CSU
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2026 UNDERGRADUATE RESEARCH POSTER SESSION

Student Center Atrium

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CSU | Office of Research

2026 Undergraduate Summer Research Award Poster Session

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2026 Undergraduate Summer Research Award Poster Session

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*McNair Projects

Late Nights and Deadlines: An Illustrated Case Study of Modern Classrooms

College of Arts and Sciences

Student Researcher: Jonas Dawson

Faculty Advisor: Sarah Rutherford

Abstract

In the landscape of modern education there are multiple schools of thought on how to face the changes happening both within the classroom and in the greater cultural context. This illustrated case study addresses three main concepts; the greater circumstances around how classrooms developed through to the present day, how the student experience as well as their perspective has changed, and finally how professors can recognize and adapt to these changes. This case study closely examines the content of the source project and portrays potentially these sensitive topics and solutions in an approachable and memorable light. After determining the best style to complement the content the decisions focused on what to illustrate. The illustrated work features a set of personas representative of student demographics, a series of smaller elements and icons to be used as part of the framework of the book's design, single panel depictions focused on single concepts, and charts used to visualize the connections between events that created the current circumstances. Each illustration required multiple iterations and stylistic choices centered around how to best support the overall message. Despite their fundamentally basic aesthetic, all of the illustrations serve to contribute to communicating the ideas found in the source material.

Climatological & Landscape Controls on Road Salt Application in Urban Pond Watersheds

College of Arts and Sciences

Student Researchers: Jay Broz, Hedy Wade, and Carson Elias

Faculty Advisors: Julie Wolin and Ruchi Bhattacharya

Abstract

Urban ponds provide important ecosystem services that support biodiversity and human well-being but are increasingly affected by changing precipitation patterns, warmer winters, urbanization, and widespread road deicer application. Despite their ecological importance, these small, shallow systems remain understudied and are rarely included in state or federal monitoring programs, limiting our understanding of their responses to global environmental change. To address this gap, we conducted monthly and event-based sampling of urban ponds spanning a gradient of watershed urbanization in NE Ohio. Water samples were analyzed for physicochemical parameters, including temperature, dissolved oxygen, conductivity and major anions. Watershed and pond characteristics (e.g., mean depth, watershed area, watershed-to-pond area ratio, and human disturbance) were also quantified. Preliminary results showed that the majority of the ponds exhibited depleted dissolved oxygen levels, with high conductivity and chloride ion concentrations frequently exceeding EPA thresholds in highly urbanized watersheds. These findings suggest that urban ponds are highly vulnerable to ongoing environmental change and highlight the need for long-term, high-resolution monitoring.

Limnological Characteristics of Urban Ponds Under Contrasting Summer Conditions

College of Arts and Sciences

Student Researchers: Carson Elias, Hedy Wade, and Jay Broz

Faculty Advisors: Julie Wolin and Ruchi Bhattacharya

Abstract

Urban ponds are important socio-ecological systems, yet they remain understudied and under-monitored, limiting our understanding of their roles in nutrient and salt dynamics. They are influenced by both climatological and anthropogenic disturbances, including urbanization and increasing road salt application. In northeastern Ohio and across much of North America, variability in temperature and precipitation can alter hydrological conditions, thermal structure, and the timing and magnitude of road de-icer inputs.

Knowledge gaps remain regarding how contrasting climatic conditions and road salt inputs interact to affect urban pond ecosystems. Water-column temperature, conductivity, and dissolved oxygen profiles provide complementary indicators of thermal structure, salinity, and oxygen availability. Changes in these physical and chemical conditions can alter nutrient cycling and create conditions conducive to harmful algal blooms, highlighting the need to understand how urban ponds respond to climatic variability and human-driven road salt inputs.

Objective: Compare limnological conditions characterized by temperature, conductivity, and dissolved oxygen profiles between a warm, dry summer, with low road salt application (2012) and a milder, wetter summer with higher salt application (2013) to assess potential implications of a warming and increasingly variable climate for urban pond ecosystems.

