MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

13th Annual Undergraduate Research Conference

A celebration of experiential learning at Missouri S&T

April 11, 2017

Missouri S&T Havener Center

13th Annual
Undergraduate Research Conference
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13th Annual Undergraduate Research Conference

8:00am – 8:30am	**Registration and Poster Set-Up** *(Upper Atrium)*
8:30am – 9:00am	**Opening Address** Vice Provost Dr. Jeffrey Cawlfield *(St. Pat's C Ballroom)*
9:00am – 12:00pm	**OURE Oral Sessions and OURE Fellows Oral Sessions**
	ENGINEERING --- SCIENCE --- FELLOW PROPOSALS *(Missouri) (Carver) (Turner)*
9:00am – 12:00pm	**Poster Sessions** **SCIENCES** *(Upper Atrium/Hallway)*
12:00pm – 1:00pm	**Luncheon & Keynote Address** *Dr. Larry D. Gragg, Ph.D.* Curators' Distinguished Teaching Professor History and Political Science Missouri University of Science and Technology ***Presents*** "Researching the History of MSM/UMR/S&T" *(St. Pat's C Ballroom)*
1:00pm – 3:00pm	**OURE Oral Sessions and OURE Fellows Oral Sessions**
	ARTS & HUMANITIES --- FELLOW FINAL REPORTS --- FELLOW PROPOSALS *(Missouri) (Carver) (Turner)*
1:00pm – 3:00pm	**Poster Sessions** **ARTS & HUMANITIES --- ENGINEERING --- SOCIAL SCIENCES** *(Upper Atrium/Hallway)*
3:00pm – 4:00pm	**Reception** *(St. Pat's C Ballroom)*
4:00pm – 5:00pm	**Awards Ceremony** *(St. Pat's C Ballroom)*

**Judges Conference Room – (Mark Twain)*

Keynote Speaker

Larry D. Gragg, Ph.D.

Curators' Distinguished Teaching Professor
Department of History and Political Science
Missouri University of Science and Technology

Presents

"Researching the History of MSM/UMR/S&T"

Larry Gragg joined the History and Political Science Department in 1977, and was chair of the department from 2003 to 2015. He is a specialist in colonial and revolutionary America, and is the author of seven books and over 30 articles on topics ranging from the Salem witch crisis to English colonization in the West Indies to the history of Las Vegas. His most recent books are *Benjamin "Bugsy" Siegel: The Gangster, the Flamingo, and the Making of Modern Las Vegas* (Praeger, 2015), *Bright Light City: Las Vegas in Popular Culture* (University Press of Kansas, 2013), and *The Quaker Community on Barbados: Challenging the Culture of the Planter Class* (University of Missouri Press, 2009). His most recent articles include "El Sonador and the Struggle to Develop Resort Hotels in Las Vegas in the 1930s," *Nevada in the West* (Spring 2015), "The Anti-Nazi Gangster," *History Today* (June 2015), "The Role of Witchcraft in the Early Modern World," *Comparative Civilizations Review* (Spring 2015), and "'A Long Struggle and Many Disappointments': Las Vegas' Failure to Open a Resort Hotel, 1905-1940," *Nevada Historical Society Quarterly* (Fall 2015).

The recipient of 11 campus Outstanding Teaching Awards, four campus Faculty Excellence Awards, the Missouri Governor's Award for Excellence in Teaching, the University of Missouri System award for Excellence in Teaching, and the University of Missouri system's Thomas Jefferson Award, Gragg currently is a Curators' Teaching Professor.

Conference Judges

The Office of Undergraduate Studies wishes to thank the following faculty & staff for their valuable contributions to the 13th Annual Missouri S&T Undergraduate Research Conference.

Jeffrey Cawlfield

Petra Dewitt

Ana Ichim

KM Isaac

Irina Ivliyeva

Jonathan Kimball

Merilee Krueger

Rachel Morris

Prakash Reddy

Fateme Rezaei

Elizabeth Roberson

Ibrahim Said

Joseph Smith

Nancy Stone

Jeffrey Winiarz

Rosa Zheng

Oral Presentations

Arts and Humanities

Name	Department	Time	Location
Victoria Kraemer	Arts, Languages & Philosophy	1:00-1:30 pm	Missouri Room
Joel Merz	Arts, Languages & Philosophy	1:30-2:00 pm	Missouri Room

Engineering

Name	Department	Time	Location
Caitlin Brocker	Chemical & Biochemical Engineering	9:30-10:00 am	Missouri Room
Patrick Cahill	Mining & Nuclear Engineering	10:00-10:30 am	Missouri Room
Chase Herman	Chemical & Biochemical Engineering	10:30-11:00 am	Missouri Room
Jonathan Kuchem	Civil, Architectural & Environmental Engineering	11:00-11:30 am	Missouri Room
Meyyammai Palaniappan	Chemical & Biochemical Engineering	11:30-12:00 am	Missouri Room

Sciences

Name	Department	Time	Location
Alexander Ayres	Biological Sciences	9:00-9:20 pm	Carver Room
Charlotte Baker	Biological Sciences	9:20-9:40 pm	Carver Room
Alexandre Cristea	Chemistry	9:40-10:00 pm	Carver Room
Emily King	Chemistry	10:00-10:20 pm	Carver Room
Madison Mara	Biological Sciences	10:20-10:40 pm	Carver Room
Qiming Wang	Geoscience, Geological, & Petroleum Engineering	10:40-11:00 pm	Carver Room
Jonah Heitman Veronica Lee	Biological Sciences	11:00-11:20 pm	Carver Room

Alexander Ayres

Department: Biological Sciences
Major: Chemical Engineering
Research Advisor(s): Dr. Katie Shannon
Advisor's Department: Biological Sciences

Funding Source: OURE

Effects of Phosphorylation on Dbf2

Cytokinesis is the physical process of cell division, which divides the cytoplasm between the two new daughter cells. One important pathway that regulates cytokinesis is called the Mitotic Exit Network, or MEN for short. The MEN is a signaling pathway that allows a dividing cell to complete cytokinesis and exit mitosis. To study cytokinetic defects, budding yeast is used a model organism. Of interest is the regulation of Dbf2, a MEN protein, by phosphorylation. Mutant alleles of the dbf2 gene that prevent phosphorylation or dephosphorylation have been created on a plasmid. The plasmid is duplicated and purified from bacterial cells, then inserted in yeast cells. After growth of the yeast colonies, the cells with Dbf2 mutations can be observed during mitosis through use of fluorescence microscopy to determine the effects of the mutations on cytokinesis.

Alex Ayres is currently in his 4th year at Missouri University of Science and Technology and plans on graduating in December with a degree in Chemical Engineer, minoring in Biology. For the last 3 years he has performed research on Cytokinesis in budding yeast under the guidance of Dr. Katie Shannon. After graduating, he plans on attending graduate school, and hopes to receive a Phd in Medical Microbiology.

Charlotte Baker

Department: Biology
Major: Psychology
Research Advisor(s): Dr. Mathew Thimgan
Advisor's Department: Biology

Funding Source: OURE Fellows program, FYRE program, Missouri S&T CASB BIC Pilot program

Data analysis to identify sleepiness from cognitive performance

This project is designed to develop an objective test to identify sleepiness in people with jobs where errors can be dangerous; for example, factory workers, pilots, or soldiers. My role in the project was to collect and analyze data from cognitive tests to search for factors associated with sleepiness. I tested for correlations between a variety of factors in several tests, including the PVT (Psychomotor Vigilance Task, testing reaction time) and the LOT (Line Orientation Test, testing the subject's spatial orientation skills). So far, I have considered: correlations between two metrics in the same test (ex: errors on a test vs mean reaction time on the same test), differences between subjects of different genders, differences based on cognitive test order, and whether there is a learning effect over the course of the study. The LOT seems shows inconsistent effects in different metrics over the course of the study, and requires further analyses. The PVT does not demonstrate any learning effect.

Charlotte Baker is a Freshman Psychology student working with Dr. Mathew Thimgan as part of a FYRE (First Year Research Experience) project. After graduation, she plans to continue academic work and begin progressing towards a PhD in Anthropology. She enjoys fencing, writing, and dog training.

Caitlin Brocker

Department: Chemical and Biochemical Engineering
Major: Biochemical Engineering
Research Advisor(s): Dr. Sutapa Barua
Advisor's Department: Chemical and Biochemical Engineering

Funding Source: Start Up of Dr. Barua
OURE Program

Heteromer Stars for the Treatment of Breast Cancer

A star-like structure has potential to carry large quantities of a therapeutic agent, improve adherence to target cells and safely release drugs after prolonged period of residence at the diseased site. However, synthesis of such a stellate structure is not an easy task. Here, the design of a polylactide-co-glycolic acid (PLGA) based star shape conformation is described for the treatment of breast cancer. About 1 in 8 U.S. women (12%) develops invasive breast cancer over the course of her lifetime. In 2016, an estimated 246,660 new cases of invasive breast cancer were expected to be diagnosed in women in the U.S., along with 61,000 new cases of non-invasive (in situ) breast cancer. Although a variety of nanoparticles have been tested in lab scale, the use of heteromer armed nanoparticles presents a unique drug release matrix. PLGA is a biocompatible polymer that enables controlled release of tetrakis(hydroxymethyl) phosphonium chloride (THPC) drugs into breast cancer cells. This novel delivery platform significantly inhibits the breast cancer cell growth population that potentiates the efficacy of THPC treatment.

Caitlin Brocker is a senior and will complete her B.S. in Chemical Engineering with a Biochemical Emphasis at Missouri University of Science and Technology in May. Caitlin is also on the Missouri S&T Women's Volleyball Team and the Love Your Melon Campus Crew. She has been working in Dr. Sutapa Barua's lab since April 2015, and her projects have involved drug delivery systems for breast cancer treatment. Caitlin has published one paper in the journal Nanotechnology (impact factor = 3.573) in 2017 and is preparing one more that will be submitted in 2017. She won 3rd place in the Engineering oral presentation in the 2016 OURE research meeting.

Patrick Cahill

Department: Mining & Nuclear Engineering
Major: Mining Engineering/Geology & Geophysics
Research Advisor(s): Dr. Catherine Johnson
Advisor's Department: Mining & Nuclear Engineering

Funding Source: Travel grant from DYNO Consult

The Effects of Detonation Wave Collisions on Rock Throw

Rock blasting is the primary method used to break rock for excavation. It serves two purposes; fragmenting the rock and throwing it to its muck pile using explosive energy. Fragmentation and throw needs are site specific, dependent on end-product requirements. Prior studies have shown that by only changing blast hole timing with the same blast design, fragmentation and throw alters. In an operating mine in Georgia, an optimum inter-hole delay for fragmentation has been found by studying timings from 0ms to 45ms. Instantaneous timing between holes increased the throw by over 100 ft, but fragmentation was poor. Shock and detonation wave collision is a potential reason for this increased throw. This paper investigates this optimized inter-hole timing while altering top and bottom column primer time to potentially improve throw while maintaining optimum fragmentation. Timings studied are top initiation, bottom initiation, and top and bottom simultaneously.

Patrick Cahill is a senior in the Mining Engineering Department, and is an active member in the Society for Mining, Metallurgy, and Exploration (of which he is currently serving as the S&T Chapter Treasurer), the International Society of Explosives Engineers, and the National Stone, Sand, and Gravel Association. He has performed undergraduate research in the Energetics Research Facility under the directorship of Dr. Catherine Johnson, Assistant Professor of Mining Engineering. Publications include "The Effects of Detonation Wave Collisions on Rock Throw", which was presented at the proceedings of the 2017 Annual SME Conference in Denver; and "Missouri S&T Mine Expansion and Associated Risk Safety Analysis", which was presented at the proceedings of the 43rd Annual Conference on Explosives and Blasting Techniques in Orlando. Patrick plans to work in the mining industry after graduation and would eventually like to return to S&T for a master's degree in Explosives Engineering.

