Pfeiffer

Mentor's Department Orthopedic Surgery

Funding Source MU College of Engineering, MU Comparative Orthopedic Lab

Minh Ma



Fulton, Missouri

Senate District 10 House District 43

Major Biochemistry

Faculty Mentor George Stewart

Mentor's Department Veterinary Pathology

> Funding Source National Science Foundation

Poster Number 22

An Economical and Efficient Approach to Degrade Dioxins in the Environment

Dioxins are persistent organic pollutants due to their long half-life in nature and contamination by these pollutants is a substantial public health problem worldwide. There are many dioxins-contaminated sites in the US, including Missouri. Among all these contaminated sites, Times Beach, also known as Ghost Town, located in St. Louis County, had the largest exposure to dioxins in the country's history, from treating their roads with dioxins-contaminated oil, and has been evacuated since 1983. Thermal desorption is the most frequently used technique to remediate many contaminated sites all over the world, but it is energy consuming with extremely high cost. Our lab has developed a more cost effective and efficient approach to degrade dioxins by using a Bacillus thuringiensisspore display system. The platform can display high levels of proteins on the spore surface that acts as a support platform for enhanced activity and stability of dioxin degrading enzymes while applied in the soil. We previously isolated and determined the genome sequence of a dioxin-degrading bacterium from a dioxincontaminated site in Taiwan. We tested its ability of degrading dioxins with dibenzofuran, a less toxic derivative of dioxin, to monitor its metabolites. Through our observations, we have identified and cloned the genes encoding for dioxin degraders to produce recombinant proteins to test them with dibenzofuran before applying our system. The goal of this research is to express the dioxin degrading enzymes from the bacterium we isolated onto Bacillus spore-based expression system for dioxin remediation. The enzymedecorated spores are then applied to contaminated soil to degrade dioxins more efficiently with a less cost than existing technologies, so that those contaminated areas can be safely repopulated. Environmental bioremediation will decrease the risks of cancers and other dioxinassociated chronic diseases, create a food chain free of dioxins, and permit eventual repopulation of abandoned contaminated areas.





Using Viruses as a Biocontrol Against Bacterial Disease of Plants

Have you have seen structures resembling tumors on the roots of plants or tree trunks? If so, this could be Crown Gall disease caused by the bacteria Agrobacterium tumefaciens. In Crown Gall disease, A. tumefaciens causes tumors to form at the roots of plants, blocking the absorption of proper nutrients needed for a plant to survive. This disease is dangerous to the nursery production of many plants such as stone fruit trees, nuts, and roses. In the state of Missouri, blackberry bushes are chronically infected. In previous years, scientists have used viruses to treat other plant diseases. In the environment, viruses can infect and kill bacterial cells, therefore, our goal is to isolate viruses that can kill A. tumefaciens. We isolated 2 viruses AP7 & AP8, from environmental water sources, which were successful in specifically killing A. tumefaciens. Using viruses as a treatment against disease-causing bacteria in agriculture has the potential to be safer and more sustainable than other treatments.



Fulton, Missouri

Senate District 10 House District 43

Major Biology

Faculty Mentor Pamela Brown

Mentor's Department Biological Sciences

Annie Rusthoven





Hinsdale, Illinois

Major Elementary Education

> Faculty Mentor Chad Rose

Mentor's Department Special Education

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How Motivation and Engagement Impact Math Standardized Test Scores

Motivation and engagement are central to academic success but little is known about how gender and socioeconomic status may influence motivation and engagement in elementary school students. We examined 5th grade math achievement score and the possible influence of math motivation and school engagement, controlling for 3rd grade math achievement, math motivation, and school engagement. We utilized data from a nationally representative longitudinal data set (ECLS K-8) to examine males and females within five quintiles of socioeconomic status as defined by the census. Of the 8, 591 students included in the data set 4,293 were male and 4,198 were females. We used statistical interpretations to predict missing values and to generalize the findings to represent all elementary students nationally. Our results indicated statistically significant difference in school engagement and math achievement by gender and class. Our findings indicated that math motivation and engagement were both significant factors for male math achievement. However, only engagement was significant for females. When broken down by SES quintiles within biological sex lower class males show little significance on math motivation wile upper class males had math motivation as an influencing factor. For females across all levels of SES only engagement is significant. All groups showed significance when math motivation and class engagement were a combined variable. Lower income refers to the poverty guidelines in which a family of 4 has a 12-month income of \$24,300 or less (this increases with the size of family). Evidence-based policy implications include an increase in programs to improve female school engagement and female school math activities. This would likely lead to increases in scores in STEM related courses. Classroom engagement activities that focus on active problem based learning approached would be one way to increase school engagement.15.5% of Missouri's population lives in poverty. With 287,081 students living in poverty, understanding their motivation and engagement can allow for targeted efforts to improve student math achievement.



