

Undergraduate Research @ Missouri University of Science and Technology



**Benjamin Hill is a Junior in Mechanical Engineering
and former United States Marine**

**Undergraduate Research Day
at the Capitol
Tuesday – March 15, 2016**



MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Office of the Chancellor

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March 15, 2016

Dear Legislator:

Welcome to Missouri University of Science and Technology's Undergraduate Research Day at the Capitol! Our students are excited to have this opportunity to present to you their research projects.

As the state's technological research university, Missouri S&T is committed to engaging undergraduate students in learning experiences beyond those in the traditional classroom setting. With research touching on everything from energy to the environment, I think you'll see these students are already making important contributions.

Featured on the cover of this publication is just one example of Missouri S&T undergraduate students involved in research each year. Benjamin Hill is a junior in mechanical engineering and a former United States Marine from Marshfield. His project, "LiDAR Applications," observes and records creep phenomenon slow slip movement associated with soft slope landslides.

Most landslides do not happen instantly, and geotechnical engineers have devised many methods to calculate their likelihood and corresponding factors of safety. Benjamin is currently studying a landslide in Stone County, Missouri, that is moving downslope at about 25 mm per month. His study typifies the type of relevant, real-world research projects Missouri S&T students undertake on a regular basis.

I am proud of the accomplishments of the students you will meet today. Thank you for taking time out of your busy schedule to meet a few of our outstanding undergraduate students and for your words of encouragement. I appreciate your continued support of Missouri S&T and higher education in our state.

Warmest regards,

A handwritten signature in cursive script that reads "Cheryl B. Schrader".

Cheryl B. Schrader, Ph.D.
Chancellor

Research Project

*Joint project with Kent Gorday

Defending bats from White-Nose syndrome with volatile organic compounds and synthetic biology

Pseudogymnoascus destructans, the fungal cause of White-Nose Syndrome responsible for the death of millions of bats in North America, grows on cave bats during their crucial hibernation. While bats are sensitive to disturbance during hibernation, those to survive until Spring are often able to recuperate after awakening to survive and eliminate their infection. Traditional responses to fungal infections, namely fungicides, indiscriminately kill beneficial and harmful fungi, while providing strong evolutionary pressure for resistance. We are instead exploring a volatile organic compound from fungistatic soils, ocimene, which has been shown to slow fungal growth. We are also investigating ways to sense *P. destructans* to impact the cave environment as little as possible, and compounds that may inhibit metabolism of the bats' skin. Our hope is that by slowing growth of the fungus, we can defend bats from the disease and give them a chance to recover after hibernation.

We designed and are assembling two plasmids encoding the mevalonate pathway, along with the enzyme responsible for (E)-beta-ocimene production. We will characterize the parts by measuring in-vivo production of mevalonate and ocimene in *E. coli*. We will then proceed to in-vitro testing by GST-tagging ocimene synthase, purify, and prepare an assay with geranylpyrophosphate to test ocimene production at various conditions. Ultimately, we will test the inhibitory effects of our ocimene on cultures of *P. destructans* to assess its viability as a solution to the White-Nose epidemic.

Major:	Biology
Faculty Mentor:	Dr. David Westenberg
Mentor's Department:	Biological Sciences
Funding Source:	None



Edna Armstrong
Rolla, MO

House District 121
Senate District 16

Edna Armstrong is a senior in the Biological Sciences with a minor in Chemistry. She is a member and former fundraising chair of the International Genetically Engineered Machines Team (iGEM) at the University of Missouri of Science and Technology in Rolla. After graduation Edna will pursue her JD with an emphasis in Patent and Environmental Law. Her interests include hiking, fishing, stargazing, knitting, and spending time with her dogs.

“Undergraduate research has allowed to appreciate the work and the different facets of what it takes for a research project to come to fruition - from the planning and funding stages, to the research, and then writing of results. More importantly, it has taught me that research rarely occurs in a vacuum, and that different points of view from different fields make a project and its results more valuable in terms of expanding our understanding of any scientific inquiry.”

- Edna Armstrong



Robert Block
Rolla, MO

House District 121
Senate District 16

Robert Block is a junior studying chemistry with a pre-medicine emphasis and a minor in biological sciences. After graduating, he plans on attending medical school and specializing in pediatric anesthesiology. His interests include martial arts, robotics, and the outdoors.

“Through undergraduate research, I have interacted with many different people, taken part in a number of projects, and learned many skills that I can easily apply in school as well as my career.”

- Robert Block

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

*Joint project with Sierra Herndon

Improving the Quality and Availability of Medical Diagnostics through Acupuncture-MRI

Magnetic Resonance Imaging (MRI) is a common diagnostics technique in medicine, providing detailed images and data on organs, soft tissue, and various other internal structures. In the St. Louis area there are more than sixty MRI providers, with patient costs (varying depending on MRI type and technique) ranging from \$370 to \$2,850. In 2007 the percentage of Missouri hospitals providing MRI was approximately 89%, but as of 2012 the number had decreased to approximately 85%. The decrease in availability of MRI in Missouri hospitals, although subtle, is likely a result of higher MRI maintenance costs, partially due to increase in liquid helium costs—a cryogen necessary for conventional MRI instrumentation. Beyond the costs and availability of conventional MRI, MRI has other limitations as well—most importantly, the inability to be used with patients who have electronic implants such as pacemakers.