Alexandre Cristea

Department: Chemistry
Major: Chemistry
Research Advisor(s): Yinfa Ma
Advisor's Department: Chemistry

Funding Source: OURE

Simultaneous Determination of Amino Acids in Urine by HPLC-MS/MS for Breast Cancer Risk Screening

The use of biomarkers in the field of disease detection is a growing field in bioanalytical chemistry. In this study the relative quantities of amino acids in urine were compared between healthy control samples with those of breast cancer patients in order to determine whether there is a correlation between the levels of these biomarker compounds and breast cancer. Given a significant change in the abundance of these chemicals, they may provide modern precision medicine a new way of detecting early onset breast cancer.

Alex is a sophomore working on his Bachelor's of Science in Chemistry. He is also involved in the Missouri S&T Student council and plans on continuing his education by attending graduate school.

Jonah Heitman, (Veronica Lee)

Department: Biology
Major: Bio Sci
Research Advisor(s): Dr. Dev Niyogi
Advisor's Department: Bio Sci

Funding Source: OURE

E. coli Survivorship

E. coli bacteria are used as indicators to detect the presence of harmful microorganisms in environmental samples. We are examining E. coli concentrations in local streams, where it is crucial to understand the conditions in which E. coli persist in a freshwater environment. We devised several microcosm experiments using experimental streams in order to better understand controls on E. coli survival. Several experiments tested temperature and sunlight effects on the survival of E. coli. Survival was much lower in full sun and at warmer temperatures. Another experiment tested the effects of streambed sediments on suspended E. coli. This included several trials of experimental streams filled with sand, gravel, and devoid of any sediment as a control. The E. coli seem to behave as predicted, acting more as particles themselves, and the counts for sand gutters were lowest, with the gravel behind it, and the highest counts yielding from the control.

Jonah Heitman, a driven student, was fascinated in his Ecology class. Instantly, he decided to jump on board Dr. Niyogi's lab and fell in love with the stream system of Mill Creek.

Chase Herman

Department: Chemical and Biochemical Engineering
Major: Chemical Engineering
Research Advisor(s): Dr. Sutapa Barua
Advisor's Department: Chemical and Biochemical Engineering

Funding Source: Missouri S&T OURE, principal investigator's start-up, and the University of Missouri Research Board Award

CELLULAR HITCHHIKING ON MICROPARTICLES TO ALLEVIATE SKIN INJURY

Regenerative medicine holds great potential for the treatment of tissue damage. However, there are currently very few clinical applications of cell-based therapies; numerous studies have encountered complications with keeping transplant cells alive. To overcome this, the present study focuses on engineering polymer microparticles. These microparticles may provide the following: mechanical support for adherent cells in suspension, a means of culturing enormous amounts of cells in small volumes, and receptor-ligand specific signal mediated cell growth.

In this study, a simple flow-focusing device was developed to synthesize poly(lactic-co-glycolic acid) (PLGA) microparticles with the solvent diffusion method. Particle diameters of approximately 200 μm were achieved. Additionally, particle surface chemistry was modified to promote cell adhesion, and human umbilical vein endothelial cells (HUVEC) were cultured with these particles in suspension. We call this "*cellular hitchhiking*". The specific goal of this research is treatment of skin injury, but the technique has versatile tissue regeneration applications.

Chase Herman is a 3rd-year undergraduate student from the Department of Chemical and Biochemical Engineering at Missouri S&T. Since his middle school days, he has enthusiastically participated in many research and design projects. During high school he competed in the Intel International Science and Engineering Fair (ISEF) and was privileged to personally meet Robert Horvitz, a Nobel laureate. Listening to Dr. Horvitz and other laureates ignited Chase's excitement for scientific research.

Since high school, Chase has worked in multiple research labs, both in academia and industry. This summer he will be participating in the National Science Foundation's Research Experience for Undergraduate program (NSF-REU) at the University of Delaware. He hopes to graduate in May of 2018 and then pursue doctoral studies.

Emily King

Department: Chemistry
Major: Chemistry
Research Advisor(s): Dr. Yinfa Ma
Advisor's Department: Chemistry

Funding Source: Research is supported by First Year Research Experience funding Colleague of Arts, Sciences, and Business, and the Department of Chemistry

Simultaneous Determination of 15 Pteridines using Capillary Electrophoresis-- Laser-Induced Fluorescence

Cancer is the second leading cause of death worldwide and it is the cause of about 13% of all deaths worldwide. Deaths from cancer worldwide are projected to continue rising, with an estimated 12 million deaths per year in 2030. Therefore early diagnosis of cancer has become an important task worldwide since it can significantly enhance the cure rate. To achieve early diagnosis of cancers, biomarkers, which are the indicators of existing cancer in human body, must be identified and their correlation with cancer development must be established.

This research project will build upon and validate the previously developed analytical method for the simultaneous determination of a fifteen pteridine panel using our proprietary P-Scan technology. Elevated levels of pteridine derivatives in the urine of women diagnosed with breast cancer has established these molecules as putative biomarkers for early risk screening. However, the sensitivity and accuracy must be improved to minimize false-positive and false-negative rates when it is applied in clinical diagnosis. This expanded biomarker panel study is intended to increase diagnostic accuracy. The impact of this study is that the resulting data and method will broaden the panel of metabolic biomarkers, enabling researchers and clinicians to more accurately characterize tumor biology in cancer patients.

Emily King is a high school graduate from St. Vincent de Paul High School in Perryville, Missouri. Currently, Emily is a freshman majoring in Chemistry and has received the William H. Webb, Trustees, University, Dean's, and Women in Engineering scholarships as well as Bright Flight. Emily is a member of the Honors Academy, has been accepted into the First Year Research Experience program, and is on the Dean's List. Her research concerns bioanalytical methods of cancer metabolite detection in urine, conducted under the guidance of Dr. Yinfa Ma and Casey Burton, within the center for Single Nanoparticle, Single Cell, and Single Molecule Monitoring.

Victoria Kraemer

Department: Arts & Humanities
Major: Engineering Management
Research Advisor(s): Dr. Audra Merfeld-Langston
Advisor's Department: Arts Languages & Philosophy

Funding Source: Opportunities of Undergraduate Research

The *Encyclopédie*: Impact on the French Enlightenment and Freedom of Thought

The *Encyclopédie* was one of the most important publications during the Enlightenment period in France. The publication of the *Encyclopédie* helped to disseminate knowledge throughout France thereby encouraging freedom of thought. Though potentially opinionated, the articles of the *Encyclopédie* brought information about a wide variety of topics to a wider public than previously possible. This knowledge led to the beginning of a new era where the editors of the *Encyclopédie*, Diderot and d'Alembert, fostered open dialogs and the sharing of information.

Victoria Kraemer is a junior in the Engineering Management Program at Missouri University of Science and Technology graduating in May 2019. On campus she is involved with Residential Life as a Programming Resource Assistant, French Club as the Vice President, and Sig Game as Manager.

Jonathan Kuchem

Department: Civil, Architectural, and Environmental Engineering
Major: Civil Engineering
Research Advisor(s): Dr. Nicolas Libre
Advisor's Department: Civil Engineering

Funding Source: -

Mechanical Properties of Steel Fiber Reinforced Concrete made with recycled materials

A push for increasing the lifespan and sustainability of infrastructure has led to a need for more durable, strong, and environmental friendly construction materials. A concrete mix design using recycled steel fibers from rubber tires was chosen to enhance the mechanical properties, durability, and sustainability of the concrete. Concrete mixtures with different quantities of steel and recycled fibers were examined. Compression and flexural tests were performed in order to analyze these properties and used to compare the results with the industry standard reinforced steel fibers. The results show the compressive strength as well as the flexural strength of fiber reinforced concrete has increased compared to reference mixtures. It is found that the recycled fibers present an environmental friendly option to reduce tire waste in landfills and present a cheaper option than the industry used steel fibers.

Jonathan Kuchem is a junior in Civil Engineering from Augusta, Missouri. He is currently the President of the Steel Bridge Design team. He is also an active member of the schools American Society of Civil Engineers chapter (ASCE), Chi Epsilon Civil Honor Society, and Kappa Alpha Order Fraternity. He is a teacher assistant for Mechanics of Materials lab and helps with course development. Jonathan is a Greenberg's Scholar in the Civil Engineering Department which will allow him to continue his schooling and get a M.S. in Civil Engineering.

Veronica Lee

Dr. Niyogi

3/7/17

Abstract:

E. coli bacteria are used as indicators to detect the presence of harmful microorganisms in environmental samples. We are examining *E. coli* concentrations in local streams, where it is crucial to understand the conditions in which *E. coli* persist in a freshwater environment. We devised several microcosm experiments using experimental streams in order to better understand controls on *E. coli* survival. Several experiments tested temperature and sunlight effects on the survival of *E. coli*. Survival was much lower in full sun and at warmer temperatures. Another experiment tested the effects of streambed sediments on suspended *E. coli*. This included several trials of experimental streams filled with sand, gravel, and devoid of any sediment as a control. The *E. coli* seem to behave as predicted, acting more as particles themselves, and the counts for sand gutters were lowest, with the gravel behind it, and the highest counts yielding from the control.

Madison Mara

Department: Biological Sciences
Major: Biological Sciences
Research Advisor(s): Dr. Katie Shannon
Advisor's Department: Biological Sciences

Funding Source: OURE

Comparing Phenotypes of IQG1 Mutants

During cytokinesis, many mutations can arise that affect formation of the actomyosin ring. Iqg1 is a protein that is required for assembly and contraction of the actomyosin ring in budding yeast. This project is designed to compare the phenotypes of three separate IQG1 mutant alleles to examine any problems that arise during cytokinesis. In this research, a mutant (2A) that has two serines mutated to alanine and a mutant (4A) that has three serines and one threonine mutated to alanine are compared in relation to the wild type strain. Investigation of another mutant (3T) has 3 serines mutated to theronines that is able to be phosphorylated but unable to be dephosphorylated, which is suspected to cause a lethal phenotype. The goal in doing this is to compare cytokinesis defects in the 2A mutant, 4A mutant, and 3T mutant and see if threonine has a unique function and determine the phenotype of permanent phosphorylation. To confirm mutant phenotype, morphological analysis will be performed via microscopy and immunofluorescence to indicate if actin ring formation has been disrupted.

Madison is a Senior at Missouri University of Science and Technology pursuing a degree in Biological Sciences with an emphasis in pre medicine. She is a member of Scrubs Pre-Med Club, Zeta Tau Alpha, Phi Sigma Biological Honor Society, and has been conducting research in Dr. Shannon's cytokinesis lab for three years. She plans on pursuing a MD/Ph.D. once she graduates from Missouri S&T.

Joel Merz

Department: History and Political Science
Major: History
Research Advisor(s): Irina Ivliyeva
Advisor's Department: Arts, Languages & Philosophy

Funding Source: OURE

Thunder in the East: Wehrmacht versus RKKA

During the Second Great War, the clash of tanks dominated the Eastern Front. From the testing grounds in Spain (1936-1939), to the fields of Eastern Europe (1941-1945), Nazi Germany and the Soviet Union fought a continuous battle for tank supremacy which defined the future of armored warfare. The goal of the research is to do an independent comparison of the tanks used on the Eastern Front. To look at the technical aspects of armor, firepower, and mobility to see which tank held the edge in battle. Taking a deeper look at how the war changed the perception and development of armored warfare and the strategies that followed. In the East, the thunder of heavy tanks and large guns dominated the battlefields, in a matchup of equipment never seen in warfare.

Joel Merz is an undergraduate working on his Bachelor of Arts, History. Having a minor already in Foreign Language Russian. He is also Working on minors in Political Science and Pre-law. Joel is in involved on campus with the History Club and Student Council. Joel is hoping to graduate in the field of military history and become a writer/researcher.

Meyyammai Palaniappan

Joint project with James Jones.

