Undergraduate Research and Creative Activity Symposium

April 17, 2024

John C. Myers Convocation Center

A Letter from the Dean

Welcome to the fifteenth annual Undergraduate Research and Creative Activity (URCA) Symposium, hosted by the College of Arts & Sciences at Ashland University! Modeling the format of a professional conference, URCA provides AU students have the opportunity to present original research; read creative fiction, poetry, or essays; and exhibit new works in visual arts and design that invite dialogue, debate, and meaningful conversations.

Mentored research and creative projects foster students' intellectual inquiry and promote sustained engagement within their fields of study under the guidance of dedicated faculty. Experiences gained at the URCA symposium enable students to present at professional conferences; author or co-author publications in journals; compete and perform at state, regional and national levels; and exhibit work in a variety of venues and formats.

Students who participate in research in any discipline are well prepared for graduate studies or professional careers. Coursework, internships, and advising within the College of Arts & Sciences enhance students' ability to solve problems, think critically and creatively, analyze data, and speaking and write effectively.

The URCA symposium is a celebration among students and faculty who share a mutual joy of learning, encounters that often lead to life-long professional relationships. Alongside our faculty, I am delighted to host and highlight the outstanding academic achievements of students across disciplines in the College of Arts & Sciences.

With many congratulations to our participants, I wish you all the best.

Dr. Katherine T. Brown, Dean
College of Arts & Sciences

The College of Arts & Sciences at Ashland

The College of Arts & Sciences is a vibrant academic community at the heart of the university undergraduate experience. Grounded in liberal arts, students prepare for careers in science, business, the arts, education, communication, government and service organizations as well as for pro-professional programs and graduate school.

Ashland University Mission Statement

Ashland University, guided by our Christian heritage, is a comprehensive private university that provides a transformative learning experience, shaping graduates who work, serve and lead with integrity in their local, national, and global communities.

Undergraduate Research and Creative Activity Symposium Committee

Chair, Dr. Wendy Schaller, Associate Professor, Art
Mohsine Bensaid, Writing and Communication Center
Dr. Scott Garlock, Professor, Music
Dr. Nicholas Johnson, Associate Professor, Chemistry
Dr. Mitchell Metzger, Professor, Psychology
Dr. Christopher Swanson, Professor, Mathematics
Dr. Kelly Sundberg, Assistant Professor, English
Dr. Robert Wyllie, Assistant Professor, Political Science
Ms. Krystal Hamilton, Administrative Assistant (Program Design and Layout)

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Trustees Room

MapEase - An Indoor Navigation App.

Sadae Smith

Student’s Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

Complex indoor environments in public spaces, like airports, campuses, and parks, pose navigation challenges, resulting in frustration, stress, and inefficiency for visitors. Accessibility gaps for individuals with disabilities, limitations in traditional real-time communication methods, and signage exacerbate the problem. There's a compelling need for a user-friendly indoor navigation tool to enhance efficiency, inclusivity, and the visitor experience, which is not currently provided in modern global positioning system (GPS) location applications. The main objective of MapEase is to solve this issue by developing an application for Ashland University that will create optimized routes. By using a filter system, the user will be able to navigate through different buildings on campus and have easy-to-access information about the location of different elevators or accessibility areas within those buildings. This will be accomplished using technologies such as React Native, Python, AWS, and Map APIs to develop the front-end, back-end, and route algorithm needed to provide a seamless and modernized experience for people from diverse backgrounds.

Gold Nanocluster-Assisted Phototherapy for Targeted Metastasis Treatment

Zoey Lockwood

Alumna Speaker

Zoey Lockwood is currently a third-year chemistry Ph.D. student at Case Western Reserve University. She obtained her bachelor's degree in Biochemistry from Ashland University in 2021, where she engaged in undergraduate research alongside Dr. Nicholas Johnson. Zoey's doctoral research centers around using gold nanoparticles for cancer therapy, specifically in the context of targeted drug delivery. Her work aims to contribute to the improvement of cancer treatment efficacy.

Despite scientific advancements that have improved survival rates for various cancer types, cancer remains the second leading cause of death in the United States. Nanoparticle-based phototherapy offers a promising solution with fewer risks compared to current treatments. We take advantage of the unique properties of gold nanoparticles (AuNPs) to amplify light absorption in cancerous tissue by several orders of magnitude. Simultaneously, we are exploring the application of indocyanine green (ICG), a near-infrared dye, which serves as both a photosensitizer (PS) and photothermal agent (PTA). To precisely target these systems to malignant tissue, we incorporate a cathepsin inhibitor, as cathepsin is an overexpressed protease in tumor cells. Therefore, we are focused on synthesizing AuNPs conjugated with a cathepsin inhibitor and ICG. Upon irradiation, the AuNPs will generate reactive oxygen species (ROS), inducing cellular damage. This novel approach exploits a combination of targeted phototherapy, coupled with cathepsin inhibition, offering a potentially highly effective cancer treatment.

The Malleability of Myths as Seen through Medusa

Eparaima Wild

Student's Major: History
Faculty Sponsor: Dr. David West, History

Roman myths and religious practices are derivative in many ways from Ancient Greece, and casual readers of classical mythology may assume Roman stories have the same themes as their Greek originals. This paper compares close readings of the story of Medusa as it appears in Hesiod's *Theogony*, a Greek poem from the seventh century BCE, and Ovid's *Metamorphoses*, a Latin poem from the first century CE. Although the narrative about Medusa is similar, Ovid reworks the Greek original in order to present different themes. Both Hesiod and Ovid tell the story of a snake-headed woman slain by Perseus. In Hesiod, Medusa is the mortal daughter of the gods who is the progenitor of monsters and heroes. She exemplifies the merging of morality and mortality. Ovid adds critical details, however, that emphasize the tragic aspects of Medusa's story. Ovid's Medusa is a beautiful woman tragically transformed into a monster and abused by men at every turn. Roman poetry may retell the stories of the Greeks who came before them. However, the case of the Medusa myth shows how Roman poets like Ovid can creatively rework very different themes into the stories they receive from the Greeks.