Conventional MRI requires variable magnetic field gradients and high-strength radiofrequency pulses to form an image, but the powerful radiofrequency pulses and rapidly changing gradients pose a danger to patients with implanted electronics. Many electronics are sensitive to magnetically induced currents that can damage internal components and cause heating. Acupuncture Magnetic Resonance Imaging (Acupuncture-MRI) probes are small needle MRI detectors that observe relatively small areas compared to conventional MRI but offer significantly higher resolution. Initially, these Acupuncture-MRI probes would focus on studying skin cancers, and could also be modified to study epidermal, dermal, and subcutaneous cells of a patient in significant detail, while simultaneously circumventing many of the standard MRI problems. The proximity of the detection equipment and the suspect tissue would allow for superior image quality as well as weaker and more localized radiofrequency pulses. As a result of the weaker and more localized pulses, Acupuncture-MRI could be used in patients with electronic implants. If paired with a benchtop MRI system, the Acupuncture-MRI probe could become more available to rural areas and small town clinics as a result of decreased investment and maintenance costs. Acupuncture-MRI could also be used in research of various cancers, including skin cancer, which could lead to a better understanding of skin cancer cells, and therefore better preventative and treatment measures.

Major:

Faculty Mentor:

Mentor's Department:

Funding Source:

Chemistry

Dr. Klaus Woelk

Chemistry

Opportunities for Undergraduate Research Experiences (OURE),
Missouri S&T Think-tank

Research Project

Putt for Show, Drive for Off Course Dough?

A significant portion of a professional golfer's income does not come from tournament purses. In a given year, a professional golfer may make millions of dollars in off-course earnings that include everything from endorsement deals to appearance fees. Though past research has monetized the value of skill sets to the golfer in relation to their on-course earnings, it is of interest to determine the effect of a certain skill level on a golfer's off-course earnings. Thus, this study attempts to determine the effects of power, short game, putting, accuracy and scoring on a golfer's off-course earnings. The results suggest that scoring most effects a player's off-course earnings.

Major: Applied Mathematics and Economics
Faculty Mentor: Dr. Michael Davis
Mentor's Department: Economics
Funding Source: Opportunities for Undergraduate Research Experiences (OURE)



Arielle Bodine
Rolla, MO

House District 121
Senate District 16

Arielle Bodine is a senior in applied mathematics and economics. She is the vice-president of the Missouri S&T chapter of Kappa Mu Epsilon, the director of recruitment for Delta Omicron Lambda Service Sorority and a member of Miner Challenge Alternative Spring Break. Her hobbies include reading, running and writing. After graduation, Arielle will begin work as a financial analyst in St. Louis.

“Taking part in undergraduate research has helped me to think critically to solve unexpected and complex problems. I never thought that at 20 years old, I would be able to take part ownership of a project that would be presented at economics conferences.”

- Arielle Bodine



Patrick Brennan
St. Charles, MO

House District 106
Senate District 23

Patrick Brennan is a Junior in Chemical Engineering. He is a member of AIChE and the Newman Center. He is also the Vice President of the Missouri Mu chapter of Phi Kappa Theta. His interests include hiking, running, rock climbing, and reading.

“Research has allowed me to apply what I am learning in class as well as letting me see the wide range of opportunities for Chemical Engineers.”

- Patrick Brennan

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

Composite Aminosilica/Polymer Hollow Fiber Sorbents for Carbon Dioxide from Flue Gas

Amine-loaded silica/poly(amide-imide) hollow fiber sorbents are created and used for CO₂ capture under simulated post-combustion flue gas conditions. Amine is infused into the mesoporous silica/ poly(amide-imide) hollow fiber sorbents during fiber solvent exchange steps after fiber spinning. The amine loaded fibers are tested by exposure to simulated flue gas at 1 atm and 35 °C. The amine functionalized mesoporous silica/poly(amide-imide) hollow fibers comprising ~5 wt% silica with a high CO₂ equilibrium capacity of 1.85 mmol/g-fiber which is significantly higher than previously reported for fiber sorbents.

Major:

Faculty Mentor:

Mentor's Department:

Funding Source:

Chemical Engineering

Dr. Fateme Rezaei

Chemical and Biochemical Engineering

Opportunities for Undergraduate Research Experiences (OURE)

Research Project

Characterization of Acidophilic Microorganisms in Red Lake

Red Lake, located approximately 8 miles north of Columbia, Missouri, at the Rocky Fork/Finger Lakes Conservation Area, possesses many different types of extremophile microorganisms, primarily acidophilic ones. The lake maintains an average pH of 3.7 throughout the year due to the influx of acidic mine drainage from a number of seeps. Trees and other biomass enter the lake and decompose, signifying that there are biomass-degrading microorganisms working and living in the lake. My project goals are to isolate and characterize microorganisms responsible for biomass degradation from Red Lake, through the use of biochemical assays, microscopy techniques, and DNA analysis. The overall goal of this project is to find the enzymes that work in this acidic environment to break down the ligno-cellulose in biomass. Ultimately, these enzymes can be used to make the process of biofuel production more efficient and economical.

Major: Biological Sciences
Faculty Mentor: Dr. Melanie Mormile
Mentor's Department: Biological Sciences
Funding Source: Opportunities for Undergraduate Research Experiences (OURE)



Abigail Campbell
Rolla, MO

House District 062
Senate District 16

Abigail Campbell was born in Rolla, Missouri and is currently a junior majoring in biological sciences, with minors in chemistry and French. She is involved in undergraduate research and dedicates her time to a local women's shelter. Abigail is a 2014 Sue Shear Fellow. After she completes her degree, she plans on matriculating at a graduate school of her choice.

