Office of Undergraduate Research
150 Bond Life Sciences Center
University of Missouri
Columbia, MO 65211-7310
undergradresearch.missouri.edu
March 7, 2013

Esteemed Legislators,

I am pleased to welcome you to the University of Missouri’s Undergraduate Research Day at the Capitol, where 21 of MU’s finest undergraduate students will display abstracts of their projects in the Capitol Rotunda. Every day more than 400 undergraduate students at Mizzou are actively engaged outside of the classroom with some of our most prominent faculty to work toward breakthrough discoveries that advance the lives of Missourians and our state’s economy. These improvements include better health, greater crop yields, effective teaching, and enhancing well-being of people worldwide.

Our students will tell you that their unique Mizzou research experience has left an indelible impact that will guide them as they become our future leaders in science, medicine, education, industry and government. In addition to making scholarly contributions to their field and engaging with top faculty who mentor and work with them, our students are better prepared to design relevant experiments, generate and analyze data, and draw meaningful conclusions to a variety of situations. This intellectual agility and self-confidence are the foundation of the life-long learners who inspire and lead Missouri and the world.

One of the students you will meet today is Alex Paino from Chesterfield. Alex, a junior majoring in computer engineering and mathematics, is working on a better way for the Army’s vehicles to detect landmines and explosive hazards by using multiple sensors.

You will also meet Centralia native Mekka Garcia, a senior majoring in biochemistry who seeks to understand the bone abnormalities of Hurler syndrome, a rare genetic terminal disorder affecting one in every 100,000 children. Mekka hopes to expand the current therapies to improve the patients’ quality of life.

Many of the students you meet today will present their research at campus, regional and national symposia and conferences. I am very proud of each of them and look forward to following their careers.

Thank you for taking time out of your busy schedules to visit with our outstanding undergraduate students. We appreciate your continued support of the University of Missouri and higher education in our state.

Sincerely,

Brady J. Deaton
Chancellor
Understanding Classroom Management: A Way to Improve K-12 Teacher Retention

*Joint project with Rebecca Mesecher and Jale’t Hickmon-Rosa

Half of K-12 classroom teachers leave the field of education within the first five years due in part to their lack of preparation in classroom management strategies, costing the public school systems billions of dollars a year (NCTAF, 2007). Disruptive behavior in the classroom takes time away from instruction, disrupts student academic growth, and contributes to student and teacher stress. Effective classroom management is vital to student learning and teacher and student emotional health.

The long-term goal of our study aims to inform what classroom management practices are most helpful toward supporting teachers in promoting positive classroom environments that stimulate student learning. We used a meta-analysis method of reviewing existing research to compare published data on strategies. Hundreds of empirical articles were screened and coded to determine the effect size for proactive strategies on student academic and behavioral outcomes. Articles reviewed evaluated the effectiveness of the implementation of proactive classroom strategies, including teacher use of praise, opportunities to respond, precorrections, behavioral expectations, and active supervision. The subjects observed covered preschool, elementary grades, or middle/high school.

Initial findings indicate that the current literature focuses primarily on teachers intervening with individual students in the classroom rather than focusing on strategies at the classroom level. Based on what we have found thus far, we recommend that universities and teacher education programs train future teachers on effective classroom management as well as provide further training for current educators. Effective classroom management is important to the future of our schools. It has the potential to reduce stress levels and increase the self-efficacy of teachers, improve student academics, prosocial behaviors, and their emotional well being.

Our research has the potential to help differentiate which classroom management practices are most helpful toward supporting teachers in promoting positive classroom environments that stimulate student learning. This research experience has helped me reflect on my current training in education and how I can better use my teaching skills in the classroom.

Callee Barrett

Callee Barrett’s Major: Elementary Education
Faculty Mentor: Dr. Wendy Reinke
Mentor’s Department: Educational, School & Counseling Psychology

“I have learned a great deal from my mentor’s experience, and I am extremely grateful to have such an amazing opportunity.”

-Calle Barrett
Understanding Specific Steps in the Process of Gene Expression

Gene expression is a complex process composed of many different steps. Understanding the intricacies of these steps is essential. Like a machine, it is important to know how something operates normally, and subsequently, be able to pinpoint and fix a problem if one arises. My research project focuses on one specific part of gene expression, transcription termination. In order to make proteins, the genetic information encoded in DNA must be transformed into an intermediate molecule called RNA. This event is called transcription. The information carried in RNA is then used to make proteins in a process called translation.

Transcription can be broken down into three main parts: initiation, elongation, and termination. I specifically focus on the last part, termination. This project is important because it aims to understand a process that is happening continuously in every cell in our body. Molecular biology, as well as transcription, must be mastered in order to fully study more complex questions. My research project focuses on discovering how the polymerase behaves during transcription termination, and how genetic mutations affect the function of the polymerase. I measure the rate of reaction, as well as the efficiency of the enzyme. The steps of my project include designing DNA templates that will mimic what is happening in our cells, collecting the RNA produced from transcription, separating the RNA molecules based on size, quantifying the amount of RNAs differing in size, and seeing how these parameters change with different DNA templates.

Through my research experience, I have learned that research is rewarding, frustrating, challenging, and exciting. I have learned dedication, perseverance, and tenacity. My research experience has allowed me to have incredible opportunities and I am thrilled to see where it will take me in the future.

Jordan Bartlebaugh

Columbia, Missouri
Boone County

House District 46
Senate District 19

Jordan Bartlebaugh is a senior at MU majoring in biological sciences. She is the daughter of David and Diane Bartlebaugh of Waterloo, Illinois. After graduation, she will pursue her PhD in biological sciences and plans to conduct research in molecular biology, genetics, and physiology. Jordan presented her research at the Massachusetts Institute of Technology Amgen Scholars Summer Poster Presentation in 2012. She is a recipient of several scholarships, including the Honors College Research Grant and Undergraduate Arts and Science Scholarship. She is a member of Phi Beta Kappa Honor Society, National Society of Collegiate Scholars, and Golden Key International Honour Society. Jordan is the Parliamentarian of Phi Sigma Pi National Honor Fraternity and is also involved with Project Sol, which raises awareness of youth homelessness. She tutors with the PREP program (Promoting Responsibility, Excellence, and Perseverance) and also mentors at Grant Elementary School. Jordan volunteers with the Central Missouri Humane Society and Preferred Hospice.

“I am excited to pursue a PhD in disease research and use the training I received at Mizzou.”