Oral Session II
10:30-11:30 a.m.
Trustees Room

Modeling Complex Growth in Christianity

Carmen Schlatter

Student's Major: Integrated Mathematics Education
Faculty Sponsor: Dr. Gordon Swain, Mathematics

When investigating the growth of a certain population, how does one choose the right type of model? In this presentation, this question will be addressed as we look at the growth of Christianity. Data was collected from several diverse sources that were all deemed reliable. From among these, the most trustworthy values were selected and used for further modeling. The given data does not fit what would normally be expected in population growth - instead of steady growth, we see varying rates of growth. Because of this, we must look beyond simple models - such as the unlimited growth model, limited growth model, and the logistic growth model - and focus on more complex models such as those that are used in epidemiology. In some ways the growth of Christianity can be compared to the spread of diseases, such as the Influenza virus, HIV/AIDS, or Covid-19. These diseases, along with the growth of Christianity, can be visualized by modeling the interactions between compartments of the population. When applying these models to Christianity, the compartments for diseases – typically susceptible, infected, and recovered - can be replaced with the unconverted, those who are converted and proselytizing, and those who are converted but are unenthusiastic, respectively. In this exploration, their defining characteristics, limitations, and intended purposes will be discussed as we investigate whether these models are appropriate to use.

Advancing Accessibility Through Technology

Jacob Levering & Anthony Wasinski

Students' Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

Information can be conveyed in numerous ways. There is a strong reliance on pictures and diagrams to give us representations of the information, however, this method restricts some from receiving the proper message. There are many factors that can prevent someone from reading a display of information, thus an audio representation can give more accessibility to those who have visual impairments. To better accommodate the display cases throughout the Ashland University campus, specifically those in the Kettering Science Center and the Patterson Instructional Technology Center, an input-driven response system will be implemented through a Raspberry Pi console which is coded in MicroPython. The console will be connected to a breadboard that will have buttons to prompt the audio to play. The button will send a signal to the console which will play the audio file stored on a micro-SD card through the speaker. This project aims to be simple in its design, so it will be quite easy to expand the application of the system in the future. This button-prompted system will work to open accessibility to all those with visual impairments.

PillPal

Dhiren Brickman, Megan Coon & Katrina Rolince

Students' Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

The modern pharmaceutical industry has evolved and resulted in thousands of different pills with an assortment of colors, shapes, and sizes. This can pose a serious health risk for patients who must take multiple different prescriptions. If they have difficulties identifying between their medications, then they could consume the wrong pills. Our system, PillPal, provides a solution by identifying the medication and generating relevant information about their pill. This machine-learning technology first takes an image of a singular pill submitted by the user via their mobile device camera. It then uses pattern recognition to extract information about the drug in the photo, including the color, imprints or text on the surface, and the shape. Next, the AI-based system utilizes Python programming language and SQL database technology to store the drug information. Finally, the machine-learning system assists in the successful extraction of the data from the medical databases in comparison to the user-submitted data, and it will output the identified drug and its relevant medical information. The ideal implementation of this code in the future is a mobile application, but this demonstration uses a simplified user interface.

Pax Vobiscum (Peace Be With You)

Eleanor Lohr

Student's Major: Digital Media Production
Faculty Sponsor: Dr. David McCoy, Journalism and Digital Media

Pax Vobiscum is an original short film that I wrote, cast, directed, filmed, and edited. The film is about a struggling young dancer named Scarlett and a red music box that she is given by her mother. The box belonged to another dancer, Amber, who still haunts it and has been in a state of unrest for years. The two become unlikely friends as they work together to find Amber peace that culminates in an emotional finale. Friendship, grief, hope, and religious undertones take center stage as the girls wrestle with complex issues and emotions.

Poster/Exhibition Session I
11:45-12:45 p.m.
Alumni Room

Can We Identify Species of *Chrysobothris*, a Genus of Jewel Beetle, by Spectral Emittance and Hydrocarbon Composition of the Elytra?

Julianna Zito

Student's Major: Biology
Faculty Sponsor: Dr. Cynthia Perkovich, Biology

Flatheaded appletree borers (FAB; *Chrysobothris* spp.) are a group of 12 distinct species that are difficult to positively identify from one another without molecular analysis. All FAB are attracted to purple-colored pole traps, but there is some evidence of variations in attraction to emitted spectral peaks as cues for conspecific and mate detection. There may be differences in the spectral emissions of individual species that allow for conspecific recognition. Furthermore, there may also be differentiations between spectral emissions of males and females from the same species. Previous studies have found that males were more highly attracted to a red hue (the purity of a base color) and a peak reflectance at longer wavelengths (i.e. red and near infrared). Contrastingly, females were more attracted to violet hues. This differentiation of attraction between sexes may influence mate seeking behaviors. These changes in spectral emissions occur in other beetles due to small pits on the cuticles of elytra, containing sex pheromones (species specific hydrocarbons) and the morphological structure of these pits. We analyzed five males and five females from 10 FAB to understand patterns of hydrocarbon composition, elytra pit morphology, and spectral emissions. Individual species are distinguishable based on the specific compounds found. Females of each species are distinguishable from males by larger hydrocarbon structures found on the elytra. Furthermore, each species displays peak emittance at unique wavelengths identifying differences in cuticular hydrocarbons and spectral emissions may offer scientists a better way to identify the various species without molecular assistance.