O'Fallon, Missouri

Senate District 2 House District 64

Major Physics and Secondary Education

Faculty Mentor Stephen Whitney

Mentor's Department Educational, School, and Counseling Psychology

Emily Shaw





Columbia, Missouri

Senate District 19 House District 46

Major Nutritional Sciences

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Mentor's Department Nutrition and Exercise Physiology

Funding Source College of Human Environmental Sciences PURE Award

Poster Number 6

The Effects of a Soy Protein-Based Diet on Bone Health in Postmenopausal Women, As Modeled by Female Rats

Due to a decrease in estrogen production, postmenopausal women have an elevated fracture risk. A possible mechanism for this is accumulation of advanced glycation end-products (AGEs) in bone, making bone more brittle. Soy contains estrogen-like compounds which might attenuate the accumulation of AGEs. Our study used rats to evaluate the effects of ovariectomy (OVX) and a soy-protein-based diet (SOY) on tibial AGE content; and to examine relationships between AGE content, bone turnover markers (indicators of bone resorption vs. growth) and tibia biomechanical properties (bone strength). Female rats underwent OVX or sham (SHM) surgery and were fed a SOY or a corn gluten meal-based protein diet (CORN). OVX adversely affected trabecular (spongy) bone microarchitecture; SOY partially attenuated these changes. SOY improved cortical (compact) bone strength. There were no significant differences in AGE content among groups, so AGE accumulation does not appear to be a significant contributor to skeletal changes in menopause.



Potential Therapeutic Target for Patients Living with Spinal Muscular Atrophy

Spinal Muscular Atrophy (SMA) is a disease that affects approximately 1 in every 10,000 babies, and it is the number one genetic cause of death for infants. The disease affects the motor nerve cells in the spinal cord, thus inhibiting movement and strength throughout the entire nervous system. These physical characteristics, like other processes and systems in the body, are determined by genes that code for specific proteins. Those with SMA are born without the Spinal Motor Neuron 1(SMN1) gene and therefore live with very little Spinal Motor Neuron (SMN) protein. This protein is required for movement and many bodily processes such as breathing and walking. Fortunately, SMN1 is not the only gene that codes for SMN protein.SMN2 produces about 10% of full-length, functional protein; 90% of the protein produced is missing a specific section of DNA called exon 7. Because of this, SMN2 is a promising therapeutic target. So far, it has been shown that a region in the SMN2 gene, called Element 1, blocks the gene from including exon 7, which allows this protein to function properly in the body. In this study, our lab developed a therapy – a synthetic polymer called an ASO- that can be directly injected into the spinal cord and inhibits Element 1. Results using this treatment on mice as SMA models showed that it positively affects physical appearance and increases lifespan. Because of this study, we know that effectively blocking the activity of Element 1 could be used as a potential therapy for patients with SMA. This could be life changing for many Missourians and their families.



Columbia, Missouri

Senate District 19 House District 45

Major Bioengineering

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Funding Source Fight SMA, Cure SMA, Gwendolyn Strong Foundation

Natalie Stanton



St. Louis, Missouri

Senate District 1 House District 91

Major Elementary Education

> Faculty Mentor Chad Rose

Mentor's Department Special Education

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Herbivore Recruitment in Brassiceae

Chemical defenses are present in a myriad of plant families due to the immobile nature of plants and their need to protect against herbivory. While being deadly to many insects, humans can benefit from using some of these naturally occurring chemicals. These chemical defenses are common in the human diet, coming in many forms including nicotine, caffeine, morphine, etc. But these defenses are not a perfect solution, as certain insects can develop a tolerance to the defenses, prompting an evolutionary arms race, a type of coevolution. The interaction between Brassicaceae (Mustard Family) species and the insects that eat them is a classic example of this type of coevolution. They are locked in an evolutionary arms race; as the plants develop diverse chemical defenses, such as their glucosinolate compounds, their herbivores develop greater resistances to these defenses. To better characterize this relationship we will be using multiple representative species of the tribe Brassiceae, the most economically important tribe in the Brassicaceae family, in field based common garden experiment. We will observe the naturally colonizing arthropods on each plant and compare the levels of consumption from insects between Brassiceae species using leaf imaging software. We will also be observing tri-trophic affects of Brassiceae herbivory, in the context of insect parasitoid avoidance. This experiment will help to evaluate the evolution of herbivory defense in the tribe Brassiceae on the micro (differences in members of the same species) and macro (differences between members of different species) levels as well as gaining ecological incite into the community affects of glucosinolate diversity. By understanding the relationships between the evolution of Brassiceae defense chemicals and the development of resistance to these chemicals in insects, we can help identify the relationship between coevolution and genetic diversity.



