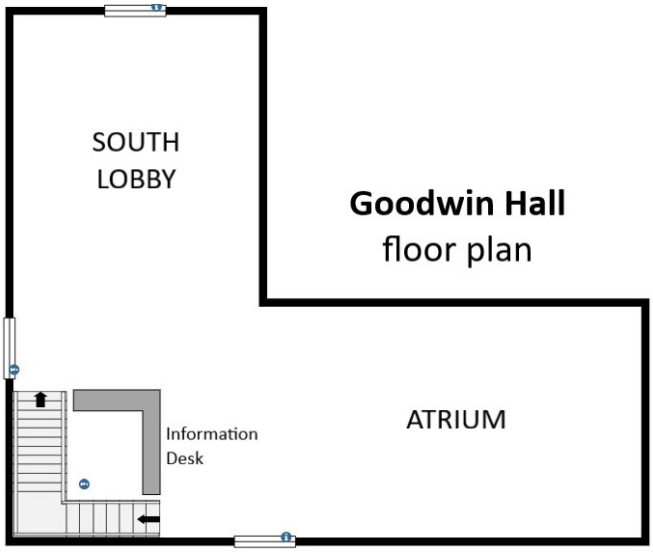
URSA
Undergraduate, Research, Scholarship and Arts
Benedictine University

2024 Poster Session Program

April 11, 2024 ❖ 12:30-2:30 pm ❖ Goodwin Hall Atrium



Poets in Person at URSA

Poets in Person is a student group of creative writers committed to imagining, typing, and sharing poetry in public spaces around campus. Stop by our table and request a typewritten poem or purchase one of our chapbooks!

in the South Lobby

► **An index of URSA poster session participants can be found at the end of this program.**

SOUTH LOBBY | Outer Wall

- **"Environmental Law: Gridlock in Water Pollution Legislation"**
  Sebastian Delatorre

  Water should be protected and treated as a human right, not deeply polarized by government officials. The issue of water pollution is not considered as a high priority by many Americans unless it directly affects their everyday lives. The objective of this amicus brief is to propose legislation to tighten regulation and prevent legislative gridlock. The U.S. Clean Water Act and Sackett v. EPA illustrate two instances where there is not enough legislation to prevent loopholes used by corporations and individuals to pollute waterways. New legislation could effectively create strict policy on water pollution that will improve the health of many Americans. Environmental damage to the health of Americans is not only a violation of human rights, but also diminishes corporations and their reliance on human capital for a key source of revenue.
  Faculty sponsor: Jean-Marie Kauth

- **"Comparing Marine Diversity Using Sepkoski's Compendium and the Paleobiology Database"**
  Zulfiqar Ali, George Dumadag, Issac George

  Paleontologists use two databases to make conclusions on marine wildlife diversity curves: Paleobiology Database (PBDB) and Sepkoski's Compendium. PBDB is an online fossil database that is up-to-date and contributed to by many scientists, while the Compendium was compiled by Jack Sepkoski throughout his lifetime until 2000. We compared whether there was a significant difference in fossil coverage between PBDB and Sepkoski's Compendium. We downloaded and compared fossil data from the PBDB and a digital version of Sepkoski's Compendium using R. Overall, there was not a significant difference between the number of genera in the PBDB database and Sepkoski's Compendium. Sepkoski's Compendium contained more marine genera with stratigraphic ranges than the PBDB database. However, the PBDB database contained more genera overall than the Sepkoski database. Our results show that it's best to combine both the Sepkoski and PBDB databases to get the most accurate diversity curves since there is a significant difference in fossil records between the two databases.
  Faculty sponsor: Phil Novack-Gottshall

- **"The Impact of a Bug in the Paleobiology Databases Genus Diversity"**
  Zulfiqar Ali

  The Paleobiology Database (PBDB) is an online database that holds fossil records of all life used by many scientists. Currently, there is a bug in the PBDB that causes the number of genera to appear in the database to be inaccurate. We wanted to find out what the effect of this bug has on the apparent diversity which is the number of genera inferred in the fossil record. In order to find this we downloaded the current PBDB data and a newer beta training version which has not yet been released to the public and compared the two. What we found was for larger groups of life like kingdoms, phyla and classes, the problem was trivial, such as 325 out of 85829 genera being incorrectly placed in the animals data. However, for smaller groups of life (some classes, and order and families) the data does show a large amount of change. As such, one should use the beta training data or vet one's data to confirm that the genus names are the proper ones based on current taxonomic practices.
  Faculty sponsor: Phil Novack-Gottshall

- **Indole-Containing Pyrrole Natural Products: Formation and Cyclization Reactions"**
  Nayyer Ahmed

  Juglans regia, also known as the Persian walnut/common walnut, is native to the Balkans and southern China. Recently, a compound containing a 2-formylpyrrole fused to an indolazepine ring structure was isolated from the flowers of this tree and was shown to have anti-cancer activity. A simpler compound, Inotopyrrole B, with a 2-formylpyrrole structure and tethered indole ring was isolated from *Inonotus obliquus*, more commonly known as the chaga mushroom, which is used in tea for multiple health benefits. Inotopyrrole B has been shown to have some neuroprotective properties. The similarity in structure of these two compounds leads to the hypothesis that inotopyrrole B could serve as a synthetic precursor to the indolazepine ring of the compound isolated from *Juglans regia*. Synthesis of the 2-formylpyrrole and an investigation of cyclization reactions to form the indolazepine will be reported.
  Faculty sponsor: Brooks Maki

- **"Water Pollution of Dal Lake: Comparing the Use of Synthetic Pesticides with Microbial Biopesticide Alternatives for Agriculture"**
  Amina Ahmad

  Dal Lake, the "liquid heart" of Srinagar, Kashmir, is the center of Kashmiri civilization. Over time, pollution has filled the lake. A major contributor is chlorpyrifos (CP) synthetic pesticide runoff from apple orchards in Dal Lake's catchment area. CP deters invasive pests, but also causes the water quality of Dal Lake to deteriorate and risks a public health crisis through pesticide exposure. An alternative is biopesticides, like the microbial insecticide *Bacillus thuringiensis* (Bt). Little is known about the effectiveness of Bt in apple orchards of Kashmir in comparison to CP. This study aims to compare the usage of CP to Bt and their effect on the following measurements: apple yield using

the crop-cut method, invasive pests density through plot sampling, and the level of chlorpyrifos-based water pollution through gas chromatography. I hypothesize that the alternative uses of Bt will drastically lessen the water pollution, maintain the apple yield, and further reduce the invasive pests density. This study adds to the growing research on Bt and its effectiveness in substituting for synthetic pesticides. Water pollution is a grave and challenging matter to overcome, but with dedicated effort, the environment and surrounding civilization can thrive once again.
Faculty sponsor: Jean-Marie Kauth

- **"Arsenic and Old Flamingos: Assessing Residual Hazards in Historic Taxidermy Collections"**
  Ameena Ambreenuddin, Karan Shetty

  Natural history specimens from the seventeenth and eighteenth centuries were commonly preserved using pesticides including arsenic, a highly toxic metal. Arsenic, being both a carcinogen and mutagen, needs to be investigated for its potential presence in historic taxidermy specimens. Every ten years, the specimens in the Jurica-Suchy Nature Museum at Benedictine University are tested to ensure a safe environment for both visitors and employees. In summer and fall of 2023, spot tests were conducted to determine arsenic levels in parts per billion (ppb). Any tests exceeding 100 ppb were considered hazardous. While most specimens were under the threshold of 100 ppb, those deemed hazardous require specialized cleaning or may have to be deaccessioned.
  Faculty sponsor: Karly Tumminello

- **"Synthesis of a Lidocaine Derivative with an Alcohol"**
  Karan Shetty, Ahmed Zain

  Lidocaine administered by IV helps in the relief of neuropathic pain and other chronic pain syndromes. Much behavioral and electrophysiological data supports that lidocaine does so by diminishing ectopic discharges: action potentials along the injured nerve that cause the symptoms of neuropathic pain. It has also been used to reduce pain experienced by those receiving a propofol injection, a practical exhibition of its use in pain relief. The purpose of this experiment is to attempt synthesizing a derivative of this molecule by removing one methyl group on the benzene ring and replacing the other one with an alcohol group. The first reaction entailed an SN2 reaction of 2-chloroacetyl chloride and our starting aromatic, 2-amino phenol. The second reaction required another SN2 reaction, this time adding a diethyl amine to the product of the first reaction. The final product was purified by washing. The final product was analyzed using thin-layer chromatography, IR spectroscopy, and NMR.
  Faculty sponsor: David Rubush

- **"Pack The Bus: School Supply Drive for Classroom Support"**
  Alexis Burnette