New Words: From Receptive to Expressive Language

Fabian Bussard

Student's Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

New Word is an iPhone application that is designed for expanding vocabulary. The aim of the application is to transform passive vocabulary into active vocabulary through intentional incorporation of user-added words into one's speech or writing. Indeed, *New Word* was built to ease the process of writing down any words the user reads or hears and would like to master. The application has five main components that work together to achieve this objective. The "Add Word Component" allows users to add new words into a personalized list, accompanied by a self-written description of the word based on their understanding. The "Phonetic Retrieval Component" automatically retrieves the phonetic version of the word and displays it next to that word to help with pronunciation. The "List Management Component" will allow users to check a box (displayed next to the word) once the word has been used in a real-world social situation. When the box is checked, the word will be removed from the list. The "Usage Tracking Component" provides a list that serves as a reminder of all the words the user has added but still must use in his speech/writing. The "Word List Manager Component" will automatically create a new blank list every day to help with the organization of the words and lists from previous days will be archived and accessible through an intuitive calendar view. The application is set up for continuous improvement with future enhancements including the introduction of additional features.

Benzoate Substituted Imidazoles as Potential Anticancer Agents

Madison Fish & Chelsea Niedermier

Students' Majors: Biology (MF) & Toxicology (CN)
Faculty Sponsor: Dr. Nicholas Johnson, Chemistry

The use of imidazoles and imidazolium salts and their derivatives as potential anti-cancer agents is gaining attention in the medical field. A common limitation of these compounds (and many pharmaceuticals) is the loss of water solubility with increased anti-cancer activity. This loss of solubility results in a decrease in the potential administration. We have synthesized a potential anti-cancer compound based upon a benzimidazole system with highly lipophilic naphthalene substituents. This compound has been utilized in conjunction with a previously synthesized phosphazene-based drug delivery system in attempts to create an amphiphilic anti-cancer drug. Currently, we are focused on utilizing a series of oxygen-containing (benzoate) substituents to be substituted on an imidazole, which will increase the hydrophilicity of the drug system itself. A structure-activity relationship (SAR) will be developed. Using IC_{50} (half-maximal inhibitory concentration), the results of benzoate additions will provide insight into which compounds could be most effective in drug delivery systems. Results from this study have been characterized via proton nuclear magnetic resonance (^1H NMR).

Synthesis of Substituted Chlorophosphazine and TPP Incorporation to Improve Drug Delivery Systems

Melanie Eichler & Maddi Whiticar

Students' Majors: Biochemistry (ME), Chemistry (MW) & Environmental Science (MW)
Faculty Sponsor: Dr. Nicholas Johnson, Chemistry

One of the main challenges with new pharmaceuticals is delivery. Many effective drugs are lipophilic; however, to deliver these molecules, they must also be hydrophilic. One method to increase the aqueous solubility of pharmaceuticals is the utilization of cyclic chlorophosphazene trimer ($[PCl_2N]_3$) as the core of a drug delivery system. $[PCl_2N]_3$ are a model system for this delivery, mainly due to the ease at which the phosphorus atoms of the ring structure can be substituted with various side groups. We have synthesized a hydrophilic phosphazene-based system by substituting three equivalents of tetraethyleneglycol monomethyl ether (TEGME) onto $[PCl_2N]_3$. With this substitution reaction, three trisubstituted structural isomers are formed. All three isomers have incredibly similar structures and polarities, making them difficult to separate. Our work is specifically focused on the utilization of the cis-2,4,6 product, which contains all three TEGME substituents on one side of the phosphazene ring. To isolate the cis-2,4,6 isomer, column chromatography is employed. Once isolated, the phosphazene-based drug delivery system can be substituted with a variety of potential anticancer agents and targeting moieties. Our research group has also been working on the development of potential anticancer drugs to be used with the previously described phosphazene drug delivery system. Specifically, we have attempted to prepare an imidazole-based compound that is functionalized with a targeting moiety (triphenylphosphonium) as well as an antimicrobial metal, silver. When silver and triphenylphosphonium are combined with a benzimidazole core, which is known for its role as a powerful therapeutic, a formidable anticancer agent could form.

CRISPR Gene Editing of *stx3a* and *tkta* Genes in Zebrafish to Identify Defects in Lens Development

Taylor Garver and Ella Ives

Students' Majors: Medical Laboratory Science (TG) & Toxicology (EI)
Faculty Sponsor: Dr. Mason Posner, Biology

Cataracts are opacities in the eye lens that obscure vision, leading to the most common cause of human blindness. This cloudiness arises due to the aggregation of denatured proteins that prevent light from passing to the retina. Therefore, understanding how protein-coding genes function within the lens is crucial to discovering the inner workings of cataract formation. The goal of this study is to damage two uninvestigated genes with CRISPR gene editing to deduce what malfunctions occur in lens formation when these proteins are missing. Zebrafish are an ideal model for studies of lens development due to their external, transparent early life stages and genetic similarities to mammalian biology. Our previous work has shown that the genes *stx3a* and *tkta* are highly expressed in zebrafish lenses; however, little research has explored their role in lens development. Prominent databases for zebrafish research predict that *stx3a* is involved in intracellular protein transport, whereas *tkta* is predicted to influence fundamental metabolic proteins. Presently, we have completed the synthesis of the guide RNAs necessary to target Cas9 damage to the *stx3a* gene and have made progress on the *tkta* guide RNAs. Once both *stx3a* and *tkta* guide RNAs are injected into the single-stage zebrafish zygote, they will target the specified genes and eliminate them from the genome. Then, we analyzed any defects using microscopy imaging as well as utilize histology to identify abnormalities at the cellular level. Exploring *stx3a* and *tkta* knockout zebrafish will help determine their function in lens development.