Saint Robert, Missouri

Senate District 16 House District 122

Major Biology

Faculty Mentor Chris Pires

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Funding Source National Science Foundation

Brooklyn White



Maryville, Illinois

Major Biological Sciences

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Mentor's Department Biological Sciences

Funding Source MU Life Sciences Undergraduate Research Opportunity Program

Poster Number 34

Utilizing Tarantula and Scorpion Toxins to Understand Electrical Signaling in the Brain

The brain is arguably the most important organ in the human body. Its highly complex nature and organized structure allow the brain to send billions of electrical signals every second. Interestingly, the brain's ability to generate electrical signals is mainly due to just three chemicals: sodium, potassium, and calcium. These chemicals cause electrical signals when they pass through the membrane, because of voltage-gated ion channels opening and closing. This makes ion channels some of the most important proteins in the brain. Of the three most important channels, calcium channels are the least well understood. It is important to understand how these channels work, because when function is disrupted neurological diseases occur. My project investigates the structure of a specific type of calcium channel, Cav3.1, using tarantula toxins as tools. By understanding how protein structure controls function, we can better understand major neurological diseases, such as epilepsy. When spiders attack their prey, the toxins in their venom target the nervous system and disrupt electrical signaling. Thus, cells become incapable of communicating and the nervous system stops functioning. Our lab uses tarantula toxins to study how function is disrupted. These toxins modify the opening and closing mechanism of the Cav3.1 channel by interacting with and modifying the gating ability. Initially, toxins integrate within the membrane. Then, they attack the voltage sensor of ion channels, the control mechanism which regulates channel opening as a function of membrane voltage. Since the voltage-sensor lies within the membrane, the ability of a toxin to insert itself within a membrane is a prerequisite for channel inhibition. We analyze toxins as they transition from solution to within the membrane. The strength of partitioning of each toxin is exhibited as different levels of channel inhibition. Our data support a positive correlation between toxin lipid partitioning strength and channel inhibition.





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Downer's Grove, Illinois

Major Special Education

Faculty Mentor Chad Rose

Mentor's Department Special Education

Katie Ziegler





Jefferson City, Missouri

Senate District 6 House District 60

Major History

Faculty Mentor Daniel Domingues

Mentor's Department History

Funding Source MU Honors College, Office of Undergraduate Research (ASH Scholars Program)

Poster Number 26

Visualizing Abolition: A Digital History of the Suppression of the African Slave Trade

In 1808, immediately after retreating from the traffic, the British Parliament engaged in a campaign to suppress the entire transatlantic slave trade. It was the beginning of a century-long crusade that would help change humanity's attitude towards slavery and the traffic. Historians have long examined the ideology behind abolition, ranging from evangelism and humanitarianism to self-serving imperialism. However, the actual campaign and how it intersected with British political and economic interests overseas remain largely unexplored. This presentation is part of an ongoing project aimed at tracing the expansion of British abolitionism around the world and its relationship to imperialism in Africa and elsewhere. It involves digitally charting over 30,000 records of correspondence between the British Foreign Office and British commissioners, naval officers, diplomats, and others from 1808 to the 1880s. The results show the global scope of suppression, reaching from the Pacific coast of South America through the Atlantic and Indian Oceans up to Eastern Australia. The project thus moves away from earlier Anglocentric perspectives to emphasize global participation in the suppression of the traffic. It recasts the major players and regions in the campaign, reinforcing the role of agents on the ground and how their relationship with local populations helped end the African slave trade. "Visualizing Abolition" combines the efforts of 2 History department faculty and 8 MU undergraduates from varying majors and disciplines.