“Undergraduate research has allowed me to build confidence in my ability to work in the lab and present my research to others.”

- Abigail Campbell



Kelci Davis
St. Charles, MO

House District 65&103
Senate District 23&2

Kelci Davis is a senior in psychological sciences with minors in biology and literature. She is the president of PsyCo, the psychological science organization at Missouri S&T, co-founder of Miners for Recovery, a member of Psi Chi, a health and wellness peer educator for Joe's PEERS, and a student representative of Missouri S&T A-TEAM. Currently she is an intern at Pathways Behavioral Health as well as a student worker at the Curtis Laws Wilson Library. She is looking to pursue a PhD in clinical psychology with an emphasis in forensics after her time at Missouri S&T.

“While I never thought much of it when I started my college career, research has shaped me into not only a better student but a better person and consumer of information. I’ve cultivated a new passion for understanding human phenomena and it’s all thanks to the opportunities I’ve been given by Missouri S&T and the Psychological Sciences Department, and especially my advisor and research leader Dr. Amber Henslee.”

- Kelci Davis

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

Drinking Motives and Protective Strategies Predict Crossover Point in a Multiple Choice Procedure

Background: College student heavy episodic drinking (HED) and its associated negative consequences are clearly documented in the literature (Ham & Hope, 2003). Efforts to reduce HED include prevention (i.e., promoting healthy behaviors among college students) and intervention (i.e., providing personalized normative feedback to at-risk drinkers), and encompass the individual, campus, and community (NIAAA, 2002). Research investigating the decision-making process surrounding alcohol use, including motives to drink and the use of protective behavioral strategies, is similarly extensive. Recent research has investigated the effect of alcohol exposure (priming) on subsequent choices and preferences related to alcohol (Fillmore & Rush, 2001; Diulio, 2014). The current study randomly assigned participants to receive alcohol or placebo to investigate subsequent alcohol choice. We hypothesized that study condition (alcohol versus placebo) would predict subsequent preference for alcohol relative to an alternative. **Methods:** Participants included 45 undergraduate students (72% female) enrolled at a mid-sized East coast university. Participants reported consuming at least four alcoholic beverages in the past 28 days, drank the equivalent of two standard drinks on at least one occasion, and were at least 21 years old. In a lab-based session, participants completed several self-report measures including the Rutgers Alcohol Problem Index, Drinking Motives Questionnaire, Protective Behavioral Strategies Scale, and Alcohol Estimation questionnaire. After exposure to alcohol or placebo, participants completed the Multiple Choice Procedure (MCP); participants make a series of discrete choices between a standard alcoholic drink and ascending amounts of money (\$0.00 - \$20.00). The point at which participants choose money over alcohol is the crossover point and represents the relative reinforcing value of alcohol. **Results:** Independent t-tests revealed no significant differences between alcohol and placebo group means with respect to estimated beverages (alcohol: $M = 1.53$, $SD = 0.69$; placebo: $M = 1.40$, $SD = 0.65$; manipulation check) or the relative reinforcing value of alcohol (alcohol: $M = \$6.00$, $SD = \$3.88$; placebo: $M = \$5.94$, $SD = \$3.77$). Independent t-tests revealed no significant difference between genders with respect to estimated beverages (female: $M = 1.49$, $SD = 0.65$; male: $M = 1.39$, $SD = 0.72$). A series of linear regressions revealed that the only variables uniquely predictive of crossover point were the Limit Drinking factor of the Protective Behavioral Strategies Scale ($\beta = -0.27$, $t(42) = -2.06$, $p = .045$) and the Drinking to Enhance factor of the Drinking Motives Questionnaire ($\beta = 0.47$, $t(42) = 3.61$, $p = .001$) and explained a significant proportion of variance in the relative reinforcing value of alcohol ($R^2 = 0.38$, $F(2,42) = 12.15$, $p < .001$). **Conclusion:** Participants' drinking motives (i.e., drinking to enhance) and use of protective behavioral strategies (i.e., limiting drinking) account for approximately 37% of the variance when predicting the crossover point in the MCP, regardless of exposure to alcohol or placebo. These results may have implications for interventions (i.e., personalized feedback) provided to at-risk college student drinkers.

Major:	Psychological Science
Faculty Mentor:	Dr. Amber Henslee
Mentor's Department:	Psychological Science
Funding Source:	None

Research Project

Development of CO₂ Removal Systems for NASA's Advanced Exploration Systems

In this project, first, we will evaluate various support materials, such as silica or alpha-alumina monoliths. Other factors that we will consider would be both size of channel and particle geometry to maximize available surface area and minimize attrition of adsorbent. Another variable that would be studied is the process of depositing the adsorbent onto the monolith's surface to maximize total adsorbent loading and hence capacity. Different techniques such as dip-coating, spin-coating and layer-by-layer will be employed for this purpose.

Materials preparation and Characterization

Materials will be prepared according to the well-established techniques developed in Dr. Rezaei's lab. Currently, there is one PhD student working on growing MOFs on various supports for different applications. After preparing materials, they will be characterized by various techniques including: nitrogen physisorption to measure the BET surface area and pore volume, Thermogravimetric analyzer (TGA) to evaluate the thermal stability of monolithic adsorbents, Scanning electron microscopy (SEM) to evaluate the surface morphology, and mercury intrusion porosimetry (MIP) to determine the macropore size distribution and macroporosity of monoliths. The CO₂ adsorption capacity of the materials will also be measured by a volumetric adsorption analyzer and CO₂ adsorption isotherms will be constructed at different temperatures.