-Jordan Bartlebaugh
Interconnection Between Bacterial Resistance and Drought Tolerance by Plant Protein MKP1

Understanding how plants respond and adapt to drought is critical for producing plants that are able to maintain yields under low water conditions. ABA (Abscisic Acid) is a plant hormone that plays a vital role in plant adaptation to environmental stresses such as drought tolerance and infection by bacteria. We have previously found that the presence of a plant protein, mitogen-activated protein kinase (MAPK) Phosphatase 1 (MKP1), enhances resistance against bacterial infection in Arabidopsis; and we have indications that it may also be involved in the plant’s responses to ABA. Thus, I am investigating if and how MKP1 may alter ABA responses in Arabidopsis plants.

We designed two different experiments to address this question. The first question was: do mutant mkp1 plants respond differently to ABA compared to unaltered plants, as measured by seed germination? Seeds were transplanted onto plates containing plant growth medium with an ABA concentration of 1.5 μM and 3 μM, as well as control plates for comparisons. The effects on seed germination and growth were examined 10 days after treatment.

Secondly, does the mkp1 mutant plant show altered expression of genes normally regulated by treatment of the plant with ABA? Time course experiments allow you to examine how plants respond at different times after treatment. Using one concentration of 10μM ABA, wild type (control) and mkp1 mutant seedlings were treated for 0, 90 and 300 minutes to observe how the expression levels change with time. RNA is extracted from these seedlings to be analyzed by qPCR (quantitative Polymerase-Chain Reaction) to compare gene expression levels.

In the seed germination experiment, the normal seeds germinated faster and had an 80% higher germination rate than the mkp1 mutant seeds. Results from the qPCR experiment showed that expression levels in the mkp1 mutant were reduced at each time point compared to the normal seedlings. These combined results demonstrated that the mkp1 mutant plant known to have enhanced resistance to bacterial infection also has a lower response to ABA. These plant results suggest that we found a novel mutation and that the MKP1 protein plays an important role in multiple types of stress responses. Therefore, there may be as yet underestimated considerations in producing crops with enhanced stress tolerance traits if the biochemical pathways for disease resistance are interconnected with those of drought tolerance.

“My faculty mentor changed my educational path by introducing me to his research. By attending a research university, I’ve gained a unique and crucial advantage over others in my field.”

-Logan DeMott

Logan DeMott is a senior at MU majoring in biochemistry. He is the son of Steve and Brenda DeMott of Kansas City, Missouri. After graduation, Logan plans to find a job pertaining to his current research. Later on, he hopes to pursue a career in neuroscience or fossil fuels. Logan presented his research at the Undergraduate Research and Creative Achievements Forum in summer 2011. His hobbies include strength training and basketball.

Logan DeMott’s Major: Biochemistry
Faculty Mentor: Dr. Scott Peck
Mentor’s Department: Biochemistry
Correcting Distortions to Improve Atomic Force Microscopy Images

How do we see and understand things like membrane proteins and molecules that are so thin it can take one hundred thousand of them just to span the width of a human hair? We have to if we want to treat cancers and other deadly diseases of all different types, because more than half of all pharmaceuticals work by targeting these proteins.

But proteins are far too small to see with even the most expensive typical laboratory microscope. Instead, we use a much better tool that can form pictures on a much smaller scale, a tool which is called an Atomic Force Microscope (AFM). Atomic Force Microscopes use small tips to achieve sub nanometer resolution of membrane proteins and other biomolecules that are of great interest to researchers trying to understand and treat a wide range of diseases.

Because the AFM tips are not infinitely tiny, distortions appear in AFM images and I correct these distortions by writing, testing and applying custom software. By selectively using software, image-processing techniques and analyzing AFM images, I determine the dimensions and volumes of specific proteins, probing their structure at previously unachievable resolutions in order to better see them.

My research experience has allowed me to observe and learn about living things on the nanoscale, to be one of the first human beings to see a particular mystery of the universe. It has also given me the opportunity to work with an Ultrastable Atomic Force Microscope. There are only two in the world, and one of those is at MU.

Nathan Frey

St. Charles, Missouri
St. Charles County

House District 106
Senate District 23

Nathan Frey is a junior at MU majoring in physics and mathematics. He is the son of Chris Frey and DiAnne Mueller of St. Charles, Missouri. After graduation, Nathan would like to attend graduate school to pursue his PhD in physics. He is the recipient of the Leaders Meeting Prize and the National Science Foundation Undergraduate Fellowship. Nathan is involved with the Society of Physics Students and is an officer in the Physics Honors Society. He works as a production director at KCOU Columbia, MU’s campus radio station. Nathan’s hobbies include playing the guitar and mandolin, recording and producing albums, and studying and reading Japanese.

“Before coming to MU, I couldn’t have imagined that over the next three years I would have the opportunity to work on unsolved problems in biophysics and that my contributions would be submitted to a scientific journal.”

-Nathan Frey

Nathan Frey’s Majors:
Physics and Mathematics

Faculty Mentor:
Dr. Gavin King

Mentor’s Department:
Physics & Astronomy

Funding Source:
National Science Foundation
Study of *Desulfovibrio vulgaris* Hildenborough Bacterium in Uranium Bioremediation

Years of mining for heavy metals has resulted in abandoned mines that are a source of ground and surface water contamination in many areas of the United States. *Desulfovibrio vulgaris* Hildenborough (DvH) is a harmless sulfate-reducing bacterium commonly found in soils contaminated with heavy metal. We are studying the DvH bacterium for its role in bioremediation. Bioremediation is the use of biological processes, rather than chemicals, to clean up contaminants such as uranium. Uranium is found in certain types of rocks and soil and is collected from human activities such as the use of phosphate fertilizer, nuclear power production, and mining. Uranium can dissolve in groundwater to become a source of contamination, causing toxic effects to all forms of life. Since uranium is a metal toxic to plants and animals, remediation of uranium-contaminated soil is of considerable interest.

Previous research has shown when the DvH bacterium metabolizes in the presence of organic acids, such as lactate and pyruvate; the resulting chain reaction causes the uranium found in underground water to be converted to the non-soluble form of uranium. Once made insoluble, the uranium can be filtered out of water. The purpose of this study is to understand the energy metabolism of the DvH bacterium so that we may one day be able to enhance its remediation activities. The genome of the DvH bacterium has been sequenced and analyzed. The key metabolic pathways in this organism are being studied.

In the DvH bacterium, lactate and pyruvate are consumed as energy sources. There are six genes that appear to be involved in this metabolism. In order to study the role of these six genes, we created mutant bacteria types that lack these genes. We then determined the effect of the loss of these genes on the growth of the bacteria. A growth defect is only seen with a multiple deletion mutation. We are still in the process of determining which one of the six genes is involved in the metabolism of the bacterium to have the most impact on uranium remediation.

This research experience has impacted my educational and career plans because it allowed me to explore the topics that interest me within the study of biochemistry.