Mathematical Modeling of the Zika Virus Transmission Dynamics: Disease Characteristics & Prevention

Several outbreaks of the Zika virus (ZIKV), including the 2007 outbreak in Yap Island, the 2013-14 outbreak in French Polynesia, and the recent devastating spread of the virus across Americas, have become an international concern for public health. Therefore, there is an urgent need to characterize ZIKV infection and transmission among populations. In this study, we used a mathematical model to investigate the ZIKV transmission dynamics and to evaluate potential prevention strategies. Our model successfully predicts epidemic data from French Polynesia and Yap Island. Using our model, we estimated the key parameters related to ZIKV infection and transmission, such as incubation period, infectious period, and basic reproduction number. Our results show that the basic reproduction number, which is defined as the expected number of secondary cases produced by a single infection in a completely susceptible population, can range from 2.18 (Marquises Island in French Polynesia) to 3.77 (Yap Island). We found that the ZIKV peak prevalence occurs during the initial 5 and 10 weeks of infection. These epidemic peaks can be reduced to nearly 0% by reducing mosquito-to-human contact by at least 70% or increasing mosquito death by at least five times. With these levels of prevention programs, the final outbreak size is predicted to be negligible, thereby successfully controlling the ZIKV epidemics.



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> **Funding Source** SUROP, SEARCH

> > Poster Number 31

Locus of Control, Sleep Education, and Psychophysiological Indices of Adaptability

The purpose of this study is to investigate the relationship between sleep loci of control and sleep quantity and quality in college students measured by responses to information presented on sleep hygiene practices. Little research has examined locus of control pertaining to sleep-related outcomes, a factor that is disproportionately affected in the college student population. This demographic is recommended to receive 7-9 hours of sleep per night In this research study, by dividing the population into two subgroups based on responses to a self-report sleep locus of control survey (internal sleep locus of control vs. chance sleep locus of control), the two populations would show significantly different responses to sleep hygiene information. Results may not show improvement if the populations were summed together, giving clinical use to finding out a participant's sleep locus of control score.

In the proposed study, undergraduate volunteers wear a FitBit activity band for a two-week period to obtain an objective measure of their sleep quality and quantity. Next we schedule them for a laboratory session in which we measure physiological responses to a sleep hygiene presentation using a photoelectric plethysmograph (PPG) to measure pulse rate and silver/silver chloride electrodes to measure skin conductance. Finally, we have participants wear the FitBit bands for a proceeding twoweek period to create two distinct periods of sleep quality and quantity for comparison to reactions to the sleep hygiene presentation.

Joe Haller



Precision Aerial Delivery with a Steerable Cruciform Parachute

An inexpensive approach to precision aerial delivery capable of reducing deployment costs while retaining sufficient landing accuracy through the utilization of a steerable cruciform or cross canopy parachute is presented. The inexpensive steerable cruciform canopy is rigged for gliding with only a single actuator, further reducing the cost of implementation. Prescribed input maneuver-based drop testing was performed to collect model information necessary for developing an accurate four degree-of-freedom simulation and for tuning of a heading angle proportional-integral-derivative control system. A path planning algorithm was developed in which the vehicle attempts to steer towards the forecast wind-generated desired ballistic trajectory. Simulations were conducted with real wind data to evaluate the cruciform-based aerial delivery platform. Experimental testing was then conducted from both fixed-wing and multirotor aircraft to verify the simulation results and demonstrate the applicability of a cross-based canopy for precision aerial delivery.



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Funding Source Natick Soldier Research Development and Engineering Center

Jorgue Martinez





Monett, Missouri

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> Funding Source National Science Foundation

Poster Number 18

dFOXO Expression Under Starved State

In the larval fat body, the pseudokinase Tribbles modulates insulin responses by binding and degrading the kinase Akt. A key target of Akt is the transcription factor dFOXO that activates genes through a winged helix DNA binding domain known as the Forkhead box. The genes that dFOXO activates are involved in diverse functions such as metabolism, cell cycle, mitophagy, and oxidative stress. Under a starved state, the insulin signaling pathway is less active, and dFOXO is hypophosphorylated, whereupon it enters the nucleus to activate gluconeogenesis enzymatic genes such as G6Pase, whose function is to dephosphorylate glucose 6 phosphate and allow more synthesized glucose into the bloodstream. Given dFOXOs central role in Tribblesregulated metabolism, we decided to develop a technique to examine dFOXO under fed and starved states in the model organism Drosophila (fruit fly) using a FOXO-GFP transgenic line. Drosophila oogenesis is highly sensitive to starvation, so we raised two sets of flies, one set on simple food (starvation conditions) and another on simple food supplemented by an extra layer of yeast medium for \sim 3 hours (well fed). The ovaries were dissected, fixed, and stained with primary antibodies anti-Phosphorylated FOXO (to detect phosphorylated dFOXO) and Anti GFP-Mouse (to detect expression of the FOXO-GFP transgene). Protocols were optimized for washing conditions. Ongoing work will test the role of Tribbles in regulating FOXO activity using these markers.