CO₂ Breakthrough Experiments

The CO₂ dynamic breakthrough experiments will also be performed by exposing the adsorbents to a simulated gas containing a CO₂ concentration in the range 0.25-0.5 vol% at ambient temperature. The CO₂ desorption kinetics will also be investigated by performing desorption step after adsorption step through vacuum (lowering the bed pressure from 1 to 0.1 atm). This is relevant to NASA's CO₂ removal systems as the energy for regeneration of the adsorbent can be minimized using the vacuum. Furthermore, both dry and humid CO₂ runs will be performed in order to investigate the stability of materials in the presence of water. The humid runs will be performed by humidifying the inlet gas stream at controlled humidity levels (10, 50 and 100 RH%).

We seek to develop material that exhibits high CO₂ removal efficiency (i.e., capable of reducing the CO₂ partial pressure in the spacecraft cabin to less than 0.25 vol%) and long-term hydrothermal stability (in the presence of water). We expect that an alumina monolith, with narrow channels and a mesh-like structure would be the best design with regard to total surface area (high cell density monolith). With regard to the adsorbent's properties, we would expect a mix of particle geometries would provide the best surface area and the smallest rate of attrition.

Major: Chemical Engineering
Faculty Mentor: Dr. Fateme Rezaei
Mentor's Department: Chemical Engineering
Funding Source: NASA-MOSGC Missouri S&T Student Award



Stephen Eastman
Saint Peters, MO

House District 105
Senate District 23

Stephen Eastman is a Junior in Chemical Engineering. He is a member of the S&T chapter American Institute of Chemical Engineers as well as the Chemical Engineering car. His interests include: Outdoor Activities, Electronics, Video Games and Chemistry.

“Participating in undergraduate research has helped me understand what direction I want to take in my future and has opened up many opportunities for me academically and professionally.”

- Stephen Eastman



Kent Gorday
Foristell, MO

House District 063
Senate District 02

Kent Gorday is a sophomore in physics and a member of the International Genetically Engineered Machine design team. He also performs undergraduate research in DNA nanotechnology and participates in the Society of Physics Students as well as the Symphony Orchestra. In his free time, Kent enjoys playing horn, reading, and hiking. Kent intends to continue his education in biophysics after Missouri S&T.

“Undergraduate research has exposed me to new ideas and developed my interests for the future. I am grateful for the opportunity to accumulate real skills in scientific inquiry.”

- Kent Gorday

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

*Joint project with Edna Armstrong

Defending bats from White-Nose Syndrome with volatile organic compounds and synthetic biology

Pseudogymnoascus destructans, the fungal cause of White-Nose Syndrome responsible for the death of millions of bats in North America, grows on cave bats during their crucial hibernation. While bats are sensitive to disturbance during hibernation, those to survive until Spring are often able to recuperate after awakening to survive and eliminate their infection. Traditional responses to fungal infections, namely fungicides, indiscriminately kill beneficial and harmful fungi, while providing strong evolutionary pressure for resistance. We are instead exploring a volatile organic compound from fungistatic soils, ocimene, which has been shown to slow fungal growth. We are also investigating ways to sense *P. destructans* to impact the cave environment as little as possible, and compounds that may inhibit metabolism of the bats' skin. Our hope is that by slowing growth of the fungus, we can defend bats from the disease and give them a chance to recover after hibernation.

We designed and are assembling two plasmids encoding the mevalonate pathway, along with the enzyme responsible for (E)-beta-ocimene production. We will characterize the parts by measuring in-vivo production of mevalonate and ocimene in *E. coli*. We will then proceed to in-vitro testing by GST-tagging ocimene synthase, purify, and prepare an assay with geranylpyrophosphate to test ocimene production at various conditions. Ultimately, we will test the inhibitory effects of our ocimene on cultures of *P. destructans* to assess its viability as a solution to the White-Nose epidemic.

Major:	Physics
Faculty Mentor:	Dr. David Westenberg
Mentor's Department:	Biological Sciences
Funding Source:	None

Research Project

*Joint project with Robert Block

Improving the Quality and Availability of Medical Diagnostics through Acupuncture-MRI

Magnetic Resonance Imaging (MRI) is a common diagnostics technique in medicine, providing detailed images and data on organs, soft tissue, and various other internal structures. In the St. Louis area there are more than sixty MRI providers, with patient costs (varying depending on MRI type and technique) ranging from \$370 to \$2,850. In 2007 the percentage of Missouri hospitals providing MRI was approximately 89%, but as of 2012 the number had decreased to approximately 85%. The decrease in availability of MRI in Missouri hospitals, although subtle, is likely a result of higher MRI maintenance costs, partially due to increase in liquid helium costs—a cryogen necessary for conventional MRI instrumentation. Beyond the costs and availability of conventional MRI, MRI has other limitations as well—most importantly, the inability to be used with patients who have electronic implants such as pacemakers.