Investigating the Role of the Transcription Factor Cebpg in Zebrafish Lens Development

Maddison Dolenga and Teddy Togliatti

Students' Major: Biology
Faculty Sponsor: Dr. Mason Posner, Biology

Networks of genes work collaboratively to produce the lens of the eye. Damage to any one of these genes can cause detrimental errors in the development of the lens, which in turn, may contribute to cataracts: the leading cause of blindness across the globe. The protein-coding gene, Cebpg, regulates gene expression to protect tissues against stress. Mice lacking Cebpg have reduced eye size, but no study has examined its role in the lens. Therefore, we are using zebrafish as a model system to examine the impact of Cebpg loss on lens development. The goal is to use CRISPR to damage the Cebpg gene to investigate the protein's role in lens development. We used CRISPR gene editing to damage the gene for Cebpg in one-cell stage embryos and examined the resulting larvae for lens defects. Approximately 75% of Cebpg crispant larvae had abnormal lenses at 3 days post fertilization (dpf) compared to 10% of control larvae. Previous literature examining a mouse model showed that other genes changed expression level when the Cebpg gene was damaged. RT-qPCR was used to measure the expression of slc7a11 and hmox1a in CRISPR-generated fish to see if the same results were yielded. Analysis showed an increase in hmox1a mRNA but reduction in slc7a11 mRNA in crispant larvae, similar to the published findings in the Cebpg knockout mouse. The genes that Cebpg appears to regulate are involved in ferroptosis, a mechanism that is poorly understood in the lens.

Phytochemical Traits of the Crape Myrtle

Jaelyn Palmer

Student's Major: Biology
Faculty Sponsor: Dr. Cynthia Perkovich, Biology

Crape myrtles are popular ornamental plants that bloom in a variety of vibrant colors. However, a variety of insects have found an interest in eating the plant. Furthermore, some diseases cause the plant to look unhealthy and thus undesirable to buyers. This makes it hard for crape myrtle producers to sell and market them to the public. By conducting extensive research on the phytochemical traits and plant defenses of the crape myrtle, it is possible to understand why these pests or diseases like the crape myrtle. Pests would consist of the crape myrtle aphid, flea beetles, and Japanese beetles. The diseases consist of powdery mildew and Cercospora leaf spot. The results of the research showed a correlation between the phytochemical traits and the pests' behavior. We will use these results to make recommendations to growers to treat the plant. This will help increase the marketability of the crape myrtle.

The Degradability and Self-Organization of Polylactide Calixarene-Core Star Polymers: Progress Towards the Development of New Biomaterials

Matthew Roberts & Caleb Dilling

Students' Major: Biochemistry
Faculty Sponsor: Dr. Perry Corbin, Chemistry

This study involves the synthesis, degradation, and aggregation of calixarene-core polylactide (PLA) and polylactide-polyethylene glycol (PLA-PEG) star polymers. Calixarenes serve as the core of our polymers and as a base for growing multiple PLA or PLA-PEG chains. These new structures have potential to function as water-degradable biomaterials in the case of the PLA polymers or as micelles in the case of the PLA-PEG copolymers. Both have potential to entrap drug molecules and to release said molecules through controlled degradation, forming a useful drug-delivery system. The synthesis requires specific target chain lengths to optimize aggregation potential in the case of the PLA-PEG polymers. Differences in PLA star degradation may also occur with varying chain lengths, so a regimented synthesis was utilized. Four and eight-armed PLAs with approximately 20 repeat units were prepared using controlled reactions. The star PLA-PEG synthesis is currently underway. A linear PLA-PEG has been used to form micelles and encapsulate pyrene. Pyrene fluoresces differently when inside a formed micelle. Therefore, a comparison of pyrene's fluorescence with and without the polymer present confirmed formation of a micelle and has provided a method for studying aggregation once the star PLA-PEG synthesis is complete. Coinciding with this research is a study of the controlled degradation of synthesized star PLAs by changing their crystallinity. To study differences in crystallinity a differential scanning calorimeter was used to measure crystallinities based on annealing times spent just below the melting point. Current work is being carried out to study degradation of star PLAs with different crystallinities.

Temperature Variation and Arthropod Biodiversity in U.S. Streams

Jihae Dick, Mia Gardner & Clara Zemancik

Students' Majors: Environmental Science (JD, MG) & Biology (JD, MG, CZ)
Faculty Sponsor: Dr. Patricia Saunders, Biology

Stream temperature affects macroinvertebrate lives greatly by influencing life stage timing, larval rate of respiration and oxygen usage, and disease susceptibility. These factors impact arthropod survival to adulthood and the reproductive success of adult aquatic macroinvertebrates. Since temperature has such a profound role in arthropod success, it is important to research and comprehend how temperature variability in streams affects the populations and diversity of aquatic arthropods. An established body of data from NEON (National Ecological Observatory Network) was utilized to research the relationship between stream temperature variability and arthropod diversity in various streams across the United States. The seasonal temperature range, represented by the temperature range through June and July of 2021, was calculated at 17 sites. Arthropod diversity was found using July 2021 NEON macroinvertebrate collections for each of the corresponding streams. It was hypothesized that streams with greater seasonal temperature variability would show less arthropod diversity, as the arthropods in these streams may face higher resource-limitation due to the shortened growing season and unpredictability of weather. There was no correlation between the number of genera present per stream and the temperature range; nor were latitude and diversity correlated. It was also found that the number of genera and families in streams was highly correlated *(R^2=0.88, P<0.0001)*, which suggests that keying invertebrates down to genera in this type of research may be unnecessary. Evaluating the NEON samples from spring and fall 2021 with other measures of temperature variability may lead to different conclusions.