Stephanie Montoya

Wage Justice

The study's purpose is to research individuals who have been victims of wage theft and seek help at the Kansas City Worker Justice Center. I can personally relate to this because my father was once a wage theft victim, and since then I wanted to know why this happened. This social issue is not just a problem in Kansas City, but nationwide. With my research I was able to find the most effected occupations and ethnicities. The reasons for doing the research on wage theft, is to create awareness for other victims that may be going through similar problems. It occurs more often, that undocumented people are victims of discrimination in the labor force and wage theft, being the most targeted in wage theft cases. Many do not search for help because they are afraid. They deal with injustices all the time. The investigation was done within more than one hundred cases from local residents of Kansas City, Missouri and the state of Kansas in the Kansas City Worker Justice Center that supports wage theft victims.



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Funding Source SEARCH Grant

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Funding Source SUROP and Interdisciplinary Applied Mathematics Program

Poster Number 27

Missouri Crop Loss Analysis Due to Late Spring Freeze

Late spring freezes in Missouri have been extremely damaging to crops, in fact they account for the four of the most damaging freezes in the state since 1979. A late spring freeze is a phenomenon where we experience a warming period in late March and a hard freeze early to mid-April. A spring freeze becomes so damaging due to the early growth stage plants are in. Plants that have the ability to acclimate to the cold have also de-acclimated and readied itself for warmer temperatures. This effect is exacerbated by the unexpected warm period in late March. This is due to the plants de-acclimating and becoming more vulnerable to the cold. Many plants are capable of acclimating to cold weather, surviving otherwise harmful temperatures, however this acclimation takes months, where de-acclimation takes only days of warm weather. This combination results in a plant losing its cold weather protection prior to a freeze event. Thus magnifying the destructive effects of the freeze. Looking at the most recent freeze event in 2007, Missouri crop losses reached an estimated 400 million dollars in Missouri with a total of 2 billion nationwide. By examining the warm period prior to the freeze and the freeze itself we hope to be able to offer a risk assessment/model for the year in question. By doing this farmers will know if a particular year carries increased risk of crop damage due to freeze, and they may choose to take precautions to mitigate that risk.



Scott Nickell

Missouri Crop Loss Analysis Due to Late Spring Freeze

Late spring freezes in Missouri have been extremely damaging to crops, in fact they account for the four of the most damaging freezes in the state since 1979. A late spring freeze is a phenomenon where we experience a warming period in late March and a hard freeze early to mid-April. A spring freeze becomes so damaging due to the early growth stage plants are in. Plants that have the ability to acclimate to the cold have also de-acclimated and readied itself for warmer temperatures. This effect is exacerbated by the unexpected warm period in late March. This is due to the plants de-acclimating and becoming more vulnerable to the cold. Many plants are capable of acclimating to cold weather, surviving otherwise harmful temperatures, however this acclimation takes months, where de-acclimation takes only days of warm weather. This combination results in a plant losing its cold weather protection prior to a freeze event. Thus magnifying the destructive effects of the freeze. Looking at the most recent freeze event in 2007, Missouri crop losses reached an estimated 400 million dollars in Missouri with a total of 2 billion nationwide. By examining the warm period prior to the freeze and the freeze itself we hope to be able to offer a risk assessment/model for the year in question. By doing this farmers will know if a particular year carries increased risk of crop damage due to freeze, and they may choose to take precautions to mitigate that risk.