Department: Chemical and Biochemical Engineering Department
Major: Chemical Engineering
Research Advisor(s): Dr. Joontaek Park
Advisor's Department: Chemical and Biochemical Engineering Department

Funding Source: OURE

Dynamic Simulation of a Nanorod and a Polymer Molecule in a Microfluidic Device with a Complex Geometry

Separation of biomolecules and biopolymers through various microfluidic devices has been an area of research that has been under development for its uses in drug delivery and biomolecule behavior. Commercial software is not able to model the intricate dynamics of non-spherical irregular shaped particles, such as a nanorod or a polymer molecule, within these microfluidic devices. The use of COMSOL Multiphysics overcomes these difficulties. A bead-spring model is used to model the polymer molecule and a rigid dumbbell model is used to model a nanorod. The microfluidic device used to model the molecule dynamics is a well in a channel (similar to a dip in a blood vessel). Length of the polymer was varied to study the effect this had on elution time.

Meyyammai Palaniappan is a senior studying Chemical Engineering and is pursuing minors in Chemistry and Biomedical Engineering. Meyyammai is a member and former president of Missouri S&T iGEM design team. She is also a member of SWE, AiChE, and Missouri S&T's Honor Academy.

Qiming Wang

Department: GGPE
Major: Geology&Geophysics
Research Advisor(s): Dr. Wan Yang
Advisor's Department: Geoscience and geological and petroleum engineering

Funding Source: MS&T Undergraduate Research Office
Dr. Alfred Spreng Research Award

Petrographic Characteristics of Paleosols in Upper Daheyan Low-Order Cycle, Southern Bogda Mountains, Northwestern China

This research is petrographic characteristics study of paleosols in the upper Daheyan Low-order cycle, Taodonggou section, Southern Bogda Mountains, Northwestern China. Paleosols and calcitic nodules within the paleosols are petrographic studied to interpret paleoenvironment and paleoclimate during pedogenesis. 400 point-counts of two paleosols documented follow composition, size, and roundness. And soil features are observed and interpreted in all seven thin sections. Two paleosol samples are highly calcified and hematitized. In the thin sections, soil texture such as replacive fabric, displacive fabric, and vein filling calcite have been identified. The composition and texture indicate the paleoclimate during pedogenesis in this area are arid to semi-arid. The depositional environment is the fluvial environment. The rainfall capacity is less than water evaporation capacity in most of the time and the climate change from relative humid to semiarid or arid.

Poster Presentations

Arts and Humanities

Poster #	Name	Department	Time	Location
1	Elisabeth DeStefano	Arts, Languages & Philosophy	1:00-3:00 pm	Upper Atrium/Hall
2	Isabelle Kersting	English & Technical Communication	1:00-3:00 pm	Upper Atrium/Hall
3	Taylor McNamee	English & Technical Communication	1:00-3:00 pm	

Engineering

Poster #	Name	Department	Time	Location
4	Michael Dalgetty	Mining & Nuclear Engineering	1:00-3:00 pm	Upper Atrium/Hall
5	Sarah Jemison	Civil, Architectural & Environmental Engineering	1:00-3:00 pm	Upper Atrium/Hall
6	Hannah Kim	Chemical & Biochemical Engineering	1:00-3:00 pm	Upper Atrium/Hall
7	Shane Lawson	Chemical & Biochemical Engineering	1:00-3:00 pm	Upper Atrium/Hall
8	Maryssa Loehr	Civil, Architectural & Environmental Engineering	1:00-3:00 pm	Upper Atrium/Hall
9	Niklas Melton	Electrical and Computer Engineering	1:00-3:00 pm	Upper Atrium/Hall
10	James Schuchard	Chemical & Biochemical Engineering	1:00-3:00 pm	Upper Atrium/Hall
11	Ye Jin	Chemical & Biochemical Engineering	1:00-3:00 pm	Upper Atrium/Hall

Sciences

Poster #	Name	Department	Time	Location
12	Isabella Bowling	Chemistry	9:00-11:45 pm	Upper Atrium/Hall
13	Mason Donnell	Biological Sciences	9:00-11:45 pm	Upper Atrium/Hall
14	Kyara Holloway	Biological Sciences	9:00-11:45 pm	Upper Atrium/Hall
15	Marketa Illetskova	Computer Science	9:00-11:45 pm	Upper Atrium/Hall
16	Eric Michalak	Computer Science	9:00-11:45 pm	Upper Atrium/Hall
17	Mark Myers II	Computer Science	9:00-11:45 pm	Upper Atrium/Hall
18	Caitlin Siehr	Biological Sciences	9:00-11:45 pm	Upper Atrium/Hall
19	Sarah Skinner	Physics	9:00-11:45 pm	Upper Atrium/Hall
20	Joseph Szatkowski	Computer Science	9:00-11:45 pm	Upper Atrium/Hall
21	Skye Tackett	Physics	9:00-11:45 pm	Upper Atrium/Hall
22	Chen Zhao	Geology & Geophysics	9:00-11:45 pm	Upper Atrium/Hall
23	Gregory Evans Madison Morris	Biological Sciences	9:00-11:45 pm	Upper Atrium/Hall
24	Steven Giangreco Allie Plunk	Mathematics & Statistics	9:00-11:45 pm	Upper Atrium/Hall
25	Elizabeth Hollen Jason Viehman	Mathematics & Statistics	9:00-11:45 pm	Upper Atrium/Hall

Social Sciences

Poster #	Name	Department	Time	Location
26	Samantha Cottrell	Psychological Science	1:00-3:00 pm	Upper Atrium/Hall
27	Sara Johnson	Psychological Science	1:00-3:00 pm	Upper Atrium/Hall
28	Dawn Little	Psychological Science	1:00-3:00 pm	Upper Atrium/Hall

Isabella Bowling

Department: Chemistry
Major: Biological Sciences
Research Advisor(s): Dr. Risheng Wang
Advisor's Department: Chemistry

Funding Source: Department of Chemistry
OURE

Bifunctionalization of nanoparticles with DNA and PEG polymers

This research entails the findings observed while testing the binding efficiency of different ratios of bifunctionalized gold nanoparticles. A polymer, polyethylene glycol (PEG), was utilized to promote interactions between DNA origami rectangles and the gold nanoparticles. Binding yields were calculated by annealing samples with the varying ratios and analyzing them. The ratios with lower consumption of DNA provides a scaling-up potential for the application of DNA-nanoparticle conjugates in nanotechnology.

Isabella Bowling is a junior studying Biological Sciences. She is involved on campus through research under Dr. Wang, the iGEM design team, and as a Senior Resident Assistant in University Commons. After graduation, she plans to attend a graduate program for Genetic Counseling.

Samantha Cottrell

Department: Psychological Science
Major: Psychology
Research Advisor(s): Dr. Jessica Cundiff
Advisor's Department: Psychological Science

Funding Source: First Year Research Experience

Examining Barriers to Inclusion at Missouri S&T

The purpose of the project was to examine barriers to inclusion that students at Missouri S&T experience on campus. In two surveys, we asked students to describe their experiences with inclusion and exclusion in three contexts: general campus, within their major, and within student organizations. Most descriptions focused on social exclusion, followed by academic exclusion. Results will discuss whether experiences differ by race and gender. Future directions include developing a quantitative survey to further examine students' experiences, and in particular, students' experiences with gender bias on campus.

Samantha Cottrell is a first year student in Psychological Science. She is currently working with Dr. Cundiff as part of the First Year Research Experience. What excites her most about research is that it is unpredictable – there is always something new to learn and discover about the world. After earning her degree, she intends to pursue a career in mental health research and practice focused on suicide prevention.

Michael Dalgetty

Department: Mining and Nuclear Engineering
Major: Nuclear Engineering
Research Advisor(s): Dr. Joseph Graham
Advisor's Department: Nuclear Engineering

Funding Source: None

Development of a low cost electron gun

The purpose of this project is to design and optimize a rudimentary electron gun at a scale and cost that would be easily achievable in a home lab. For the electron gun to function properly, a high vacuum chamber was constructed from surplus components. A number of parts were custom machined including vacuum parts, power electronics, vacuum gauges and the cooling system. The gun consists of a thermionic cathode held at a high negative potential relative to a grounded anode. The system was characterized using a phosphor screen, a floating collector plate, and current-voltage measurements.

Michael is a sophomore in Nuclear Engineering. He is an active member of the Nuclear Science Design Team and is training to become a reactor operator. This project is a continuation of a related project started for high school science fair. He hopes to use the experience gained in this research in future related endeavors.

Elisabeth DeStefano

Department: Speech and Media
Major: Electrical Engineering
Research Advisor(s): Terry Robertson
Advisor's Department: ALP

Funding Source: FYRE Grant

A Perfect Storm: A Case Study Analysis of the Clinton and Trump Campaign

Not unlike the causes of a mass meteorological event several factors played into the "perfect storm" that allowed Donald J. Trump to defeat Hillary Rodham-Clinton in the 2016 presidential campaign. This multi-pronged case study evaluates these factors. First, a content analysis of the television advertising developed by the Clinton and Trump campaigns is evaluated. Next, the newspaper stories from the nation's five largest newspapers were explored to determine the framing and agenda setting developed by the media. Finally, the study looks at the effects of the last Trump/Clinton debate held on October 28, 2016. Results suggest that the culmination of all three of these media artifacts led to Trump's victory.

Elisabeth DeStefano is an electrical engineering major who is in her freshman year of study from Diamondhead, Mississippi. She has received first place in the state of Mississippi for the National Beta Club's oratorical competition and has worked on several FIRST robotics teams not only as a team member, but now as a mentor to many. She is a member of the Kappa Delta sorority as well as serving as the public relations chair for the FIRST alumni association at Missouri S&T.

Mason Donnell

Department: Biological Sciences
Major: Biological Sciences, minor in Chemistry
Research Advisor(s): Dr. Katie Shannon
Advisor's Department: Biological Sciences

Funding Source: OURE-Missouri S&T

Investigating Cytokinetic Protein Homologs in Yeast

Cytokinesis is the process of cytoplasmic division in a cell. One of the processes in cytokinesis is actomyosin ring (ARM) assembly. IQG1, a protein involved in ARM function, possess four domains with the C-terminal domain named Ras GAP C terminus (RGCT). This domain, when deleted, causes cell death. I will use DNA plasmids to introduce wild type IQG1 to yeast cells with a RGCT deletion allele. To confirm the proteins expression, SDS-PAGE will be used to isolate the protein and Western Blotting will confirm the IQG1 expression. Once the strain has been made, analysis of the RCGT domain will begin. Qualitative effects of IQG1 in cytokinesis will be achieved by fluorescent microscopy. The ability of the mutant IQG1 to bind to other proteins will be tested using a GST assay followed by Western Blotting. The merit of this project comes from understanding cytokinesis, which can lead to novel cancer treatments.

Mason Donnell grew up in rural Willard, MO before he made his journey to Missouri S&T. Within his hometown, Mason was actively involved in his high school and community. Being the creator of the school's first science club and volunteering at the local hospital for three years, his love for science and innovation was pronounced. While looking for the right university, he saw Missouri S&T as a good challenge for his academic abilities and decided to pursue a degree in Biological Sciences while minoring in Chemistry. Mason's activity didn't stop at home, but continued here on campus and in the local community. He has taken leadership roles in organizations such as Society of Women Engineers, Spectrum, and volunteers at Rolla Publics Schools to tutor students. Mason Donnell is excited about the applications of his research, and hopes you enjoy his presentation.