“My faculty mentor had confidence in me to conduct my own experience, allowing me to reach my full potential.”

-Huitian Gao

Huitian Gao’s Majors: Biochemistry and Chemistry
Faculty Mentor: Dr. Judy Wall
Mentor’s Department: Biochemistry
Funding Source: Life Sciences Undergraduate Research Opportunity Program
Understanding the Bone Abnormalities of a Genetic Disease: Hurler Syndrome

Hurler syndrome is a rare genetic disease that affects one in 100,000 children and is not routinely tested for by newborn screening. Hurler syndrome is a terminal disorder in which most children do not survive past the first 10 years due to heart and respiratory failure. There is currently no cure for Hurler syndrome, but therapeutic treatments are being used to improve quality of life but do not improve the abnormal bones and joint limitations experienced by the patients. My research focuses on characterizing the bone features of Hurler syndrome in an effort to improve current therapies or find new therapies to further improve their quality of life.

In order to study the bone features of the disease, we use a genetically engineered mouse that carries the most common Hurler syndrome mutation. Weekly weighing of the mice demonstrates that mice with Hurler syndrome have increased body mass and size compared to their littermates. At four months, we sacrificed the animals and harvested their right hind leg. We then examined bone geometry (using a microCT scan), strength, integrity, and composition in 24 4-month old animals. Femoral bone geometry analysis showed decreased femur length and increased polar moment of area (how much bone there is), cortical bone width (radius) and marrow diameter for Hurler syndrome mice, compared to their littermates. We then twisted the bone until it broke, a process known as torsional loading to failure, in which 5 out of 8 Hurler syndrome right femurs revealed a unique pattern of fracture at the growth plate, rather than mid-shaft. Preliminary results indicate that the Hurler syndrome mice demonstrate altered bone geometry, strength, integrity, and composition, which may be consistent with the clinical bone abnormalities seen in human patients.

My research experience has strengthened my passion and love for science, especially medicine. It has also allowed me to be a part of a research lab that has become a family to me. My faculty mentor is a great example of a successful, yet humble scientist. She has taught me about patience, hard work, and life itself.

Mekka Garcia

Centralia, Missouri
Boone County
House District 44
Senate District 19

Mekka Garcia is a senior at MU majoring in biochemistry. She is the daughter of Ray Blair and Liza Garcia of Centralia, Missouri. After graduation, she will spend two years in the National Institutes of Health Post-baccalaureate Intramural Research Training Award Program, where she will perform full-time research. Upon completing the program, Mekka plans to obtain her MD/PhD and then pursue a career in medical genetics to work with children. Mekka is the recipient of the Howard Hughes Research Fellowship, Life Sciences Undergraduate Research Opportunity Scholarship, MFA Foundation Scholarship, MU’s Excellence Award, and the Anthony W. Rollins Scholarship. Mekka has volunteered at the University Hospital, MU Women and Children’s Hospital, Harry S. Truman Memorial Veterans’ Hospital, and Ellis Fischel Cancer Center.

“My research project is exciting to me because I know that for every second I spend in the lab, I am essentially getting closer and closer in helping so many children.”

-Mekka Garcia

Mekka Garcia’s Major:
Biochemistry

Faculty Mentor:
Dr. Charlotte Phillips

Mentor’s Departments:
Biochemistry and Child Health

Funding Source:
MU-HHMI Research Fellowship
Half of K-12 classroom teachers leave the field of education within the first five years due in part to their lack of preparation in classroom management strategies, costing the public school systems billions of dollars a year (NCTAF, 2007). Disruptive behavior in the classroom takes time away from instruction, disrupts student academic growth, and contributes to student and teacher stress. Effective classroom management is vital to student learning and teacher and student emotional health.

The long-term goal of our study aims to inform what classroom management practices are most helpful toward supporting teachers in promoting positive classroom environments that stimulate student learning. We used a meta-analysis method of reviewing existing research to compare published data on strategies. Hundreds of empirical articles were screened and coded to determine the effect size for proactive strategies on student academic and behavioral outcomes. Articles reviewed evaluated the effectiveness of the implementation of proactive classroom strategies, including teacher use of praise, opportunities to respond, precorrections, behavioral expectations, and active supervision. The subjects observed covered preschool, elementary grades, or middle/high school.

Initial findings indicate that the current literature focuses primarily on teachers intervening with individual students in the classroom rather than focusing on strategies at the classroom level. Based on what we have found thus far, we recommend that universities and teacher education programs train future teachers on effective classroom management as well as provide further training for current educators. Effective classroom management is important to the future of our schools. It has the potential to reduce stress levels and increase the self-efficacy of teachers, improve student academics, prosocial behaviors, and their emotional well being.

My research experience has allowed me to work with a mentor who is invested in my learning. Dr. Reinke has made my experience more interactive with other academics in the field.

“My research project has the potential to establish new direction for researchers.”

-Jale’t Hickmon-Rosa
Using Ramp Meters to Improve Traffic Flow and Driver Safety at Missouri Work Zones

Ramp metering is an up-and-coming technique currently used by many state Departments of Transportation to ease traffic flow from minor roads onto major highways and interstates. This system involves the use of a continuously changing traffic light set up at the on-ramp which forces vehicles to come to a complete stop before beginning to merge onto the highway. For interchanges with high levels of traffic, a tightly spaced group of cars attempting to merge simultaneously can often cause a severe build up for both the highway and on-ramp vehicles, causing longer travel times as well as increased risks to driver safety. Ramp meters force drivers to widen their individual gap spaces while entering the highway, preventing a kind of build-up of this type from occurring. This consequently improves travel time and the safety of drivers on both the on-ramp and highway. Many studies have been performed nationwide that document the positive mobility and safety benefits of ramp metering. However, there have been no studies on the effects of ramp metering on interchanges near reduced-lane work zones. The goal of this study was to provide the research and data necessary to prove that ramp meters set up temporarily near reduced-lane work zones effectively improve flow of traffic and more importantly, save the lives of Missouri drivers.

To determine if ramp meters cause a significant difference in the behavior of traffic around work zones, temporary ramp meters were placed on 7 different on-ramps to major highways and interstates undergoing reconstruction around Columbia, Missouri. For each sample, video footage of the ramp, merge area and mainline were recorded both with and without ramp metering. Safety measures such as driver compliance, merging behavior, and speed differentials were extracted from over 50 hours of video-based field data. We then used statistical analyses and traffic simulation models to analyze how these variables contrasted with and without the ramp meters.

