URSA
Undergraduate, Research, Scholarship and Arts
Benedictine University

2018 Poster Session Program

April 5, 2018 ❖ 12:00-5:30 pm ❖ Goodwin Hall atrium

Daisy Jimenez, Mujtaba Ahmed
"Cobalt, Calcium and Copper Oxygen Evolution Using the HARPOON project"

Based on the HARPOON project, we chose three different metals to test for oxygen evolution in different ratios. The literature helped us determine which three metals to use. We did this to possibly find a way to decrease the effects of climate change. We set up an eight-by-eight plate with all of our different ratios of our mixed metals and it resulted in oxygen evolution.
Faculty sponsors: Anne Marie Smith, Kari Stone

Alexandro Hernandez
"Cerium (III) Nitrate, Zinc Nitrate, and Cobalt (II) Nitrate Solutions' Ability to Produce an Efficient Amount of O_2 in a NaOH solution"

We hope to determine if cerium (III) nitrate, zinc nitrate, and cobalt (II) nitrate solutions would be proficient catalysts for water oxidation to provide more efficient solar panels. The metals were placed in different ratios and were dotted on an electrode glass plate. Afterwards, they were placed in a NaOH solution under a black light to determine if they were able to produce O_2. The chosen metals are known to have a relationship with one another and are effective at speeding up the water oxidation process.
Faculty sponsors: Anne Marie Smith, Kari Stone

Rishabh Jakhariya
"Using Cerium (II) Nitrate, Zinc Nitrate, and Cobalt (II) Nitrate as Catalysts in the Water Splitting Process to Produce Oxygen and Hydrogen."

The use of non-renewable energy in industries, homes, vehicles, and other structures is at a high rate which is dangerous because they cause climate change. To reduce the stress of producing energy on non-renewable resources, we will use the water splitting process to produce oxygen and hydrogen; this process can be used to produce energy. In this process, we are finding a ratio of cheap and effective catalysts which can be used. The metal salts that we will use are cerium (II) nitrate, zinc nitrate, and cobalt (II) nitrate. Fifteen different ratios of these metals will be prepared and compared to a known effective catalyst containing nickel, iron, and cobalt in the ratio of 20, 40, and 40, respectively (in uL).
Faculty sponsors: Anne Marie Smith, Kari Stone

Timothy Benjamin
"Using a Non-Destructive Technique to Measure Mercury (Hg) Concentrations in Endangered Adult Blanding's Turtles (*Emydoidea blandingii*) in Northeastern Illinois"

Mercury (Hg) is a highly toxic metal that bioaccumulates in individuals as well as biomagnifies up the trophic ladder, posing health risks to exposed wildlife. Wetlands play a key role in Hg cycling by functioning as a sink for total mercury and as a net source of methylmercury (MeHg) production. Reptiles, specifically aquatic turtles, can function as

bioindicators of wetland ecosystem health because they are long-lived and occupy elevated trophic positions in wetland food webs. The purpose of this study was to determine Hg exposure in Blanding's turtles, an endangered prairie-wetland species endemic to northern North America. Toenail samples were collected from gravid females from four wetland sites in northeast Illinois. Toenail Hg concentrations ranged from 654 to 3132 ppb and we found no significant effect of wetland site or body size on Hg concentrations. Toenail Hg concentrations reported in this study were lower than those of other aquatic turtles, suggesting Blanding's turtles in this region are not exposed to high Hg concentrations. This is the first Hg-related study on Blanding's turtles and can serve as a reference for other Hg studies in northeast IL wetlands.
Faculty sponsor: Leigh Anne Harden

Sajina Jacob, Elizabeth Kvitek
"Copper, Magnesium, and Cobalt for Oxygen Production and Sustainable Energy"

We are aiming to find sustainable energy sources using the metals copper, magnesium, and cobalt. Metal solutions with varying ratios were spotted on a FTO plate and put through the process of electrolysis. We chose the metals based on their properties including conductivity and research of the Activity Chart. Copper is a good conductor of electricity. Magnesium can prevent itself from rusting when exposed to air, and makes other metals lighter when used in an alloy. Cobalt is ductile and produces sparks when struck. Through the process of electrolysis, we were able to see significant oxygen production with our metal solutions.
Faculty sponsor: Kari Stone

Habib Hassan, Martinas Stanys
"Exploring the Selection of Ba, Fe, and Co to Serve as Catalysts for the Oxygen Evolution Reaction at the Anode of a Photochemical Cell"

Metal oxide catalysts are known to catalyze the oxygen evolution reaction within in the anode of a photochemical cell. These catalysts are based on the manganese, calcium, and oxygen catalyst that functions in plants during photosynthesis. We propose researching an alternative metal complex, BaxFeyCoz (x, y, and z are the most efficient ratios), in hopes of replacing the current standard, NiFeCo. Barium, cobalt, and iron were selected due to recent literature pointing to a synergistic effect in producing oxygen. To test water-splitting potential, we will use the method of testing an array of ratio-varied catalysts through a current as outlined in the Solar Army's HARPOON project. If the hypothesized efficiency is achieved in one or more ratios, this compound will aid in improving hydrogen fuel production in modern-day photochemical cells.
Faculty sponsor: Kari Stone

Wamuyu Munyiri, Drake Berry
"An Investigation of the Properties of Mn, Ni and Co Oxide Catalysts for Oxygen Evolution"

Cobalt nitrate has been recently examined as an oxidation catalyst. Certain studies have found that cobalt is useful in its efficiency to produce water oxides, as displayed by its ability to form cobalt oxide nano clusters when calculated at 550 degrees Celsius. Cobalt was also found to hold success as a water oxidation catalyst, improving stability for hydrogen gas production by means of solar water splitting. Nickel has also been shown to be an effective metal oxide catalyst when combined with cobalt. This study aims to survey Mn, Ni, Co oxide catalysts for oxygen production.
Faculty sponsor: Kari Stone

Mujtaba Ahmed
"Oxygen Evolution with a Copper, Cobalt and Calcium Oxide Catalyst"

Oxygen evolution and water splitting are important for energy production. We use three metal oxide solutions to find optimal concentration to catalyze oxygen evolution. The FTO plate with solution mixtures will glow as oxygen molecules evolve. Our goal is to use copper, cobalt and calcium from first row transition elements which are cheaper than ruthenium and iridium. The results of the reaction show up as illuminated wells on the FTO plates.
Faculty sponsor: Kari Stone

Katherine Walter Easley
"Benefits of Early Palliative Care: A Literature Review"

The World Health Organization and the National Hospice and Palliative Care Organization advocate the integration of palliative care throughout the course of a long-term illness. Palliative care is often confused with hospice care, which is limited to end-of-life, whereas palliative care can be utilized during the entire illness. The purpose of this evidence-based project was to review documented research on outcomes of early initiation of palliative care for adult patients. 17 research studies were retrieved. Search terms were "palliative care," "patient outcomes," and "patient perceptions." Databases used were CINAHL Plus, Ovid, Medscape, and ScienceDirect. Inclusion criterion: written no earlier than 2010. Exclusion criterion: not directly related to adult patient benefits. Of the original 17 studies, eleven were retained. Patients who received early palliative care had a greater overall quality of life, better understanding of prognosis, longer survival, were satisfied with their involvement in decision-making, and experienced fewer symptoms. Based on these findings, it is recommended to start palliative care earlier in the disease process.
Faculty sponsor: Barbara Simmons