Thank a Farmer

Kaitlyn Adkins

Student's Major: Art Education
Faculty Sponsor: Professor Keith Dull, Art

A farmer's connection to the land, which they use as a means of feeding multitudes of people, has always been a fascination to me. I have grown up around farming through my grandfather and uncles who still utilize their land to this day. I have always loved the farming process and have admired all of the work they put into their trade. However, as I have grown, I have realized how few people actually appreciate where their food comes from and all of the necessary work to get it from the farm to their plate. To celebrate my family and the farming community, I depict pristine images of farm machinery using oil paints. Then, using charcoal and a larger piece of paper, I sketch what the land looks like outside the canvas to create a sense of the expansiveness of the land, and to capture the realistic side of farming with the messy and dirty medium used. By depicting the machinery and the steps necessary to grow these plants that feed so many people, I want viewers to recognize this and "Thank a Farmer" for all the hard work and dedication they put into their craft. I wish to showcase how farmers utilize the land they were given by God, and how they use it to feed so many people. The purpose of my paintings is to celebrate farmers and farming and to thank them for all they do.

Poster/Exhibition Session II
12:45-1:45 p.m.
Alumni Room

Impact of the Gene *ell2* on Development of the Zebrafish Eye Lens

Erica Samples

Student's Major: Biology
Faculty Sponsor: Dr. Mason Posner, Biology

Many genes work in coordination to ensure proper development of the eye, especially when it comes to the lens, as defects can cause cataracts, the leading cause of blindness worldwide. One gene, *ell2*, is known to be involved in transcription elongation and is expressed in the lens. Work from a colleague using mice showed the removal of an important lens gene, *Celf1*, led to an increase in *Ell2* expression. This suggests that *Ell2* is involved in lens development, but there has been little research on its function in this process. Therefore, we used CRISPR editing to inject guide RNAs into zebrafish embryos to guide the Cas9 enzyme to the *ell2* gene to damage it. PCR showed large base pair deletions, indicating the gene was successfully damaged. 74% of larvae at 4 days post damage had body abnormalities while 47% had lens abnormalities. We used RT-qPCR to measure expression of important lens genes after *ell2* damage. Expression of the abundant lens gene *crybb1* went down by 3.2-fold, which was similar to what our colleague found in his mouse study. However, expression of the stress protective gene *hmox1a* went up by 2.8-fold, while our colleague found it went down by 7.8-fold. Currently, damaged *ell2* PCR products are being sequenced. Two new batches of zebrafish embryos have been injected to begin a second and third biological replicate to confirm changes in gene expression. Determining the specific function of *ell2* in the lens adds new details on the way the lens develops.

The Process and Application of Zebrafish Lens Illustrations

Kaylee Burke

Student's Major: Biology
Faculty Sponsor: Dr. Mason Posner, Biology

Scientific illustrations are helpful tools that allow us to better understand the processes and anatomy of our world. Researchers studying eye lens development have primarily used mice as a model species, although the small, tropical zebrafish have become more important in the field. The goal of this study was to produce illustrations comparing development of the mouse and zebrafish lens to facilitate the scientific use of both species. The process of making these illustrations requires references: source images of the subject that are either found in the research literature or generated by the illustrator. Using these reference images, it is important to have an in-depth understanding of the subject being drawn in order to accurately communicate this to the viewer. Once these references are found and utilized, they are turned into an illustration. One illustration has been completed, comparing a three-day old zebrafish lens and a two-day old mouse lens. The main differences between each lens mostly lie in the nuclei. As zebrafish mature, the inner cell's, or fiber cell's, nuclei eventually disappear in order to help the lens become transparent. The placement of nuclei in a mouse lens is vastly different than that of the zebrafish. They are more spread out and leave a much smaller window for the fiber cells. The zebrafish fiber cells form an almost rose petal like pattern, while the mouse's fiber cells form straight lines. These lens illustrations allow the viewer to gather a basic understanding of the differences and similarities between mouse and zebrafish lenses.

Exploring a Novel Role in Eye Lens Development for the Gene *crygn2* in Zebrafish

Emma Arra

Student's Major: Biology
Faculty Sponsor: Dr. Mason Posner, Biology

The leading cause of blindness worldwide is the development of cataracts. Lens formation relies on the function of many different genes. The gene *crygn2* is responsible for an abundant lens protein called gamma N2-crystallin. However, the function of this protein in lens development is still a mystery. The goal of this project is to better understand the role of *crygn2* in lens development through CRISPR gene editing. With the use of two gRNAs, the enzyme Cas9 targeted the *crygn2* genes, resulting in a non-functional gene. Phenotypic findings of these fish includes pitting, irregular borders of the lens, and more. To ensure that the phenotypic abnormalities reflected the expected genotypic damage, small regions flanking the deletion site were sequenced to determine where Cas9 cuts were made. Deletion of *crygn2* should result in a smaller PCR band size, due to the primers selected to cut before and after the target site. To ensure phenotypic abnormalities are correlated to this deletion our lab is producing a line of pure-bred null fish. To do this, identified heterozygote fish injected with the gRNAs were bred with wild type fish. Some offspring of this cross will be heterozygous. Heterozygotes were in-crossed, producing a null population. Currently, the lab is identifying individuals in the null in-cross population. Other experiments may examine how *crygn2* alters the expression of other genes, required for normal lens development. It is through understanding the various roles that different genes play, such as *crygn2*, that the knowledge of lens biology expands.