The evaluation suggested that ramp metering effectively decreased the number of vehicles that merged onto the highway as part of a collective group. The percentage of single-vehicle merges increased from 50% to over 70%. This increase in single-vehicle merges reflects the increased widening of the gaps between merging vehicles as well as the improvement of the overall safety of the system.

The analyses also revealed that ramp metering produced quicker travel times for both mainline and ramp vehicles for work zones operating above capacity. On average a 24% decrease in total time of delay resulted from ramp metering. Overall, it was concluded that temporary ramp meters are proven to be effective for improving both the flow of traffic and driver safety near congested work zones.

Tyler Horn’s Major: Civil Engineering
Faculty Mentor: Dr. Carlos Sun
Mentor’s Department: Civil & Environmental Engineering

“My research project is important because ramp metering can improve traffic flows and transportation safety, leading to quicker travel times and fewer accidents.”

-Tyler Horn
Understanding Classroom Management: A Way to Improve K-12 Teacher Retention

*Joint project with Callee Barrett and Jale’t Hickmon-Rosa

Half of K-12 classroom teachers leave the field of education within the first five years due in part to their lack of preparation in classroom management strategies, costing the public school systems billions of dollars a year (NCTAF, 2007). Disruptive behavior in the classroom takes time away from instruction, disrupts student academic growth, and contributes to student and teacher stress. Effective classroom management is vital to student learning and teacher and student emotional health.

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My research project is exciting to me because I get to implement many of the strategies we talk about directly into my field classrooms and see the impact they have. Not only will it make me a more informed educator in the future, it has changed my perception and convinced me to pursue a graduate degree.

Rebecca Mesecher is a junior at MU majoring in elementary education. She is the daughter of Tim and Mary Mesecher of Blue Springs, Missouri. After graduation, Rebecca plans to work as an elementary school teacher in Kansas City or Columbia and pursue her master’s degree with MU’s Teaching Fellowship Program. She frequently volunteers with Susan G. Komen for the Cure and the Central Missouri Food Bank. Rebecca’s hobbies include watching and playing sports, reading, and spending time with her family.

“My faculty mentor is the absolute greatest. She is the most knowledgeable educator I know and is able to transfer her passion for research to all of our team.”

- Rebecca Mesecher

Rebecca Mesecher’s Major: Elementary Education
Faculty Mentor: Dr. Wendy Reinke
Mentor’s Department: Educational, School & Counseling Psychology
How Students Study in Wireless Coffee Shops: Personal Learning Environments

Since the boom of wireless internet, a growing number of students have been traveling to local coffee shops for routine studying. A study was conducted to seek a better understanding of behaviors common in college students studying in wireless coffee shops. There are 12 coffee shops within one mile of the University of Missouri-Columbia’s campus. For this study four shops, commonly used by university students, were chosen to host the study.

During this study we mapped student’s virtual behaviors through Personal Learning Environment (PLE) Maps. Virtual behaviors are the sites and programs that one might visit during their time on a computer in order of when they visit them, such as; 1st, email; 2nd; Facebook, 3rd, dictionary; and so on until the end of their computer session. PLE’s are internet or software tools used by students to take control of and manage their own learning, sites like Wikipedia, blogs, or even social networking sites. The goal was to understand why students study outside of the designed spaces at home or on campus; identifying the student’s processes and the order in which they go about learning activities; what types of students come to coffee shops to study; and what implications these have to specific physical features.

Through 51 interviews and 98 surveys, the PLE’s revealed the order and emphasis of virtual behaviors conducted by students. These behaviors were then organized in an order of hierarchy based on the frequency and intensity of activities. The activities were also categorized in the sequence of their occurrence. Students spent more time on music and studying than any other activity both at home and at the coffee shop. The most important aspects for the choice of coffee shops are location, people density, noise, and internet access. The first activities students participate in while studying all involve the internet with music background. As for the physical spaces students preferred lower lighting with task lights instead of a larger space equally lit. Students also preferred a firm chair in order not to get too comfortable.

My research project has the potential to lead to new creative design solutions for educational learning. Without my research experience, I would not have learned that I wanted to continue as a professor, giving students the opportunity I had.

Nathan Moore’s Major: Architectural Studies
Faculty Mentor: Dr. Newton D’Souza
Mentor’s Department: Architectural Studies
Funding Source: Human Environmental Sciences Program for Undergraduate Research Experiences

Nathan Moore
Birch Tree, Missouri
Shannon County
House District 143
Senate District 25

Nathan Moore is a senior at MU majoring in architectural studies. He is the son of David Moore of Birch Tree, Missouri and Kathy Geery of West Plains, Missouri. After graduation, Nathan plans to pursue a graduate degree in architecture and work as a principal architect. He would also like to become a professor. Nathan received a scholarship through the Human Environmental Sciences Program for Undergraduate Research Experiences. In 2012, he presented his research at the Environmental Design Research Association’s 43rd Annual Conference in Seattle, Washington. Nathan is a co-ed U19 soccer coach and rock climbing technician.

“My research experience has allowed me to visit the Environmental Design Research Association, giving me the opportunity to meet innovative professionals from around the world.”

-Nathan Moore
Development of an Optical Biosensor to Detect a Food Poisoning Bacterium in Wastewater

Each year approximately 1 in 6 Americans develops an illness due to a food-borne disease. The infectious bacteria *Campylobacter jejuni* is reported to cause roughly 2.4 million cases of mild to extremely severe food poisoning each year, and is a leading cause for hospitalization among the known foodborne pathogens. *C. jejuni* is primarily found in the fecal matter of chickens and cattle, and can easily contaminate streams and water sources. Consumption of unpasteurized milk and undercooked meats may result in an infection in humans, and although rare, can result in death if not properly treated. Therefore, developments in environmental monitoring for the *C. jejuni* bacteria in wastewater are very important for the safety of drinking water and the prevention of food-borne illness. The current monitoring techniques for *C. jejuni* bacteria are highly intensive and time consuming, requiring trained biochemists and long hours in the lab to confirm detection.

An alternate method to test for *C. jejuni* in wastewater is to use a biosensor, a device attached to biological probes that can detect biological matter. My project has been to develop a biosensor that can detect the *C. jejuni* bacteria in water using optics. Therefore, we propose a novel technique which utilizes the properties of optical resonators as highly sensitive, rapid, and specific biosensors that can detect *C. jejuni* in very low concentrations. After adding several layers of chemicals to the surface of our device, we attach the antibody which allows for specific binding to the *C. jejuni* bacteria. The high sensitivity of the biosensor is confirmed at each level of chemistry by testing its Quality Factor, this figure of merit tells the sensitivity of the biosensor. In approximately 4 days a biosensor is fabricated using lasers, chemical techniques, and optics that will show detection of bacteria in wastewater. By confirming this technique, the abilities of this biosensor are expanded and show that it can perform in more real-world scenarios.