Gregory Evans

Joint Project with Madison Morris

Department: Chemistry
Major: BioChemical Engineer
Research Advisor(s): Dr. Thimgan
Advisor's Department: Biology

Funding Source: N/A

Altering the Behavior of Flies Using Optogenetics

Our project aims to modify sleep and wake behavior of flies through stimulation of a light-activated channel inserted into specific neurons, known as optogenetics. Flies expressing this channel in sleep and wake regulating cells were exposed to an activating light using an automated program on a Raspberry Pi developed by students in electrical engineering. We first recorded baseline sleep characteristics of these specific genotypes. We then exposed the animals to optogenetic stimulation, which altered their sleep and wake patterns. Our data are consistent with these cells being involved in sleep and wake regulation. Thus, we have successfully adapted optogenetic techniques to identify cells in sleep and wakefulness. Next, we will test flies expressing the channel in unique cells to determine if they are involved with sleep and wakefulness.

Gregory Evans is a senior biochemical major at Missouri S&T with a biomedical minor. He is a member of Pi Kappa Alpha fraternity, and plans on getting a master in biomedical engineering.

Steven Giangreco

Joint project with Allie Plunk

Department: Mathematics and Statistics
Major: Applied Mathematics
Research Advisor(s): Dr. Gayla R. Olbricht
Advisor's Department: Mathematics and Statistics

Funding Source: Center for Undergraduate Research in Mathematics via the National Science Foundation (NSF) grant #DMS-0636648 / #DMS-1148695 awarded to Brigham Young University (BYU).

Modeling the Relationship Between Age, Genetics, and White Matter Microstructures

The human brain's structure can change with age and different health conditions. A genetic risk factor called the epsilon 4 (e4) allele of the apolipoprotein E (ApoE) gene is linked with increased risk of Alzheimer's disease and reduced brain health. This study investigates whether healthy individuals with the e4 allele exhibit specific brain structure differences. Diffusion tensor imaging (DTI) was used to measure five different aspects of white matter structural integrity (e.g., fractional anisotropy) in seven different brain regions. A multivariate analysis of covariance (MANCOVA) was performed to test for differences in white matter structures and e4 status while controlling for age. Additional statistical methods were employed to test for demographic differences by e4 status and to control the family-wise error rate across multiple tests. These results will enable researchers to better understand the association between the e4 risk factor, age, and white matter structural differences in specific brain regions.

Steven Giangreco is a junior in applied mathematics. He is the recording secretary for the S&T chapter's ACM SIG-Security and a member of the Cyber Defense Team (CDT). He is also an undergraduate researcher for the Department of Mathematics and Statistics.

Elizabeth Hollen

Joint project with Jason Viehman

Department:	Mathematics
Major:	Applied Mathematics with an emphasis in Statistics
Research Advisor(s):	Dr. Gayla R. Olbricht
Advisor's Department:	Mathematics and Statistics

Funding Source:	Center for Undergraduate Research in Mathematics via the National Science Foundation (NSF) grant #DMS-0636648 / #DMS-1148695 awarded to Brigham Young University (BYU).

Statistical Analysis of DNA Methylation Data in a Cervical Cancer Study

DNA methylation occurs when methyl groups attach to cytosine bases on DNA segments. Previous studies have established links between specific methylation patterns and many diseases. In this research, statistical methods are employed to test for significant differences in methylation levels between HIV patients with different stages of cervical cancer. DNA methylation levels are measured at cytosines across the genome with Illumina 450K methylation microarrays. After initial pre-processing to eliminate low-quality data, testing was performed at each cytosine site using t-tests and empirical Bayes tests to identify any statistically significant site level methylation differences between the cervical cancer stages. Two region level statistical methods (Bumphunter and DMRcate) were also applied to identify statistically significant regions of interest in the genome. Significant sites or regions that overlap with genes, CpG Islands, or other genomic annotations can help researchers better understand the molecular impact of DNA methylation and its connection to cervical cancer.

Elizabeth Hollen is a senior in applied mathematics with an emphasis in statistics. Active on campus, she is a Student Ambassador and a board member of the undergraduate student leadership council.

Kyara Holloway

Department: Biological Sciences
Major: Biological Science
Research Advisor(s): Chen Hou
Advisor's Department: Biological Sciences

Funding Source: N/A

Heterogeneous activity causes a nonlinear increase in the group energy use of ant workers isolated from queen and brood

Increasing evidence has shown that the energy use of ant colonies increases sub-linearly with colony size so that large colonies consume less per capita energy than small colonies. It has been postulated that social environment (e.g., in the presence of queen and brood) is critical for the sublinear group energetics, and a few studies of ant workers isolated from queens and brood observed linear relationships between group energetics and size. In this paper, we hypothesize that the sublinear energetics arise from the heterogeneity of activity in ant groups, that is, large groups have relatively more inactive members than small groups. We further hypothesize that the energy use of ant worker groups that can move freely increases more slowly than the group size even if they are isolated from queen and brood. Previous studies only provided indirect evidence for these hypotheses due to technical difficulties. In this study, we applied the automated behavioral monitoring and respirometry simultaneously on isolated worker groups for long time periods, and analyzed the image with the state-of-the-art algorithms. Our results show that when activity was not confined, large groups had lower per capita energy use, a lower percentage of active members, and lower average walking speed than small groups; while locomotion was confined, however, the per capita energy use was a constant regardless of the group size. The quantitative analysis shows a direct link between variation in group energy use and the activity level of ant workers when isolated from queen and brood.

As a rather active female student, Kyara Holloway is a lover of all things living, from microscopic, to photosynthetic, to enormous. With this love, comes a lust for understanding, and thus, along with theatre and dance, she partakes heavily in research. Due to her efforts, a new understanding of ant dynamics has surfaced in the paper recently published, with her and a fellow undergraduate, Nolan Ferral as first authors. While she is very much proud of this achievement, this is hardly the end, as there is more work to be done, and plenty of polishing for her presentation skills! She is very happy to apply for this opportunity, as well as pave an encouraging path for other female African-Americans interested in STEM.

Marketa Illetskova

Department: Computer Science
Major: Computer Science
Research Advisor(s): Dr. Daniel Tauritz
Advisor's Department: Computer Science

Funding Source: Missouri S&T Opportunities for Undergraduate Research Experiences (OURE)

The Automated Design of Boolean Satisfiability Problem Solvers Employing Evolutionary Computing

Many important real-world problems, from computer chip layout to cryptography, can be modeled as Boolean Satisfiability Problem (SAT) classes with unique structures. Customizing solver components to target a specific class using evolutionary computing can lead to an improvement in the performance of the solver on the specific class. The goal of this project is to optimize such an automated design system for SAT solvers to satisfy expectations of current SAT solving systems and to possibly improve the quality of produced solvers. In particular, it focuses on (i) selecting new datasets to evaluate the performance of evolved solvers on different SAT problem classes; (ii) adding CPU time to objectives on which the fitness of each solver is based; (iii) changing the main fitness objective for single objective evolutionary algorithm to CPU time; and (iv) changing parent selection to epsilon-lexicase selection.

Marketa Illetskova is a senior in Computer Science at Missouri University of Science and Technology and plans to complete her B.S. in Computer Science by May of 2017. She is an Undergraduate Research Assistant in S&T's Natural Computation Laboratory. Furthermore, she is on the Missouri S&T Women's Volleyball Team and the Love Your Melon Campus Crew.

Sarah Jemison

Department: Civil, Architectural, and Environmental Engineering
Major: Civil and Architectural Engineering
Research Advisor(s): Dr. Lesley Sneed
Advisor's Department: Civil, Architectural, and Environmental Engineering

Funding Source: Opportunities for Undergraduate Research Experiences (OURE)

Investigation of Bond Behavior of PBO Fiber-Reinforced Cementitious Matrix Composite on Low-Strength Concrete Interfaces

Fiber Reinforced Cementitious Matrix (FRCM) composites can be employed as a valid alternative to Fiber Reinforced Polymer (FRP) composites for strengthening existing reinforced concrete (RC) structures. The investigation of the bond between fiber reinforced composites and the substrate onto which they are applied is important to understand their failure mechanism. In this study, the bond was investigated using single-lap shear tests carried out on FRCM strips, comprised of one layer of PBO fiber net embedded within two layers of matrix, bonded on a concrete prism. The role of the substrate characteristics on the failure mechanism of the FRCM composite was under investigation, comparing normal-strength concrete and low-strength concrete substrates.

Sarah Jemison is a senior Civil and Architectural Engineering duel major from Nixa, MO. She is part of the first generation of Greenberg Scholars of the Civil, Architectural, and Environmental Engineering Department who will be participating in the Missouri S&T Master Student Fellowship Programs pursuing BS+MS in an accelerated manner. She is a member of the Steel Bridge Design Team as well as Chi Epsilon and a Mechanics of Materials Teaching Assistant.

Ye Jin

Joint project with Xiaofeng Wang

Department: Chemical & Biochemical Engineering
Major: Chemical Engineering
Research Advisor(s): Dr. Xinhua Liang
Advisor's Department: Chemical & Biochemical Engineering

Funding Source: ACS Petroleum Research Fund
NSF CBET 1402122

Optimal preparation of Fe/TiO2 catalysts with highly enhanced photocatalytic activity using atomic layer deposition

A series of uniform and highly dispersed Fe-deposited TiO_2 samples were prepared by atomic layer deposition (ALD) at 400 ºC. The prepared samples were characterized by inductively coupled plasma - atomic emission spectroscopy (ICP-AES), nitrogen adsorption-desorption measurements, high resolution transmission electron microscopy (HRTEM), X-ray diffraction (XRD), X-ray absorption spectra (XAS) and diffuse reflectance UV-vis measurements. The photocatalytic activity was evaluated based on the degradation of methylene blue (MB) solution under UV light. The results showed that Fe subnanometer particles were deposited on TiO_2 particles uniformly. The photocatalysis experiment demonstrates that 2 cycles Fe deposited TiO_2 sample showed the highest activity and have a more than six-fold photocatalytic activity enhancement over pure TiO_2 for the degradation of MB. The enhanced photocatalytic activity should be attributed to the fact that Fe^{3+} ions played a role as e^-/h^+ pair traps and consequently reduced e^-/h^+ pair recombination rate.

Ye Jin who joined joint undergraduate program between Missouri University of Science and Technology and China University of Petroleum in the Department of Chemical & Biochemical Engineering in January 2015. Being part of Dr. Xinhua Liang research group, Ye Jin research focus is on nanostructured materials for environmental application.

Sara Johnson

Joint project with Dr. Gayla Olbricht and Luke Settles (Master's student) in the Mathematics and Statistics Department.

Department: Psychological Science
Major: Psychology
Research Advisor(s): Dr. Amber Henslee
Advisor's Department: Psychological Science

Funding Source: CASB FYRE Pilot Program

Self and Peer Perceptions of Ethical Behavior among Engineering Students

Background: The prevalence of academic dishonesty (e.g., cheating, plagiarism) is a concern across all academic disciplines, including engineering and STEM fields. In a review of 115 articles, Marfarlane, Zhang, & Pun (2014) reported rates of cheating as high as 82%. Engineering students report more academic integrity infractions compared to students in other academic disciplines (Newstead, Franklin-Stokes, & Armstead, 1996; Harding, Mayhew, Finelli, & Carpenter, 2007; Yeo, 2007). Yang et al. (2013) found that engineering students attribute their academic dishonesty to self-interest concerning scholarships and future job offers. Additionally, complicated scientific or mathematical ideas and phrases, and students' inability to paraphrase them properly may account for higher rates (Yeo, 2007). Factors that contribute to unethical behavior include one's prior unethical behavior as well as self-perception of integrity and perceptions of peer behavior (e.g., social norms). Objective: To investigate S&T freshmen engineering students' self-perception and peer perceptions of ethical behaviors. Method: Students participated as a part of their grade for FE 1100, but were not penalized if they chose not to participate. Surveys of self and peer perceptions, and demographics were administered to approximately 1,300 students at the beginning of the fall semester. Data from students who failed to complete the surveys were omitted. Preliminary Results: Approximately 19% of freshmen engineering students reported a previous history of academic dishonesty. On a Likert scale of 0 (*not at all*) to 7 (*extremely*), participants' self-perception were positive (M = 5.6, SD = 1.2). Data analysis is ongoing. Discussion: Results may be helpful in targeting ethics education to incoming S&T students as well as ongoing efforts throughout the college curriculum.