Analysis of Cannabinoids in Legally Distributed Gummies, Tinctures, and Vape Products by High Performance Liquid Chromatography

Megan Tomasic & Sarah McKee

Students' Majors: Toxicology (MT) & Biochemistry (SM)
Faculty Sponsor: Dr. Brian K. Mohney, Chemistry

The cannabinoid content of various edibles, gummies, tinctures, and vape-products that are legally sold in Ohio was measured using high-performance liquid chromatography (HPLC). Within the last decade, cannabidiol (CBD) products have become immensely popular in the United States due to loopholes in state laws permitting medical and recreational marijuana. CBD products are used to treat a wide range of medical conditions and lifestyle diseases. Chemists can easily convert CBD, extracted from hemp, into several psychoactive cannabinoids that can be mixed in the form of gummy candies, tinctures, and vape products for recreation and medical use. Since CBD products are not fully regulated by the FDA (Food and Drug Administration), they can contain several unadvertised cannabinoids – cannabinol (CBN), cannabigerol (CBG), cannabichromene (CBC), cannabidiol (CBD), and Δ-8-, Δ-9-, Δ-10-, and Δ-11-tetrahydrocannabinol. Each has different physiological effects, from relaxation to pain relief to psychoactive effects. Cannabinoid products - peach gummies (Δ-8), vegan gummies (Δ-8, Δ-10), blue-ring gummies (Δ-8, Δ-11), a tincture (Δ-8, Δ-10) and several vape products - were analyzed for their cannabinoid content. The samples were extracted using both Soxhlet extraction and solid phase extraction methods and then run on the HPLC, which separates the cannabinoids based on chemical structural differences. HPLC provides concentrations of each drug in a sample, which are then compared to what is advertised on the package. The advertised cannabinoid content of each product was verified, but multiple unadvertised cannabinoids were found in each sample.

Phytochemical Changes in Maples Induced by Overspray from 2 Commonly Applied Herbicides and the Effects they have on *Chrysobothris* sp. Preference

Melanie Eichler

Student's Major: Biochemistry
Faculty Sponsor: Dr. Cynthia Perkovich, Biology

Red maple (*Acer rubrum*) is one of the most popular ornamental trees in the United States. When grown in nursery production, weeds form around the trunks of the maples and compete with the trees for resources. Herbicide sprays are used to manage weedy pests and promote maple growth. Growers use precautions such as spray guards to help prevent chemical herbicides from hitting maple trunks, but there is often overspray. The stress herbicides cause on red maples can weaken defenses and increase susceptibility of trees to insect pests, including wood-boring beetles in the *Chrysobothris* genus. The exact mechanism of increased attraction of herbicide damaged nursery trees is unknown. However, previous research has found a direct relationship between herbicide stress and *Chrysobothris* attraction to the stressed trees. This study focuses on analyzing the phytochemical changes caused by herbicide application and the interactive effects between herbicides and red maple cultivars that may influence *Chrysobothris* preference. Susceptible cultivars had reduced tannin defenses and increased sugar concentrations.

The Chemistry of Cyclic Hexachlorophosphazenes and Their Potential Use as Drug Delivery Systems

Jaron Dibert

Student's Major: Chemistry
Faculty Sponsor: Dr. Nicholas Johnson, Chemistry

Recent research has shown the potential of cyclic hexachlorophosphazene for use as a drug delivery agent. Many highly active drugs display high lipophilicity, which has proven to be a problem for drug delivery. To circumvent these issues, cyclic hexachlorotriphosphazene ($[PCl_2N]_3$) can be utilized. $[PCl_2N]_3$ is inexpensive to synthesize and allows a wide variety of substitutions, allowing for various properties. We have synthesized a hydrophilic phosphazene-based system by substituting three equivalents of tetraethyleneglycol monomethyl ether (TEGME) onto the phosphazene trimer ring. Following the addition of TEGME, the phosphazene rings system contains additional sites for further modification and substitution. These sites can be substituted with imaging agents, anti-cancer agents, and targeting moieties. Specifically, we have focused on the incorporation of imidazole-based compounds as potential anti-cancer drugs. The products of this study have been characterized via multinuclear Nuclear Magnetic Resonance.

Solid-Phase Sediment Extraction (SPSE) with Hydrophobic Pesticide Contaminants in Sediment

Mikayla Ortiz & Noelle Little

Students' Major: Toxicology
Faculty Sponsor: Dr. Andrew Trimble, Biology/Toxicology &
Dr. Jeffrey Weidenhamer, Chemistry

Solid-Phase Sediment Extraction (SPSE) is an innovative passive sampling technique that is rapid and inexpensive compared to other methods of trace pesticide analysis. Passive sampling uses SPSE probes constructed with silicone-based tubing to accumulate chemical pollutants from the environment. The aim of this study was to use this technique to passively sample pesticides from sediment. Select current-use insecticides (chlorpyrifos, bifenthrin, and imidacloprid) and previously used legacy insecticides that are still detectable in the environment (dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyldichloroethane (DDD), methoxychlor, and lindane) were examined. Insecticide residues were extracted from probes and analyzed using a gas chromatograph equipped with an electron capture detector (GC-ECD) that is sensitive to halogenated compounds. The amount of analyte extracted from sediment increased with concentration, temperature, and sediment-probe contact time. Sediment samples were then collected from eight different sites at Ashland University's Black Fork Wetlands to see whether any of the selected pesticides were present. A probe was placed into each sample and kept at a constant temperature of 22°C for a duration of 14 days. Probe extraction and analysis showed that numerous halogenated compounds were present in the Black Fork sediment samples. Among those were peaks co-eluting with lindane, chlorpyrifos, and bifenthrin, along with several other unknown halogenated compounds. To assist in confirming the identities of these compounds, a method was developed for gas chromatography equipped with mass spectrometry (GC-MS). Preliminary analyses indicate that this method, along with those developed for GC-ECD, will be useful for the detection of pesticide contamination in aquatic habitats.

Why Are Red Cedars Invasive?