Conventional MRI requires variable magnetic field gradients and high-strength radiofrequency pulses to form an image, but the powerful radiofrequency pulses and rapidly changing gradients pose a danger to patients with implanted electronics. Many electronics are sensitive to magnetically induced currents that can damage internal components and cause heating. Acupuncture Magnetic Resonance Imaging (Acupuncture-MRI) probes are small needle MRI detectors that observe relatively small areas compared to conventional MRI but offer significantly higher resolution. Initially, these Acupuncture-MRI probes would focus on studying skin cancers, and could also be modified to study epidermal, dermal, and subcutaneous cells of a patient in significant detail, while simultaneously circumventing many of the standard MRI problems. The proximity of the detection equipment and the suspect tissue would allow for superior image quality as well as weaker and more localized radiofrequency pulses. As a result of the weaker and more localized pulses, Acupuncture-MRI could be used in patients with electronic implants. If paired with a benchtop MRI system, the Acupuncture-MRI probe could become more available to rural areas and small town clinics as a result of decreased investment and maintenance costs. Acupuncture-MRI could also be used in research of various cancers, including skin cancer, which could lead to a better understanding of skin cancer cells, and therefore better preventative and treatment measures.

Major: Biological Sciences
Faculty Mentor: Dr. Klaus Woelk
Mentor's Department: Chemistry
Funding Source: Opportunities for Undergraduate Research Experiences (OURE), Missouri S&T Think-tank



Sierra Herndon
St. James, MO

House District 120
Senate District 16

Sierra Herndon is a freshman in biological sciences with a minor in chemistry. Whenever she graduates, she plans on pursuing a PhD and continuing to do research in biomedical sciences. Her interests include martial arts, hiking, writing, and video games.

“Undergraduate research has allowed for many opportunities that I never would have imagined even a couple of years ago. I have learned many helpful and relevant skills by participating in research, and I have also been able to meet some amazing people.”

- Sierra Herndon



Katherine Herries
St. Louis, MO

House District 095
Senate District 01

Kate Herries grew up with an admiration of the outdoors. This love fueled her to study geology and geophysics at Missouri S&T, and she is currently a senior. She plans on continuing her studies at graduate school researching volcanoes. In her free time, she loves to play her guitar and banjo, hike any trail she can find, and play with her dog.

“Undergraduate research has given me opportunities I never thought possible. I was able to travel to the Bahamas to do field work. All of this has only fed my desire to learn everything that I possibly can.”

- Katherine Herries

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

An Investigation of the Genesis of Microbialite Communities in Storr's Lake, San Salvador Island, The Bahamas

Living microbial communities are found in the hypersaline and turbid waters of Storr's Lake, San Salvador Island, The Bahamas. The living organic-rich microbialite mats are composed of mixed communities of symbiotic bacteria and cyanobacteria that utilize both the energy from sunlight and aqueous sulfur reduction-oxidation reactions for their life cycles. The microbialite mats precipitate mixed calcium-magnesium carbonate minerals as a result of their biologic activity. These minerals have coalesced into mound-shaped structures that initially began to form more than 2360 years ago after Storr's Lake was isolated from the open ocean by drifting coastal sand bars. Growth patterns of the microbialite layers and their corresponding calcium and magnesium stable isotope chemistry may be used to determine both the growth process and sources of mineral components in the mounds. It is hoped that a better understanding of the modern mineralization process(es) will eventually allow the researchers to use these isotopic patterns to reconstruct the paleoclimate history of Storr's Lake.

Microbialite communities that are involved in the precipitation of carbonate minerals will naturally influence the Earth's carbon-cycle and thus will have some impact on atmospheric carbon dioxide levels, and correspondingly may influence global climate. Similar microbialite communities have also been identified in the fossil record of Missouri's ancient geologic strata. Thus the chemistry, structures, and environment of occurrence of modern microbialites can provide us with glimpses into the evolution of the Earth's climate and atmosphere over geologic time.

Major:	Geology/Geophysics
Faculty Mentor:	Dr. David Wronkiewicz
Mentor's Department:	Geosciences and Geological and Petroleum Engineering
Funding Source:	Petroleum Research Fund

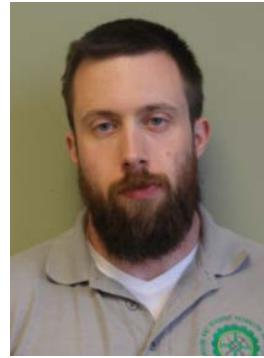
Research Project

LiDAR Applications

Soft slope landslides cost the world over one billion dollars annually. It is estimated that globally there have been over 60,000 deaths from landslides during the 20th century, and almost 4 million people made homeless by landslides. In addition landslides cause transportation and logistic inconveniences by closing traffic arteries and disrupting supply chains. Geotechnical engineers have devised many methods to calculate the likelihood of landslides and the corresponding factors of safety. Most landslides do not happen instantly. Often there is advanced warning of imminent catastrophic failure. Because of creep phenomenon slow slip movement has a steady state phase during which the movement, although small, can be observed and recorded.

LIDAR scanners can measure these imperceptible movements. We have demonstrated that movements of less than 1 mm can be measured when scans are repeated over time, using oversampling techniques on spherical targets. In addition the underground morphology of the slides can be inferred by mounting two spherical targets on rods driven into the ground. Currently we are studying a landslide in Stone County, MO that is moving downslope at about 25 mm per month.

Major: Mechanical Engineering
Faculty Mentor: Dr. Norbert Maerz
Mentor's Department: Geological Engineering
Funding Source: None



Benjamin Hill
Marshfield, MO

House District 137
Senate District 33

Benjamin Hill is a Junior in Mechanical Engineering. As a former United States Marine, he is involved in the Missouri S&T Chapter of the Student Veteran's Association, as well as the S&T Rider's Society. His free time is consumed by DIY projects, motorcycles, and weight lifting.