  Multiple surveys, including one by the U.S. Department of Education, show that 94 percent of teachers reach into their own pockets to purchase classroom necessities. On average, teachers spend up to $800 of their own money on their classroom materials. These supplies offer teachers the opportunity to differentiate their instruction to support students who learn in a multitude of ways. Because I plan to become a high school history teacher, I wanted to alleviate some of that burden. I initiated a school supply drive on campus including a fun "Pie a Professor" event in the Goodwin College of Business to help encourage students to donate school supplies. My goal was to collect as many supplies as possible for elementary-aged students to help support the teachers at Lee R. Foster Elementary in Oak Forest, Illinois. Foster Elementary serves a 46% minority population of students, while 43.6% of them were in the low-income bracket on 2023 taxes.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"The Sizes of Particulate Matter and Their Influence on Brain Structure"**
  Faizan Ahmed

  Particulate matter (PM) is an air pollutant that negatively affects the cognitive health of everyone. However, the

most susceptible group to PM's negative effects are older individuals, specifically older women. Studies have been done to research PM's effects on cognition and brain structure, and treatments to reverse them. However, minimal research has been conducted to determine which size of PM is most detrimental to cognitive health. I propose a study to assess harms related to different sizes of PM. A sample group of women (ages 55 to 95) will be chosen from the cities of Los Angeles, Bakersfield, and Fresno, which have the highest concentrations of $PM_{0.1}$, $PM_{2.5}$, and PM_{10}, respectively, in the U.S. Women from each city will be grouped together and undergo an MRI scan. The MRI data will be analyzed using voxel-based morphology to assess distinctive brain morphology changes associated with PM exposure, to compare the range of brain structure morphing attributable to exposure to each PM variant. My hypothesis is that $PM_{0.1}$ will be the most detrimental to the cognitive health of the women because the body's defense mechanism against air pollutants has evolved to neutralize pollutants that are 2.5+ microns in diameter. Understanding how the size of PM affects the severity and rate of cognitive decline in older women can promote policies to limit sources of air pollution that most affects their cognitive health.
Faculty sponsor: Jean-Marie Kauth

- **"Low-Energy Treatment of Lake St. Benedict, Lisle, IL"**
  Ernesto Carlton, Rachel Cepolski, Alexander Corbett

  Lake St. Benedict is a shallow, suburban, man-made freshwater ecosystem susceptible to eutrophication, the process of adding excess nutrients to the lake, causing low oxygen levels that threaten aquatic life. Previous studies reveal that Lake St. Benedict experiences high nutrient levels primarily due to phosphate transfer at the sediment-water interface when dissolved oxygen levels are low (i.e., <3 mg/l). In 2022 and 2023, phosphate sequestering treatments were applied to the sediments in an attempt to mitigate nutrient transfer. However, it was found that these treatments did not change the overall trends of dissolved oxygen and phosphorus at deeper parts of the lake. The goal of this study is to explore various low-energy treatment schemes to improve dissolved oxygen concentrations in the lake. Current water quality assessments reveal that Lake St. Benedict undergoes diurnal variation of dissolved oxygen concentrations and thermal stratification in the deeper parts of the lake. With this data, we consider low-energy treatment designs that mix stratified water. Mixing will "break" the thermocline, promote the mixing of oxygen, lower oxygen concentrations at the sediment-water interface, and optimize surface diffusion. Potential mixing equipment was tested to determine its hydrodynamic efficiency, given the irregular geometry of the lake bottom.
  Faculty sponsors: William Schubert, Leigh Anne Harden

- **"Synthesis of Sinopyrine B Isolated from Chinese Moonseed"**
  Zaina Amer

  Sinopyrine B is a pyrrole alkaloid naturally found in the plant *Sinomenium acutum* native to central and southern China. Pyrrole alkaloids are generally isolated from aquatic vegetation, fungi, and bacteria, and their chemical structures serve as important pharmacophores in pharmaceutical drugs including Atorvastatin, Tolmetin, and Roseophilin. Our research involves an attempt to synthesize Sinopyrine B through the lens of previously established pyrrole synthesis research. The procedure begins with an Isovanillin Bromination reaction to attach a bromine atom to the C_3 carbon. This is followed by a Henry reaction to replace the aldehyde group on C_2 with a nitroalkene group. The nitroalkene is then reduced into an amine group through a Zinc Reduction reaction. After this step, the Zinc Reduction product is purified through an extraction and evaporation followed by column chromatography. The following part of the procedure includes a furfuryl alcohol substrate undergoing an Achmatowicz Rearrangement reaction to form the dihydropyranone product. Future work includes reacting the dihydropyranone product with the Zinc Reduction Product through a Paal Knorr Reaction to result in a 2-formylpyrrole product. The final step of this synthesis involves a palladium catalyzed reaction to cyclize the Paal-Knorr product and to form Sinopyrine B.
  Faculty sponsor: Brooks Maki

- **"Understanding the Dynamic Significance of the Electric Vehicle"**
  Sofia Corona

  In the auto industry, technology can greatly contribute to helping the environment. This has recently become a

reality, with almost all car manufacturers selling at least one type of electric vehicle (EV). An important focus lies in communicating to the buying public the environmental reasons for buying EVs, the health benefits to society and the earth, as well as safety, and other reasons it is important to adopt EVs. Marketing such vehicles as providing social status does seem to increase the sales of electric vehicles. This white paper will evaluate the best way for companies to market and promote EVs and overcome consumer concerns with potential downsides, including novelty, cost, range anxiety, and charging station availability. Government support like infrastructure support and subsidies are important, but car manufacturers also need to play a role in effectively marketing these planet-saving products. For example, more men favor electric vehicles than women, so ads should work on advertising and marketing the importance that electric vehicles have on the world.
Faculty sponsor: Jean-Marie Kauth

- **"Phage Ameer, an *Arthrobacter globiformis* Lytic Phage Isolated from Ondrak Hall at Benedictine University"**
  Ameer Elabsi

  SEA-PHAGES (Science Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science) is a program designed to encourage early undergraduate research. This program focuses on isolating viruses (phages) that infect bacteria through cell lysis (lytic) or through genomic integration (lysogenic). As part of this project, we used the soil bacterium *Arthrobacter globiformis* as the host for phage isolation. Our soil sample was collected in spring 2022 from under a bush outside Ondrak Hall at Benedictine University. We hypothesized that the soil would have higher phage activity due to it not being covered in snow and affected by colder temperatures. We isolated from the soil sample two phages, one characterized here and named Ameer. A number of studies were used to characterize Ameer including infection assays, transmission electron microscopy (TEM), and genome restriction. Preliminary work indicates that Ameer is a lytic phage with plaques that have clear centers measuring 1 mm in diameter. TEM images show that Ameer has a viral structure similar to Siphoviruses which include a flexible long tail. Different from other phages, Ameer infects at a variety of temperatures (22°C – 37°C). In the future, we would like to explore its genome composition to identify genes used for bacterial cell lysis.
  Faculty sponsor: Tiara Pérez Morales

- **"Advancing the Achmatowicz: Paal Knorr Reaction Sequence to Access New Pyrroles"**
  Ali Ebraheemi

  In the pursuit of more sustainable and environmentally friendly chemical processes, green chemistry principles have gained considerable attention. However, pyrrole synthesis using the Achmatowicz/Paal-Knorr reaction faces drawbacks: poor atom economy, toxic solvents like dichloromethane, purification challenges, and noxious fumes. To address these limitations, this research aims to develop a greener and sustainable pathway for accessing new pyrroles with diverse applications as versatile building blocks of biologically active compounds and materials. These oxidations will be evaluated using the following criteria: (1) yields and efficiency: environmentally benign oxidizing agents must provide competitive yields with improvements in reaction efficiency; (2) purification: simple and quick purification processes will reduce the environmental impact and increase the utility of these processes; (3) shorter reaction times; and (4) access to new products: green processes must produce products that can be used in the subsequent synthesis of pyrroles, new classes of natural products, and other valuable compounds with diverse applications.
  Faculty sponsor: Brooks Maki

- **"Hope This Winter: Humanizing the Homeless Community"**
  Emma Ehrhardt

  The main goal of my service project was to humanize those who are homeless or in need of shelters. We often try not to look at homeless people, but that makes us forget that they, too, are human. Each winter I do a blanket drive of sorts to help the homeless in my area. However, I always felt that something was missing from these efforts and that was menstrual products. The lack of access to menstrual health products for people who are either homeless or low-income is appalling. These necessary products are not covered by SNAP or other welfare programs. Each month, this leaves countless people without the products many of us take for granted. Menstrual products are often

forgotten when people run drives, so I wanted to try to help by donations and spreading awareness to the women in need in such shelters. When I delivered the menstrual products at a women's shelter, I had an amazing conversation with a woman who was a survivor of domestic violence. This conversation was eye-opening and reminded me that we all have a story, and it is a beautiful and important thing not only to help others but to have a conversation with them. People are amazing and you can learn a lot from them if you just take the time to sit, serve, and listen.
An Arthur J. Schmitt Future Leaders Project
Faculty sponsor: Julie Bjorkman