Sydney Vu

Student's Major: Chemistry
Faculty Sponsor: Dr. Jeffrey Weidenhamer, Chemistry

Eastern Red Cedar Trees (*Juniperus virginia*) can be invasive when introduced to some environments. Evidence indicates that red cedar produces chemicals that affect the ability of nearby plants, particularly grasses, to grow and compete with the trees. Understanding how these chemicals are produced and broken down will improve our understanding of red cedar ecology and can also be helpful in other fields such as agriculture science. Eastern Red Cedar contains a compound called podophyllotoxin, which is reported to be toxic to other plants. This research is designed to locate and quantify podophyllotoxin in Red Cedar Trees. High-performance liquid chromatography was used to develop a separation method to identify podophyllotoxin in solution. Extracts and standards were made using methanol as a solvent and stored in the freezer. UV-Visible spectrophotometry was used to determine the absorbance maximum of podophyllotoxin at 292 nm. Spectrofluorimetry showed intense fluorescence at 322 nm when excited at 292 nm. Podophyllotoxin elutes at approximately 22.7 minutes with the current HPLC method and is highly fluorescent. UV absorbance is linear from 10 mg/L to 100 mg/L and fluorescence is linear from 0.1 mg/L to 75 mg/L. Optimization of the current HPLC method will allow for the analysis of Red Cedar foliage and roots to locate where podophyllotoxin is produced as well as analysis of podophyllotoxin's stability in soil.

Illustration Techniques in Comic Book Artwork

Allison Spencer

Student's Major: Fine Arts
Faculty Sponsor: Prof. Keith Dull, Art

Comic books have always been an interest of mine since childhood. As an illustrator who appreciates comic book artwork, I decided to research, write, and illustrate a comic book project of my own. The comic book series that I started is titled *Autobound*, and it focuses on a crew who dedicates their lives to the automotive world. As someone who is also interested in cars and more particularly their bodywork, I took the opportunity to design and incorporate my own car concepts into the storyline, along with pre-existing car models. The goal of *Autobound* is to create a visually interesting and creative piece that will demonstrate my drawing ability, grasp of anatomy, and understanding of composition. Before engaging in the process, I researched the history of comic books and the various drawing styles of their artists. Additionally, I observed artists' methods in gridding out engaging panel layouts. The challenges of my work involved designing dynamic and interesting scenes within confined spaces. For most of the story the characters are stuck inside cars, and so to make those tight interior spaces interesting, I used various angles, zoom lengths, and emphasized various perspectives. I approached each panel as if it were a filming shot for an action movie. *Autobound* does not have a hidden deeper meaning, but rather is just a story that I wanted to challenge myself with illustrating. My project is simply a creation that I enjoy and is something that I hope viewers can enjoy, too.

Oral Session III
2:00-3:00 p.m.
Trustees Room

EARF – Environmental Awareness and Research Framework

Kaitlyn Scheutzow, Keaton Sundberg & Cole Weber

Students' Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

Feral Swine, an invasive species since 1539, have been causing significant damage each year to agricultural crops, property, and natural resources. They can carry a plethora of diseases and parasites which pose a serious risk to humans, wildlife, and the domestic swine industry. To help combat this issue, the research application *"EARF"* was developed. This project's goal was achieved in 4 steps. First, simulate the ecosystem of Vinton County located in Southeastern Ohio, including its crops, native wildlife, and structures. Using a topographic map, the simulation will generate a close replica of Vinton County. Second, model an Artificial Intelligence (AI) to act as the feral swine, programmed to destroy crops and property and cause havoc on the ecosystem. Third, train the virtual swine and create a dataset that will collect research information on how the swine are negatively impacting the ecosystem. Lastly, implement an additional AI to test the data collected and have it produce logical solutions to combat the swine. *EARF* will be developed with a few different domains. The ecosystem will be developed using Ecotwin, an open-source agent-based ecosystem simulator housed in Unity and developed with C#. The AI will be trained and modeled using AI-based coding languages such as Python and its subsidiary libraries. The trained model will be saved and uploaded to the cloud so that the swine can be implemented in other countries. *EARF* will provide an advanced machine learning way to research invasive species and use AI to come up with solutions to an ever-growing problem.

Beyond Shame and Sin? Shame in the Moral Thought of Augustine and Kant

Anne Casey

Student's Majors: Philosophy & Political Science
Faculty Sponsor: Dr. Robert Wyllie, Political Science

Philosophers have always been reluctant to afford shame a role in ethics, and today, we are more concerned with "shaming" as a weapon used to degrade others' self-esteem. If anything, our sense of shame seems like a significant liability to psychological well-being and clear moral reasoning. However, shame was central to how early Christians understood themselves and their relationship to God. Saint Augustine describes lust and shame as consequences of the first sin in Genesis 3, and in his *City of God*, shame offers restorative abilities to correct lust, pride, and the sinful condition of humanity. The Enlightenment thinker, Immanuel Kant, believes human beings are capable of moral reasoning and choosing to live morally without being shamed into it. In my presentation, I compare Augustine and Kant's different interpretations of Genesis 3, exploring how they raise questions about the role of shame in moral life. While Kant suggests shame makes disturbing forms of moral cruelty possible, Augustine gives us reasons to believe it is harder and perhaps even detrimental to eradicate shame from our moral lives than Kant may realize. If shame is ineradicable and part of human experience, this means that our attempts to expel it from ethics could lead us to withhold from ourselves important insights about human nature and morality. Moreover, by distancing shame from its initial relation to human nature, we may risk our natural shame being inverted and misused.