Elijah Medlock, Nicole Jeffrey, Alissa Potts
"Historically Significant Scientists at Benedictine University"

This poster is about two significant figures at Benedictine, Dr. Frank Shonka and Dr. William Jesse, who played pivotal roles in developing the physical sciences laboratory in old Procopius Hall. Dr. Shonka assembled a collection of electrometers that he used to help develop the Shonka electrometer, which has seen many commercial uses in medical physics and radiation studies. A plastic was developed at the physical science laboratory that was used in lunar exploration and studies of the Van Allen radiation belt in the late 1950s and 1960s. Dr. Jesse contributed to work on the Manhattan project. Both Shonka and Jesse were well known for their research in radiation physics and they each worked with Nobel prize winning physicists throughout their career.
Faculty sponsor: Tim Marin

Anthony Marzano
"The Causes and Effects of the 2008 Financial Crisis"

This research project investigates the causes and the effects of the 2008 financial crisis. The process and some of the factors which could have led to the crisis are explained. As for the crisis itself, data analysis was done by using an S&P 500 index ($IVV). Among the aspects looked into is the amount the United States economy receded, how it recovered, how market volatility was effected, and many other statistical analyses. The accuracy of the statistical analysis is also inspected. Additionally, the long-term effects of the crisis and the legislation measures enacted as a result of the crisis are explored.
Faculty sponsor: Larissa Adamiec

Alexandra Arrich, Nicolette Vanderwarren
"The Plant-tastic Preservation of the Jurica-Suchy Nature Museum Herbarium"

Herbariums provide substantial information to scientists about the history, environment, and genetic profile of preserved plant specimens. This information is essential to the study of taxonomy, conservation biology, biodiversity, and climate science. In the Jurica-Suchy Nature Museum Herbarium Digitization Project, we are accessioning, inventorying, cataloging, and barcoding approximately 3500 preserved plant specimens that date from the late 1800's to present day. After we complete this step, we will create a new online data portal on the SEINet Herbarium Network within the North American Network of Small Herbaria, using the guidelines provided by the Morton Arboretum Herbarium staff and volunteers. The overall purpose of the project is to make the collection and associated material accessible to the public. Future goals for this project include the digitization of the full JSNM Herbarium and the development of an educational, interactive herbarium outreach program.
Faculty sponsor: Karly Tumminello

Luis Moreno
"Choosing Redox Active and Inactive Metals in Use for Catalytic Water Oxidation in Turn for Production of Oxygen in Oxygen Evolution"

HARPOON is a scientific project using the ideology behind photosynthesis in order to find certain redox inactive and active metals that when exposed to solar light that can then split apart and produce oxygen just as photosystem II does in plants. Choosing nickel, calcium, and copper as our three metals is based on their characteristics and could result in the most hits. Our goal by making these metallic solutions in different ratios is to see which hit ratio would produce the most amount of oxygen.
Faculty sponsors: Anne Marie Smith, Kari Stone

Hamzah Malik, Fardeen Sayed
"Synthesis of Diiminopyridine, a Redox Active Ligand"

A diiminopyridine (1,1'-(pyridine-2,6-diyl)bis(N-(2,6-diisopropylphenyl)ethan-1-imine)) was synthesized through a Schiff's base reaction. Diiminopyridine is a redox active, or non-innocent, ligand. Redox active ligands are such that the metal complex can assume more than one oxidation state. The three interior nitrogen atoms will bind to a metal to form the redox active ligand in a tridentate fashion, which allows for the formation of pincer complexes. The elevated level of conjugation possessed by the ligand results in greater stability of the metal in irregular oxidation states.
Faculty sponsor: David Rubush

Hajira Nayeemuddin, Robert Szczypta
"Nucleophilic Fluorination with with Small Molecules"

Nucleophilic fluorination is the generation of fluoride ions through chemical reactions to create a new nucleophilic fluorine reagent. The incorporation of fluorine is an essential element in the pharmaceutical and agrochemical industry. Carbon fluoride bonds contain many beneficial properties such as increased bond polarity and strength due to the high electronegativity of fluorine in comparison to carbon hydrogen bonds. However, existing fluorinating reagents must be handled with care due to their toxicity and high reactivity. Our goal is to create nucleophilic fluorine under mild conditions. Pyridine is a reactive nucleophile and has a stable aromatic system, and so is a strong candidate for a substrate where a nucleophilic fluorine can be generated. These organic-soluble pyridine based substrates can successfully transfer their fluoride anion through substitution at a benzylic position to give benzyl fluoride.
Faculty sponsor: Brooks Maki

Hajira Nayeemuddin, Sarah Zarnowski
"The Preparation of a Redox Active Ligand (N,N'-Bis(3,5-di-tert-butyl-2-hydroxyphenyl)-1,2-phenylenediamine)"

In this experiment, a redox active ligand, N,N'-Bis(3,5-di-tert-butyl-2-hydroxyphenyl)-1,2-phenylenediamine, was synthesized. Redox active ligands are used to react with metal complexes that then get oxidized to participate in chemical transformations. The function of this chosen ligand is to act as a Lewis Base that donates electrons. The primary coordination sphere of N,N'-Bis(3,5-di-tert-butyl-2-hydroxyphenyl)-1,2-phenylenediamine consists of four donor atoms, resulting in an effective ligand. With the mixture of butylcatechol, o-phenylenediamine, and triethylamine, this redox active ligand was successfully synthesized. The reactants mentioned above were left to stir over a span of 5 days. Vacuum filtration and washes with n-pentane of this mixture allowed us to yield 1.01 grams (20.6%) of N,N'-Bis(3,5-di-tert-butyl-2-hydroxyphenyl)-1,2-phenylenediamine. Analysis of H-NMR spectrum and InfraRed Spectroscopy confirmed the structure of the product.
Faculty sponsor: David Rubush

Nicole Chacin
"The Therapeutic Aspects of Art Therapy for Children"

Art Therapy is a powerful human experience transforming a person's hospital stay, frame of mind around an illness, and expression of his/her vulnerability and strength in the midst of pain and suffering. A simple act of putting a utensil to

paper and exploring realms of thought, imagination, and feeling change the atmosphere of a sterile, uniform hospital to a place of healing and safety. In the same way a picture says a thousand words, a piece of art regardless of aesthetic value, accuracy, or correctness enables individuals to have a voice and unique signature when it seems like all the decisions about their well-being are decided for them. Art therapy provides control to people who might feel they do not have any. My research will explore the various ways art therapy helps children heal and why it is important in health care. My research targets three key areas of art therapy: the process, its benefits, and its implementation in hospitals for children. My sources encapsulate art therapy programs for children in hospitals in the Midwest while examining practices worldwide.
Faculty sponsor: Jennifer Scavone

James Hoshell, Ferhan Syed
"Formation of Metalloenzymes via Myoglobin with Cobaloximes"

Two cobalt-based complexes, [Co(II) (dmgH)2(Py)2] and [Co(III) Protoporphryin IX Cl], were reconstituted in apomyoglobin by removing the native heme from the protein. These complexes were chosen due to ease of access and their similarity to vitamin B_{12}, as they both consist of an aromatic structure. This allows structural similarity to the native-heme which was removed from the apomyglobin. Myglobin was chosen due to its robust protein structure and ease of access. The synthetic metalloenzyme was then used with $NaBH_4$ with the goal of forming a stable hydride complex inside the protein. Analysis includes UV/vis spectroscopy and H1-NMR; the proposed hydride complex may be able to reduce other compounds. These synthetic metalloenzymes may be capable of water reduction and hydrogenation.
Faculty sponsor: Kari Stone