“Through my research experience, I have learned how to be a leader in lab. Also, it has helped me to learn valuable communication skills when presenting my research by going to conferences.”

-Emily O’Brien
Detecting Buried Landmines in front of a Moving Vehicle

Our ongoing research project is aimed at improving the Army’s ability to detect landmines and explosive hazards in front of a moving vehicle using multiple sensors, including Forward Looking Ground Penetrating Radar (FLGPR) coupled with color and infrared video. This is a problem that has direct impact on the mobility of the Army and on the safety of the troops. Our research involves continually improving the detection rate of our system while optimizing it so that it can run in real time.

The data our system analyzes is infrared video captured by a camera mounted to the hood of the vehicle. The system automatically analyzes the video using a computer program and alerts the driver if the data suggests a landmine is present. We rely on the fact that landmines react to changes in temperature differently than the soil around them in order to detect them. Our system begins by finding “spots” in the infrared video that are either warmer or colder than their immediate surroundings. Our system then extracts several features from each of the spots we find in a given frame of the video. These features together help to represent the infrared signature of the object contained in the spot. Our system then decides whether the spot in question is a landmine or not by using a computer to run the extracted features through a statistical model that has been previously built based on a training dataset. One big issue with this technique is the choice of various parameters involved in the spot finding and feature extraction sections of the process, such as the thresholds used to identify spots in the image.

My most recent effort in this project is to create a system to automatically find the best parameters for these sections of our process in order to further reduce false alarms. We have been steadily improving our system during my time on the project, but still have more work to do before the system meets the Army’s requirements to be deployed.

Through my research experience, I have learned how a large project is coordinated between people across the country. My faculty mentor has given me a great opportunity by allowing me to do real research work, such as work that a graduate student might do.

Alex Paino

Chesterfield, Missouri
St. Louis County
House District 101
Senate District 26

Alex Paino is a junior at MU majoring in computer engineering and mathematics. He is the son of Tom and Debbie Paino of Chesterfield, Missouri. After graduation, Alex plans to attend graduate school or work full-time for Facebook, where he will be interning this summer. Alex co-authored a paper titled “Detection of Buried Objects in FLIR Imaging using Mathematical Morphology and SUM,” which was presented at the Institute of Electrical and Electronics Engineers Symposium on Computational Intelligence for Security and Defence Applications in 2012.

“MU has benefitted me by allowing me to start researching as a freshman, something I doubt I would have done at many other places.”

-Alex Paino
Understanding the Movement of Breast Cancer Cells to the Lung

Breast cancer is the second most common type of cancer in the United States and afflicts one of every nine women worldwide. Triple negative breast cancer is a type of breast cancer that does not contain any of the hormonal receptors (estrogen, progesterone or HER2/neu). Patients that suffer from this type of breast cancer only have the options of chemotherapy, radiation and surgery. This happens because there all current therapies target these receptors. It is important to note that the original tumor in the breasts is not typically lethal. Breast cancer tumors can move to other parts of the body. The impact of this action alone is responsible for 60 to 70% of deaths associated with breast cancer.

My work will help uncover potential reasons that breast cancer tumor cells move to the lung specifically. SOX4 is a protein that has a role in cellular division for growth and movement of cells to other organs in certain types of cancer. HuR is another protein that typically makes it easier for a specific protein to be generated. We are trying to understand the interaction between these two proteins (SOX4 and HuR) within the tumor cells that may be responsible for the movement of the cells to the lung. Prior to each experiment, we simply determine if there is a physical interaction between the two proteins. We discovered that there is an interaction in multiple types of breast cancer. Next, we reduced the levels of HuR protein to see if it would affect the SOX4 RNA because RNA makes protein. There was no change in the protein levels, which inferred that HuR does not make SOX4 more stable.

Following this experiment, we reduced the levels of HuR protein and checked for a change in the amount of RNA in the ribosomes, the cellular component that creates protein. Unfortunately, there was not more RNA in the protein creation centers without HuR. This signified that HuR does not allow more SOX4 RNA to reach the ribosomes. In our final experiment, we reduced the levels of HuR protein and checked the amount of SOX4 protein. There appears to be no change in the level of protein. If we can gain a better understanding of this process, then scientists may be able to create a treatment option for all types of breast cancer.

“My research has the potential to help save the lives of thousands of people afflicted with breast cancer.”

-Joe Rowles III

Joe Rowles’ Majors: Biochemistry and Food Science & Nutrition
Faculty Mentors: Dr. Ulus Atasoy and Dr. Joseph Magee
Mentors’ Department: Surgery and Molecular Microbiology & Immunology
Funding Source: National Institutes of Health IMSD EXPRESS
The Role of Genetic Diversity and Stress on Growth and Survival in Wood Frogs (*Rana sylvatica*)

One of the main goals for the research conducted in Dr. Ray Semlitsch’s lab is to establish biologically-based principles for amphibian management and conservation. Wood frogs reach the edge of their Midwest distribution in Missouri. Because they are patchily distributed and have small population sizes on the border of their geographic range, monitoring these populations is an important conservation issue for the state. Genetic diversity is a critical component of a population’s fitness and evolutionary potential. A previous study of wood frogs at three Missouri conservation areas (Danville CA, Daniel Boone CA, and Little Lost Creek CA) revealed significant differences in genetic diversity as well as significant genetic differentiation among conservation areas. These population genetic differences provided an ideal case study for examining the effects of genetic diversity on larval growth and survival.

While research has been conducted to examine the role of genetics in relation to survival in wild populations of wood frogs, the combined effects of genetic diversity and environmental stress have not been experimentally assessed. Our study involved rearing tadpoles from each conservation area under controlled conditions and systematically lowering the water level throughout the experiment to mimic the natural drying of ponds, resulting in increased water temperature. Fitness parameters measured in the experiment included maximal burst swimming speed of tadpoles, tadpole growth rate, survival to metamorphosis, time to metamorphose, as well as metamorph length, mass, leg length, and body condition. For each metamorph frog we calculated homozygosity by loci.

Overall, we found significant growth and survival differences between our conservation areas and treatments. Overall we found that the number of metamorphs, tadpole size, time to metamorphosis, and leg size at metamorphosis differed significantly among conservation areas and by treatments. An increase in homozygosity significantly increased the time to metamorphosis, decreased the number of metamorphs, and decreased the body condition of metamorphs. The drying treatment caused tadpoles to metamorphose sooner and with shorter legs, which increased their probability of dying following metamorphosis. Future research will seek to assess the effects of selective breeding to increase genetic diversity as a means to increase growth and survival, which will provide insight for future management of Missouri wood frog populations.