Identification and Characterization of Mutants that Bypass Heat-Induced Meiotic Arrest in Saccharomyces cerevisiae

College of Arts and Sciences

Student Researchers: Brianna Campbell, Francisco Monge Neria, Lea Oehlsen, and Emma Hamm

Faculty Advisor: G. Valentin Boerner

Abstract

The model organism, *Saccharomyces cerevisiae* (baker's yeast), undergoes two modes of cell division: mitosis and meiosis. While mitosis produces two genetically identical daughter cells, meiosis is a reductional division that form four haploid gametes, allowing for sexual reproduction.1 Unlike mitotic growth, meiotic progression is extraordinarily sensitive to heat stress, resulting in complete arrest even at temperatures at which mitotic proliferation can still occur.2 This study aims to understand the mechanisms underlying the greater sensitivity of meiosis to elevated temperature and to investigate whether this sensitivity can be overcome.

Heat-resistant (**HR**) mutants were generated with an EMS-based forward genetic screen. This study focused on identifying causal mutations in seven candidates and characterizing an eighth candidate, which was identified as a point mutation in the histidine kinase Sln1 and designated ***sln1*-HR**. Since heat-induced arrest shares similarities with an arrest caused by defects in meiotic recombination, *sln1*-HR was tested for its ability to bypass a meiotic arrest in a mutant lacking the transverse filament of the synaptonemal complex, ZIP1. The *sln1*-HR mutant bypassed zip1Δ-induced meiotic arrest, suggesting that Sln1 may act on a shared pathway that regulates meiotic progression under stress. Additionally, tetrad analysis of candidate **HR1-1** revealed variable segregation patterns that did not follow simple Mendelian inheritance, suggesting that multiple genetic factors may contribute to its HR phenotype. The remaining six candidates, **HR2-1** through **HR2-6,** were validated and await backcrossing for further analysis. Overall, these findings identify pathways that may allow *S. cerevisiae* to overcome meiotic sensitivity to heat stress.

1. Börner, G. V., Hochwagen, A., & MacQueen, A. J. (2023). Meiosis in budding yeast. *Genetics*, *225*(2), iyad125. https://doi.org/10.1093/genetics/iyad125
2. Kim, B., Park, K., & Rhee, K. (2013). Heat stress response of male germ cells. *Cellular and molecular lifesciences: CMLS*, *70*(15), 2623–2636. https://doi.org/10.1007/s00018-012-1165-4

Investigating a novel barrier of differentiation in erythropoiesis

College of Arts and Sciences

Student Researchers: Laith Nijem and Hari V. Pandiarajan

Faculty Advisors: Merlin N. Gnanapragasam and Mahesh Ramamoorthy

Abstract

Cohesin subunits form ring-like complexes that tether DNA together to form enhancer-promoter loops and demarcate the genome into Topological Associated Domains (TADs). We identified a protein-protein interaction between cohesin subunit Stag1 and a High Mobility group protein HMGB1 using mass spectrometry. Co-immunoprecipitation experiments in erythroid cells demonstrated that STAG1 was detected in HMGB1 pulldowns, validating the interaction between the two proteins. Western blot analysis of adult globin protein expression after knockdown of HMGB1 in K562,erythroleukemia cells, found α-globin levels increased. Further, flow cytometry analysis revealed a 3–4-fold increase in erythroid differentiation following the HMGB1 knockdown. This suggests that the loss of HMGB1 promotes erythroid maturation and support a potential role for HMGB1 in regulating erythropoiesis.

Weather-Driven Sediment Dynamics in Sandusky Bay: Nutrient Loading through a Satellite Lens