Anthony Marzano
"Causes, Effects, and Analysis of the 2008 Uranium Bubble"

This research project investigates the causes and the effects of the 2008 uranium bubble. The process and some of the factors which could have led to the crisis are explained. As for the crisis itself, data analysis was done by creating a proprietary index of uranium mining companies. Among the aspects looked into is the amount the uranium market receded, how it recovered, how market volatility was effected, and many other statistical analyses. The accuracy of the statistical analysis is also inspected. Additionally, the long-term effects of the bubble are explored.
Faculty sponsor: Larissa Adamiec

Amanda Del Aguila, Moira Wendel
"Environmental Awareness, Attitudes and Behaviors at Benedictine University"

The environment is degrading at an alarming rate, and in order to abate environmental destruction it is necessary for individuals to change their behavior towards the environment. Educating students about the environment is an important component of this goal. This study assessed the attitudes, beliefs, and behaviors of Benedictine students towards the environment. The investigators also wanted to see how successful Benedictine was at providing information about the environment and creating an environmentally-aware community. The goal was to determine the relationship between one's attitude, beliefs, and behaviors towards the environment and to understand how education at Benedictine may have affected those variables. A survey was electronically distributed among Benedictine students using Qualtrics, a research software program. Participants were selected from a convenience sample, and all students that participated remained anonymous. Various statistical tests were used to analyze the data.
Faculty sponsor: Jean-Marie Kauth

Alaina Thompson
"Helping and Serving Morningstar Mission: An Arthur J. Schmitt Project"

This project was done solely through donations and volunteer work amongst faculty and staff of Benedictine University and members of the surrounding community. The purpose of the project was to help benefit MorningStar mission, a non-profit organization, located in Joliet that provides shelter, food, clothing and resources to help lift up those in need in the community. This goal was completed through holding drives on the Benedictine campus, outreaching to the

community and through volunteer work at the soup kitchen located at MorningStar. Through these services, the organization was benefitted with sixty-eight pairs of children's pajamas, eight kits of men's shaving products, eighteen hours worth of service, and other miscellaneous clothing items.
Sponsor: Joan Henehan

Furkhan Ali
"Speaking of Animals: Public Interactions at the Brookfield Zoo"

This poster details my experience working as a Roving Naturalist at the Brookfield Zoo during summer 2017. I was given certification as a Certified Interpretive Guide (CIG) and, with knowledge from this training, I engaged in all sorts of activities. I held snakes, lizards, and turtles while simultaneously giving talks about them to zoo visitors. After these talks, I gave the general public the opportunity to come and pet the reptiles. Additionally, I spoke about other animals including Amur (Siberian) tigers, Amur leopards, llamas/alpacas, reticulated giraffes, dolphins, sloth bears, and even gorillas. I was also tasked with approaching visitors and talking to them about the zoo's animals.
Faculty sponsor: Allison Wilson

Mohammed Haq, Emily Gornick
"Novel Endoperoxides Increase Apoptosis Only in Cancer Cells by Inducing Oxidative Stress"

Artemisinin (ART) is an antimalarial drug that forms free radicals and induces cell death in the iron-rich malarial parasite. ART also exhibits anticancer properties, though the mechanism is unknown. Our goal is to develop novel ART analogs that can induce apoptosis in cancer cells at low doses and with minimal toxicity. We examined the efficacy of the trioxane analog DMR1 and the dioxazinane analog HSM2 in inducing apoptosis in normal and cancer cells. T84 (colon cancer), A549 (lung cancer) and BEAS2B (normal lung) cells were grown to confluency and treated overnight with increasing doses (0 – 100μM) of DMR1 or HSM2 ± 1mM NAC (an antioxidant). Cells were then stained with fluorescent dyes and analyzed for cell apoptosis or reactive oxygen species (ROS) production via flow cytometry and fluorescence microscopy. Flow cytometry analysis suggested that the analogs increased cancer cell apoptosis (HSM2>DMR1) and increased ROS production in T84 cells. Neither analogs increased cell death in BEAS2B. Additionally, scavenging ROS with NAC decreased cell apoptosis, confirming the role of ROS in ART analog-induced cell death in cancer cells.
Faculty sponsor: Jayashree Sarathy

Sara Cecco, Ugne Dinsmonaite, Yechan Kim
"Fluoresceinamine-tagged Chenodeoxycholic Acid (CDCA-FA) Causes Epithelial Barrier Dysfunction and Moves Paracellularly in Human Colonic T84 Cells"

Bile acid (BA)-induced diarrhea (BAD) affects one-third of patients with IBS, but the underlying mechanism is unclear. We have previously shown that the primary BA chenodeoxycholic acid (CDCA) adversely affects epithelial tight junction (TJ) function when present in the apical surface (AS) and that it altered transcellular fluid secretion when applied to the basal surface (BLS). To track the movement of apical CDCA, we tagged CDCA with fluorescein (CDCA-FA) and characterized it. T84 cells grown in Transwells ± 500μM CDCA or CDCA-FA for 0.5-18 hours were stained with propidium iodide and subjected to fluorescence microscopy and ImageJ analysis. CDCA-FA's effects on TJs ± ROS scavenger NAC (1mM) were assessed by measuring transepithelial resistance (TER) and permeability of CDCA-FA. Overnight exposure to CDCA-FA, like CDCA, caused a small (~18%) decrease in cell viability and a time-dependent decrease in TER, neither of which were altered by NAC. Additionally, CDCA-FA permeability increased over time, which was attenuated by NAC. We conclude that CDCA on the AS travels to the BLS by a ROS-dependent increase in paracellular permeability through TJs.
Faculty sponsor: Jayashree Sarathy

Sowghandhi Umashankar
"An Exploration of Ocean Acidification and Its Impact on Squid, Their Survival Prospects Compared to Related Species, and the Effect of Their Possible Disappearance on the Larger Marine Ecosystem"

This project will include information on how squid grow and develop, and how that development will be affected by ocean acidification. The effects of seasonal laying time on squid development in acidified ocean will be disused, as well

as the effects on adult squid populations. It will explore the role of squid in the marine ecosystem and how the predators of squid and squid prey will be affected by potential loss of squid from the ecosystem. The survival prospects of squid will be compared to closely related creatures, like cuttlefish, and the survival rates of different species of squid will be compared to one another.
Faculty sponsor: Jean-Marie Kauth

Jonathan Shubert
"Tutoring Workshop at St. Peter and Paul Catholic School: An Arthur J. Schmitt Project"

For this project I joined a few other aspiring teachers in visiting St. Peter and Paul Cathlic School in Naperville, IL, and tutoring fourth, fifth, and sixth grade students in math. These students are those who the teachers and superiors at St. Peter and Paul felt needed more assistance in math. The resources that we used were computers at the school, games that can be related to math, and various worksheets. We aimed to help these students improve significantly on their math tests in class. This was shown to us through their improvements during the tutoring workshop. The poster will consist of images from the workshop as well as the methods that were used and the results that were collected.
Sponsor: Joan Henehan

Rebecca Weber
"Bringing Free Little Libraries to Local Nature Centers: An Arthur J. Schmitt Project"