Sara Johnson is a freshman student majoring in Psychology. She is involved in the College of Arts, Science, and Business (CASB) First Year Research Experience (FYRE) Pilot Program.

Isabelle Kersting

Department: English and Technical Communication
Major: insert major
Research Advisor(s): Rachel Schneider
Advisor's Department: English and Technical Communication

Funding Source: FYRE program

Generic Mutation in the Eighteenth Century

Eighteenth-century fragments can be a real can of worms. The contents can be completely unexpected and tricky at times. The mixture can be satirical and religious without the reader even realizing. Some works are labeled fragments, but it's not clear why. Fragments are intriguing in their odd writing style, their openness to interpretation, and the symbols or annotations on the pages. In pursuing these curiosities, we have begun to create a database of eighteenth-century fragments which we have and will continue to study. This database will allow for the expansion of fragments into the digital humanities, give the public access, and facilitate further research in the area by students, teachers, and any individual seeking to educate themselves further on the subject. In establishing this database, we as researchers will make it possible for others to continue or build upon the foundation that we have created

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Isabelle Kersting is a transfer student this year at Missouri S&T. She is from Flint Hill, Missouri and is a graduate of Troy Buchanan High. She is now enrolled in the teacher education program and will receive a BA in English in addition to her certification to teach at the secondary level once she graduates in 2019. She is also an active member of Zeta Tau Alpha, Junior Panhellenic Council, and Student Missouri State Teachers Association, in addition to being one of the First Year Research Experience student.

Hannah Kim

Department: Department of Biological Sciences
Major: Biological Sciences, minor in Biomedical Engineering
Research Advisor(s): Dr. Sutapa Barua
Advisor's Department: Department of Chemical and Biochemical Engineering

Funding Source: Opportunities for Undergraduate Research Experiences (OURE), NASA- Missouri Space Grant Consortium (MOSGC)

Development of novel indirect radiation damage-proof nanoparticles

Space medications help prevent astronauts from being ill and provide acute treatment in medical emergency situation to fulfill the primary goal of a successful long duration space mission: maintaining astronauts' health in a unique, isolated, and extreme space environment. However, recently, National Aeronautics and Space Administration (NASA) have reported a shorter shelf life of space medications caused by chronic ionizing radiation and its long term efficacy in space became questionable. Hence, to help extend the space medications' stability and protect pharmaceuticals from the radiation damage, free radical scavenging antioxidants were bio-conjugated on the surface of drug encapsulated biocompatible nanoparticles to create a novel indirect radiation damage-proof nanoparticle. Radiation induced highly reactive free radicals, hydroxyl radicals, will be eliminated by antioxidants before it could react with the pharmaceuticals in the nanoparticle's core. Hydroxyl radical scavenging capacity assay (HOSC) was performed to test designed nanoparticles and selected antioxidant's free radical quenching ability.

Hannah Kim is a senior majoring in Biological Sciences with minor in Biomedical Engineering. Her research interests include nanoparticle synthesis for drug delivery, microbiology, and genetic engineering. Hannah hopes to build on her interest in biomedical engineering research and development career. She is also involved in Missouri S&T Chamber orchestra as first violin.

Shane M. Lawson

Department: Chemical Engineering and Biochemical Engineering
Major: Chemical Engineering
Research Advisor(s): Dr. Fateme Rezaei
Advisor's Department: Chemical Engineering and Biochemical Engineering

Funding Source: 2016 NASA-Missouri Space Grant Consortium (NASA-MSGC) award as well as Opportunities for Undergraduate Research Experiences (OURE)

Torlon-MOF Composite Films Coated on Cordierite Monoliths and their CO_2 Adsorption Performance

In our previous work we demonstrated immobilization of metal-organic frameworks (MOFs) on monolithic substrates by various techniques including layer-by-layer + secondary growth and *in-situ* dip coating. Although these earlier methods showed promising results, the MOFs weight loading did not exceed 55 wt%. Here we demonstrate the improvement in coating a thicker film of MOF on the monolith walls using a novel technique that involves pre-seeding MOF powder onto the monolith using a Torlon polymer solution. This coating procedure is not only simpler and eliminates the complexity of previously reported procedures, but also results in higher MOF loadings. Whereas the earlier loading was 52 wt% for Ni-MOF 74 and 55 wt% for UTSA-16, the new loading has been found to be ~73 wt% for Ni-MOF 74 and a maximum of ~80% for UTSA-16. In addition, the substrates treated with this new method have shown improved CO_2 capacities with similar kinetics to that of the earlier method. This facile and simple method opens up fascinating possibilities for scalable fabrication of MOF-coated monoliths with different properties tailored to various gas separation applications.

Dawn Little

Department: Psychological Science
Major: Psychology
Research Advisor(s): Dr. Jessica Cundiff
Advisor's Department: Psychological Science

Funding Source: N/A

Impact of Suspect Race on Perceived Legitimacy of Police Use of Force

Recent social movements have drawn attention to the excessive use of police force on African American men. The purpose of this research is to examine whether police use of force is perceived as more legitimate when used on African American compared to European American male suspects. Participants will read one of six scenarios describing a police encounter with a male suspect. The scenarios vary on two dimensions: (1) whether the suspect is threatening, non-threatening, or ambiguous and (2) whether the suspect is African American or European American. After reading the scenarios, participants will rate their perceptions of the legitimacy of police use of force. We hypothesize that participants will rate police use of force as more legitimate when used on African American vs. European American suspects, but only when threat of suspect is ambiguous. We did not expect differences based on suspect race for the threatening and non-threatening conditions.

Dawn Little is a senior graduating in December 2017 with her BA in Psychology and a minor in Leadership Communication. She plans to attend Graduate School and focus on Social Psychology. She is the Vice President of the CASB Undergraduate Student Leadership Council, a STEP UP Student Ambassador, a member of the Student Leadership Conference planning committee, and has interned with COER. When not at school, she works year round at Six Flags St. Louis as a Managerial Supervisor of Guest Services.

Maryssa Loehr

Department: Civil, Architectural, and Environmental Engineering
Major: Environmental Engineering
Research Advisor(s): Jeffrey Pierce & Emily Fischer (Colorado State University)
Advisor's Department: Atmospheric Science and Climate (Colorado State University)

Funding Source: NSF Research Experience for Undergraduates – Summer 2016

Is wildfire smoke going to ruin your blue sky? An evaluation of a wildfire smoke forecasting tool.

Particulate matter decreases quality of life by harming physical health. Each year hundreds of fires occur across the United States including wildfires and prescribed burns. Wildfires release massive quantities of particulate matter into the air that can travel hundreds, or thousands, of miles. This research investigates the performance of the BlueSky wildfire smoke forecasting tool by comparing it to actual surface measurements during summer 2015. Analyzing any bias in concentration forecasts and plume arrival forecasts can help determine errors in the tool's framework. Identifying these biases provides the first step to fixing them or accounting for them in real time use. This forecast tool may be used to help inform the public or decision makers about incoming wildfire smoke in order to take preventative measures to protect human health.

Maryssa Loehr is a senior studying Environmental Engineering with a minor in Chemistry. She is passionate about learning about and engineering solutions to atmospheric challenges, and she plans to focus her career endeavors towards this passion through air quality engineering. She is an active member of the Missouri S&T Symphonic Orchestra where she enjoys playing her violin. When not practicing her violin, she plays intramural sports, paints her nails, and plays video games.

Taylor McNamee

Department: English and Technical Communication
Major: English Education
Research Advisor(s): Dr. Sarah Hercula
Advisor's Department: English and Technical Communication

Funding Source: First Year Research Experience (FYRE) Program
College of Arts, Sciences, and Business
Missouri University of Science and Technology

Cultural and Linguistic Variation on Campus: Developing a Survey on Linguistic Perceptions

As a result of the national and global reputation of Missouri S&T, a large number of students with diverse cultural and linguistic backgrounds have been attracted to the university. The purpose of this research project is to study perceptions of this diversity through the lens of the English language.

To determine such perceptions, a survey is being developed for dissemination among faculty, staff, and students on campus. In addition to providing basic demographics and background information, survey participants will listen to audio samples of various English speakers and answer questions regarding their perceptions of the speakers.

Through analysis of respondent data, the researchers hope to gain insights not only on perceptions of linguistic diversity but also on factors among respondents that correspond to specific kinds of perceptions. Subsequently, data will be utilized to make recommendations regarding how to foster positive experiences among culturally and linguistically diverse groups on campus.

Taylor McNamee is a first-year student at the Missouri University of Science and Technology. She is a member of the Teacher Education Program on campus and is working to pursue her goal of teaching at the secondary level. Her current research interests include a diverse range of topics relating to the fields of linguistics, foreign language study, and language learning, including sociolinguistics, second language acquisition, teaching methods involving standard English and dialects, and indigenous language use and preservation in the United States and worldwide.

Niklas Melton

Department: Mechanical and Aerospace Engineering
Major: Aerospace Engineering
Research Advisor(s): Donald C. Wunsch
Advisor's Department: Electrical and Computer Engineering

Funding Source: Missouri S&T OURE Program

Resonating Perceptron Networks

A novel learning algorithm was developed to increase the speed, stability, and robustness of neural function approximators. A clustering technique is used to identify corresponding regions of the input and output space. These regions and their mappings are then learned independently of all other regions. The resulting behavior is an algorithm which overcomes the problem of catastrophic forgetting while both increasing the speed of learning and minimizing the computational requirements of the network.

Niklas Melton was born and raised in Kansas City, MO. He will graduate from Missouri S&T this May with a B.S. in Aerospace Engineering. He has been accepted into the Ph.D. program in the Computer Engineering Department beginning in the Fall of 2017. He hopes to continue his fruitful research in neural networks and machine learning far into the future.

Eric Michalak

Department: Computer Science
Major: Computer Science
Research Advisor(s): Dr. Daniel Tauritz
Advisor's Department: Computer Science

Funding Source: Los Alamos National Laboratory / S&T – Cyber Security Sciences Institute

A Universal API for Agents in Computer Network Emulations

Software agents have great potential to simulate 'humans' for network security research by acting autonomously in a computer network. But in order to exhibit this autonomous behavior, these agents need a convenient and efficient means to observe, and then act upon, a dynamic environment – these agents need an API. An application programming interface (API) is a generic computer science toolset which abstracts away complex implementation into high-level actions. The successful construction of this API allows agents to more quickly explore new solutions in the vast search space of cyber security by removing the burden of making myriad low-level decisions.

Eric Michalak is a Senior in Computer Science, an Undergraduate Research Assistant in the Natural Computation Laboratory working on the Coevolving Attacker and Defender Strategies for Large Infrastructure Networks (CEADS-LIN) project, Chair of S&T's Association for Computing Machinery (ACM) Student Chapter Special Interest Group on Security, and Captain of S&T's Cyber Security Capture The Flag (CTF) team.

Madison Morris

Joint Project with Gregory Evans

Department: Biology
Major: Biology Pre-Med
Research Advisor(s): Dr. Thimgan
Advisor's Department: Biology

Funding Source: N/A

Altering the Behavior of Flies Using Optogenetics

Our project aims to modify sleep and wake behavior of flies through stimulation of a light-activated channel inserted into specific neurons, known as optogenetics. Flies expressing this channel in sleep and wake regulating cells were exposed to an activating light using an automated program on a Raspberry Pi developed by students in electrical engineering. We first recorded baseline sleep characteristics of these specific genotypes. We then exposed the animals to optogenetic stimulation, which altered their sleep and wake patterns. Our data are consistent with these cells being involved in sleep and wake regulation. Thus we have successfully adapted optogenetic techniques to identify cells in sleep and wakefulness. Next, we will test flies expressing the channel in unique cells to determine if they are involved with sleep and wakefulness.