“Between Sky and Stream”

Micaiah Gerber

Student’s Major: Creative Writing
Faculty Sponsor: Dr. Kelly Sundberg, English

“Between Stream and Sky” is a prose poem that reflects on the separation between animal and human experiences as well as the intimacy with the natural world that flyfishing provides. The first half of the piece delves into technical aspects of flyfishing such as gear and spot selection while the latter half focuses in on the relationship between a fly fisherman and a trout that he has caught. Stylistically, the poem follows a loose prose style with few line breaks, sections with rhythm characterize it as poetry rather than other subgenres of fiction. With a length of one page, the relationship between the two characters is succinct and mirrors the relationship between the natural and human world. The interaction between the two shows how connections between humans and animals are rare in modern life but meaningful when they occur.

Grim Gestures

Anthony Meier, Emily Murray, Jules Papesh & Christopher Taylor

Students' Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

Despite sign language being one of the few forms of nonverbal communication, there is a concerning lack of interest in learning this valuable tool for discussion. According to a 2022 study from Mitchell and Young, which focused on learning the number of people using sign language, only 2.8% of the hearing-impaired population in the United States are proficient. The game *Grim Gestures* intends to help improve this statistic by using video games and machine learning. It throws players headfirst into the basics of sign language learning in a horror environment which compels them to keep alert and observant. Over the past few years, the use of machine learning and AI-based technologies has grown exponentially, enhancing the field of Computer Science. By using the game engine GoDot, with AI-supported programming languages Python and C# as the backbone of production, this video game will be designed to teach sign language. Using a common medium like video games will be an effective method to draw new audiences into nonverbal communication that never had the chance to be exposed to it before. By implementing teaching into a more digestible form for people who may struggle with upfront learning, *Grim Gestures* can open new communication avenues for the average person.

Oral Session IV
3:15-4:15 p.m.
Trustees Room

Love, Anon

Lauren Gulden

Student's Major: Digital Media Journalism
Faculty Sponsor: Dr. David McCoy, Journalism & Digital Media

Love, Anon is a 10-minute film that I wrote, directed, produced, and starred in during my fall semester of 2023. It takes the viewer through the mystery and thrill of operating a successful anonymous love letter business. Scout, the female lead, frames her side hustle by observing the usually mundane details of university crushes, writing them into enthralling love letters, and charging the boys that could not write them themselves. She knows these people like the back of her hand, until something interesting happens. Her plan unravels when she starts working with a partner; her best friend, Ruse. Through a soundtrack of love songs, modern and classic, *Love, Anon* takes the viewer through a realistic but dreamy story of friendship, mystique, and, most importantly, love.

The House on Widowlane

Zoe Bogarty

Student's Major: Digital Media Journalism
Faculty Sponsor: Dr. Kelly Sundberg, English

The House on Widowlane is a young adult fiction novel following the recently widowed Loralai Felix-Russel through her personalized journey of healing from the death of her husband Eric Russel. The story progresses through a first-person point of view, and readers can hear Loralai's inner monologue as, with the help of the newest saleswoman in town, Loralai makes the decision to become a better version of herself. The themes of the piece revolve around grieving one's former self, the cost that comes with healing, and the fine line between authentic love and obsession. The story addresses the taboos of being a Black woman as well as the reality of how repressing trauma does more harm than good on one's mental stability. *The House on Widowlane* seeks to answer the question, "How far will a person go to heal themselves and find restitution from life's harshest challenges?" Through the eyes of Loralai, readers may reflect on their own paths of healing, growth, and personal relationships. *The House on Widowlane* not only unveils the profound exploration of healing and restitution but also clues readers into the arts of expecting the unexpected and keeping one's enemies closer. As Loralai navigates the intricate web of her personal growth, the story promises twists, turns, and the revelation of hidden truths. It invites readers to embrace the unpredictability of life within the pages of this compelling narrative.

Xenophon's View of Justice: The Military Trials and the Grecian Legal System

Bryn Sobas

Student's Major: Criminal Justice
Faculty Sponsor: Dr. Gregory McBrayer, Political Science

In many of Xenophon's works, there are detailed descriptions of trials, including civil, criminal, and military trials. This paper focuses on military trials in order to gain insight into Xenophon's view of justice. The presentation of the legal system and the outcomes of these trials in Xenophon's works offer a critique of the Spartan and Athenian legal systems and of the characters participating in the trials. These critiques also provide guidelines about how to develop a legal system focused on delivering justice. The decisions that arose from these trials, the punishments, the guilty and innocent verdicts that were delivered in these trials not only impacted the parties involved but had secondary consequences, since they impacted other citizens and even other nations. This paper argues that the military trials in Xenophon's works are necessary to help us understand Greek history, appreciate the larger and more lasting impact of ancient Greek thinking about justice, and teach legal lessons in the modern day.

Sprinter's Edge

Dylan Phelps & Jacob Pielech

Students' Major: Computer Science
Faculty Sponsor: Dr. Selvanayaki Kolandapalayam Shanmugam, Computer Science

In track and field, athletes of all competition levels often lack access to high-quality coaching or workout plans. Many athletes are unable to reach their full potential due to the absence of proper training. *Sprinter's Edge* is a web application to provide track athletes with personalized workout plans, training tips, progress tracking, and demonstrative videos to enable those athletes to reach their desired potential. *Sprinter's Edge* assists athletes by tracking their progress throughout their season by choosing from a variety of professional and quality workout plans and training tips for the user. In addition, the app will have a variety of video tutorials available upon the creation of an account. Track athletes will see improvement in their performances from using and following what the app offers. Using Python as a coding language and Azure Database to store user data made this project simple and easy to manipulate for the creation process. Although facing limitations in its current stage, such as the inability to read biometrics and being a web only based application, our future aim is to mitigate those limitations, turning *Sprinter's Edge* into a mobile application used on the go by many.