As an Arthur J. Schmitt scholar, I am responsible for choosing, designing, and executing a community service project. For my project, I have chosen to raise funds, and install "Free Little Libraries" filled with books about wildlife to the Morton Arboretum, the Little Red Schoolhouse Nature Center, and the Iron Oaks Environmental Learning Center. I chose to pursue this project because I was deeply affected by the visits I took as a young child to nature centers, some of which I will have the pleasure of donating to as a part of my project. It is my goal that installing Free Little Libraries at these nature centers will help to foster a strong sense of community and environmental stewardship among visitors.
Sponsor: Joan Henehan

McKayla Holmes
"Animal Agriculture and Its Contribution to Environmental Issues"

Typically when a person thinks of reducing their carbon footprint, they turn to ways to improve and cut down air pollution caused by the transportation sector. In fact, research shows that the transportation sector is not the largest contributor of pollution. The animal agriculture sector is responsible for about 18%, or almost one fifth, of air emissions today. These numbers take into account the production of feed, transportation of animals, the waste, and the use of space to raise livestock. If this is the main cause of our reduced air quality, then why has do we direct our attention to a different source? My research deals with why the government has limited restrictions on the animal agriculture industry. I will discuss possible conclusions based on economic theories, such as our Gross Domestic Production and production possibilities. The United States is one of the countries that consume the highest amount of animal-derived products. I will also discuss possible solutions that involve reducing consumption of these products.
Faculty sponsor: Jean-Marie Kauth

Daniel Hejny
"Finding Inexpensive Solutions for Oxygen Catalysts Using Copper, Nickel, and Calcium"

The search for an alternative to hydrocarbon fossil fuels for a source of abundant energy is of great relevance today. One area of interest is fuel cells, a cell that converts chemical energy to electrical energy via a reaction of hydrogen and oxygen. The limiting factor in production of these cells is finding oxygen catalysts to serve as the anode end of the cell. Our group surveyed mixed metal oxide catalysts, specifically copper, nickel, and calcium, according to the details laid out in the Solar Army HARPOON handbook. These metals are both abundant and inexpensive when compared to other metals, with the industrial infrastructure already in place to extract them in the required amounts.
Faculty sponsor: Kari Stone

Mary Keenan, Reenie Baidya
"Using CRISPR to Create a Transferrin-receptor KO Model to Elucidate the Role of Artemisinin-analog Induced Apoptosis in Cancer Cells"

In a joint project, Dr. Jayashree Sarathy and Dr. David Rubush tested the ability of artemisinin-derivatives to induce apoptosis in cancer cell lines. It was postulated that the higher concentration of iron present in cancer cells relative to normal cells, would allow for these anti-malarial drugs to create free radicals that would lead to death in cancer cells. Preliminary evidence shows that the cancer cell line (A459) was affected but not normal bronchial cell line (Beas2B). To further substantiate the role of iron in the mechanism of action of these drugs, the creation of a cell line with reduced or absence of transferrin receptors would be ideal. Using CRISPR, it is our goal to produce an expression vector capable of knocking out the transferrin receptor gene in normal and attenuated cancer cell lines. We hypothesize that the subsequent decrease in the effect of artemisinin-analog induced cell death in cancer cells will confirm a role for transferrin receptors in its action.
Faculty sponsor: Mark Poch

Steven Gibson
"Density of Mixed-Race Births vs. Incidence of Social Inequality: Income, Education, Overall Health"

In 1993, *Time* released an issue of what they believed would be the new face of humanity in the future. Using photo editing software, they compiled hundreds of different pictures of individuals from a wide variety of racial backgrounds, in an attempt to illustrate what they saw as the end product of a increasingly multicultural society. The theory was that in a world becoming more and more connected and integrated, more people from different ethnicities would mix and produce children. Eventually these children would increase in number to the point where racial divisions became meaningless—or so it was believed. My project attempts to examine the accuracy of *Time*'s prediction: is the number of mixed children born increasing? Are people becoming less likely to identify themselves by race or ethnicity? Finally, to what extent is there still a social stigma against people of a mixed heritage? I intend to examine these questions by revealing potential links between the prevalence of mixed race people and occurrences of social inequality that such individuals suffer.
Faculty sponsor: Jonathan Lewis

Sylvia Pawlica, Lakshmi Madathil, Aditya Kapoor, Hannah Joseph
"Defending Your Territory: How Inequality Predicts Territorial Defence of Space"

People take longer to pull out of a parking spot when another driver is waiting for that spot compared to when no one is waiting (Ruback & Juieng, 1997). The current studies examine social devaluation as an additional mechanism that can explain ethnicity based differences in territorial parking behavior (TPB). Non-whites perceive greater social devaluation relative to whites (Davis & Reyna, 2015) and we predict that this may drive ethnic differences in TPB. For study 1, we conducted a conceptual replication and extension of the Ruback and Juieng (1997) study and found that income inequality moderated the effect of ethnic differences in TPB. We are currently collecting field experiment data measuring the amount of time it takes participants to complete a survey (with an embedded experimental manipulation) depending on if there is a confederate waiting to participate or not. This data should provide a more direct test of the hypothesis that social devaluation leads to ethnicity based differences in territorial behavior.
Faculty sponsor: James Davis

Quynh-Nhi Nguyen, Faith Donner
"Synthesis and Biochemical Potential of Redox-Active Ligands"

In the field of organic chemistry, redox-active ligand research is a topic that has gained interest due to ligands' unique properties and reactivity. Some ligands have also been found to enhance the redox potential of certain transition metals and display catalytic activity in reactions. A unique property of ligands includes being able to study electron transfer as a result of their ability to accept or donate electrons. Synthesizing ligands and exploring the reactivity of metal-complexes with these types of ligands are the focuses of Dr. Kari Stone's synthesis project, which also aims to immerse undergraduate science students in research. The ligand 2,6-diisopropyl-(N-((pyridine-2-yl)methylene)benzenamine was

synthesized in the lab over a period of three weeks, with its identity confirmed by H-NMR and IR spectroscopy. The ligand was stored for usage in future experiments, and the procedure was documented for future reference.
Faculty sponsor: David Rubush

Alec Jessen, Omar Jafry
"Cycloadditions to Access [2.1.2]-Bicyclic Heterocycles Inspired by Lycojaponocumin Natural Products"

Lycopodium japonocumin is a common club moss found throughout China used as a traditional medicine to treat contusions, strains, and myasthenia. Three new alkaloids (Lycojaponocumins A-C) have recently been isolated. These natural products have biological activity paired with a unique bridged heterocyclic core structure. The purpose of this study is to simplify and synthesize correspondingly similar structures to the bridged heterocyclic core structures of the intricate Lycojaponocumin A-C in order to investigate and access the bioactivity of these compounds. A cycloaddition between a nitrone and an alkene will be performed to access the bicyclic core. Progress toward an intramolecular substrate will be presented along with the initial investigation of conditions for the cycloaddition step that have been carried out.
Faculty sponsor: Brooks Maki

Jack Surin
"How Well Does Apple, Inc., Preserve the Environment?"