College of Arts and Sciences

Student Researchers: Emily Perish, Trevor Holm, and Anshula Dhiman

Faculty Advisor: Brice Grunert

Abstract

Sediment resuspension is an important process influencing water quality and phosphorus cycling in shallow aquatic systems such as Lake Erie's Sandusky Bay. Phosphorus is an important nutrient in Lake Erie because phosphorus availability can limit algal growth and contribute to harmful algal bloom development when elevated. This study used Sentinel-3 satellite observations and the Nechad et al. (2010) suspended particulate matter (SPM) algorithm to assess spatial and temporal patterns in sediment dynamics across the bay. Changes in SPM were evaluated in relation to wind conditions, while West Basin station-based measurements were used to infer relationships between SPM and phosphorus concentrations in the bay, including total phosphorus (TP) and soluble reactive phosphorus (SRP). Results showed substantial increases in SPM during and following high-windspeed events, with some areas of the bay experiencing changes of approximately 400%. Station-based observations also indicated a positive relationship between SPM and TP, suggesting that periods of increased SPM are associated with greater concentrations of total phosphorus in the water column. In contrast, the relationship between SPM and SRP was relatively weak, indicating that increased sediment suspension does not necessarily result in an immediate increase in dissolved reactive phosphorus. Based on the relationship between SPM and phosphorus demonstrated by Dhiman et al. (2026), areas and periods of elevated SPM may represent periods of increased sediment-associated phosphorus mobilization and potential internal P loading. The absence of phosphorus measurements from Sandusky Bay highlights the need for future in-bay sampling to directly evaluate these relationships. Together, these results demonstrate the potential of satellite-based SPM observations to characterize sediment dynamics and identify weather-driven processes that may influence phosphorus cycling and water quality in Sandusky Bay.

Evaluating PIP2 and PI-PLC inhibitors for Inflammasome Activation

College of Arts and Sciences

Student Researchers: Yesha Thakkar and Kalash Neupane

Faculty Advisor: Kailash Gulshan

Abstract

Chronic tissue inflammation is a prolonged immune response that can persist for months or years and contribute to tissue damage and the development of chronic diseases, including cardiovascular and autoimmune disorders. Understanding the cellular pathways involved in inflammation is important for identifying potential therapeutic targets. This study investigated the role of phosphatidylinositol 4,5-bisphosphate (PIP2) metabolism in the NLRP3 inflammasome pathway. PIP2 plays an essential role in cholesterol metabolism and inflammation, but detailed mechanism is not clear. We used an in-vitro model to investigate NLRP3 inflammasome activation in human monocytic THP-ASC-GFP cell line. We found that U-73122 inhibited LPS priming, resulting in reduced inflammasome assembly. Western blot analysis further showed that ASC protein expression was markedly reduced following U-73122 treatment compared with BAY-091 treatment, in which ASC expression remained detectable.

These findings suggest that PI-PLC inhibition by U-73122 may interfere with inflammasome priming and reduce inflammasome assembly.

Repurposed FDA-Approved Drugs Promote Macrophage Efferocytosis

College of Arts and Sciences

Student Researchers: Ashley Kucia and Swati Sharma[1]

Faculty Advisor: Kailash Gulshan

Abstract

Background: Efferocytosis is essential for maintaining tissue homeostasis by promoting the clearance of apoptotic cells. The TAM receptor MerTK plays a key role in apoptotic-cell recognition and engulfment, while impaired efferocytosis contributes to chronic inflammation and disease progression. We investigated whether pharmacological modulation with the AT1 receptor blocker Irbesartan and PPARγ agonist Rosiglitazone enhances macrophage efferocytosis.

Methods: RAW-ASC macrophages were treated with Irbesartan or Rosiglitazone (20 μM) for 16 h and co-incubated with staurosporine-induced, Calcein-AM-labeled apoptotic Jurkat cells for 4 h. Efferocytosis was quantified by confocal microscopy as the percentage of macrophages containing internalized apoptotic cells. MerTK expression was assessed by immunofluorescence and quantified using ImageJ.

Results: Both Irbesartan and Rosiglitazone increased macrophage efferocytosis by approximately 2-fold compared with vehicle-treated controls. Both compounds also significantly increased MerTK protein levels, consistent with enhanced apoptotic-cell clearance.

Conclusion: Pharmacological treatment with Irbesartan and Rosiglitazone enhances macrophage efferocytosis and increases MerTK expression, suggesting that these compounds may promote efficient apoptotic-cell clearance through modulation of the MerTK pathway.