Rio Schondelmeyer is a senior at MU majoring in biochemistry. She is the daughter of Bruce and Sandy Schondelmeyer of O’Fallon, Missouri. After graduation, Rio plans to attend graduate school to obtain her PhD. She would also like to conduct research in ecotoxicology and become a professor in the future. Rio presented her research at the Undergraduate Research and Creative Achievements Forum in summer 2012. She volunteers at the Harry S. Truman Memorial Veterans’ Hospital and MU’s Relationship & Sexual Violence Prevention Center. Rio has participated in Alternative Spring Break. She enjoys watching movies and listening to music.

“My research has the potential to provide insight to the future conservation and management of amphibian populations.”

–Rio Schondelmeyer
Investigating Polymer Based Biomaterials for Improved Medical Implant Performance

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

I have been working to develop a nonfouling hydrogel, which is a hydrated polymer, or a plastic such as a soft contact lens, for this purpose. Over the past two and a half years, I have prepared hundreds of hydrogel samples to conduct studies using a bioassay to prove that this material is resistant to proteins sticking to the surface of the gel. The hydrogels were synthesized using varying amount of cross-linker material to optimize the properties of the sample in order to mimic human tissue. The experiment involved soaking the gel sample in a protein solution, soaking it in an antibody solution, and then adding a chemical reagent to cause a color change in the presence of the antibody—indicating the presence of protein on the gel. Our samples exhibited low levels of protein adsorption and therefore, nonfouling characteristics.

Our next step was to purposefully attach protein to the surface of the hydrogel, to provide specific biological signals. Once there is a layer of protein on the surface of the gel, it is possible to bind cells to the proteins, and the hydrogel becomes a tissue “scaffold.” In our lab, we have demonstrated mouse bone cells adhering to the surface of our sample. This scaffold has the potential for use in future studies to fabricate tissue and for many other biomedical applications.

My research project is important because it has allowed me to experience cutting-edge technology in the biomedical field as well as to apply coursework to hands-on research. Undergraduate research has prepared me for life after college more than any course would be able to do.

“Researching has been my favorite aspect of academics at MU and I’ve altered my career path as a result.”

-Megan Schroeder

Megan Schroeder

Ballwin, Missouri
St. Louis County
House District 98
Senate District 15

Megan Schroeder is a junior at MU majoring in biological engineering. She is the daughter of Daniel and Barbara Schroeder of Ballwin, Missouri. After graduation, Megan hopes to attend graduate school to study biomaterials or toxicology. Afterward, she would like to pursue a career in research. Megan presented her research at the Undergraduate Research and Creative Achievements Forum in spring 2012. She is the recipient of the Hightower-Excell Engineering Scholarship, University of Missouri’s Curators Scholars Award, and she is a Missouri Bright Flight Scholar. Megan volunteers at the Humane Society of Missouri and is actively involved in Engineers without Borders. Her hobbies include running, art, reading, and exploring the outdoors.

Megan Major:
Biological Engineering

Faculty Mentor:
Dr. Matthew Bernards

Mentor’s Department:
Chemical Engineering

Funding Source:
College of Engineering Undergraduate Research Option
Positive and Negative Factors of Sibling Relationships and their Effects on Self-Worth

Sibling relationships are a significant part of the lives of children and adolescents. Research has shown sibling relationships can be characterized along positive (e.g. warmth) and negative (e.g. conflict) dimensions. Additionally, it has been found that sibling relationships characterized by warmth and other positive factors enhance adolescent self-worth. However, little research exists on sibling relationships and their influence on subcategories, or domains, of self-worth. The present study focuses on the positive and negative factors of adolescent sibling relationships and how they affect five domains of self-worth.

Participants were 101 adolescent sibling pairs containing at least one sibling in grades 10-12 and the next closest in age sibling being less than 5 years younger. The sample was overwhelmingly middle-class and European American. Self-worth was assessed by the Self-Perception Profile for Adolescents; this measure consists of five separate subscales that assess adolescent competency in the academic, social, behavioral conduct, athleticism, and physical domains, as well as a combined “global” score. Positive and negative factors of sibling relationships were assessed using the Network of Relationships Inventory.

Very few sibling relationship qualities were associated with overall self-worth, with the exception that the more negativity girls reported towards their brothers, the lower those girls’ global self-worth. However, sibling relationship qualities, depending on the sex composition and birth order of the siblings, were more specifically associated with particular domains of self-worth. For example, girls (particularly with sisters) with more positive relationships rated their behavioral competency higher, while boys with sisters rated theirs lower. Additionally, associations with appearance self-worth were only evident for girls and sisters, while social self-worth was particularly evident for brother-sister pairs. This study is important because it shows how influential the sibling relationship, a relationship that almost everyone experiences, is on adolescents and their self-worth, especially within the different domains. The results of this study show that mental health professionals and clinicians need to be aware of the impact siblings have on adjustment and to pay close attention to adolescents’ comparisons to their siblings. This provides further evidence that family therapy maybe be the best option for prevention/intervention in some cases.

Christopher Shepard

Sedalia, Missouri
Pettis County
House District 52
Senate District 28

Christopher Shepard is a senior at MU majoring in psychology and sociology. He is the son of Paul and Michele Shepard of Sedalia, Missouri. After graduation, Christopher plans on attending graduate school to study clinical psychology. He is interested in developing interventions for at-risk and minority youth that help them combat stress arising from negative life events and situations. In May 2013, Christopher will present his research at the Midwestern Psychological Association Meeting in Chicago, Illinois. He is a psychology department honors scholar and a recipient of Missouri’s Curators Scholars Award. He is also a member of the Psychology Club and Psi Chi Honor Society. Christopher mentors and tutors at-risk adolescents and second language learners at Douglass High School. In his spare time, he enjoys playing tennis and racquetball, traveling, watching movies, and eating.

“My faculty mentor has supported and pushed me in both my research experience and my career goals.”

-Christopher Shepard

Christopher Shepard’s Majors: Psychology and Sociology
Faculty Mentor: Dr. Nicole Campione-Barr
Mentor’s Department: Psychological Sciences
Parent-Child Communication May Encourage Academic Success in Adolescence

In adolescence and high school, one’s level of academic success becomes increasingly more relevant. Students at this age are learning complex materials, dealing with more freedom and extracurricular activities, as well as preparing themselves for college or careers. Many parents turn to media or products that claim to have educational value in order to give children a better advantage. Some do so without even realizing they themselves might be just as helpful. A number of recent studies have emphasized the importance of parental involvement during adolescence. Their results show that both parental monitoring – a significant awareness of their child’s activities and whereabouts – and parent-child communication both, independently, have positive relationships with adolescent behavior and higher levels of academic achievement. Other researchers suggest these measurements of parental monitoring and willing disclosure of life events need to be reevaluated, noting that these two may not always coexist. While some parents acquire knowledge about their children indirectly, others are more involved by supervising their activities.