My presentation will be on Apple, Inc., and I will be asking the question, "Is Apple a green company?" Over the years, Apple has been very successful at getting their products in the hands of people in both the United States and around the world. However, as a consumer of Apple products, I had little to no knowledge about how efficient they are at preserving the environment. Over a decade ago, Apple ranked near the bottom of Greenpeace's rankings of electronic companies and their environmental initiatives. This was due to its lack of attention to eliminating toxic chemicals, such as polyvinyl chloride (PVC) and brominated flame retardants (BFR), from their product lines, showing Apple's early struggles in preserving the environment. However, Apple is now recognized as one of the top electronic companies in this area, making many changes to better protect the environment. This poster will detail these changes and argue that Apple has, in fact, become a "green" company.
Faculty sponsor: Jean-Marie Kauth

Isaac Zacarias
"Examining Transgender Identity and Socioeconomic Status"

A map detailing the socioeconomic status of transgender identity in the country. The map will function to use the data collected to highlight and offer new perspectives into the conditions faced in the LGBTQ communities. Data displayed in the map will address any patterns that appear in categories such as healthcare, wealth, race, and income. Concerns over discrimination and the effects of poverty will be addressed as well. Data will be acquired from surveys, previous academic journals, and government sources. This map aims to continue a conversation over the social injustices faced by a group composed of a diverse group of individuals and use data to call for change and reform of current conditions.
Faculty sponsor: Jonathan Lewis

Jenna Stobbe, Elena Nicholson, Phil Whitman
"The Frequency of Student Questions Compared to the Style of Teaching"

A study using science, technology, engineering, and mathematics (STEM) courses was conducted to test the efficacy of active-engagement teaching. Research has shown active-engagement teaching leads to a decrease in student unenrollment of the course. This study gathered faculty within STEM courses at Benedictine University to test the correlation between the frequency of student questions relative to the professor's teaching style. Observers were paired and trained in Classroom Observation Protocol for Undergraduate STEM (COPUS).Observers filled out observation sheets marking certain codes for both the students and professor in regard to their actions in two-minute intervals. The two observers discussed any disparities amongst their findings. As a result, the correlation between student questions and learning style shows that an active-engagement learning course facilitates an increase in student questioning. This

information can be utilized by academic professors who perceive student questioning as a strong learning environment. We hope this study will influence academic professionals to reflect on their teaching methods and consider the effects on the student's learning.
Faculty sponsor: Allison Wilson

Sameen Khurshid, Suhayl Khan
"Synthesis of a More Reactive and Efficient Redox Active Ligand, Pyridine-2-Carboxylaldehyde Oxime, from Pyridine-2-Carboxylaldehyde"

Redox active ligands can dramatically affect the efficacy of many multi-electron processes by providing proficient electron donating atoms. Identifying and synthesizing a compound that contains good electron donors such as O, N, and S is a fairy unexplored area of organic chemistry that could greatly benefit further research. Pyridine-2-carboxylaldehyde is a well known redox active ligand containing a single N and a single O. With an 85% yield we were able to produce pyridine-2-carboxylaldehyde oxime which contains two N and one O while maintaining the general structure of the original compound in the hopes that the efficiency of this molecule as a redox active ligand increases.
Faculty sponsor: David Rubush

Alexis Cerrillos
"The Detrimental Effects of Global Climate Change on Mental Health"

Global climate change is a continually increasing problem in today's world. With global climate change comes various physical effects including increased global temperatures, increases in the severity and frequency of weather-related disasters, rising sea levels, etc. While much research has been conducted on these physical effects of global climate change, there has been little done to understand the psychological effects of global climate change. There are significant negative impacts on mental health due to climate change including stress, anxiety, depression, increases in suicidal tendencies, increases in aggression, as well as increased severity of pre-existing mental illness. By better understanding the psychological effects of global climate change and the relationship people have with the environment, it is possible to create more successful treatment and prevention for climate change triggered issues in the mental health care field.
Faculty sponsor: Jean-Marie Kauth

Daisy Jimenez
"Cobalt, Copper and Calcium Oxygen Evolution Catalysts"

This poster details an experiment using the HARPOON project to see if calcium, copper and cobalt do oxygen evolution. If we find that these mixed-metal ratios do produce oxygen evolution, we are closer to finding a way to reduce the use of fossil fuels.
Faculty sponsor: Kari Stone

Najah Azim, Ifrah Khan
"Initial Quorum Sensing Studies in the Probiotic *Lactobacillus acidophilus*"

Quorum sensing is a mechanism used by bacterial populations to sense and respond to environmental cues. A recent QS system composed of short hydrophobic peptides (SHPs) and transcriptional regulators termed Rgg has been described for Gram-positive bacteria. These Rgg/SHP systems have been shown to modulate gene expression for stress response, toxin production, and pathogenicity. Most of these systems have been described for Streptococcal species and very little is known about how these QS systems function in other Gram-positive bacteria. We are focused on a putative Rgg/SHP QS system present in the probiotic *Lactobacillus acidophilus* ATCC 4357. *L. acidophilus* is a beneficial microbe found in the human gastrointestinal and vaginal tract, and contains three putative Rgg QS systems but potential peptides do not follow the characteristics of currently described SHPs. Our goals are to initiate characterization of a putative Rgg nestled within a maltose operon. We hypothesize a small sequence found just upstream from the Rgg is the SHP required for this system. We are in the process of generating transcriptional reporters to measure activity in the presence and absence of this peptide.
Faculty sponsor: Tiara Perez Morales

Breanna Sobotka
"Supporting GiGi's Playhouse: An Arthur J. Schmitt Project"

This poster describes a service project to fund-raise and donate physical education equipment to GiGi's Playhouse. GiGi's Playhouse is non-profit, achievement program for both children and adults of all ages diagnosed with Down Syndrome. I will be focusing my project on the Tinley Park, IL, location. This location is currently moving to another, larger lot in the area that will allow them to add to their services by providing physical activity within a gym atmosphere.
Sponsor: Joan Henehan

Renee Bowman
"Comedy in the Classroom: Using Humor as an Effective Teaching Strategy"

There is a high correlation between student engagement and retention with a student's enjoyment of activities used by educators. Humor in the classroom encourages students to return and promotes social development, as well as an integrated and positive learning environment. My goal is to show that using humor in the classroom is an effective teaching strategy and how to avoid difficulties during its application. I will show multiple activities that can be executed while maintaining classroom management and address possible modifications and/or accommodations needed for English Language Learners (ELL), students with learning disabilities, and students who are gifted.
Faculty sponsor: James Pelech

Alissa Potts, David Nguyen
"Application of Metal-Phosphate Complexes with Various Ligands"

Layered solid materials are used for transporting different compounds to limit exposure to the atmosphere. This is possible because the chemical bonding in the layers is very strong and bonding between the layers is weaker van der Waals bonding. This makes the compounds that are transported easier to access the space between these layers. The vanadium layered solid of $(VO)(PO_4)(H_2O)_2$ is used as an oxidation catalyst due to its high oxidation state of +5. The exploration of different metal complexes, such as manganese or niobium, to form new layered solids were conducted as well as the oxidation of different compounds. Niobium consists of the same oxidation state of +5 and the manganese was used at two different oxidation states of +4 and +7. The vanadium complex easily oxidizes alcohols to ketones. Further exploring reactivity towards amines, butylamine, and 1-2 phenylenediamine, the rate of the reactions were investigated. Reaction rates were determined by quantifying amounts of butanol and butanone by gas chromatography.
Faculty sponsor: Kari Stone

Alexandra Saucedo
"Social Inequality: Differences in Wages Between the Genders in the United States"

This map displays difference in wages between men and women across the country and how they have changed over time.
Faculty sponsor: Jonathan Lewis