- **"Air Pollution Interventions to Locally Reduce Incidence of Pediatric Respiratory Illnesses"**
  Janna Mahmoud

  Children are most vulnerable to illness, as their immune systems have not fully developed. Air pollution has been determined to be one of the leading environmental threats to public health, as it has been linked to many pediatric respiratory diseases. However, there has been a significant lack of research regarding interventions that reduce air pollutants. This study will determine the effects of clean buses, transportation regulations, urban greenery, and educational seminars on local air quality and children's respiratory diseases. Specifically, these interventions will be implemented in one of two schools in nearby neighborhoods, with socioeconomic status considered. Air pollution levels will be measured, as well as children's missed days of school, and nurse, clinic, and hospital visits. Reducing air pollutants will mitigate health risks imposed on children to ensure a healthier future generation. The correlation between air pollutants, local interventions, and children's respiratory diseases will be examined, potentially confirming the hypothesis that implementing these measures will improve the quality of pediatric health.
  Faculty sponsor: Jean-Marie Kauth

SOUTH LOBBY | Inner Wall

- **"Shay With Copts: Introducing the Coptic Orthodoxy"**
  Jacob Gorgey

  Introducing the Benedictine community to a little-known sect of Egyptian religion was the goal of this service project. "Shay With Copts"—tea with Coptic Heritage—was an event held in mid-January to showcase Coptic Orthodoxy. The Coptic people have seen centuries of brutal persecution. Originally referring to all Egyptians, the term Copt became synonymous with native Christians considering Egypt's Islamization and Arabization after the Muslim conquest of Egypt in the 7th century. Following the Muslim conquest of Egypt in 639–646 AD, the treatment of the Coptic Christians who refused to convert ranged from relative tolerance to open persecution. As the victims of a silent genocide, immigration allowed many Copts to escape persecution. However, in that escape, the Copts found themselves in countries where no one knew who or what they were. This introduced a flurry of problems for the Coptic community, mainly one of identity in a new land. This gave rise to my project. Part of our struggle in the US has been our association with certain stereotypes about western Christians. This makes the mistake of associating the actions of some Christian groups as the actions of all Christians. The purpose of this event was thus to showcase our faith to create awareness and understanding and share the story of the Coptic people.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Characterization of *Microbacterium foliorum* Phages Isolated from Public and Private Soil Sites"**
  Subohi Fatima

  Bacteriophages (phages) are viruses that specifically infect bacteria. Their host specificity provides an ideal field of study for infection treatments. Phages can infect bacteria via cell lysis (lytic cycle) or through integration (lysogenic cycle). In this work, we focused on phages that infect bacteria belonging to the genus *Microbacterium sp*. *Microbacterium* species can be found in a variety of environments including soil, water, and even human samples. This project describes the phage isolation and characterization process using the soil microorganism *Microbacterium foliorum* as the host. We hypothesized that soil sites with yearly turnover would yield at least one *M. foliorum*

phage. We isolated one phage per site, named Feta, Fanta, Bentz, and Cherry-Cola. The phages have large plaque diameters (1 – 2 mm) with clear zones indicating the lytic cycle potential. All were able to infect between 22 – 37°C although they prefer cooler temperatures. Lysates were prepared for imaging and genome analysis. Most phages belong to the *Siphoviridae* family with short capsids and long tails. Through SEA-PHAGES references, we selected restriction enzyme sites to perform DNA fingerprinting and predict genome size. In the future, we would like to study the phages' host range capabilities using other *Microbacterium* species.
Faculty sponsor: Tiara Pérez Morales

- **"Is It What You Say, or How You Say It? Comparing Content and Form of Communication Surrounding Climate Change"**
  Delaney Schretter

  Media is a vital source of communication, especially when discussing the climate crisis. Many studies have examined how to convey information most effectively within a given medium and have analyzed which form of media is most convincing to an audience. These two types of studies, though seemingly interconnected, remain separate from one another. My study will address whether form or content is more important when informing the public about climate change. Participants will view a map or a video, either personally relevant or not. Data will be collected through pre- and post-surveys. It is expected that the personal relevance will have a more pronounced effect on the audience's opinion when looking at maps, whereas videos will be consistently well-received. This study will aid communicators in finding the most effective ways to spread information on climate change, displaying strengths and limitations of certain communication methods in different scenarios.
  Faculty sponsor: Jean-Marie Kauth

- **"Determination of Selected Trace Elements in Red Wine via Atomic Absorption Spectroscopy"**
  Rayhan Hussain, Aaron James

  Flame Atomic Absorption Spectroscopy (Flame-AAS) is a precise and easy-to-use analytical technique often employed to quantify metals in various samples. Elements absorb light at a specific wavelength unique to them. When the sample is exposed to this wavelength, some energy is absorbed by the gas-phase atoms, and the concentration of the element in the sample can be determined using Beer's law. A serial standard addition technique was used with flame-AAS to quantify copper, iron, manganese, and zinc in selected red wines. Quantifying levels of metals in the wines is important as it affects taste, can be used to calculate nutritional intake of essential elements by wine drinkers, and even helps trace wine production locations to minimize wine fraud.
  Faculty sponsor: Niina Ronkainen

- **"An Overview of Thermoelectric Materials: Properties, Characterization, and Applications"**
  Rayhan Hussain

  Thermoelectric (TE) materials have recently been a field of interest in energy production as they represent a sustainable energy source. They provide a pathway for energy harvesting from excess heat through conversion to usable electricity. The research adjacent to this abstract provides a comprehensive review of TE materials, their fundamental properties, material design, and applications. The principles start with the Seebeck effect and Peltier effect which describe how applied heat can be converted to electricity and how electricity can be used to create a temperature gradient, respectively. The effectiveness of TE-materials is assessed through a dimensionless figure of merit, known as the ZT-value. The emphasis of the current research is on the strategies for enhancement of the ZT-value, for example through selecting appropriate materials and optimizing their TE-properties, while addressing the issues of cost effectiveness and scalability. Additionally, the thermoelectric properties of a commercially available demo-TE turbine were measured and its efficiency calculated in a series of experiments in the laboratory.
  Faculty sponsor: Stefan Stefanoski

- **"The Proposal and Synthesis of a New Lidocaine Derivative"**
  Ishaa Jain, Nashra Syeda

  There are many uses for lidocaine that are especially common in the medical field. It is most regularly used as an anesthetic that works by temporarily stopping the sensation of pain. Altering the structure of a drug changes its biological activity. In this experiment, we aimed to create a derivative of lidocaine that had never been synthesized before. Using SciFinder, we researched the synthesis of analogs similar to our proposed structure and procured a procedure. This included reacting chloroacetyl chloride with 2-6 diisopropylaniline, then taking the product and adding pyrrolidine and toluene. The product was purified and isolated, giving a 61% yield, and its presence was confirmed by NMR spectroscopy.
  Faculty sponsor: David Rubush

- **"Bisphenol A (BPA) Accelerates Development at Low Doses and Inhibits Development at High Doses"**
  Rida Ali, Amaan Faruqi, Ishaa Jain, Sofija Tunkevicius

  Endocrine-disrupting chemicals (ex. bisphenol A [BPA]) are widely distributed in our environment, and there is continued concern over their impacts on human health. The proposed experiments utilized fully aquatic, African-clawed frogs (*Xenopus laevis*) as a model. We aim to investigate the relationship between long-term, low-dose BPA exposure and morphological and behavioral effects such as staging, growth, length, and swimming behavior. The frogs were monitored throughout development from embryo to froglet. Our highest concentrations (5 µM – 10 µM BPA) caused deficits in development. These include more diminutive size, delayed development, and lower survivorship. In contrast, our lower concentration groups (0.15 µM – 1.5 µM BPA) displayed accelerated development. These groups displayed greater size, higher survivorship, and more rapid development to the froglet stage. Our future experiments will continue to track these groups into adulthood, with a specific focus on vocal behavior and the maturation of the brain and larynx.
  Faculty sponsor: Ian Hall

- **"Synthesis of 2-(dimethylamino)-N-(2-hydroxyphenyl) acetamide: A Derivative of Lidocaine"**
  Angeline Nato, Sofija Tunkevicius