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Funding Source SUROP and Interdisciplinary Applied Mathematics Program

Monika Patel





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> Funding Source SEARCH Grant

Poster Number 19

Scale Up and Production Optimization of our Silorane-Based Bone Cement

Approximately 161,040 cases of joint replacements were observed within the USA of year 2015 and are expected to rise in the future, according to American Joint Replacement Registry of 2016. Many complications can occur including infections of the joint or the surrounding bone. In these cases, antibiotic-loaded acrylic bone cements, spacers, and beads are used to treat joint infections. The drawback to this treatment is that only heat and che mically stable antibiotics can be incorporated into these cements. We have developed a novel silorane-based bone cement that is non-toxic and non-exothermic. It maintains comparable mechanical properties to commercially available bone cement and addresses the limitations of antibiotic incorporation into acrylic bone cements. This biomaterial is composed of two monomers, CYGEP and PHEPSI; along with filler and initiation system. To investigate the efficacy of silorane bone cement as an antibiotic delivery device, our research was focused on two parameters. The first was the optimization of CYGEP and PHEPSI monomers. The second parameter was focused on quality control with an emphasis on assessing mechanical strength of the material. Optimization of the monomers was attempted by varying reagents and reaction conditions with proper purification techniques. The quality control procedures were used to assess mechanical strength of the bone cement for its optimal success as an antibiotic delivery device. From this research effort, we were able to accomplish the goals set forth and are now working toward the antibiotic and antifungal incorporation and elution studies, which would have wider range of application toward infections.

Chelsea Pfaffly



Acid Leaching of Pervious Concrete for Heavy Metals Recovery

Catastrophic release of heavy metals from Minas Gerais dam in Brazil and the lead released from aging pipes in Flint, Michigan has brought to the forefront the importance of heavy metal contaminant remediation techniques. Permeable reactive barriers are a method of remediating groundwater using a reactive media to remove contaminants. Permeable reactive concrete (PRC) can be used to treat effluents from mine wastes. industrial processes, or as a preventative curtain for mining facilities; to intercept potential contaminants before the contaminants impact the environment. Breakthrough testing was performed for 8 months on two different concrete specimens to measure capacity of the sample mixtures and evaluate the rate of the reaction for removal of lead cadmium and zinc. This research was a follow-up project to measure the amount of metals retained in the PRC filter. Concrete samples were extracted from breakthrough columns every 6 inches for a total of eighteen samples per column. Samples were then submerged in acid, allowed to react, filtered, and measured by ICP, EPA method 6010. Filtered samples were desiccated and weighted to provide a mass balance. Results indicated over 40% of the metals from Class C Fly Ash were contained within the first 6 inches and 60% from Portland cement in the first 6 inches. 95% of the metals from both mixtures were contained within two feet. This indicates a high concentration removal zone due to precipitation and coprecipitation of the metals within the initial contact area of the PRC. This data will be used to model the contamination front by estimating the depth of penetration for each mechanism of removal (precipitation, adsorption, ion exchange) and to evaluate the lifespan of the filter. Correspondingly, these results indicated a mineable region as metals within this first two feet are well concentrated and in the future could be economically beneficial.



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Morgan Staudinger





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Poster Number 32

Ribbon-like Molecules with Theoretical Interest

Molecules known as longitudinally twisted acenes (LTAs), are a class of polycyclic aromatic hydrocarbons (PAHs) which exhibit chirality or handedness. A molecule is chiral when its mirror image is nonsuperimposable on itself. Because LTAs adopt a helical conformation, akin to a molecular ribbon, they are inherently chiral. LTAs are typically formed in enantiomeric pairs like your left and right hands which we call a racemic mixture. But a racemic mixture may be resolved separated to isolate each enantiomer. A pure enantiomer, unlike its racemic mixture, interacts with plane polarized light and exhibits chiroptical properties. They make these compounds unique and potentially useful as substrates in novel LEDs, chiral separation architectures, and asymmetric synthesis. LTAs for use in materials need to be configurationally stable their pure enantiomers must maintain their left- and right-handed configuration when separated and efficiently synthesized that is, made in high yields at low cost. Unfortunately, the few currently known LTAs that have displayed any configurational stability were available in yields too low to be of any practical use. But recently, our group has designed a synthetic protocol, one which has allowed for the efficient synthesis of LTAs. We now hope to exploit this approach in the design of configurationally stable LTAs, as well. The syntheses and calculated stabilities of several new LTAs will be presented.





Identification of the Molecular Causes for Neurodegeneration

Devastating and incurable neurodegenerative diseases such as Huntington's disease and Amyotrophic Lateral Sclerosis (ALS) are caused by genetic changes that alter the function of critical molecular machines called *multiprotein complexes*. However, why these alterations to protein function lead to neurodegeneration is unknown, making it difficult to design effective therapies. Our research focuses on understanding how dysfunction of these multi-protein complexes leads to establishment and progression of neurodegenerative disease. Using a combination of biochemical, genetic and proteomic approaches, our research group is identifying novel pathways that are disrupted, causing neurodegeneration. Ultimately, our goal is to find a suitable therapeutic treatment in patients.