“Undergraduate Research has allowed me to combine my leadership experience, engineering knowledge, and people skills, together into an environment that closely resembles a real business, with the possibility of changing the world.”

- Benjamin Hill



John Hostetler
Columbia, MO

House District 044
Senate District 19

John Hostetler is a senior dual majoring in Aerospace and Mechanical engineering and minoring in Mathematics. He is an active member on the M-SAT satellite design team, and was formerly the Secretary for the Missouri S&T student chapter of AIAA. Since completing his OURE, he has become an undergraduate research assistant, and plans to continue pursuing his research interests as a graduate student.

“I found the opportunity to conduct undergraduate research to be extremely rewarding. The experience encouraged my studies by contextualizing the ideas and knowledge presented in my courses, while presenting an avenue to apply this knowledge firsthand.”

- John Hostetler

Research Project

Dielectric EAP Composite Actuation for use in Aeronautic Aileron Actuation

Dielectric Electroactive Polymer (D-EAP) transducers are studied for their viability as an actuator to replace the mechanical components of an aircraft's aileron. The mechanism was designed for installation into a Cessna 182 in subsonic flight, utilizing a trailing edge flap capable of being deflected from -40° to $+20^\circ$ with respect to the chord of the wing. Using this as a model, the hinge moment required to produce deflection against the aerodynamic surface forces acting on the flap was determined, as well as the internal joint forces and moments acting on the links composing the actuating mechanism. Subsequently, a dynamic force analysis was conducted on the actuator's structure to calculate the maximum total force demanded of the EAP material in order to deflect the flap, as well as other critical material characteristics dictated by the desired motion. The analysis yielded the critical parameters needed in the selection criteria for several candidate polymeric materials. The minimum blocking pressure required of the expanding material was 0.6615 MPa in order to withstand the net force acting on the flap, and the maximum percent expansion of the material with respect to its un-deformed length is 30.97%. A comparison of several potential EAP candidates revealed that several of these materials are certainly capable of meeting these design thresholds. Therefore it may be concluded that an EAP actuation mechanism is not only a viable means of driving the deflection of an aileron, but also that D-EAP composites may extend their unique material characteristics to a wide range of aerospace applications to substantially improve man's flight capabilities.

Major:	Aerospace/ Mechanical Engineering
Faculty Mentor:	Dr. Lokeswarappa Dharani
Mentor's Department:	Mechanical and Aerospace Engineering
Funding Source:	OURE

Research Project

Development of Paraffin Selective Adsorbents for Ethylene/Ethane

Ethylene (C_2H_4) is an important chemical used as feedstock in manufacture of polymers as well as other organic chemicals. The current technology for separating ethylene from ethane is a highly energy-intensive cryogenic distillation due to the small difference in their boiling point. Adsorption by porous materials (adsorbents) provides an energy-efficient alternative to obtain a high purity ethylene product (99%). However, current adsorbents used for this application typically adsorb ethylene over ethane and therefore the desired product (ethylene) can only be recovered in the next step (desorption step).

In this project, we are trying to develop materials such as zeolite imidazolate frameworks ZIF-7 and ZIF-8 that are capable of selectively adsorbing ethane from ethylene/ethane mixture. In this way, it is possible to recover ethylene in the adsorption step, thus making the separation process economically attractive and feasible.

Major: Chemical Engineering
Faculty Mentors: Dr. Fateme Rezaei
Mentor's Department: Chemical Engineering
Funding Source: OURE



Morgan Hovis
Fredericktown, MO

House District 145
Senate District 27

Morgan Hovis grew up in the small town of Fredericktown in southeast Missouri. In high school, Morgan decided that she wanted a degree in Chemical Engineering. So she followed her father's footsteps and is now a junior at Missouri University of Science and Technology. Her other hobbies and interests include: Kappa Delta Sorority, Phi Sigma Pi National Honor Fraternity, Ballet and Dance Club, and Aerial Swing Dancing Club.

“Undergraduate research has taught me valuable lessons about working in my field of study. It has also given me the opportunity to work with fellow classmates and faculty and allowed me to build new relationships I would not have had otherwise.”

- Morgan Hovis



Ava Hughes
St. Louis, MO

House District 083
Senate District 04

Ava Hughes is a senior in biological sciences with minors in chemistry and studio art. She is a Head Resident for Residential Life and a member of Phi Sigma. Her interests include biology, conservation, drawing, sports, and volunteering.

“Undergraduate research has allowed me to be a part of project that I never could have imagined and the lessons I have learned will forever imprint the way I approach research in the future.”

- Ava Hughes

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY

Research Project

**Joint Project with Katlyn Lonergan*

Isolation and Characterization of Novel HaloAcidophilic Microorganisms Present in Hypersaline Lakes from Western Australia

The microbial communities in the acidic hypersaline environments in Lake Magic, Lake Gounter, Lake Gneiss, and Lake Aerodrome in Western Australia are currently unknown. These lakes are of interest due to their pH and salt concentrations, recorded to be between 1.4-3.5 pH and 13-32% salt concentration. Halite and gypsum crystals form as evaporates as a crustal layer on the sediment. With these extreme conditions, it is likely that novel species of microorganisms will be isolated. There have been microorganisms found to be acidophilic and halotolerant but not haloacidophilic. Retrieved isolates will be isolated from halite and in some cases gypsum crystals from the various lakes mentioned above and are expected to be in this new category of extremophiles. This will lead us to a new understanding of extremophiles while pushing the envelope of where life can thrive.