  Lidocaine, commonly used as a numbing or pain-killing agent, was utilized as a template for a synthesized derivative. The desired derivative of lidocaine consisted of a similar structure with only three distinct differences: the presence of an alcohol in place of a methyl group and the deletion of a methyl group on the benzene ring, as well as a dimethylamino group replacing the terminal diethylamino group. The reaction was performed in two steps in order to synthesize and isolate the lidocaine derivative: 2-(dimethylamino)-N-(2-hydroxyphenyl) acetamide. The first step involved the reaction of 2-chloroacetyl chloride, 2-aminophenol, and acetic acid, of which the resulting product was confirmed to be 2-chloro-N-(2-hydroxyphenyl) acetamide; the percent yield was 75.69%. This molecule was then reacted with dimethyl amine, potassium iodide, and acetone to produce the final product; the percent yield was 37.12%. The presence of the products from the first and second steps was confirmed via TLC, NMR spectroscopy, and IR spectroscopy.
  Faculty sponsor: David Rubush

- **"Automakers' Environmental Commitments and Hybrid-Electric Vehicles"**
  Mohammed Hussain

  In 2024, most automobiles being manufactured are either ICEVs (Internal Combustion Engine Vehicles) or EVs (Electric Vehicles). While switching from ICEVS to EVs is a necessary move, people are concerned about switching because of anxieties about their range and costly repairs. Climate change, however, makes it imperative for the vast majority of consumers to switch to EVs or PHEVs (Plug-in Hybrid Electric Vehicles) within the next ten years. Current research says that, considering how electricity is now generated, PHEVs and EVs are almost directly comparable when it comes to total emissions. This paper will make recommendations to automakers on developing PHEVs that will be more widely accepted while also being environmentally friendly. By increasing their focus on PHEVs, automakers will save some capital when it comes to R&D because pre-existing parts can be used to cut costs. This

research is important because it will save companies money, while also moving consumers towards more environmentally-friendly options that won't compromise their choice of automobiles.
Faculty sponsor: Jean-Marie Kauth

- **"The Physics of the Eye: A Comprehensive Examination Integrating Ocular Anatomy, Optical Principles, Visual Deficiencies, and Physics-Based Corrective Treatments"**
  Jennah Khan

  The human eye is an incredible example of biological engineering made up of intricate structures that work seamlessly to facilitate vision. While the physiological underpinnings of these functions and processes are conventionally emphasized, the indispensable role of applied physics principles in shaping various aspects of vision is just as important. Lens optics, light regulation, retinal imaging, and color perception all rely on fundamental physics phenomena. This inquiry delves into the practical applications of these physics concepts underlying the eye's functionality. The optic nerve, in particular, serves as the conduit for transmitting visual information from the retina to the brain, where complex processing occurs in specialized areas like the visual cortex. The intricate interplay of electrical impulses along this neural pathway underscores the remarkable efficiency of visual signal transmission. Meticulous examination of the optic nerve's thermal properties sheds light on its thermoregulatory mechanisms, elucidating its role in maintaining optimal physiological conditions for signal conduction. Understanding the intricacies of eye anatomy and visual processes is crucial for diagnosing and treating various eye conditions, from refractive errors like hyperopia and myopia to age-related ailments like presbyopia and cataracts. These developments underscore the profound impact of interdisciplinary connections between biology and physics in advancing healthcare.
  Faculty sponsor: Stefan Stefanoski

ATRIUM | Inner Wall

- **"Prototype Refinement for Recycled Polystyrene Products"**
  John Creviston, Vasilios Katsambas, Brendan Truett

  The increasing consumption of single-use plastics, including Styrofoam (also known as expanded polystyrene or EPS), continues to have adverse effects on the environment and human health. If EPS is not disposed of properly, it can damage terrestrial and aquatic ecosystems. This project extends research from last year to develop prototypes for construction products, using recycled EPS from the manufacture of insulated concrete wall panels. In our recent work, we have introduced the use of fly ash and microfiber to reduce the density and improve the flexural strength of the recycled product. Testing indicates that the recycled matrix in the wet casted prototypes meets specifications for constructions products, such as box beam core insulation and geofoam. Steam molding has also been used to develop alternatively manufactured prototypes for recycled lightweight insulation boards. A breakthrough in the recycling of waste polystyrene can potentially mitigate the harmful effects of improperly disposed EPS.
  Faculty sponsor: William Schubert

- **"A Look into Whether the Oakland Athletics Should Pursue LEED Certification for Their New Las Vegas Stadium"**
  Kash Koslowski

  With a move to Las Vegas on the horizon, the Oakland Athletics will need a brand new stadium. In the desert, environmental consciousness will be a key design issue. Professional sports stadiums are using more energy than ever, leading to a push for greener energy use in these stadiums. Many recently built professional sports stadiums have integrated Leadership in Energy and Environmental Design (LEED) certifications in their builds. This white paper will assess whether or not the Athletics' new stadium should pursue a LEED certification, and if so, at which level. A LEED certification is a chief indication that a building is attempting to be environmentally conscious, and a professional sports stadium able to show off their certification can improve public perception of an organization.
  Faculty sponsor: Jean-Marie Kauth

- **"Scaroused: Examining the Effects of Haunted House-Induced Physiological Arousal on Romantic Attraction"**
  Sarah Beyler, Abigail Koloze-Morgado, Mary Kate O'Dell, Shifaa Yezdani

  The misattribution of arousal phenomenon involves misinterpreting heightened physiological arousal. In a study by Dutton and Aron (1974), participants crossing a fear-inducing bridge were more likely to misattribute romantic arousal. Our current study replicates this using a modern technique: a professional haunted house. Participants exit the haunted house or a benign environment and complete a survey assessing arousal symptoms. They then rate photos on attractiveness. We predict heightened arousal from the haunted house will lead to higher attractiveness ratings. This study could offer insights into fear's impact on arousal misattribution, potentially shedding light on previous failed replications.
  Faculty sponsor: James Davis

- **"The Implementation of the Biopsychosocial Model in Healthcare"**
  Jenna Demas

  The implementation of the biopsychosocial model (BPSM) of healthcare provides a holistic and sustainable approach to medicine. Currently, the biomedical model does not cultivate a practitioner-patient relationship that addresses multifactorial contributions to illnesses, diseases, and chronic conditions. There has been little research that connects the development of this model to American education systems. The BPSM provides a framework to treat patients that may or may not present with underlying pathologies. There is a 37.5% chance that this model will be used by a health care practitioner. Private care facilities or alternative medical professionals are more inclined to use this model. Despite the qualitative and quantitative evidence that suggests that the BPSM can be used as a framework for educating, building relationships with patients, and uncovering the root of a medical problem, medical professionals are not fully utilizing this model in clinical practice. It is important to evaluate the educational systems of allopathic, osteopathic, chiropractic, and naturopathic doctorate programs. More research must be conducted to determine if it is essential to develop a training program for medical professionals and to implement biopsychosocial models in modern healthcare techniques.
  Faculty sponsor: Thomas Solecki

- **"Hope for Hope House: Students Delivering Resources and Support"**
  Jonathan Henderson

  Helping others and making a difference in their lives is the passion that gave rise to this service project. As the Service and Justice Coordinator for Benedictine's Campus Ministry, I have the privilege to serve at Hope House once a month with student volunteers to provide a hot meal to the residents. Hope House provides emergency shelter and supportive services to individuals and families who are homeless—often due to divorce, job loss, or depleted savings. During a temporary stay, participants work toward securing employment and permanent housing. Residents are given a specific amount of time that they are permitted to stay at Hope House. This is why I felt the need to help at Hope House: new people come in regularly. I initiated a special student volunteer opportunity to get my fellow students out of their comfort zones, strengthen teamwork skills, and ultimately make a difference in the lives of others. My team and I came together to acquire necessary resources for Hope House such as canned goods, toiletries, and kitchen cabinets/containers while cooking a fresh meal for the residents.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Post-Quantum Cryptography and the Most Effective Algorithms"**
  Khalid Mahmood, Vicente Pina, Faisal Siddiqui

  The emergence of quantum computing presents a significant change in the world of cryptography. Quantum computers will render current cryptographic methods vulnerable to a swift decryption process. Quantum computers gather their computing power from a combination of traditional computing concepts and new concepts from qubits to entanglement. This paper dives into the intricacies of quantum computing and the implications for current cryptographic systems, breaking down key components that demonstrate the dire need for post-quantum

cryptographic methods. Quantum computing and its applications will be a revolutionary step forward that introduces a new realm to security. This research provides a comprehensive overview of the two most effective viable solutions for ensuring data security in the face of quantum computing advancements: lattice-based cryptography and hash methods. We focus on the issues posed by quantum computing and suggest solutions to those issues by exploring each method's strengths and weaknesses, thereby contributing to the ongoing battle to secure digital security in a post-quantum world.
Faculty sponsor: Manmohan Kaur

- **"Fascist and Communist Ideology: Power Consolidation in Totalitarian Environmentalism"**
  Anna Lakomiak