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> Funding Source SEARCH Grant

Poster Number 12

Fela and Today: Kendrick Lamar, Beyoncé & Us.

Beyoncé Knowles-Carter, popularly known as Beyoncé, is one of the most influential faces in today's music scene. On the one hand, the singer and songwriter writes music that is fun, empowering and irresistibly danceable. On the other hand, Beyoncé releases work that reflects her strong social stances and approaches toward social change, including her most recent release, Lemonade. Similarly, artist Kendrick Lamar is staking his claim in the industry with a vengeful sound music and socially stigmatic lyrics. His sophomore album To Pimp a Butterfly, made its debut contesting the issues of racial discrimination in our community. How do these two artists make political statements while delivering music that clears for chart toppers? They look to older African roots, particularly those grounded in Afrobeat. Fela Kuti, born Olufela Olusegun Oludotun Ransome-Kuti, revolutionized a relationship between music and politics through his invention of Afrobeat. Although known for his career in jazz, Kuti was more respected, and widely criticized, for the social ideas he packed into his own genre. Kuti's Afrobeat is incomparable to most other forms of art; its intensity focuses on the experiences of the post-colonial Pan-African state. Through the comparative analysis on both context and compositional technique, we can then focus on how Beyoncé and Kendrick Lamar have galvanized social activism within our masses, using pop music.





Low-Cost Rapid FDM Tooling with Ultem 1011 Thermal Conductivity

Knowledge generated by this research will allow for the reduction in time, cost, and materials used in the production of complex parts. Understanding the thermal conductivity of the material used in this tooling is vital to the success of the end product. The amount of heat that may be either extracted or provided to the part being made, will have effects on the curing rate and time of the parts.



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> Funding Source DYNO Consult

> > Poster Number 4

The Effects of Detonation Wave Collisions on Rock Throw

Aggregate mines and quarries can reduce the costs of moving and crushing rock by using optimized rock blasting design. This study investigates the effects that precise timing delays in the blast column have on rock throw and fragmentation (the distance the rock is blasted and the particle size distribution of the resulting rock pile). The ability to control delay timings with electronic detonators could potentially propagate wave collisions down each drill hole which could positively or negatively impact rock throw and fragmentation, depending on the requirements for the final product.

This study could potentially introduce new blasting methods that improve the efficiency of a mining operation, which could boost profits and/or lower the prices of crushed rock. Considering that there are over 200 active mines in Missouri, this could lead to significant economic growth for mining companies and the communities in which they operate. Lower aggregate prices could render large-scale infrastructure projects cheaper for state and local governments, and ultimately Missouri tax payers.

Jana Hochard



Autonomous Drilling Rig Research and Design

Autonomous drilling is a system of optimizing drilling parameters using data collected from sensors, a control system, and a specifically programmed algorithm. This innovation will provide lower costs, increase efficiency of the drilling rig, and reduce safety risks. The Society of Petroleum Engineers (SPE) and Drilling Systems Automation Technical Section (DSATS) have presented a competition to design and construct a miniature autonomous drilling rig, with the intentions of inspiring innovation in this area. A multidisciplinary team was formed to accomplish this task. The research and design was split into three sub-categories: mechanical, electrical, and optimization. The mechanical design focused solely on the rig framework. The electrical design encompassed programming the drilling algorithm, selecting sensors for data recovery, and designing the control system. Optimization focused on the fluid circulation system and the bottom hole assembly (BHA).

The design is a two-tiered rig of t-slotted aluminum. The top section of the rig contains a traveling block that will control the weight-on-bit (WOB), while the larger bottom section provides stability of the rig and support of the rock sample. A detachable fluid circulation system is connected to the traveling block through a reinforced PVC braided vinyl tube. Instead of using a typical drilling mud, air, or water, the fluid system is designed to operate with drilling foam. Research shows that foam provides cooling for the drilling bit as well as a higher efficiency for removing cuttings. To control the drilling, the system architecture is comprised of phidgets sensors, Arduino control, drill control software, and a data visualization server. This system allows the rig to automatically adjust drilling parameters; additionally, the data will be transmitted to a local server through an interactive webpage, allowing a live public view.