Alexandra Kiszluk
"Effects of Pesticide Exposure on the Pathogenesis of Systemic Lupus Erythematosus"

Despite the widely-held belief that pesticides are necessary to control weeds and other unwanted specimens, recent research has shown that the health risks of pesticide use outweigh the practical benefits. In vitro experiments, epidemiological analyses, and model organism studies have clarified the causal relationship between pesticide exposure and the pathogenesis of systemic lupus erythematosus (SLE). However, limited research has been conducted to evaluate whether the means by which pesticides enter the body plays a role in the immunotoxic effects of these chemicals. In this study, the pathway of exposure will be manipulated in laboratory mice to compare the effects of ingestion, inhalation, and dermal absorption of chlorpyrifos and chlordecone on the development of SLE. Antinuclear antibody (ANA) tests, cytokine assays, and measures of renal impairment will be used to assess the presence of the disease.
Faculty sponsor: Jean-Marie Kauth

Fardeen Sayed, Sameen Khurshid
"Sub-cloning of the Sperm Whale Myoglobin into a pET Expression Vector to Enhance Purification"

An integral step in the nitrogen cycle, Hydroxylamine Oxidoreductase (HAO) is a large, complex enzyme with 24 heme groups that poses a challenge for elucidating its enzymatic mechanism. With a similar active site but only one Heme group, sperm whale myoglobin may provide an easier model. In previous research, an expression vector having the sperm whale myoglobin gene was modified at several potential sites that should improve it as a model for the HAO active site. The current protocol for purification of the expressed protein involves several steps and presents a very low yield. It is postulated that purification of the modified expressed sperm whale myoglobin can be improved with the addition of a His-tag. In this study, the sperm whale myoglobin gene-containing plasmid will be sub-cloned into another plasmid that would attach the His-tag. Additional modifications of the gene resulting in improvements of sperm whale myoglobin as a HAO model will be done using site-directed mutagenesis.
Faculty sponsor: Mark Poch

Shawn Kumpuckal, Maryam Mohamed, ,
"Synthesis of Stable Antioxidants using Oxazolines"

Antioxidants play a crucial role in maintaining and protecting human health. Due to the instability of naturally occurring antioxidants, it is difficult to observe and experiment with them. Arginine residues produce the antioxidant methylglyoxal-derived hydroimidazolones (MG-Hs), an unstable product. The project involves synthesizing oxazolines as replacements the hydroimidazolone heterocycle and evaluating their stability and antioxidant activity. By replacing the heterocycle with oxazoline, the stability of the molecule will increase while also maintaining its antioxidant activity. This experiment will allow for further observation and experimentation of antioxidants. Multiple synthetic routes to the desired oxazolines have been investigated, and their progress will be presented.
Faculty sponsor: Brooks Maki

Lily Feng, Syed Iqbal
"Biomimetic Synthesis of Pyrrole-Based Natural Products"

Several families of pyrrole-based natural products have recently been isolated, and these structurally related compounds have been shown to demonstrate interesting bioactive properties. All of these compounds are derived from similar biological pathways which involve the combination of sugar metabolites and amines. Inspired by the biosynthetic pathway of an isolated glutamine derivative from the Day lily flower, an alternative route to the pyrraline structure of these natural products has been investigated. The synthetic approach to this intermediate and its application to the synthesis of the representative natural product pyrrolezanthine has been conducted over a five-step sequence. Current work is focused on expanding the scope of this route by investigating new substrates and targeting derivative structures of this key medicinal hetero-aromatic compound.
Faculty sponsor: Brooks Maki

Ezah Ijaz
"Efficacy of Action on Plastic Waste"

My research question is: does environmental education that conveys the impact of individual action change attitudes about the efficacy of action on plastic dependency and waste? My research proposal aims to demonstrate how motivation and proactive action can encourage lifestyle changes. My proposal will use the methodology of a study by Erika Salomon, Jesse Preston, and Melanie Tannenbaum—about bridging the gap between environmental awareness and action by conducting three studies. Steps include gathering participants, assessing where participants stand on the environmental problem through a survey (Study 1), having participants read about the impact of individual actions (Study 2), and then assessing how participants changed aspects of the environmental problem in response to reading how their actions can contribute change (Study 3) (Salomon, Preston, & Tannenbaum, 2017). I will use these methods to assess how intervention through education can influence people to take action pertaining to the amount of plastic usage and waste they contribute to.
Faculty sponsor: Jean-Marie Kauth

Ross Evans, Grace Wangler
"Synthesis of a Novel Redox-Active Ligand- 2,2'bis"

The chemical structure of a novel redox-active ligand, 2,2'-(1,2-Phenylenediimino)bis[4,6-bis(1,1-dimethylethyl)phenol], was synthesized and confirmed using IR and HNMR. This compound was produced via a condensation reaction utilizing triethylamine, n-heptane, o-phenylenediamine, and 3,5-di-tert-butylcatechol. The reaction yielded a pure ligand, which, in turn, will be bound to a metal in further research.
Faculty sponsor: David Rubush

Frankie Veal, JaVon McBride
"Comprehensive Analysis of Training Track and Field Jumping Events"

The roots of vertical and horizontal jumping events in track and field date as far back as the late 1800s to the early 1900s. Other than sprinting, Olympians would express their natural athletic ability through a variety of competitive field events which included a total of four distinct jumping competitions. In this study, we focused on the training methods used for former vertical and horizontal Olympic jumpers and how these methods relate with the present-day training process. We analyzed 30 volumes of track and field journals published by Athletics Canada between 1980 and 1991. We found and accessed 10 different articles that focused mainly on the training of these four distinct jumping events. We conducted a thematic analysis which allowed us to examine these articles through in-vivo and open coding. The current presentation demonstrates our initial findings of the of coaching and training methods for vertical and horizontal jumps that have been used on Olympians and carried on to each new generation of Olympic athletes.
Faculty sponsor: Marshall J. Milbrath

Emily Zimel
"A Comparison of Brain Growth in Neanderthals, Modern Humans, and Great Apes"

The evolution of a large brain is one of the characteristics that unites us with Neanderthals and separates us from other hominoids (the taxonomic group including us and chimpanzees, bonobos, gorillas, orangutans, and lesser apes). In modern humans, the brain is generally 80% complete at 2 years of age and 95% complete at 7 years of age. Rosas et al. (2017) recently reported that brain growth in a 7.7-year-old Neanderthal child from Spain was 87.5% complete, thus suggesting that growth rates were slower in Neanderthals than in living modern humans. These studies looked at mean rates of growth without accounting for the range of growth rates in different modern human populations or other hominoid species. We are using piecewise quadratic (polynomial) regression to model brain growth in expanded cross-sectional samples of modern humans (*Homo sapiens*), chimpanzees (*Pan troglodytes*), mountain gorillas (*Gorilla beringei*), and Neanderthals. Preliminary data suggest that brain growth rates in Neanderthals do not fall outside an expanded range of values for modern humans.
Faculty sponsor: Robert McCarthy

Akansha Bhatt, Zainab Ahmed
"Different Methods to Generate High Yield of 2,6-Bis(Imino)Pyridyl"