  While communism and fascism represent the extremes of the political spectrum, giving the illusion of a sole contradictory nature, the totalitarian regimes of the communist Soviet Union and fascist Nazi Germany both implemented environmental policies. My research explores the various ways both regimes carried out these policies so as to demonstrate their similar underlying ideological motives. Building on the findings of Stephan Brain, Peter Staudenmaier, and Douglas Weiner, I argue fascist Nazi Germany and communist Russia exhibit more similarities than differences within the realm of environmentalism, despite their political divergences. This totalitarian environmentalism extends to the regimes' actions and ideology that promotes them, illustrating the idea that Nazi and Soviet ecological efforts are not borne of a concern for sustainability but rather to showcase and "greenwash" the power of totalitarianism and its drive toward the preservation and expansion of said power.
  Faculty sponsor: Jean-Marie Kauth

- **"Examining the Impact of Stereochemistry and Dose of Bile Acids (BA) on Probiotic Growth and Role in Barrier Dysfunction in Human Colon T84 Cells"**
  Zohaib Farooq, Alexander Leininger, Ayesha Moosani, Ebaad Rehman

  In patients with inflammatory bowel diseases, BAs disrupt gut microbiota and epithelial barrier. Probiotic supplements counteract these effects. In T84 colonic cells, chenodeoxycholic acid (CDCA) induced apoptosis, oxidative stress, and IL-8 production, altering tight junctions, whereas lithocholic acid (LCA) did not. Here we continued to investigate the dose-dependent effects of CDCA, ursodeoxycholic acid (UDCA), and LCA on microbial and epithelial cells, predicting varied outcomes due to differences in BA structure. Up & Up™ probiotic strains were exposed to BAs; CDCA reduced microbial growth and altered the predominant species to *Lactobacillus fermentum*, while UDCA and LCA. In T84 cells, CDCA increased apoptosis and ROS production, while UDCA and LCA did not. Additionally, CDCA decreased barrier integrity with time and dose. In contrast, UDCA and LCA alone had no effect on paracellular permeability but restored CDCA-induced barrier dysfunction. Comparing the effects of CDCA with that of the hydrophilic isomer UDCA highlighted the importance of structure and stereochemistry of -OH groups in BA action. Further, CDCA's deleterious effects on microbiota and epithelia started as low as 50uM. Thus UDCA, like LCA, could be used to restore the microbiota and epithelial barrier, serving as a therapeutic drug for inflammatory and diarrheal ailments.
  Faculty sponsor: Jayashree Sarathy

- **"Feeding Futures: Empowering Communities through Hunger Relief"**
  Moustafa Elghor, Ayesha Moosani, James Yelo

  This service project emerged from a shared interest in making a meaningful impact in our community around the pressing issue of hunger. By partnering with the Feed The Need organization, we worked to recruit volunteers, lead volunteer committees, and secure donations. In partnership with Feed My Starving Children, we helped coordinate a three-day event at Benedictine in early March 2024. Their mission aligns with the university's values and hallmarks: they aim to eradicate malnutrition and starvation in children globally by instilling compassion in a generation that listens and responds to the cries of those in need until every child is fed. The goal was to pack meals and make a substantial impact on local and global communities through a comprehensive fundraising campaign.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"My Friends MAT and SAM: Optimization of Expression and Purification of Methionine Adenosyl Transferase (MAT) Required for S-Adenosyl Methionine Transferase (SAM)"**
  James Yelo

  S-adenosyl methionine (SAM), a vital methyl group donor, plays a key role in many biochemical processes, notably in cancer biology and epigenetics research. This study focuses on Methionine Adenosyl Transferase (MAT), an enzyme pivotal in the synthesis of SAM, which links the amino acid methionine with adenosine triphosphate (ATP), the cell's energy currency. We aim to determine if MAT can effectively bind methionine to modified ATP substrates and produce modified SAMs, thereby shedding light on MAT's substrate specificity. The research methodology involved cloning, overexpressing and purifying MAT, which was to be used in the production of modified SAMs. We utilized recombinant techniques to integrate the MAT gene with matching NdeI and XhoI restriction sites into the PET19b plasmid with a poly-histidine tag. After cloning, we confirmed that the MAT gene was inserted correctly using restriction digestion followed by agarose gel electrophoresis. The plasmid was then transformed into BL21-competent cells for protein overexpression. Ni-NTA affinity column chromatography purified the crude protein mixture to obtain the purified MAT protein. Despite these efforts, the polyacrylamide gel electrophoresis showed that our resulting protein was not of sufficient purity. Our current research is focused on optimizing the expression and purification of the His-tagged Methionine Adenosyl Transferase.
  Faculty sponsors: Mark Poch, Madhavan Narayanan

ATRIUM | Center

- **"Increased Exposure to Pesticides and Reproductive Health Among Couples"**
  Anastasia Disho

  Pesticides are used throughout the world on crops by farmers and on lawns by homeowners and park districts to remain weed- and bug-free. However, these chemicals can have irreversible impacts on human health, especially on reproductive health. Research on mice and humans shows that pesticide exposure can cause infertility in both males and females as well as irregular menstruation, premature ovarian failure, and erectile dysfunction (ED). With the continued use of pesticides, fertility statistics for populations all over the world are expected to worsen. Measures of pesticide exposure among couples will be tested through blood tests, urine tests, and patient questionnaires. Fertility among couples will be assessed via semen concentrations, number of follicles in ovaries, the rate of child per woman, and hormone levels of progesterone and testosterone. This observational study is unique because congruence in fertility and other reproductive health measures among couples will be factored in instead of separately looking at the fertility rates of men and women singly. I hypothesize that increased pesticide exposure will contribute to poor reproductive health and that there will be congruence among couples in both pesticide and fertility measures. Countries all over the world must implement proactive plans regarding pesticide usage so that couples who want to have children do not struggle.
  Faculty sponsor: Jean-Marie Kauth

- **"Synthesis of a Lidocaine Derivative with Ethylethanolamine"**
  Alexis Masseo, Jordan Werner

  Anesthetics play a vital role in modern medicine, providing effective pain relief during surgical procedures and alleviating discomfort in various medical operations. However, conventional local anesthetics like lidocaine often exhibit limitations, such as short duration of action and potential toxicity. To address these drawbacks, this study focuses on the design and synthesis of a unique lidocaine-derived molecule. The design strategy involves structural modifications to the lidocaine molecule, aiming to improve its potency, duration of actions, and safety protocols. Through computational modeling and structure-activity relationship, modifications are identified to optimize interactions with target receptors. Synthesis of the designed molecule involves a series of organism reactions, starting from commercially available precursors. Characterization techniques, such as NMR spectroscopy and thin-layer chromatography, are employed to confirm structure and purity of the synthesized molecule.
  Faculty sponsor: David Rubush

- **"Comparing the Real Distribution of Asteroids to Simulated Asteroids in Rubin DP0.3"**
  Arman Svoboda

  This study explores the comparison between the real distribution of asteroids found in the Minor Planet Center (MPC) and the simulated asteroid population found in the Rubin Observatory's Data Preview DP0.3. The Rubin Observatory is an astronomical observatory whose goal is to conduct a ten-year survey of the sky called the Legacy Survey of Space and Time (LSST). The Rubin Observatory created DP0.3 in anticipation of the completion of the observatory in the next year. Once completed, the observatory will be able to observe and gather data on more of the sky than ever before. Consequently this data set is much larger than the MPC in anticipation of the vast amount of data to be recorded. Our goal is to compare and contrast these data sets with the same parameters to understand more about asteroids present in our solar system.
  Faculty sponsor: Matthew Wiesner

- **"Preserving Native American Cultural Heritage: The Impact of NAGPRA Rules at Jurica-Suchy Nature Museum"**
  Maaha Amer

  The Native American Graves Protection and Repatriation Act (NAGPRA) was passed on November 16, 1990. This federal act was established in order to protect the rights of Native American descendants, tribes, and Native Hawaiian organizations, and their remains, funerary objects, sacred objects, and objects of cultural patrimony. NAGPRA is a federal requirement with set procedures for museums and federal agencies to inventory, research, and, if necessary, return specific Native American cultural items to lineal descendants and tribes. The methods used in this research included thoroughly examining the artifact information within the Jurica-Suchy Nature Museum's Native American collection. This involved reviewing associated tribal information, collector histories, and information regarding the artifact types within the collection. Working with the Museum Collections Manager, the updated inventory for the collection was established. This research project has worked to verify the artifact data and confirm the museum is within compliance of NAGPRA regulations. This project has been funded by a St. Procopius Abbey Centennial Foundation Grant.
  Faculty sponsor: Karly Tumminello

- **"Analysis of Parasitic *Wolbachia* in *Ischnura verticalis* and *Formica pallidefulva*"**
  Huda Fatima, Jannah Papa