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Funding Source Various donors

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Poster Number 10

Heterogeneous activity causes a nonlinear increase in the group energy use of ant workers isolated from their social environment

In this project, we worked on studying social behaviors in ants. Taken from the nest, the group was recorded via video and the metabolic rate was also taken at times. The results clearly show the fewer ants are present, the more active they all are, however, not in a linear fashion.





MOF coating and its Impact on CO2 adsorption

In my research, I use the principals of polymer phase separation and seeding to create an adsorbative surface. By first seeding my metal-organic framework on my substrate, crystal growth is facilitated and Carbon Dioxide capture is possible.



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Funding Source OURE, GAF roofing, & EPA

Poster Number 17

Novel Approaches to Amend Green Roof Media for Urban Water and Urban Heat Island Benefits

Green roofs provide many environmental benefits such peak flow attenuation, runoff reduction, and increased roof life expectancy to buildings. However, green roofs need media that is fertile to sustain vegetation. Nitrogen, potassium, and phosphorous are common nutrients in fertilizers present in commercial green roof media to promote plant growth. Water leaching from green roof media carries nutrients from the building and enters nearby water bodies, contributing to eutrophication as observed in Missouri waters and the Dead Zone in the Gulf of Mexico. In order to design the best green roofs for our urban waters, methods of assessing water quality and quantity is imperative.

To assess nutrient leaching, an in-vitro study simulate precipitation events typical to Missouri was performed to show the decrease of solids, total organic carbon, nitrogen, and phosphate in green roof leachate. The apparatus simulated rainfall, using valves to evenly distribute water to each cylinder at a rate equivalent to a 1 year-30 minute rainfall event for Rolla, MO. In evaluating new media design, 3 varieties of biochar and hydrogel particles were integrated into the GAF media. Testing was then carried out to quantify the benefits of the amendments on the green roof leaching characteristics.

The new methods assessed leaching characteristics and elucidated implications of improved green roof design approaches. This work also integrates with full-scale research at Missouri University of Science and Technology, looking at the water retention and thermal benefits of green roof media design. Accurate assessments will be incorporated into urban water quality models.





Spectral Analysis of Communication Networks Against Targeted Attacks

Communication networks are a critical infrastructure that society is highly dependent on. In order to ensure reliability of these networks, we can analyze how they behave under in an attack scenario and use the resulting data to improve network resilience by optimizing the network structure. To study resilience across dissimilar networks with different numbers of nodes and links, we can use the normalized Laplacian spectra of the networks as a common point of comparison. Utilizing this method of comparison, we can simulate targeted attacks on critical communication infrastructure by systematically removing crucial components, then examine how the spectra is altered when components are removed. This spectral analysis can further our understanding of how network structures break down under an attack and can provide insight into the preventative optimization of communication infrastructure.



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Funding Source OURE

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Funding Source NSF

Poster Number 25

FlyQ: Testing Evolved Intelligence Across Multiple Contexts

Intelligence is one of the most important determiners of an animal's success in its environment. Learning, the ability to gain and use new information, in an important component of intelligence. Learning enables animals to make good choices in changing environments. However, not all individuals learn with equal ability, allowing evolution to shape cognition in nature as well as in experimental studies. The mechanisms underlying intelligence are found in the brain, and the study of these mechanisms, both neural and genetic rely on model organisms such as fruit flies. We have evolved populations of flies in the laboratory that vary in how well females learn about where to place their eggs, an important aspect of maternal care. A decades old and still unanswered question in animal learning is exactly how broadly evolution acts in shaping cognition. Does learning evolve to solve one type of problem as an adaptive specialization, or does it evolve as a general process, able to solve many types of problems? To test these hypotheses, we compare populations of flies with different evolved learning traits in a series of learning tasks (i.e. a fly IQ test). We find that evolution has indeed acted in a broad sense, and flies that evolved to learn better about where to lay eggs also learn better in other tasks. This novel result means that the neural circuits enabling learning about one context act broadly, giving an important window into how the brain works and shines light on a new series of questions across multiple fields of study.



Chris Summers

Missouri's Need for an inclusive Nondiscrimination Act

The Missouri Nondiscrimination Act (MONA) is needed in our state to extend protections based on sexual orientation and gender identity under the existing Missouri Human Rights Act. Currently, LGBT Missourians can be fired from their jobs, denied housing, and refused service in public places.



Fenton, Missouri

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Major Social Work

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