Madison Morris is a Junior Biology major at Missouri S&T with a chemistry and history minor. She plays college soccer for the Lady Miners, is a member of Zeta Tau Alpha, and plans to attend medical school after graduation.

Mark Myers II

Department: Computer Science
Major: Computer Science and Computer Engineering
Research Advisor(s): Dr. Daniel Tauritz & Dr. Bruce McMillin
Advisor's Department: Computer Science

Funding Source: Opportunities for Undergraduate Research Experience (OURE)

Automated Security Domain Partitioning with a Formal Method Perspective of a Cyber-Physical Systems

Modern society increasingly relies on the correct functioning of a myriad of interacting Cyber-Physical Systems (CPS) such as water systems, electric power grids, and air traffic control systems. Two critical vulnerabilities present in these systems are the potential for information leakage and susceptibility to deceptive information. The goal of this project is to improve CPS information security by automating the complex task of optimally partitioning the system into security domains. Automated Theorem Provers are employed to automate testing partition quality. Testing is performed by examining each pairwise connection in a system to determine whether it is Multi-Security Domain Non-Deducibility (MSDND) secure. The performance measure of each partition is then obtained by taking the percentage of connections that are MSDND secure. This implies that a higher percentage of secure connections corresponds to a higher performance measure and in turn a better partitioning of a CPS into information flow security domains.

Mark Myers is a sophomore at Missouri S&T majoring in both computer science and computer engineering. He is an undergraduate research assistant in Dr. McMillin's Critical Infrastructure Protection Laboratory and Dr. Tauritz' Natural Computation Laboratory (NC-LAB). During the 2016-2017 academic year, he is enrolled in S&T's OURE program.

Allie Plunk

Joint project with Steven Giangreco

Department: Mathematics Department
Major: Applied Mathematics
Research Advisor(s): Dr. Gayla R. Olbricht
Advisor's Department: Mathematics and Statistics

Funding Source: Center for Undergraduate Research in Mathematics via the National Science Foundation (NSF) grant #DMS-0636648 / #DMS-1148695 awarded to Brigham Young University (BYU).

Modeling the Relationship Between Age, Genetics, and White Matter Microstructures

The human brain's structure can change with age and different health conditions. A genetic risk factor called the epsilon 4 (e4) allele of the apolipoprotein E (ApoE) gene is linked with increased risk of Alzheimer's disease and reduced brain health. This study investigates whether healthy individuals with the e4 allele exhibit specific brain structure differences. Diffusion tensor imaging (DTI) was used to measure five different aspects of white matter structural integrity (e.g., fractional anisotropy) in seven different brain regions. A multivariate analysis of covariance (MANCOVA) was performed to test for differences in white matter structures and e4 status while controlling for age. Additional statistical methods were employed to test for demographic differences by e4 status and to control the family-wise error rate across multiple tests. These results will enable researchers to better understand the association between the e4 risk factor, age, and white matter structural differences in specific brain regions.

Allie Plunk is pursuing her B.S. in Applied Mathematics with a minor in Business at Missouri University of Science and Technology and is graduating in May 2017. She has been participating in undergraduate research for the Mathematics Department since August 2016. Active on campus, she is the president of Delta Omicron Lambda Service Organization, as well as a member of the Phi Eta Sigma Honor Society and the Love Your Melon Campus Crew.

James Schuchard

Department: Chemical and Biomolecular Engineering
Major: Chemical Engineering
Research Advisor(s): Dr. Sutapa Barua
Advisor's Department: Chemical and Biomolecular Engineering

Funding Source: The PI's Start-up and The Ozark Biomedical Initiative Grant

Power Combos: Antibody Conjugated Drug Nanorods and T Cell Therapy for Breast Cancer Treatment

The purpose of this proposal is to explore a complementary combination of two promising treatments of breast cancer. Nanoparticles are appearing as an increasingly favorable approach for non-invasive and targeted delivery of therapeutic agents to breast tumor tissues. However, there are significant challenges in the delivery of nanoparticles to the target tissue. Another exploratory approach to breast cancer treatment is to activate a patient's own immune system to attack the tumor. Specialized cells known as T cells have been shown in some cases to recognize tumor antigen and initiate systemic immune responses in the body that destroy tumor cells. While this approach shows promise, it often lacks the potency necessary for complete treatment. I want to explore a combined approach that utilizes the direction of a patient's T-cells as well as the potency of nanoparticles of trastuzumab-conjugated camptothecin by anchoring the nanoparticles to the surface of the T-cells.

James Schuchard is an active scholar as well as an involved and impactful member of the Missouri S&T student culture. He excels academically and has been awarded the Excellence, Curators, and University scholarships by his school and the James Johnson Scholarship by the Chemical Engineering department. He contributes to the department as a Peer Learning Assistant and grader for Materials and Energy Balances. He serves Missouri S&T through involvement in Christian Campus Fellowship and Kappa Kappa Psi honorary band fraternity in which he served as Service Committee Chair.

Caitlin Siehr

Department: Biological Sciences
Major: Biological Sciences
Research Advisor(s): Dr. Katie Shannon
Advisor's Department: Biological Sciences

Funding Source: OURE

Cytokinesis and the effect of mutations on protein-protein interactions

Iqg1 is a protein involved in cytokinesis in budding yeast. It is required for the assembly and contraction of the actin ring- which is responsible for dividing the two cells. In previous studies, Iqg1 has been shown to interact with the two formin proteins Bni1 and Bnr1. The overall objective of my research is to determine how mutations affecting Iqg1 phosphorylation alter protein-protein interactions. My research began with a preparation of yeast extracts from three different strains- a wild type, a mutant that prevents Iqg1 phosphorylation, and a mutant that mimics Iqg1 phosphorylation. I then used these extracts to perform GST-pull down experiments and conduct western blots to determine the results. By the end of this research, it will be determined if mutant Iqg1 alleles affect the binding of Iqg1 to Bnr1 and Bni1.

Caitlin Siehr is a junior at Missouri University of Science and Technology, pursuing a B.S. in Biological Sciences. She has studied under Dr. Shannon since September 2014. She is the President of Sigma Tau Delta, Missouri S&T's English Honor Society, and enjoys taking care of her many plants and animals. After obtaining her Bachelor's degree, she plans to further her education with graduate studies.

Sarah Skinner

Department: Physics
Major: Physics
Research Advisor(s): Dr. Yew San Hor
Advisor's Department: Physics

Funding Source: FYRE

Scanning Tunneling Microscope Malfunction Correction

The scanning tunneling microscope (STM) scans the surface of a given material and maps out the topography of the surface at the atomic level. This tool is useful for analyzing the atomic structure of the given material and for further research in material science. By using a stylus to tunnel a narrow beam of electrons. This relationship is very sensitive and as the stylus glides over the surface of the material, the stylus head will move up and down to maintain that precise distance. The machine then detects these movements and maps out what it reads on a three dimensional graph.

Sarah Skinner is a freshman at Missouri S&T. She is pursuing a bachelor's in physics. She was recently taken under the wing of the FYRE (First Year Research Experience) program and given this wonderful opportunity of correcting the STM's malfunction. She is also a Second Degree Black Belt of the Midwest Taekwondo Association.

Joseph Szatkowski

Department: Computer Science
Major: Computer Science/Computer Engineering
Research Advisor: Dr. Tauritz
Advisor's Department: Computer Science

Funding Source: N/A

Evolutionary Computation for the Automated Design of Puzzle Instances for Artificial Intelligence Education

High-quality Artificial Intelligence (AI) education goes beyond traditional lectures by stimulating students' desire to learn more deeply through Problem Based Learning (PBL). A typical approach in introductory AI courses involves providing the students' challenging puzzles and games which capture the algorithmic complexity necessary to deal with real-world problem solving without overloading the students with having to deal with the messy details and scale of the real-world. However, it takes very significant effort to manually create such puzzles and games that are both intellectually stimulating and appropriate for the AI algorithms being taught. A critical component of puzzle design is creating a sequence of puzzle instances which differentiate the solving power of aforementioned AI algorithms. This project is concerned with automating the design of puzzle instances employing evolutionary computation in order to provide a high-quality hands-on learning experience.

Joseph Szatkowski is a senior pursuing degrees in Computer Science and Computer Engineering. He has previously taken classes in AI and Evolutionary Computing.

Skye Tackkett

Department: Physics
Major: Physics
Research Advisor(s): Thomas Vojta
Advisor's Department: Physics

Funding Source: This work was partially supported by the NSF under Grant Nos. DMR-1205803 and DMR-1506152.

Nonequilibrium phase transitions in a model of ecological and evolutionary dynamics

We employ large-scale Monte-Carlo simulations to study the extinction transition in a model describing the ecological and evolutionary dynamics of biopopulations. In the case of a neutral, time-independent fitness landscape, the extinction transition falls into the well-known directed percolation universality class. Temporal disorder (representing, for example, climate fluctuations) drastically changes the transition and leads to an exotic infinite-noise critical point. It is characterized by anomalously large fluctuations of the population size and logarithmically slow dynamics.

Skye Tackkett is an undergraduate junior majoring in Physics and minoring in Mathematics and German. Currently, they are a member of the Gaffers Guild and the president of the Society of Physics Students. After earning their bachelor's, they intend to obtain a PhD in Materials Science with a research focus on nanostructured material applications and following that, they would like to become a professor and continue researching nanomaterials.

Jason Viehman

Joint project with Elizabeth Cundiff

Department: Mathematics and Statistics
Major: Applied Mathematics
Research Advisor(s): Dr. Gayla R. Olbricht
Advisor's Department: Mathematics and Statistics

Funding Source: Center for Undergraduate Research in Mathematics via the National Science Foundation (NSF) grant #DMS-0636648 / #DMS-1148695 awarded to Brigham Young University (BYU).

Investigating Statistical Issues in DNA Methylation and their Relation to Cervical Cancer

DNA methylation occurs when methyl groups attach to cytosine bases on DNA segments. Previous studies have established links between specific methylation patterns and many diseases. In this research, statistical methods are employed to test for significant differences in methylation levels between HIV patients with different stages of cervical cancer. DNA methylation levels are measured at cytosines across the genome with Illumina 450K methylation microarrays. After initial pre-processing to eliminate low-quality data, testing was performed at each cytosine site using t-tests and empirical Bayes tests to identify any statistically significant site level methylation differences between the cervical cancer stages. Two region level statistical methods (Bumphunter and DMRCate) were also applied to identify statistically significant regions of interest in the genome. Significant sites or regions that overlap with genes, CpG Islands, or other genomic annotations can help researchers better understand the molecular impact of DNA methylation and its connection to cervical cancer.

Jason Viehman is a sophomore in applied mathematics. He is the historian and community service chair of S&T's chapter of Kappa Mu Epsilon. He is also starting to get involved in the local MAA chapter, in addition to being a peer learning assistant.

CHEN ZHAO

Department: GGPE
Major: Geology & Geophysics
Research Advisor: Dr. Francisca Oboh Ikuenobe
Advisor's Department: GGPE

Funding Source: Missouri S&T Undergraduate Research Office

Stratigraphy, Sedimentation, and Depositional Environment of the Clifty Creek Natural Area, South-Central Missouri

The purpose of this project is to conduct a combined geologic field and laboratory study on the exposed sedimentary rocks at the Clifty Creek Natural Preserve, South-Central Missouri in order to interpret their stratigraphy, sedimentation, and environment of deposition. Project includes field measurements, stratigraphic descriptions, and hand samples and thin section descriptions. These observations results will help to identify the stratigraphic relationships between the rock units as well as their sedimentary primary structures. The data gathered from the field will be used to interpret a depositional model for the area.