  Occurring in over 50% of insect species across the world, *Wolbachia* is a bacterium that is solely passed down from infected females to her eggs. The parasite targets the reproductive organs of a male insect and alters its genetic material so that it can grow and function as a female. Since *Wolbachia* can only spread from infected females, this genetic alteration improves the efficiency of its transmittance and causes it to infect populations at a rapid rate. Although much is known about how *Wolbachia* is spread and its effects on hosts, it is still unclear which insects are more likely to be infected and which geological habitats may carry higher frequencies of the parasite. To determine this information, genetic material from the reproductive organs of a damselfly and ant were extracted and sequenced to find any DNA matches that determined their own species and indicated whether or not they were infected with *Wolbachia*. After assessing the extracted DNA through sequencing softwares, it was determined that both the damselfly and ant found at the campus pond and sidewalks contained *Wolbachia* DNA with significant match rates. The results support the presence of *Wolbachia* in a broad spectrum of hosts in various locations.
  Faculty sponsor: Phil Novack-Gottshall

- **"Synthesis of a Lidocaine Derivative: 2-cyclochexylamino-N-phenylacetamide"**
  Kara Jandacek, Evelyn Majerczyk

  Lidocaine is a commonly used local anesthetic that reduces the permeability of cell membranes to sodium ions, which in turn prevents the depolarization of cellular membranes, blocking neural conductions. The purpose of this research project was to synthesize an analog of lidocaine through a two-step process. The first part of the synthesis required reacting aniline with 2-chloroacetyl chloride to create the intermediate 2-chloro-N-phenylacetamide, then reacting it with cyclohexylamine to obtain the product of 2-cyclochexylamino-N-phenylacetamide. The product was

purified using extraction with HCl, water, and ethyl acetate. The structure of the product was confirmed using infrared spectroscopy and NMR spectroscopy.
Faculty sponsor: David Rubush

- **"Phage Lylo25 Is a Potential Lysogenic Phage Isolated from a Jasmine Sambac Plant in Lombard, IL"**
  Nuha Nawaz

  Principles of Biology Laboratory students can develop individual research projects through the SEA-PHAGES (Science Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science) program. In this project, we focused on isolating bacteriophages (viruses) that specifically infect the soil microorganism *Arthrobacter globiformis*. A soil sample from the *Jasminum sambac* plant was selected for this work as it was hypothesized that a nurtured plant with yearly soil turnover can contribute to increased microbial diversity. Through isolation, purification, and amplification protocols we identified and studied one phage named Lylo25. The phage plaques are 1 mm in diameter with slightly cloudy center and edges, indicating that its infection type may be lysogenic. Lysogenic phages integrate in the bacterial chromosome and when observed on plates, they do not have full bacterial lysis. Its infectivity was affected by temperature as Lylo25 was only able to infect between 22 – 30 °C. Through transmission electron microscopy (TEM) we observed that the viral structure of Lylo25 belongs to the Siphoviruses, with a slightly extended capsid and a long tail. We extracted DNA to analyze the genome using restriction enzymes but were unable to acquire results. In the future, we would like to remake the phage samples and test a new panel of restriction enzymes. We would also like to sequence the genome and determine if Lylo25 contains the integrase gene required for lysogenic infection.
  Faculty sponsor: Tiara Pérez Morales

- **"Animal Rehabilitation: Wildlife Baby Shower with Anderson Humane Society"**
  Gwen Palmer, Madeline Saunders

  For more than fifty years, Anderson Humane Society as been the leading animal welfare organization in our community. Anderson places more than 4,000 pets in loving homes each year. Their innovative programs make the healing presence of animals available to seniors, veterans, and those in crisis. We partnered with Anderson on their Wildlife Baby Shower event to make use of our interest in marketing and our individual leadership styles and skills. Each spring, baby animals such as possums and squirrels are born at high rates and require support when orphaned or injured. Anderson rehabilitates these animals for release back into the wild. Their annual fundraising event educates the community about the needs of these animals. Our team created a fundraising drive for Anderson and promoted the event with outreach to senior living communities, forest preserves, and local colleges to bring together the community, donate crucial supplies, and educate about orphaned and injured animals.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Properties of Lithium-Ion Batteries in Biomedical Applications: Cardiac Pacemakers"**
  Monika Pawlikowski

  Batteries have become the major source of electric power in many biomedical applications. Over time, the structure of batteries has been changed to improve longevity, size, and reliability. This project focused on lithium-ion batteries for cardiac pacemakers. Battery capacity, discharge voltage and current, and internal resistance measured through impedance spectroscopy were investigated by employing potentiostat/galvanostat instruments in a temperature-regulated environment. To recreate the conditions experienced by pacemaker batteries in the human body, tests were also run in a temperature-regulated oven to mimic a fever-level scenario. Experiments also imitated the frequencies of a human heartbeat during activities such as resting, walking, and running. Overall, this research displays the relationship between battery characteristics and their effect on battery longevity and capacity. Currently, batteries in leadless pacemakers can last a maximum of 15 years. By examining conditions in the body, it is possible to discern the effect of various factors on pacemaker lifespans. Analysis of these variables will allow for design improvements that increase lifespan and reduce the need for frequent replacements of pacemakers.
  Faculty sponsor: Stefan Stefanoski

- **"Exploring the Impact of Incubation Time on DNA Concentration and Wolbachia Detection in Insect Samples"**
  Haya Banian, Mustafa Mahmood, Abdur-Rahman Majid

  Our research aimed to isolate and extract DNA from multiple insects to investigate the presence of Wolbachia bacteria and DNA concentration relative to incubation time. Previous studies have suggested that incubation time influences genetic parameters like DNA concentration and Wolbachia presence in insects. However, it remains unclear whether longer incubation periods lead to higher DNA concentrations, increased detection of Wolbachia, or other genetic improvements in insect samples. In this study, we demonstrate that longer incubation times correlate with higher DNA concentrations and increased detection of Wolbachia in insect samples, using molecular techniques such as DNA extraction and sequencing. These results support the hypothesis that longer incubation periods enhance genetic analyses of insects, potentially refining our understanding of their biology and ecology. Further statistical analyses will confirm the significance of these correlations. Understanding the relationship between incubation time and genetic parameters in insects can enhance our ability to study and manage insect populations, with implications for agriculture, public health, and conservation efforts.
  Faculty sponsor: Phil Novack-Gottshall

- **"Environmental Influences on Reproductive Health: Exploring the Impact of Endocrine-Disrupting Chemicals on Pregnancy Loss"**
  Ryann O'Malley

  The National Institute of Environmental Health Sciences states that "reproductive health refers to the condition of male and female reproductive systems during all life stages." These systems are composed of organs and hormone-producing glands that maintain the health of their respective systems. Reproductive health, though, is being increasingly threatened by environmental factors, with media advertisements exacerbating the issue by promoting products containing toxic chemicals. Evidence suggests a correlation between exposure to toxic environmental chemicals and an increased risk of pregnancy loss. This study investigates how toxicants, particularly endocrine-disrupting chemicals, affect reproductive health outcomes, including pregnancy loss. The Program on Reproductive Health and the Environment (PRHE) emphasizes that "understanding exposures is critical to both identify potential health risks and identify opportunities for intervention and prevention of harmful chemical exposures." This white paper assesses legal options and encourages policy makers to implement policies that restrict the use and release of hazardous substances into the environment. Reducing human exposure to such chemicals can mitigate the burden of pregnancy loss, safeguard reproductive health, and ensure the well-being of current and future generations.
  Faculty sponsor: Jean-Marie Kauth

- **"Synthesis of a Lidocaine Derivative with o-phenylenediamine"**
  Mustufa Rehman, Yusuf Rehman

  Lidocaine is a chemical used as a local anesthetic in various medical or dental procedures in order to numb tissue or relieve pain. This project aims to create a derivative of lidocaine and observe its biological properties. The original synthesis of lidocaine requires starting with the reagent 2,6-dimethylaniline. The derivative replaced this amine with o-phenylenediamine in an attempt to create a molecule with two nitrogen groups which could react in SN2 reactions simultaneously. In the first step, the amine was reacted with 2-chloroacetyl chloride in an SN2 reaction. The second step added 2-ethyl amino ethanol to the two chlorines in the intermediate in another set of SN2 reactions. The product was purified through vacuum filtration and extraction. It was analyzed using thin-layer chromatography, infrared spectroscopy, and NMR spectroscopy.
  Faculty sponsor: David Rubush

- **"Generalized Additive Mixed Models for Estimating Body Mass from Juvenile Anthropometric Data"**
  Jacob Pipowski