The reaction of 2,6-Diacetylpyridine with 2,6-Diisopropylaniline in the presence of an acid catalyst produces 2,6-Bis(Imino)Pyridyl. 2,6-Bis(Imino)Pyridyl is a redox active ligand that made into a catalyst when bonded with metal halides to synthesize ethylene into a linear chain. Synthesis of ethylene into polymers produces the common plastic.. Research has shown ligands bearing Iron (II) and Cobalt (II) create highly active ethylene polymerization. The process of the production of 2,6-Bis(Imino)Pyridyl is discussed. HNMR, CNMR, and IR spectroscopy were observed to test the contents of the experimental product. The IR spectrum showed peaks containing Sp3 and Sp2 hybridized carbons, along with overtones indicating aromaticity, but no primary amine peak was found. Our yield was 22.34 %, which suggests that not a lot of product was formed.The purpose of this experiment was to understand how observing spectrums can help us identify a compound and understand specific reaction mechanisms that occur using an acid catalyst.There is ongoing research on identifying metals that would make 2,6-Bis(Imino)Pyridyl an even better catalyst.
Faculty sponsor: David Rubush

Sumaiya Shahjahan, Alexandra Karwowska, Rebecca Weber
"Assessing the hematological health of augmented Blanding's Turtle (*Emydoidea blandingii*) populations"

Blanding's Turtles (*Emydoidea blandingii*) are a wetland-dependent species that are on the IUCN red list of threatened species due to habitat loss and fragmentation, road mortalities, and increased depredation rates from subsidized predators. Current research focuses on developing a framework of conservation practices to maximize long-term survivorship and population growth of Blanding's Turtles in the Midwest. We investigated the hematological health via leukocyte profiles of juvenile Blanding's pre and post-release from captivity. Between May and October 2016 and 2017, blood was drawn monthly from 12 radio-tagged juvenile turtles and blood smears were made in triplicate per individual. Lab methods included staining blood slides with a Giemsa Stain and counting leukocytes via the zigzag method up to 100 total. Lastly, heterophil to lymphocyte (H:L) ratios were calculated. H:L ratios are positively correlated with corticosterone, a glucocorticoid stress hormone. This study utilizes a physiological assessment of Blanding's to measure stress response to environmental factors, which is essential to understanding how they respond to conservation efforts.
Faculty sponsor: Leigh Anne Harden

Shamama Ali, Haripriya Koritala, Shubha Sivasankar
"Classroom Pedagogy Observed in Off-Sequence vs On-Sequence Courses in the College of Science"

In order to understand the level of student engagement in the classroom, we used a standardized method of observing classroom interactions between students and instructors. COPUS (Classroom Observation Protocol for Undergraduate STEM) is a tool that allows for the collection of data in two-minute intervals categorizing the specific actions of the instructors and students. Using the data we collected, we are comparing the level of engagement between on-sequence and off-sequence STEM courses. On-sequence courses are normally taken during a Fall or Spring semester. An off-sequence course is taken the opposite semester, and is usually offered as a second option. From this study, we hope to better understand how the student-instructor interactions vary between the two types of course sequences.
Faculty sponsor: Allison Wilson

Ali Sultan
"Educating Low-Income Patients about the Risks of Contracting Oral Cancer and Providing Free Oral Cancer Screenings to Patients: An Arthur J. Schmitt Project"

A not-uncommon oral health problem, oral cancer poses a serious risk to society because it is so easily contracted due to chronic alcohol and tobacco use. For my Arthur J. Schmitt service project, I teamed up with colleagues at the VNA Health Care Group to organize a seminar and lecture for low-income patients and others at high risk for contracting this disease. This seminar will also offer free on-site oral cancer screenings to attendees.
Sponsor: Joan Henehan

Quinn Schumaker
"Effects of Maritime Shipping on Health and the Environment"

This project explains how the shipping industry, specifically maritime shipping, has harmful effects on the environment. In this white paper, maritime shipping emissions from multiple different fuel types will be analyzed. There will also be an evaluation of different regulations currently in effect and a discussion of ways to improve them to prevent the shipping industry from exploiting loopholes. The negative health effects and the dangers of such emissions will also be examined. The goal of this white paper is to inform the audience of the dangers of shipping emissions and discuss ways in which we can better regulate the shipping industry so that it has less of an impact on the environment.
Faculty sponsor: Jean-Marie Kauth

Suhail Malik
"Science Business: The World of Biotech and Health Administration"

The research paper incorporates the status of biotechnology, pharmaceuticals, and healthcare administration within the current political, environmental, and ethical landscape. I visited, interviewed, and shadowed a number of companies

within the healthcare field to gain knowledge about and perspective on the healthcare field in regards to business. Each interview revealed the intricacies of the healthcare industry, especially the R&D process. With the help of the book *Science Business*, I'll delve into various techniques that can help improve the biotechnology and healthcare industry.
Faculty sponsor: Jodi Houlihan

Abdullah Damra
"Facilitating the Youth: An Arthur J. Schmitt Project"

As an Arthur J. Schmitt Scholar, I developed a project that would allow me to work with my community and serve its youth. I have always had supportive mentors in my life and I firmly believe everyone deserves mentorship as well. As a future leader, I decided to start a youth program at my local community center in partnership with Young Muslims, a national youth organization whose motto is "facilitating the youth in becoming the future." On a weekly basis, I meet with youth in a safe environment where we spend quality time and build bonds to support one another.
Sponsor: Joan Henehan

Kassandra Soto
"The Correlation between Higher Education and Household Income"

This project investigates the correlation between income and higher education in the Chicagoland area. I think there is usually a correlation between the income of a family and their ability to send their children to college, so I wanted to make a map to see if it was true in the different areas of the Chicagoland. I will represent people with higher and lower incomes in certain colors and then indicate the higher education rate in the income levels using a specific pattern to distinguish the differences among the groups.
Faculty sponsor: Jonathan Lewis

Dylan Garbutt, Mike Traversa
"A Comprehensive Review of Literature Found in the Canadian *Track and Field Journal* as it Pertains to Coaching Running Events"

Track and field dates back to the ancient Olympics games where a cook named Koroibos won a stadium race 600 feet long. Track and field in the U.S. dates back to the 1860's and is still prevalent today. In this study, we performed a comprehensive review of the literature found in the *Track and Field Journal* associated with the Canadian Track and Field Association dating from 1980 to 1991. Reviewing twenty-nine journals, we found 37 articles that pertained to coaching an athlete in running events in track and field. We found, through a process of identifying in vivo codes, open codes, and developing convergent themes, that the techniques, strategies, and evaluations used by coaches of this period resemble that of the same used by coaches today with few variations. Recurring themes throughout the literature: pace, speed, strength, flexibility, exertion, strategies, conditioning, testing, objectives and goals are all present in today's track and field coach methods and research. The present study indicates that track and field coaches have been focusing on much of the same aspects of running throughout the years but testing new methods and theories to try to improve athletes.
Faculty sponsor: Marshall J. Milbrath

Giselle Campos
"Using Interdisciplinary Aspects of Environmental Science to Facilitate High School Physics Education"

It has been observed that one of the most difficult subjects for students to understand in the high school general curriculum is physics. It is therefore necessary to make changes to the way physics is taught in high school. Through research concerning environmental science education, it has been discovered that there are many interdisciplinary benefits to environmental education. Applying this interdisciplinary science to a traditional physics will help to create more real-life and applicable problems for students and therefore motivate them to become more interested in this science. Including environmental science in the curriculum will also allow for students to become more aware of environmental issues. As a culmination of this research, a sample curriculum for an environmentally geared physics class will be compiled in order to one day be put to use in a real-life classroom.
Faculty sponsor: Jean-Marie Kauth