Major:

Faculty Mentor:

Mentor's Department:

Funding Source:

Biological Sciences

Dr. Melanie Mormile

Biological Sciences

NASA

Research Project

A low-cost lithium-borate compound for solid state lithium-ion battery electrolyte

In the area of lithium-ion (Li-ion) battery a lot of research activities are focused towards building an all solid-state battery. This means that a highly Li-ion conducting solid is required to play the role of a solid electrolyte. This has been a major barrier towards the realization of a high efficiency all solid-state Li-ion battery. For this reason we focused our research to discover new materials that can potentially play the role of solid state Li-electrolyte. In this direction we have synthesized a Li-borate composition and solved the structure using single-crystal X-ray diffraction. The compound, $\text{Li}_3\text{B}_5\text{O}_{13}(\text{OH})_2$, crystallizes in the orthorhombic space group of $Pnc2_1$ and have the following cell parameters: $a = 8.499(5)$, $b = 26.520(10)$, $c = 9.308(3)$ $\alpha = \beta = \gamma = 90^\circ$, $\text{Vol} = 2097.96$. The structure of this compound is built with BO_3 and BO_4 polyhedra and forms a layered topology. The Li-ions are located in between the layers. This compound shows a good Li-ion conduction when measured on a pressed pellet. In this presentation we will focus on the synthesis, structure, powder X-ray diffraction and IR and NMR spectroscopic characterization; and Li-ion conduction measurement of the new composition.

Major: Chemical Engineering
Faculty Mentors: Dr. Amitava Choudhury
Mentor's Department: Chemistry
Funding Source: OURE



Darian Johnson
Kansas City, MO

House District 37&27
Senate District 7&9

Darian Johnson is a graduating senior in chemical engineering at Missouri University of Science & Technology. She is involved in several student organizations and activities including, the Student Leadership Conference, Miner Challenge Alternative Spring Break, and the Omega chapter of Omega Chi Epsilon. In her free time she enjoys baking, running, and watching the Food Network. Darian has always been passionate about food and throughout college has been inspired to develop a healthier lifestyle. After graduation, Darian would like to pursue a career in the food and beverage industry, creating healthier food products.

“At first I was apprehensive about participating in undergraduate research. I was worried that I would not have a good foundation of the research material. Through my undergraduate research experience I have learned a lot from my research advisor and the graduate students in the lab. I have become more comfortable asking questions and asking for help. I have also learned new lab and safety techniques that I hope to use while working in industry.”

- Darian Johnson

MISSOURI UNIVERSITY OF SCIENCE AND TECHNOLOGY



Katlyn Lonergan
Raymore, MO

House District 055
Senate District 31

Katlyn Lonergan's curiosity for the natural world has been a part of her since childhood. She is a senior in Geology & Geophysics at Missouri S&T who has expanded into the biological sciences. From the macro to the microworld, she wants to understand the processes occurring. Katlyn is graduating in May and will further her education in a Master's program. In her free time, Katlyn enjoys being involved with the local Geology club, spending relaxing evenings with her friends, and cooking new foods.

“Undergraduate research has taken my education beyond textbook and classroom discussions to an actual research setting. The skills and experience I've gained in lab are invaluable for future projects and have gotten me much closer to my long term goals.”

- Katlyn Lonergan

Research Project

**Joint Project with Ava Hughes*

Isolation and Characterization of Novel HaloAcidophilic Microorganisms Present in Hypersaline Lakes from Western Australia

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Major:	Biological Sciences
Faculty Mentor:	Dr. Melanie Mormile
Mentor's Department:	Biological Sciences
Funding Source:	NASA

Research Project

Simulation of Cement Flows using Yield Stress Model

Interested in the vane geometry and flow of self-consolidating concrete compared to the analytical solutions in a rotation rheometer, a Chemical Engineering student examined the simulations of yield-stress models for self-consolidating concrete. The main project goal of the student is to collect yield stress data through simulations utilizing COMSOL and assess the data to verify if the hypothesized patterns were forming. This effect is studied by investigating the torque vs rotational velocity relation, flow pattern, and the shear stress distribution. The data showed that the number of the vane blades is crucial in the torque-rotational velocity relation whereas the vane curvature has minimal effect of the difference between the numerical results and the analytical equations. The results will prove useful in determining efficient rotational rheometer design for cement-based materials as well as any yield-stress fluids.

Major: Chemical Engineering
Faculty Mentor: Dr. Joontaek Park
Mentor's Department: Chemical & Biochemical Engineering
Funding Source: Energy Research & Development Center



Angelica Oliva
Sullivan, MO

House District 120
Senate District 16

Angelica M. Oliva is a senior in Chemical Engineering. She is a member of AIChE, the Missouri S&T and National chapter. Her interests include crafts such as crocheting, reading, video games, and is a cooking enthusiast.

“The field of chemical engineering, through undergraduate research, has shown myself and other students that there are endless questions and possibilities to be discovered that are only limited by what we ask.”