  Body mass is an important parameter associated with an organism's physiology, behavior, and ecology. Because soft tissues are rarely preserved in the fossil record, researchers working on early hominins have had to use prediction equations to estimate body masses from skeletal dimensions. KNM-WT 15000 is a 1.6-million-year-old partially-

complete juvenile skeleton of *Homo erectus*. Despite its juvenile status, KNM-WT 15000's body mass has been previously estimated using equations incorporating adult anthropometric data. Here, we developed new equations for estimating body mass from juvenile anthropometric data including stature, bi-iliac (hip) breadth, and biacromial (shoulder) breadth. We used Generalized Additive Mixed Models (GAMM) to account for the non-linear relationship between body mass and anthropometric dimensions during the juvenile growth period. We compared model parameters, predicted values, and likelihood statistics for GAMMs constructed in different ways. New estimates of KNM-WT 15000's body mass-at-death are larger than previous estimates, but not proportionally so, implying different body proportions than originally reconstructed for this specimen.
Faculty sponsor: Robert McCarthy

- **"The Impact of Endocrine-Disrupting Chemicals on Female Reproductive Health: From Conception to Maternal Mortality"**
  Sumaya Mansour

  Care for the female reproductive system from conception to menopause is critical for sustaining human life. The hormones released in response to gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), and luteinizing hormone (LH) induce and regulate activity in the reproductive tract. Their functions are altered by synthetic endocrine disrupting chemicals (EDCs), resulting in significant generational deterioration of reproductive health, leading to impacts ranging from birth defects to maternal mortality. I propose a study measuring urine, blood, amniotic fluid, and breast milk levels of EDCs circulating throughout the body during gestation. I believe that abnormal levels of EDCs will correlate to adverse obstetric outcomes including preeclampsia, miscarriage, low birth weight, and maternal mortality. Ultimately, a general increase in awareness and action from healthcare providers is vital for navigating reproductive health in an EDC-contaminated world.
  Faculty sponsor: Jean-Marie Kauth

- **"Characterization of Amaya: A Potential Lysogenic Phage that Infects the Soil Bacterium *Arthrobacter globiformis*"**
  Nusaiba Hashmi

  SEA-PHAGES is an undergraduate program that trains students in biology and research techniques. The program's research goals are to isolate and characterize bacteriophages—viruses that infect bacteria using a variety of hosts. Our research focused on isolating phages that specifically infect the soil bacterium *Arthrobacter globiformis*. I collected soil from a heavily planted area in Oak Brook, IL. I hypothesized that the plant diversity would likely yield phages for this bacterial host. From this sample, I isolated and characterized one phage, named Amaya. Phage Amaya generated bacterial plaques 1 mm in diameter. The plaques had circular edges and a slight cloudiness, suggesting that Amaya infects through the lysogenic (bacterial chromosome integration) cycle. Unlike other phages isolated that semester, Amaya had a strict phage infection temperature of 22°C. Our transmission electron microscopy (TEM) image showed that Amaya is part of the *Siphoviridae* phage family, due to its long, flexible tail attached to an isometric capsid. Amaya's DNA was also analyzed via restriction enzyme digest and we found genome restriction sites for only 1 of the 2 restriction enzymes selected. In the future, we would like to test Amaya's host range and study its genome due to its limited infection capabilities.
  Faculty sponsor: Tiara Pérez Morales

- **"Improving our Methods of Implementing Technologies Within Businesses"**
  Landen Johnston

  With the massive changes in technology in recent years, it only makes sense for business owners to look toward the ways that these innovations can help their businesses. The changes in technology have led to the business landscape taking a primarily digital form, which has redirected traditional business practices. Businesses should develop these technologies to their needs to reach their full potential. For this project, I analyzed scholarly and practitioner journal articles and identified artificial intelligence, data analytics, and blockchain as key areas of technological change. These innovations are used in different ways in business organizations, but the main ways they have been implemented involve decision-making processes and running programs. These tools are able to create simulations and programs using many datapoints. These models provide leaders with more accurate and nuanced predictions

about the direction of their business, leading to better-informed decision-making. Businesses that can find a balance in incorporating these new methods with their existing staff can gain a competitive advantage in an advancing market. I will illustrate my findings through graphs, methods, and data to identify the extent to which businesses have implemented these technologies and reasons behind the drive by businesses for their implementation.
Faculty sponsor: Robert Rebman

- **"Exploring the Relationship Between Deforestation Patterns and Malaria Incidence: A Multi-Country Satellite Analysis and General Additive Modeling Approach"**
  Humna Haque

  Deforestation can increase the risk of infectious diseases by disrupting ecosystems and bringing humans into closer contact with wildlife hosts of pathogens. The destruction of natural habitats and loss of biodiversity can increase the transmission of infectious diseases from animals, leading to a higher risk of malaria-specific regions. Deforestation leading to diseases like malaria is a major concern as it heightens human exposure to disease vectors, disrupts natural habitats, and poses risks to public health and ecosystem stability. However, studies have yet to investigate how the root causes of deforestation in various regions like Sub-Saharan Africa, South America, and East Asia can influence this phenomenon between deforestation and the occurrence of malaria. Studies have also not determined if different kinds of deforestation, patchy vs. clear-cut, have different effects on malaria rates. In this study, three countries, Brazil, Malaysia, and Mali, will be observed using satellite imagery of forest loss over the span of three years through General Additive Modeling (GAM). I hypothesize that regions with deforestation on a larger scale will have higher rates of malaria compared to countries with small-scale deforestation. In addition, I hypothesize that patchy vs. clear-cut areas will have different rates of malaria. Recognizing the connection between deforestation and diseases such as malaria is vital for creating effective public health interventions.
  Faculty sponsor: Jean-Marie Kauth

- **"A Season of Giving to Tails Humane Society: Helping One Animal at a Time"**
  Madeline Russelburg

  Roughly 6.3 million companion animals end up in animal shelters across the United States annually. Of these 6.3 million, 4.1 million shelter animals are adopted each year (ASPCA). Many shelters or humane societies are non-profit organizations and care for an enormous number of animals. Thus, many shelters rely heavily on volunteers to aid in the proper care of these animals until they find their forever homes. Tails Humane Society in Dekalb, IL, is one of those shelters, influencing my decision to volunteer my time and talents for a total of 12 hours in their Spay/Neuter Clinic in December 2023. As a clinic volunteer, I prepped animals for their procedures and assisted in their recovery. During my time at Tails, I gained knowledge of shelter medicine and the operational routine of animal shelters while continuing to develop and refine my leadership skills.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Validating the Use of Bacterial Killing Assays to Investigate Immune Health of Spotted Turtles Living in Contaminated Environments"**
  Madeline Russelburg

  Heavy metals such as mercury, lead, and arsenic enter into and contaminate freshwater ecosystems via anthropogenic industries like agriculture, urbanization, and mining. These heavy metals build up in sediments as long-term chemical deposits and can enter aquatic food webs via bioaccumulation. For freshwater turtles, bioaccumulation occurs through their dietary and sedimentary lifestyles, and can have adverse health effects. Our study is the first to investigate immune responses of wild, endangered spotted turtles (*Clemmys guttata*) inhabiting contaminated wetlands in northern Indiana using bacterial killing assays (BKAs). We used BKAs to directly measure growth of the microorganism *Escherichia coli* in the presence and absence of spotted turtle plasma, which provides a measure of bactericidal capacity (i.e., immune status). We hypothesized that there would be spatiotemporal variation in plasma bactericidal capacity and that it would be lower in turtles with higher heavy metal concentrations. We performed BKAs on 53 plasma samples from June 2022, August 2022, October 2022, and March

2023. Bactericidal capacity was determined after 1.5 and 3 hours. Preliminary results revealed that bactericidal capacity varied seasonally, between sites, and among individuals. Studying immune status of turtles in degraded habitats provides insight into the potential effect of chronic environmental stress on immune health.
Faculty sponsors: Leigh Anne Harden, Tiara Pérez Morales

- **"How Mosquitoes Infected with the Chikungunya Virus Are Affected When Exposed to *Wolbachia* and Radiation in Ghana, Kenya, and Sudan"**
  Bailey Soto

  Many diseases are spread by vectors, which are living organisms such as parasites and mosquitoes. Studies of the correlation between zoonotic diseases, vector-borne diseases, and climate change examine many different areas of Canada, Sub-Saharan regions, South Asia, New York, and Connecticut. Because of the hazards and limitations of pesticides, scientists have tried alternate methods of mosquito control, including irradiation and using strains of *Wolbachia* to help reduce the mosquito population. This project will study the Chikungunya (CHIKV) virus and will take place in Ghana, Kenya, and Sudan. This project will measure the infection rates of mosquitoes and the level of human disease as mosquitoes sterilized with radiation and mosquitoes sterilized with *Wolbachia* are released into these areas, while controlling for temperature. I hypothesize that both methods of sterilization will better prevent the spread of the CHIKV virus than the control group, but that *Wolbachia* will be more efficient in stopping the spreading of the disease. Every year at least 100,000 people die of the Chikungunya virus. Knowing the most effective way to sterilize mosquito populations could not be more essential in the fight against the spread of vector-borne diseases as climate change increases temperatures.
  Faculty sponsor: Jean-Marie Kauth