To further explore the influence of the parent-child relationship, we examined both parental supervision and child disclosure. Our population consisted of 90 adolescents between the ages of 12 and 18. Adolescents reported, through online questionnaires, about their parents’ active supervision and their voluntary disclosure to parents about a variety of activities. Data on academic achievement was gathered by asking parents and adolescents about the teen’s grades over the last year using a 5-point scale. We examined age and gender as control variables, finding that girls tended to earn better grades than boys. Considering these variables, parental supervision as reported by adolescents was not found to be associated with academic achievement overall, but the association was moderated by age. In other words, greater supervision was associated with higher academic achievement only in older participants, while younger adolescents who reported high levels of supervision tended to report lower grades. Recognizing variations in age, gender and supervision, we found no connection between parent-child discussion of general topics and academic achievement, but a marginally significant association was found between discussion of academic issues and better grades. These findings would suggest that parental supervision is indeed related to higher grades only when children are in the later stages of adolescence. Most evidently, discussion of school-related issues throughout this period may provide adolescents with the support they need to ensure academic success. While there are numerous benefits to incorporating technology into the classroom, what parents and should understand is that direct communication with their child is just as, if not more, important to promoting success. It would be advantageous for schools and even entire districts to encourage parental involvement in all areas of their adolescents’ lives, but particularly when academic performance is involved.

Allison Siroky

Allison Siroky is a senior at MU majoring in psychology. She is the daughter of Ron Siroky and Karen Sarazin of Rock Island, Illinois. After graduation, Allison plans to pursue her PhD in school psychology. In May 2013, Allison will present her research at the Midwestern Psychological Association Meeting in Chicago, Illinois. Allison is a recipient of the Missouri Alumni Association Scholars Program Scholarship. She volunteers with the Mid-Missouri Crisis Line and teaches with the Catholic Education Program. Allison also works as a personal assistant for Wirecloud software company.

“My research project is exciting to me because it sheds some light on the light that extensive measures may not be necessary to improve a child’s academic performance.”

-Allison Siroky

Funding Sources:
UM Research Board, MU Research Council

Allison Siroky’s Major:
Psychology

Faculty Mentor:
Dr. Nicole Campione-Barr

Mentor’s Department:
Psychological Sciences

House District 50
Senate District 19

Columbia, Missouri
Boone County

Allison is a recipient of the Missouri Alumni Association Scholars Program Scholarship. She volunteers with the Mid-Missouri Crisis Line and teaches with the Catholic Education Program. Allison also works as a personal assistant for Wirecloud software company.

“My research project is exciting to me because it sheds some light on the light that extensive measures may not be necessary to improve a child’s academic performance.”

-Allison Siroky
Working with a Local Startup Company to Develop a Gold Nanoparticle-Collagen Soft Tissue Filler

The cosmetic soft tissue filler industry, including injectables such as Botox and hyaluronic acid, is projected to have sales worth over a billion dollars across the globe by the year 2019. Our research group, in coordination with a University of Missouri start-up company called Eternogen™, has been investigating the properties of an alternative filler, made out of a naturally occurring component of the body, that will be useful for cosmetic applications as well as surgical applications including the areas of urinary incontinence, coronary implants, and musculoskeletal regeneration. The natural filler we are creating is made from porcine (pig) collagen.

Collagen protein fibers are a major component of connective tissue, and one of the most commonly utilized biomaterials, with applications including tissue engineering. While collagen is compatible with the human body, it tends to degrade, due to mechanical instability, which makes it inadequate for many in vivo- in living cell- applications. This means that, once injected into the body, it is not stable enough to withstand breakdown by various biological processes and thus will not be useful for long periods of time.

To circumvent the mechanical shortcomings of collagen, it can be bound to another substrate to increase stability by a chemical “crosslinker,” which, like glue, holds the two together. However, cross-linking schemes can lead to a host of their own problems including toxicity as well as less than ideal changes in the microstructural properties of the collagen. As a unique solution to these problems, our group utilizes small amounts- less than a thimble full- of gold nanoparticles (AuNPs) attached to collagen fibrils to make them more durable and increase biocompatibility so that patients do not experience adverse reactions.

Our results indicate that the presence of the AuNPs and “cross-linkers” added to our collagen scaffolds greatly improve stability of our fibers, with minimal change of the natural formulation of collagen (less than 1% change), according to the denaturation temperature- temperature at which the fibers completely degrade. While the stability of our fibers is competitive with commercial products, animal studies show that it agrees with living cells in a way that botox or a hyaluronic acid injection cannot. By acting as an antioxidant, anti-inflammatory and antimicrobial agent it improves tissue in-growth which is more than its commercial competitors can boast.

Claire Spradling’s Major:
Biological Engineering

Faculty Mentor:
Dr. Sheila Grant

Mentor’s Department:
Biological Engineering

Funding Sources:
EternoGen, Food for the 21st Century, and College of Engineering
Undergraduate Research Option

Claire Spradling is a junior at MU majoring in biological engineering. She is the daughter of Kevin and Rebecca Spradling of St. Louis, Missouri. After graduation, Claire plans to apply to a one-year fellowship abroad, obtain her master’s degree in biomedical engineering, and then continue on to medical school. She presented her research at the Biomedical Engineers Society in 2012, as well as at the National Nanotechnology Infrastructure Network Conference in 2011. Claire is the coordinator of the Armory Science Klub (ASK), where she teaches weekly science lessons to children ages 8-10. Claire is involved in the Griffiths Leadership Society for Women, Phi Sigma Pi National Honor Fraternity, Honors College Ambassadors, Engineering Student Council, and the Biomedical Engineers Society.

“Performing research with a company has prepared me for a future in medicine by allowing me to work with professionals ranging from professors to CEOs. This has given me insight into industry and how important cooperation is between the business world, research, and medicine.”

-Claire Spradling
Using Genome Sequencing to Understand Plant Evolution and Photosynthesis

Broccoli, cabbage, canola and papaya are members of the Brassicales order of flowering plants. Many common ornamental garden plants are also in this taxonomic order. Arabidopsis thaliana is perhaps the most studied Brassicales species because it can be grown quickly for genetic experiments. A unique thing about Brassicales and all other plant groups is that they contain three libraries of genes, or genomes. Animals only have two genomes. One of the genomes comes from the parents and resides in the nucleus, while the other two are located in other compartments of the cell (mitochondria and chloroplast) are derived from bacteria approximately one billion years ago. Dr. J. Chris Pires at the University of Missouri is interested in the bacteria-derived genome that resides in the chloroplast, which is the compartment in cells that allows plants to make their own food from sunlight. This process is known as photosynthesis—one of the most important biological processes that helps support life on this planet.