- Angelica M. Oliva



Jenna Slocum
New Haven, MO

House District 061
Senate District 26

Jenna Slocum is a sophomore in nuclear engineering. She is the President of the Missouri S&T chapter of American Nuclear Society, a member of Women in Nuclear, and works in Jefferson City as a Legislative Intern for the Associated Student of the University of Missouri.

“Through my undergraduate research, I have had the privilege of countless hours of hands on work that just can’t be compared to anything I could have learned in a standard lecture hall. Taking hold of this wonderful opportunity has given me the chance to network with industry professionals, experience what it is like to write my own protocols, explore the vast opportunities my career field and department has to offer, and so much more. I would truly recommend undergraduate research to any student that is interested in building a firm base for their future career and life to be built upon.”

- Jenna Slocum

Research Project

Production of Radioactive Gold Nanoparticles for Cancer Treatment

Cancer is the second leading cause of death in the US (cdc.gov) with 584,881 deaths in 2013. Also more than fourteen million people are diagnosed with the disease annually in the world.

Radioactive gold nanoparticles (NPs) are being used as therapeutic agents in the treatment of cancer. The size similarities of the NPs to cellular systems allows it to cross multiple biological barriers and enhance delivery and retention for optimal treatment. Delivery and retention of therapeutic agents to the tumor is one of the main contributing factors to the efficacy in the treatment of cancer.

We have developed a new technique for the production of radioactive gold nanoparticles in a single step.

We are reducing the cost and flexibility in the production of gold nanoparticles for cancer treatment.

The main issue to develop a successful cancer treatment is to achieve a high concentration of therapeutic agent in tumor sites, while minimizing damage to normal cells. The idea of creating more effective cancer treatments by engineering matter at nano scale has recently become one of the most promising areas of cancer research. Nanoparticles have the potential to preferentially eliminate cancer cells without damaging normal cells.

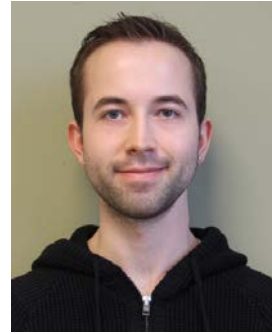
Major:	Nuclear Engineering
Faculty Mentor:	Dr. Carlos Castano
Mentor's Department:	Mining & Nuclear Engineering
Funding Source:	NRC-HQ-12-G-38-0075

Research Project

A Study to Understand Human Behavior in Managing Information Security

Information security is a necessity for every organization, particularly those which deal with sensitive data. Every year, companies lose millions of dollars due to information security breaches. Studies show that human error is the primary factor leading to these breaches. Thus, it is crucial to gain a better understanding of human behavior in the information security context. Our research focuses on understanding user behavior related to information security and how user interface can be better designed to mitigate information security breaches. We hope that the results of our research will help to enhance organizational cybersecurity and minimize information security breaches.

Major: Information Science and Technology
Faculty Mentor: Dr. Fiona Nah
Mentor's Department: Business & Information Tech
Funding Source: National Science Foundation



Samuel Smith
Bourbon, MO

House District 120
Senate District 16

Samuel Smith is a junior majoring in information science and technology, with a minor in data science. He is an assistant lab manager for the Laboratory for Information Technology Evaluation (LITE), a teaching assistant for computer programming courses, and the secretary of S&T's Business and Information Technology student ambassadors group. Samuel greatly enjoys the school environment and plans to pursue a Master's degree upon graduation. He is interested in technology, psychology, math, and philosophy.

“Undergraduate research has exposed me to a world that I never knew existed. I have gained so much insight into the field of information science and been given the opportunity to build meaningful relationships with experts in the area.”

- Samuel Smith

HOUSE

SENATE

Undergraduate Research Day at the Capitol March 15, 2016

Schedule of Events:

9am - Display Set Up
10am - House and Senate Introductions
10:30am - Displays Open for Viewing

- 39 Matthew Paul
- 38 Jared DeLee
- 37 Morgan Hovis
- 36 Mariana Bichara
- 35 Benjamin Hill
- 34 Annie Liljegren
- 33 Andrew Ramsey
- 32 Darian Johnson
- 31 Samantha Dodda
- 30 Sara Lamprise
- 29 Andrew Ludwig
- 28 Katherine Herries
- 27 Larry Hernandez
- 26 Maria Juarez
- 25 Colton Luttrell
- 24 Abigail Campbell
- 23 Arielle Bodine
- 22 Samuel Smith
- 21 Angelica Oliva
- 20 Sierra Herndon & Robert Block
- 19 Kent Gorday & Edna Armstrong
- 18 Kara Schrand
- 17 Sam Runge
- 16 Casey Yocks
- 15 Kelci Davis
- 14 Chelsea Titus
- 13 Devin Petersohn
- 12 Romanus Hutchins
- 11 Katherine Hobbs
- 10 Sarah Biehn
- 9 Kirtan Joshi
- 8 John Hostetler
- 7 Jenna Slocum
- 6 William Gavin
- 5 Will McHargue
- 4 Alex Willenbrink
- 3 Katlyn Lonergan & Ava Hughes
- 2 Jade Casey
- 1 Patrick Brennan
- 40 Badr Almadi
- 41 Nathan Coffey
- 42 Jonathan Gootee
- 43 Bailee Kain
- 44 Kathleen Kowalsky
- 45 Khalil Rahman
- 46 Benton Berigan
- 47 Taylor Wagner
- 48 Brendan Marsh
- 49 Stephen Eastman
- 50 Christine Noto
- 51 Diane Queensen



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