ATRIUM | Outer Wall

- **"Spotlight Community Hallmark: Mary, Our Mother Clean Up"**
  Nick Reid

  There is no greater thing than being a part of a community, family, or like-minded group. One of the Benedictine hallmarks is community, grounded in service for the common good, respect for the individual, virtuous friendship, and the beatitudes. I took this to heart as I considered my Schmitt Service Project to align not only with my values but also Benedictine's identity as a Catholic community. When I struggle, I turn to my faith and prayers and constantly find myself sitting in front of our Mary statue and shrine. I noticed the weeds, dirty concrete, missing plants and knew I had to do something for our Mother. Partnering with our University Grounds Crew during the cleaning process, I learned just how important these statues and shrines are to other people. Even in the darkest times for people's faith, Mary gives people a source of light and I wanted Mary to shine for all. The next step is to come back in spring, complete some gardening, and invite more of our community to participate.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Synthesis of a Never-Before Made Lidocaine Derivative: A Possible Alternative to Local Anesthetics?"**
  Nathan Robelo, Levin Kandakudy

  Lidocaine is commonly used in local anesthetics due to its effectiveness. This project focuses on a newly designed synthesis for a derivative of lidocaine. The synthesis involves structural modifications of the actual structure of lidocaine in hopes of improving its productiveness or duration while also limiting side effects. The original structural components of lidocaine (2,6-dimethylaniline and chloroacetyl chloride) were kept throughout the synthesis; however, a new structural component, sarcosine, was attached rather than diethylamine. Throughout this process, a variety of chemical techniques were used, such as filtration and chemical refluxes, to synthesize the reaction, while chromatography, IR and NMR were done to confirm the compound's identity. Although the results of this experiment do not suggest its useability as an anesthetic, it provides a potential new alternative to lidocaine.
  Faculty sponsor: David Rubush

- **"*Arthrobacter sp*. Phage Isolation and Characterization Using a Variety of Soil Samples: A Pilot Study for a Research Classroom at Benedictine University"**
  Manal Syeda

  Viruses are infectious particles that affect a variety of hosts. We are interested in phages which target bacteria via two infection mechanisms known as lytic and lysogenic cycles. In this work, we studied phages that infect the genus *Arthrobacter sp*. Our goal was to identify soil samples that provide *Arthrobacter* phages for *A. globiformis*, *A. atrocyaneus*, and *A. sulfureus* when used in a research course. This would help reduce the number of phage isolation rounds. We hypothesized that sites with seasonal turnover would yield the most phages. We detected phages for *A. globiformis* and *A. atrocyaneus* after only one round of isolation. Here, we focus on the characterization of three *A. atrocyaneus* phages named Slak, Starboy, and Olbo. The phages have small plaque diameters with clear or cloudy centers. They infect between 22 – 37°C with lower success rates at higher temperatures. Samples were prepared for transmission electron microscopy and DNA analysis. Most resemble Siphoviruses with isometric capsids and flexible tails. We selected restriction enzyme sites to perform genome analysis but were unable to visualize. We would like to continue our study by increasing the number of sites to determine which soil samples are best to isolate *A. sulfureus* phages.
  Faculty sponsor: Tiara Pérez Morales

- **"Identifying Influential Factors on the Interaction Between Microplastics and Trace Elements in Natural Waters in Will County, Illinois"**
  Amber Tramutolo

  Microplastics are pervasive plastic pollutants measuring less than five millimeters in size. Though found virtually everywhere, little is known about the long-term health consequences of microplastics, especially in natural waters. To fully analyze the broader health implications, it is crucial to understand the physicochemical characteristics that make microplastics so harmful and the role of environmental conditions—namely, the presence of trace elements, which can be harmful in high concentrations and are often adsorbed onto microplastics, and water chemistry. This research proposal suggests a study in which samples are taken from various natural waters throughout Will County, Illinois. By recording precise solution chemistry, determining trace elements present using inductively coupled plasma-optical emission spectrometry and flame atomic absorption spectroscopy, and characterizing the microplastics found with fluorescence microscopy, the most influential factors can be determined. The hypothesis is that microplastic weathering, polymer type, temperature, UV index, and pH will be the most influential factors contributing to interactions between microplastics and trace elements in natural waters. Knowing these factors will open up the opportunity for more reliable identification of natural waters at-risk for higher toxicity due to microplastics, facilitating more effective mitigation of toxicants due to plastic microplastic pollution.
  Faculty sponsors: Jean-Marie Kauth, Niina Ronkainen

- **"Mental Health for Leaders: Supporting Our Community"**
  Mary Jane Aguilar

  Focusing on mental health and providing understanding and resources is increasingly common, with many individuals now sharing their struggles. An underrepresented population that experiences theese challenges are college students. In a recent study, 44% of students reported experiencing symptoms of depression while 15% reported thoughts of suicide and self-harm. With such a large population struggling with their mental health, it is crucial that mental health resources are available and that those around them are trained on how to support them. For this project, I worked with the Benedictine Office of Human Resources to arrange training by professionals for campus leaders on how to assist others in times of need. When someone comes to you with concerns about their mental health, saying or doing the wrong thing can cause more harm. Through this event, campus leaders received information that can be applied in real-world scenarios, including resources for students on and off campus.
  An Arthur J. Schmitt Future Leaders Project
  Faculty sponsor: Julie Bjorkman

- **"Mastering the Market: Insights on Advanced Fundamental and Technical Analysis"**
  Stephany Mondragon

  Company Stock analysis is a mixture of technical and fundamental methods used to evaluate the performance and future growth of publicly traded companies. To determine a stock's value and to make an informed decision, fundamental analysis focuses on company-specific measures such as ratios in earnings, revenue, profit margins, and other financial indicators. This approach looks at economic statistics and industry trends to assess a company's financial standing and potential growth over the short-term or long-term such as days, weeks and up to years. On the other hand, technical analysis looks at market movement and stock price changes to find patterns and trends that could indicate future price movement. This is a way to forecast investor behavior and market movements using historical data, charts, and indicators.
  Faculty sponsor: Thomas Nicholas

- **"Synthesis of a Lidocaine Derivative: A Potential Anesthetic"**
  Zach Johnson, Musab Shaikh

  Lidocaine is a local anesthetic used in the medical field. It can be applied topically or intravenously, and it functions by blocking sodium channels in nerves. It is synthesized using a two-step reaction. 2,6-dimethylaniline and 2-chloroacetyl chloride are combined using a reflux reaction to make 2-chloro-N-(2,6-dimethylphenyl)-acetamide. The intermediate reacts with diethylamine to form lidocaine. The purpose of our experiment was to synthesize a structural analog of lidocaine and test for biological activity and effectiveness. We used bromopropionyl bromide with 2,6 dimethylaniline to form 2-Bromo-N-(2,6-dimethylphenyl)propanamide. This intermediate should react with 2-(Ethylamino)ethanol to give a final product of N-(2,6-Dimethylphenyl)-N2-ethyl-N2-(2-hydroxyethyl)alaninamide. To purify this product, we used techniques such as extraction, vacuum filtration, and evaporation.
  Faculty sponsor: David Rubush

- **"Comprehensive Collection of Data on PFAS Contamination in Drinking Water Throughout Illinois"**
  Karlee Stuiber

  Per- and polyfluoroalkyl substances (PFAS) are prevalent in modern life. These substances are very useful in industrial applications and can be found in many domestic products. However useful they may be, PFAS have been linked to negative health outcomes, and research has found that the contamination crosses generations. PFAS have been found in drinking water sources; however, there is a lack of detailed cataloging of the burden on local Illinois communities from their drinking water. This project will create a database that reveals the burden of PFAS contamination in different locations. We will take samples from public water treatment plants and wells used to supply small communities. We expect to find PFAS contamination that requires remediation or implementation of better filtration techniques. This information will be able to be used in determining where remediation efforts are needed and inform individuals so that they may make better-informed personal health decisions.
  Faculty sponsor: Jean-Marie Kauth

- **"Unraveling the Origins and Analysis of *Wolbachia*: Insights into Evolution, Host Interactions, and Symbiotic Mechanisms"**
  Luqman Alam, Ammar Ekram, Adam Hussaini, Isa Shams

  Our research investigates the rate of *Wolbachia* bacterial infections in various insect populations. Numerous insects have *Wolbachia* within their cells, which can have a variety of biological effects. We collected insects from various environments and employed DNA sequencing to identify *Wolbachia*. Our research showed a significant range in *Wolbachia* infection rates. Certain insect species had large rates, while others had minimal or no rates at all. This illustrates how closely *Wolbachia* and the insects they live with are connected. It's important to understand how *Wolbachia* works because what it does could affect the environment and the way insect groups evolve.
  Faculty sponsor: Phil Novack-Gottshall

Index of Poster Session Participants