OURE Fellows Final Oral Presentations

Name	Department	Time	Location
Robert Block	Biological Sciences	1:00-1:130 pm	Carver Room
Natalie Holste	Biological Sciences	1:30-2:00 pm	Carver Room

OURE Fellows Proposal Oral Applicants

Name	Department	Time	Location
Jakeb Baldridge	Biological Sciences	9:00-9:20 am	Turner Room
Sarah Buckley	Biological Sciences	9:20-9:40 am	Turner Room
Jamielee Buenemann	Mechanical and Aerospace Engineering	9:40-10:00 am	Turner Room
Kent Gordy	Biological Sciences	10:00-10:20 am	Turner Room
Lisa Gutgesell	Biological Sciences	10:20-10:40 am	Turner Room
Andrew Hedlund	Mechanical and Aerospace Engineering	10:40-11:00 am	Turner Room
Seth Kitchen	Mathematics and Statistics	1:00-1:20 pm	Turner Room
George Malinee	Mechanical and Aerospace Engieering	1:20-1:40 pm	Turner Room
Erin Nischwitz	Biological Sciences	1:40-2:00 pm	Turner Room
Nicholas O'Gorman	Electrical and Computer Engineering	2:00-2:20 pm	Turner Room
Tristan Shatto	Electrical and Computer Engineering	2:20-2:40 pm	Turner Room
Richard Snyder	Electrical and Computer Engineering	2:40-3:00 pm	Turner Room

OURE Fellows Program

Oral Abstracts

Final

Robert Block

Department: Chemistry
Major: Chemistry
Research Advisor(s): Dr. Matthew Thimgan
Advisor's Department: Biological Sciences

Funding Source: Missouri S&T OURE Fellows, BIC-Missouri S&T College of Arts, Sciences, and Business

Application of Voice Analysis Programs to Quantify Fatigue

Sleepy people exhibit increased cognitive impairment, a higher likelihood of falling asleep involuntarily, and increased error rates. These fatigue related effects are concerning for fields like healthcare and transportation. It would be useful to have a fast, reliable, inexpensive, and objective method to quantify the sleepiness level of an individual.

Commonly, subjective surveys and cognitive tasks are used to assess sleepiness, but these methods are either flawed or prohibitively time consuming. Previously, a person's speech patterns have been shown to indicate fatigue level, and this project sought to apply this methodology as an objective readout of sleepiness in a real-world situation.

Human subjects completed both subjective and objective tasks to characterize them as sleepy or not. Mel-Frequency Cepstrum transformations of voice samples were used with Hidden Markov Modeling to build fatigue prediction models. The models were then evaluated to categorize people as sleepy or alert based on their sleep patterns.

Robert Block is a Senior studying Chemistry with a Pre-medicine emphasis and a minor in Biological Sciences. After graduation he plans attending Pharmacy school. He has had internships at Vanderbilt University Medical Center, where he completed data visualization and delivery projects with the VAPIR team. He has also had several research projects at Missouri S&T, including work with drosophila flies and Nuclear Magnetic Resonance Spectroscopy. Robert mentors the Rolla High School FIRST Tech Challenge Robotics teams. He enjoys shooting sports, canoeing, programming, martial arts, and tinkering.

Natalie M. Holste

Department: Biological Sciences
Major: Biological Sciences; Minor in Chemistry and Biomedical Engineering
Research Advisor(s): David Westenberg
Advisor's Department: Biological Sciences

Funding Source: Opportunities for Undergraduate Research Experiences Fellows

Synthetic Biology Approach to Making Drought Tolerant *Bradyrhizobium japonicum*

Droughts all across the globe are causing hardship to crops and creating food shortages. One complication for the soil in the regions with drought is high salt concentrations. Because of osmosis, plants' cells shrivel up, therefore becoming useless and killing the plants. Drought also affects the bacteria that associate with plant roots, particularly nitrogen-fixing symbionts of legume plants. The project would let agriculture be introduced to drier areas of the planet. This will allow more crops to be grown and food to be made because they can survive in high salt conditions. The goal of my project was to develop successful salt tolerant strains of *Bradyrhizobium japonicum* that would protect crops. The success of this project would bring about many positive changes to agriculture and the world.

Southwest Chicago suburbanite, Natalie Holste, is now a senior pursuing a degree in Biological Sciences. Some of her many involvements on campus include holding three positions in Phi Sigma Rho, being a euphonium player in the Symphony Orchestra, and living in the solar village assisting the horticulture sub-team of the Solar House Design Team. In her free time, Ms. Holste loves to play badminton and the piano. After receiving her Bachelor of Science, she plans to get a job in research and development and eventually attend graduate school pursue a PhD.

OURE Fellows Program

Oral Abstracts

Applicants

Jakeb Baldridge

Department: Chemical Engineering
Major: Biochemical Engineering
Research Advisor(s): Dr. Julie Semon
Advisor's Department: Biological Sciences

Funding Source: None

A novel approach of 3D bioprinting using uncultured stem cells and bioactive glass

The primary research objective of this project is to investigate the ability of adipose derived mesenchymal stem cells (AD-MSCs) and bioactive borate glass (B3 glass) to collectively repair tissues requiring high vascularization. The research is also expected to generate a novel technique of solvent-based extrusion of a unique B3 glass and uncultured AD-MSCs to produce a vascularized scaffold by 3D printing. The proposed research will investigate the 3D printing of AD-MSCs with pluronic P-127 hydrogel and polycaprolactone (PCL)/bioactive glass composite in a single process. This will generate new knowledge on the role of uncultured AD-MSCs and B3 glass in vascularization. The long-term practical objective of this research is to produce a reproducible, cellularized scaffold that could be used to repair highly vascularized tissues such as kidney, skin, bone, and cardiac tissue.

After scaffold fabrication, tests will include a long-term degradation analysis of the hydrogel and polymer-glass composite in a simulated body fluid, its bioactivity, and mechanical assessment of the scaffold. The tests will be followed by in vitro assessment including cell viability, differentiation to endothelium and bone, and AD-MSCs deposition of extra cellular matrix in a 3D environment. Finally, we propose a chick embryo chorioallantoic membrane (CAM) assay to investigate the vascular network formation in the 3D bioprinted scaffold as it provides an excellent model system to quantify the blood vessel formation and growth.

Jakeb Baldridge is a Junior in chemical engineering with a biology emphasis and will be graduating in May of 2018. He is currently the fundraising and public relations officer of ChemE Car, vice-president of Order of Omega, an active member of Sigma Nu fraternity, and currently in his third semester of undergraduate research. Jakeb joined Dr. Semon's research team at the end of the fall 2015. He also spent the summer of 2016 working for Dr. Jim Smay at Oklahoma State University where he worked on building a commercial 3D printer, which prints multiple materials at once.

Sarah Buckley

Department: Biological Sciences
Major: BS Biological Sciences
Research Advisor(s): Dr. Matthew Thimgan
Advisor's Department: Biological Sciences

Funding Source: UM Research Board, Missouri
Missouri S&T OURE

Genetic Dissection of Sleep Deprivation by Starvation in Drosophila

It is a common misconception that sleeping does not require energy. When flies are starved, they will disrupt their sleep time for waking behaviors. We have identified a gene, that when disrupted, accelerates the waking due to starvation. We don't know which cells are responsible for this response. We will use a genetic strategy to find the cell and to understand the mechanism and the detection of waking due to starvation. If the mechanism can be understood, it may apply to understanding the causes of insomnia and decreased sleep.

Sarah is a sophomore from Richland, MO. She is studying Biological Sciences with an emphasis of Pre-Med and minors in Chemistry and Bio-Medical Engineering. On campus, Sarah is a Student Ambassador for the Admissions office, a member of Scrubs Pre-Health Group, an Honors Academy student, and she is currently working on an OURE with Dr. Thimgan.

Jamielee Buenemannn

Department: Mechanical and Aerospace Engineering
Major: Mechanical Engineering; Chemistry Minor
Research Advisor(s): Daniel Stutts, Fatih Dogan
Advisor's Department: Mechanical Engineering, Ceramic Engineering

Funding Source: OURE

PIEZOELECTRIC ROTARY ENERGY HARVESTER DESIGN, PROTOTYPING, AND CHARACTERIZATION

In order to power microcontrollers and low-power wireless communication hardware to monitor and control remotely located processes, a piezoelectric rotary energy harvester was designed. A ring shaped sheet of polyvinylidene fluoride (PVDF) separated into four poled quadrants is bonded to an elastic aluminum substrate. Spinning low-friction impingers deflect the stationary disk and cause the piezoelectric segments to slightly deflect and generate voltage. The design's voltage responses are modeled using MAPLE and then verified through prototyping and proper data acquisition. The effect of the number and configuration of segments, the magnitude of the force applied, and the addition of alternating polarity within the PVDF segments to generate a traveling wave are additionally examined.

Jamielee Buenemann is a sophomore studying mechanical engineering minoring in chemistry interested in research and development in the energy and material science sectors. She is honored to be a recipient of the Chancellor's Scholarship and 2017 MAE Distinguished Research Fellowship. Jamielee is currently an active member of the Solar House Design Team, Society of Women Engineers Executive Board, Chancellor's Leadership Academy, Honor Academy, and Student Union Board. Jamielee was recognized as a National Young Woman of Distinction where she represented Girl Scouts as a national spokeswoman on sustainability. As a high school student, Jamielee presented research at the regional and international level focusing on the design and prototyping of a piezoelectric shoe insole, repurposed residential scale wind turbine with blade variance, and repurposed materials passive solar air heater.

Kent Gorday

Department: Physics
Major: Physics
Research Advisor(s): Dr. Chen Hou
Advisor's Department: Biological Sciences

Funding Source: Opportunities for Undergraduate Research Experiences (OURE)

Understanding Mortality and Aging from a Theoretical Model of Damage

Modern understanding of oxidative stress at the molecular level has led to a theory of aging which implicates the accumulation of oxidative damage. Dr. Hou previously published a simple theoretical model for the accumulated damage throughout growth and its relationship to longevity, expanding the explanatory power of this theory by demonstrating reduced biosynthesis energy demands result in an increase in energy available for oxidative repair. We successfully simulated mammalian populations from empirical data under an OURE project to verify essential behaviors of the model. Additionally, the population parameters which largely determine the shape of the mortality curve call into question widespread interpretation of certain mortality statistics as aging rate analogues, while allowing us to make simplifying assumptions. We hope to continue improving the model and its application to a wide variety of species. We will address lifespan extension under diet restriction, analyze novel empirical data, and propose better aging statistics.

Kent Gorday is lab manager of Missouri S&T International Genetically Engineered Machine (iGEM) team and hosts visitors' nights at the campus observatory. He enjoys playing horn in the Symphony Orchestra and Wind Symphony, photography, and hiking. Kent hopes to pursue graduate education in biophysics after graduating May 2018.

Opportunities for Undergraduate Research Experience

Healthy and Diabetic Mesenchymal Stem Cells and Bioactive Glass Fibers Increase Angiogenesis

Undergraduate Student Researcher:
Lisa Gutgesell, Dept of Biological Sciences
Mentored by: Julie Semon, Assistant Professor, Dept of Biological Sciences

Diabetes affects almost ten percent of the United States Population. As a disease that dimishes the bodies ability to repair itself, being able to affectively treat the diabetic population's wounds would help the quality of life for diabetic patients. Recently, a primed population of MSCs (MSC2) has demonstrated a more uniform, anti-inflammatory phenotype than the unprimed, heterogenous MSCs, while maintaining the capacity for differentiation, homing, and cytokine secretion. When co-cultured with bioactive glass, MSCs have also shown the ability to accelerate wound repair and improce cutaneous architecture while improving vascular. This proposal will compare MSCs from a healthy population to MSCs from a diabetic population. It will also evaluate the effects of co-culturing bioactive glass microfiber scaffolds (BG scaffolds) and MSCS. This will show examine how MSCs from a healthy population act with the BG verses how unhealthy MSCs act and if there is a difference in how successful either MSCs is at treating chronic, nonhealing dermal wounds. This proposal will test the hypothesis that bioglass activates MSCs and alters their phenotype to increase wound healing. The work in this proposal will begin by optimizing the conditions for the co-administration of MSCs and BG scaffold. In the subsequent experiments, the homing and angiogenic capacity will be evaluated.