Our goal is to compare chloroplast genomes across representative species in Brassicales and identify which types of mutations shape the chloroplast genome. Since we know the evolutionary relationships between different species of the group, the Brassicales serves as a powerful model system. We used the state-of-the-art Illumina sequencing technology at the University of Missouri’s DNA Core to sequence whole genomes of 19 representative species of Brassicales. Currently, fully assembled genomes are available for five of the representative species. We aligned the assembled genomes based on sequence similarities using computer algorithms. This method allows us to detect mutations such as substitutions, insertions, deletions, gene losses, and genome rearrangements. Other studies have shown that gene loss is prevalent in the nuclear and mitochondrial genomes, and our preliminary results revealed that chloroplast genomes in Brassicales are subjected to deletions and gene losses as well. Future work includes mapping mutations onto the “family tree” of Brassicales to estimate the rate of change of chloroplast genomes. By understanding how the chloroplast genome changes, we can gain a deeper understanding of the genetic and genomic controls of photosynthesis and plant evolution.

The latest DNA sequencing technology poses new challenges in computational power and data handling. Dr. Pires and his lab members are at the forefront of seeking solutions to optimize the use of this new technology. Using the University of Missouri’s newest DNA sequencing equipment, it only takes a week to obtain a full genome compared to the years of doing it through the old method of sequencing.

Michelle Tang’s Major: Biological Sciences
Faculty Mentor: Dr. J. Chris Pires
Mentor’s Department: Biological Sciences
Funding Source: McNair Scholars Program
A Model of Post-Traumatic Stress Disorder in Mice

Post-traumatic stress disorder (PTSD) is a debilitating condition that affects a significant portion of this country’s population including rape victims, natural disaster survivors and, most prominently, U.S. veterans. While the disorder is common, its treatment options are limited and often come with negative side effects.

Mice have nervous systems that are very similar to those of humans, and it is likely that treatments and mechanisms effective in mice would also be effective in humans. Before we look at PTSD in mice though, we need to develop a method of consistently giving mice PTSD or, in other words, we need to develop a model.

To accomplish this goal, we used the Pavlovian principle of conditioned learning. Over three days, we introduced mice to a trigger followed by a stressor. Thirty minutes before light-onset, each mouse’s normal cage was replaced with another cage without bedding (this movement to a blank cage served as a trigger). At light-onset, mice were either exposed to soiled cat litter (stressor) or clean cat litter (control). On all three days, exposure to the stressor was terminated 4 hours after light-onset by replacing the cage containing cat litter with the original cage. Then, after 21 days, we introduced to the mice only the trigger and then examined their sleep behavior using electrodes that had been implanted into their brain before the experiment. Mice exposed to no stressor and only a trigger 21 days after conditioning demonstrated insomnia, a hallmark of PTSD, which indicates we have successfully developed a model of the disorder.

Now that we’ve had a chance to confirm our model, it is time to put it to use. While there are several procedures we could use to monitor molecular levels in our mice during the disorder, our first step will be to try to relieve the PTSD-mice of their insomnia. One way we will attempt to do this is by putting our mice on a diet of *Sutherlandia frutescens*, an herb found in southern Africa with potent anti-stress activity. If the herb relieves insomnia in mice with PTSD, then it has the potential to do so in humans as well.

Omar Taranissi

Columbia, Missouri
Boone County
House District 50
Senate District 19

Omar Taranissi is a sophomore at MU majoring in biological sciences. He is the son of Ahmed Taranissi and Eman Darrag of Columbia, Missouri. After graduation, Omar plans to obtain his MD/PhD so he can practice medicine and continue conducting research. He has presented his research on campus at the Life Sciences Research Poster Session, Health Sciences Research Day, and the Undergraduate Research and Creative Achievements Forum. Omar volunteers with the Medzou patient assistant program, Boone Hospital oncology and general medicine floors, and Harry S. Truman Memorial Veterans’ Hospital emergency room. He is also involved with Big Brothers Big Sisters and Alternative Spring Break. Omar’s hobbies include Brazilian jiu-jitsu, Kaotlx dance crew, and the Blacklisted Banned Book Club.

“Because of my faculty mentor, I have practical knowledge of science and neurology, rather than just the theoretical knowledge I would gain from class. Because of him, I feel like a scientist, rather than just a student.”

-Omar Taranissi
Stormwater Pollution Control Using Drinking Water Treatment Byproducts

During a rain event, the storm water runoff picks up chemicals present in the soil including the plant nutrient phosphorus. In 1987 Congress amended the Clean Water Act with section 319 to address the management of nonpoint sources, therefore directly dealing with storm water runoff pollution potential. The focus for this research effort is reduction of the phosphorus content in the runoff so that it does not increase the amount of phosphorus in the streams which can be a cause of reduction of ecological diversity due to over growth of algae.

Phosphorus is also a contributor to hypoxia in the Gulf of Mexico. Nutrient rich fresh water from the Mississippi River promotes the growth of phytoplankton (drifting plants). As the phytoplankton die, sink down, and are decomposed by the bacteria, oxygen is consumed. Most aquatic organisms either move away or die, affecting the balance of ecosystem.

Phosphorus binds to metals such as ferric iron (Fe), aluminum (Al) and calcium (Ca) and if these metals are present in a storm water runoff, best management practices should remove phosphorus from the runoff before it gets into a stream. Metal coagulants are commonly used in the drinking water treatment process to help remove solids from the water, which are then typically discarded in a landfill. This effort to make beneficial use of these discarded materials should help both storm water managers and treatment plant operations.

Our research uses three kinds of slurries from the drinking water treatment plant as a chemical additive in two kinds of soil mixes to reduce the amount of phosphorus in the synthetic storm water runoff. The synthetic stormwater was run in the soils, first without any additives and after with metal additives and then different water quality parameters, including amount of phosphate, to determine if the phosphorus was reduced by modifying the soil with metals.

My research project is exciting to me because it is something I want to do all my life. My faculty mentor is a great source of knowledge, a kind human being, and always interested in student learning.

“My research experience has allowed me to think outside the box, analyze other research, and come up with new ideas every day.”

-Sital Raj Uprety

Sital Raj Uprety’s Major: Civil & Environmental Engineering
Faculty Mentor: Dr. Enos C. Inniss
Mentor’s Department: Civil & Environmental Engineering
Funding Source: McNair Scholars Program