Zaed Hussain, Omair Ali
"Using CRISPR Technology to Create an Ideal Cell-line for Testing Therapeutic Drugs for McCune-Albright Syndrome"

McCune-Albright Syndrome (MAS) is a rare disorder characterized by polyostotic fibrous dysplasia, café au lait spots, precocious puberty, and various endocrine pathologies affecting several body systems. The etiology of MAS involves a de novo, activating mutation early in development of the GNAS gene, which causes the constitutive activation of the α subunit of the Gs transmembrane protein. The ability of potential therapeutic drugs to counteract the mutation has been tested in cell culture using HEK 293 cells transfected with a plasmid expressing the mutated GNAS. However, it would be desirable to test the system without the endogenous GNAS already present. The goal of this study is to use the effective CRISPR/Cas9 gene-editing system to knockout this specific gene. Transfection efficiency will be evaluated via cellular fluorescence analysis and western blotting to detect the knockout of the Gs protein. Generating this cell line will allow for novel experiments in the future, where this cell line can be used as a closer model for the disease process.
Faculty sponsor: Mark Poch

Jessika Avanzado, Emerson Rodriguez, Michael Valipour
"A Change from the Traditional: A Comparison Between Teaching Experience and the Implementation of Engaged Learning in STEM Courses"

Engagement in science, technology, engineering, and mathematics (STEM) courses has been shown to promote learning by providing better experience and retention of information. The purpose of this study is to examine the correlation between how long the instructor has been teaching and the amount of class time the instructor spends presenting. Data was collected using COPUS (Classroom Observation Protocol for Undergraduates STEM), a structured protocol designed to capture distinctions of teaching behaviors in a descriptive manner. Each class was observed for a minimum of 150 minutes, and data was collected from 62 classes across six different departments: biology, chemistry, computer science, physical sciences, physics, and mathematics. Observed faculty were surveyed and asked to provide information regarding the length of time they have been teaching. We hypothesize that because experience leads instructors to better understand how to facilitate student learning, experienced instructors use stimulating and engaging activities in the classroom more frequently than inexperienced ones.
Faculty sponsor: Allison Wilson

Scott Paull, Richard Montelbano
"Comprehensive Analysis of Track and Field Throwing Events"

This study takes an in-depth look at training methods and results of athletes that take part in the shot-put, hammer and discus events and how training has changed, or stayed the same over the years. Throwing sports can be found as early as the first century Scotland. The Olympics brought forth world competition with hammer, shot put, and discus here athletes used regulated size objects to measure strength and skill. Through qualitative analysis, we analyzed methods and techniques across all three events across time. Information was gathered from all 38 volumes of the *Track and Field Journal* (*TFJ*) published from 1980 to 1991. We conducted a thematic analysis. With the articles inside each volume we made classifications of themes and put them into in-vivo, open codes to create higher order themes through convergent process. Analysis revealed commonalities in all throwing events from a coaching perspective. Some of the commonalities found were techniques of footwork & handgrips with different spins & explosion of follow through with the throw. Results will enhance training methods for all throwers.
Faculty sponsor: Marshall J. Milbrath

Madeline Kim
"Effects of Climate Change on the Geographic Distribution and Transmission Intensity of Malaria"

Malaria is an mosquito-borne infectious disease caused by *Plasmodium* parasites. It is most prevalent in tropical regions near the equator like sub-Saharan Africa and Southeast Asia. The geographic distribution of malaria indicates that it is dependent on temperature. Therefore, climate change would cause an increase in the geographic distribution and transmission intensity of malaria. Temperature increases would cause more regions to become ideal for the parasite and

vector and shorten the extrinsic incubation period of the parasite. Mathematical models project the effects of temperature increases on malaria by calculating the basic reproduction number in various regions predicted to experience an increase in temperature. The results project that malaria will spread into regions among its northern and southern limits as those more temperate regions become warmer. Additionally, there is predicted to be a net increase in the transmission of malaria into new regions due to changes in land use, such as deforestation. Treeless areas are shown to have higher average temperatures than forested regions, and therefore may be better suited for the spread of malaria. I am proposing to measure the effect of deforestation on the spread of malaria by measuring the *Anopheles* mosquito populations in deforested areas and forested areas and analyzing the results to determine if deforestation does have a significant effect on the spread of the malaria vector.
Faculty sponsor: Jean-Marie Kauth

Ramla Khalid
"Measuring Phosphate Absorption by Calcium Carbonate and Recycled Oyster Shells to Determine the Most Effective Eutrophication Solution"

Eutrophication is the result of excess nutrients, such as nitrogen and phosphate, causing abundant growth of plants and algae in bodies of water. These nutrients typically come from agricultural runoffs due to continued use of nutrient-rich fertilizers. My project will focus on comparing the effectiveness of phosphate removal between calcium carbonate and recycled oyster shells. This will be done by digging two man-made ponds and adding in nitrogen and phosphate to the water to produce excess algae growth. $Ca(OH)_2$-treated zeolite will then be added to one pond, while the recycled oyster shells will be crushed and added to the other in a filtration system. Levels of phosphate absorption in the ponds will be observed for several days in order to determine which solution was the most effective. This research is imperative as it focuses on improving the quality of freshwater, and can contribute by bettering drinking water in local areas.
Faculty sponsor: Jean-Marie Kauth

Ryanne Ehrman, Syed Qadri
"Salophen, a Redox Active Ligand, Single-Step Synthesis From o-Phenylenediamine and 2-Hydroxybenzaldehyde"

Redox -active ligands, or 'non-innocent' ligands, are compounds that have more energetically available levels that allow for redox reactions to change their charged state. Non-innocent ligands can participate in two types of reactions. The first type of reaction is a catalytic cycle, where the ligand accepts and donates electrons. The second type of reaction a redox-active ligand can participate in is a reaction that involves the formation or breaking of a substrate's covalent bonds. There are many uses for the redox-active ligands. Redox-active ligands can be used in oxidation/reduction reactions to help define the electric properties of a metal, allows there to be multiple electron transformations for certain metal complexes that are hesitant to transformations, and are involved in the generation of reactive ligand radicals that actively participate in the making and breaking of chemical bonds in a catalysis reaction. In a previous study, the redox active ligand Salophen was synthesized in a single and purified, producing a 92% yield using the following reagents: 1,2-phenylenediamine and salicylaldehyde in absolute ethanol.
Faculty sponsor: David Rubush

Urva Mehveen
"Relative Brain Size and Basicranial Flexion in A Mixed-Longitudinal Series of Modern Humans"

Compared to other primates, modern humans have a brain that is larger relative to cranial base length. The basicranium needs to "flex" early during development to accommodate the brain's rapidly increasing size. Although the relationship between brain size, basicranial flexion, and cranial base length has been investigated in adult specimens of different primate species, very little research has looked at these parameters during growth and development. In this study, we are looking at the relationship between relative brain size (brain size divided by basicranial length) and flexion in a mixed longitudinal series of cephalometric radiographs from the Colorado Child Research Council (Denver) Growth Study. We are currently exploring methods to estimate endocranial volume from measurements collected from lateral and anteroposterior radiographs. Once we estimate endocranial volumes for individual radiographic records, we will be able to assess the relationship between relative brain size and basicranial flexion during human growth and development.
Faculty sponsor: Robert McCarthy