Aim 1: Evaluate phenotypic of healthy MSCs and unhealthy MSCs i*n vitro*.
This aim will compare healthy human MSCs with diabetic MSCS. Cells will be grown under standard culture conditions. The cells will be grown to ~70% and then the cells will be lifted with trypsin/EDTA . They will be analyzed for cell growth, colony forming units, viability, differential potential, cell surface antigen expression, and extracellular matrix deposition.

Aim 2: Evaluate phenotypic changes in both MSCs populations co-cultured with BG scaffold *in vitro*. This aim will compare human MSCs co-cultured with bioglass to MSCs grown under standard conditions. Cells will be grown under standard culture conditions. After 7-9 days from initial plating, when MSCs typically become ~70% confluent, bioglass will be added to cultures. The next day, cells will be lifted with trypsin/EDTA and analyzed for cell growth, colony forming units, viability, differential potential, cell surface antigen expression, and extracellular matrix deposition.

Andrew Hedlund

Department: Mechanical and Aerospace Engineering
Major: Aerospace Engineering
Research Advisor: Dr. Charles S. Wojnar
Advisor's Department: Mechanical and Aerospace Engineering

Funding Source: Office of Undergraduate Studies

Characterization of the Mechanical and Piezoelectric Properties of Polymer Fibers

The development of piezoelectric materials has enabled new realms of fine precision motors, sensors, and generators. The most commonly used piezoelectrics are ceramics. Less commonly used are also piezoelectric polymers such as polyvinylidene-fluoride (PVDF). PVDF has applications in the biomedical industry as a sanitary and sensing material, as well as having applications in the aerospace industry as a sensing material for skins and structures. Most of the information regarding the piezoelectric properties of PVDF applies only to a woven mat of polymer created through the electrospinning process. This study aims to characterize the Young's Modulus and direct piezoelectric effect constant of an individual fiber of the PVDF polymer. To this end, an experimental setup that was constructed during a previous OURE project will be utilized, which has the capability to apply mechanical stresses to fibers while measuring the voltage generated by the fiber.

Andrew Hedlund is an undergraduate student researcher with the Mechanical and Aerospace Engineering Department at the Missouri University of Science and Technology. He is a junior in aerospace engineering, focusing on structural analysis and applications. In 2016 he began studying the optimization of testing piezoelectric fibers and in March 2017 developed a cantilever beam tensile testing setup which minimized ambient noise and reduced error due to friction loss. Andrew is due to graduate with a B.S. in Aerospace Engineering in May 2018.

Seth Kitchen

Department: Mechanical and Aerospace Engineering
Major: Aerospace Engineering
Research Advisor(s): Dr. Matt Insall
Advisor's Department: Mathematics and Statistics

Funding Source:

Investigations into the Navier-Stokes Equations

The Navier-Stokes Equations are important for modelling fluid flow. However, it has not been proven that there are solutions to the equations that are both bounded and smooth. The problem has been labeled the Navier–Stokes existence and smoothness problem, and is so important the Clay Institute of Mathematics has offered a one-million-dollar bounty for a solution. We propose to look for a solution by adding a constraint specifying that the nonlinear term in the Navier-Stokes equations has a specific simple form. We intend to write a computer program to construct the simple forms effectively and efficiently.

Seth Kitchen is a junior in Aerospace and Computer Engineering. He has done research in aerodynamics, number theory, and formal concept analysis. His poster "On the Existence of Perfect Cuboids" won the Missouri S&T Undergraduate Research Fair in the Sciences category in Spring 2015.

George Malinee

Department: Mechanical and Aerospace Engineering
Major: Mechanical Engineering
Research Advisor(s): Dr. Cheng Wang
Advisor's Department: Mechanical and Aerospace Engineering

Funding Source: OURE funding and Dr. Wang's Start-up funds

Design and Fabrication of Lab-on-a-Chip Device for Studying DNA-based Drug Delivery to Cancer Cells

The objective of this project is to design and fabricate lab-on-a-chip devices for culturing cancer cells, and for investigation of the efficacy of DNA-based drug delivery. In-vitro tests are common way to provide biologists with data and information about cell response to stimuli or in this case the uptake of drugs such as doxorubicin (Adriamycin) and their action within cells. However, they do not address dynamic complexity of the tumor environment, which can greatly affect tissue availability and overall treatment efficiency. This project will develop a lab-on-a-chip device for the 3D co-culture of a cancer cell line using microfluidic technology that simulates a tumor environment of multicellularity and spatiotemporal complexity in which cancer and stromal cells can still be studied with in-vivo like characteristics and expression.

This project requires several steps across multiple disciplines in order to accomplish the research tasks. First, microfluidic devices will be designed and fabricated to produce desired concentration of drug, which will be fed into cell culture chambers. Second, in collaboration with a research group (Dr. Y.W. Huang) in the biological sciences department, these microfluidic devices will be used to study diffusion of DNA-based drug delivery for cancer treatment.

George Malinee is a junior studying mechanical engineering and minoring in biomedical engineering. He knew he wanted to study engineering from an early age and has enjoyed his time on campus. George plans to pursue a graduate degree in biomedical engineering and hopes to one day design artificial joints and organs. George currently works under the direction of Dr. Cheng Wang of the Mechanical and Aerospace Department and one of his graduate students Chris Sobecki in the Microscale Transport Laboratory as part of the OURE program.

Erin Nischwitz

Department: Chemistry
Major: Chemistry
Research Advisor(s): Dr. David Westenberg
Advisor's Department: Biological Sciences

Funding Source: Opportunity for Undergraduate Research Experience (OURE) Fellows Program

Detectable Biosensing Processes in Arabidopsis

Plants' advanced ability to sense and respond to a variety of biological triggers could possibly be harnessed to make an easily contained biosensor with the possibility of more obvious and accurate reporting than those readily available to the average consumer. Their property of uptaking and accumulating chemicals over time could prove useful in sensing pollutants plants are exposed to consistently and at low concentrations over time. Though a plant may have collected chemicals, this signal will not be easily recognizable by humans without aid, undermining a plant's perceived ability as a detector. This project focuses on developing a genetic circuit to trigger an easily detectable reporter in response to contaminants using a model plant. Possible reporters include a degreening process to lessen chlorophyll in leaves combined with the cell's creation of a chromoprotein or the production of a fluorescent protein visible under blacklight. A pre existing cytokinin system in the cells can be used to test the success of the system dependent upon which reporter is chosen.

Erin Nischwitz is a sophomore majoring in Chemistry with an emphasis in pre-med and minors in Biological Sciences and Cognitive Neuroscience. She is currently the President of Internationally Genetically Engineered Machine Team, the Sisterhood Chair for Omega Sigma Service Sorority, and the Public Relations Chair for Helix Life Sciences. She intends to continue her education by attending medical school.

Nicholas O'Gorman

Department: Electrical and Computer Engineering
Major: Electrical Engineering and Mechanical Engineering
Research Advisor(s): Dr. Pommerenke
Advisor's Department: Electrical and Computer Engineering

Funding Source: OURE Fellowship

Controllable Plasma Array System to Manipulate Electromagnetic Waves

Plasma possesses many unique properties that allow it to be extremely useful in many areas of engineering. One such property is the ability to change its permeability and permittivity by changing the density of the plasma. When these properties change, the effects of the plasma on incoming electromagnetic waves changes as well. Using this feature of plasma, it is possible to find a specific density that will have a desired effect at a desired frequency of an incoming wave. With an array of plasma filaments, it then becomes possible to have controllable geometry as well as controllable material properties. The large number of controllable parameters within a single device will allow this research project to construct a plasma array that will be able to be tuned for many effects on many frequencies. This removes the need for having a different device for every frequency and effect that you need to achieve. The results of this research can also be used to help in the development of better plasma antennas, Impedance matching devices, and super lenses.

Nicholas O'Gorman has had a love of designing and building for since he was a child. He spent most of his childhood taking apart machines and building devices. During high school, his love of engineering flourished within his school's robotics team. After entering college, he learned of the OURE program offered at Rolla and took it as an opportunity to work on new ideas. He worked on two different projects involving robotics, a controllable humanoid robot and a surveillance robot. However, during his time at S&T, he learned that his passions lied within the field of electromagnetics and energy flows. While helping Matt Paliwoda on his research for his masters with plasma, he found a field that possessed both. With a large interest in the plasma field, he began working to learn about how plasma works and what can be done in that field.

Tristan Shatto

Department: Electrical & Computer Engineering
Major: Computer Engineering & Electrical Engineering
Research Advisor(s): Dr. Egemen Çetinkaya
Advisor's Department: Electrical & Computer Engineering

Funding Source: Electrical & Computer Engineering Department

Graph-Theoretic Analysis and Design of Communication Networks

An important aspect of the design of communication networks is the resilience of the network. A resilient network is one that can withstand distributed damage from a targeted attack or random failures while maintaining a majority of its underlying connection structure (i.e., not becoming disconnected). The main goal of this project is to conduct a graph-theoretic analysis of networks in order to gain a deeper understanding and optimize networks against potential attacks or environmental damages. The project utilizes graph theory and a variety of software tools, particularly Python and the NetworkX software packages, with which we can simulate the network structure and analyze it based on a variety of metrics. We will focus on the spectra of graphs as the graph metric, which are the eigenvalues and multiplicities of the normalized Laplacian matrix. Graph spectrum is a useful metric to study the internal structure of complex networks and how they react when components are removed or added since it is especially helpful in our understanding and visualization of networks containing hundreds of nodes and links. Using metrics such as this, we can also study a variety of network types besides communication networks, such as social networks (Twitter metadata, Facebook friends, etc.) or infrastructure networks (power grids, roadways, etc.). Analyzing these networks, we can gain a deeper understanding of how complex networks are structured and use our findings for a variety of beneficial applications.

Tristan Shatto is a 2nd semester junior that is dual majoring in Computer Engineering and Electrical Engineering at Missouri S&T. Originally from the Kansas City area, he has been working as an undergraduate research assistant under Dr. Egemen Çetinkaya of the Electrical and Computer Engineering department for the past 2 years; His main area of research is the graph-theoretic analysis of complex networks. He is a member of IEEE, and has had his paper entitled "Spectral Analysis of Backbone Networks Against Targeted Attacks" published in the *International Conference on the Design of Reliable Communication Networks* (DRCN) 2017. Tristan wishes to pursue a career in the aerospace and defense industry after graduation.

Richard Snyder

Department: Electrical and Computer Engineering
Major: Computer Engineering
Research Advisor(s): Dr. Egemen Cetinkaya
Advisor's Department: Electrical and Computer Engineering

Funding Source: No funding needed

Monitoring and Detection of Network Anomalies

Networks face a variety of attacks from both interior and exterior sources. Timely detection and reaction to these attacks is important for the operation and management of networks. This research will focus specifically on detecting network anomalies on the Missouri S&T network. Network traffic data will be gathered from the Missouri S&T network using honeypots. This data will then be analyzed to discern anomaly detection criteria. It will be possible to write an anomaly detection program using the discerned criteria.

Eli Snyder is a junior standing student majoring in computer engineering. This past summer, Eli was an intern at Los Alamos National Laboratories. During this internship Eli learned how to set up a Linux supercomputer and attended talks about new and upcoming technology. During the teaching, security was emphasized, as Los Alamos protects national secrets. These security topics interested Eli. To further this interest, Eli participated in the OURE program fall term of 2016 and the spring term of 2017, researching methods to improve network security through application of graph theory. He enjoyed the challenge presented in optimizing the logical and physical networks of the largest internet service providers. He plans to continue researching a different facet in network security until he graduates.

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