[1] *Post-Doctoral Fellow*

Generating TbTIF2 Expression Construct for Downstream Testing of its DNA Binding Activity

College of Arts and Sciences

Student Researchers: Zuriah Radeff-Koonce, Danny Wardeiner, Lovlesh Thakur[1], and Puja Kunwar

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei is the protozoan parasite responsible for African trypanosomiasis, also known as sleeping sickness in humans and nagana in cattle. The parasite evades the host immune response through antigenic variation by expressing different Variant Surface Glycoproteins (VSGs) sequentially. *VSG* genes are located at subtelomeric regions, making telomere-associated proteins important for understanding antigenic variation. Our lab has shown that *T. brucei* telomere proteins contribute to genome stability and regulation of VSG switching. *Tb*TIF2 is a telomere-associated protein predicted to contain a TRFH-like region—important for protein-protein interaction—spanning amino acids 1–180, followed by a positively charged lysine/arginine-rich region spanning amino acids 191–203. Preliminary electrophoretic mobility shift assay (EMSA) data indicate that *Tb*TIF2 fragments 1–205 and 1–230, both of which contain K/R-rich regions, can bind single-stranded DNA in a sequence non-specific manner. The presence of positively charged lysine and arginine residues within amino acids 191–203 raises the possibility that this region may contribute to DNA binding. However, this has not been confirmed, and the specific residues involved in this interaction remain unknown. This project aims to generate *Tb*TIF2 expression constructs containing targeted lysine/arginine-to-alanine mutations to investigate the contribution of these residues to DNA binding. Two mutant expression constructs have been successfully generated, while additional constructs are currently being generated. These constructs will be used to express *Tb*TIF2 in *E. coli* followed by EMSA. These studies will help determine whether specific positively charge inding activity and provide further insight into its functions.

[1] *Post-Doctoral Fellow*

Generating Tagging and Inducible Expression Constructs for Tb86700 to Study its Function

College of Arts and Sciences

Student Researchers: Danny Wardeiner and Farheen Naz[1]

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei is a parasitic organism that resides in the bloodstream of humans and is known to cause African sleeping sickness in humans. *T. brucei* is commonly studied for its antigenic variation process, which is a strategy in which a pathogen switches its major surface antigen in order to evade adaptive immune system responses by its host. T. *brucei* presents variant surface glycoproteins (VSGs) as its primary surface antigen, but only one type of VSG is expressed at any time. The genes that code for different VSGs are known to be in the sub-telomeric regions of chromosomes. *Tb*RAP1 is a key regulator for VSG monoallelic expression – all but one VSG gene is expressed. In addition, we recently found that *Tb*RAP1, as a transcription regulator, also suppresses the expression of *Tb*86700. This project aims to understand why *Tb*86700 expression needs to be kept low, as this gene is not typically expressed in wild-type *T. brucei* cells. *Tb*86700 appears to encode an SLAC-type reverse transcriptase, which may facilitate the mobility of retrotransposon elements within the genome. By making a tagging construct and an overexpression construct, it is possible to study the expression level of the protein encoded by this gene and examine the phenotypes after the gene is induced to express at a higher-than-normal level. This information will help us better understand the functions of *Tb*RAP1.

[1] *Post-Doctoral Fellow*

Exploring the Role of PPL2 in Trypanosoma brucei Telomere Maintenance and Antigenic Variation

College of Arts and Sciences

Student Researchers: Asana Bostani and Liyang Hu[2]

Faculty Advisor: Bibo Li

Abstract

Trypanosoma brucei is a protozoan parasite that causes human African trypanosomiasis (HAT), also known as African sleeping sickness. The parasite survives in its mammalian host through antigenic variation, a process in which it periodically switches its major surface antigen, Variant Surface Glycoprotein (*VSG*), to evade the host immune response. *VSG* genes are located near telomeres, making proper telomere maintenance important for VSG expression and antigenic variation. Previous research in our laboratory has shown that PPL2, a translesion DNA polymerase, plays an important role in coordinating telomere end processing at *T. brucei* telomeres and interacts with the DNA polymerase POLIE. However, the specific function of PPL2 in telomere maintenance and antigenic variation remains to be further investigated. This research aims to generate targeting constructs for downstream establishment of a *T. brucei* strain with a floxed *PPL2* allele that can be used to further study functions of PPL2. We generated two constructs with different selecting markers to integrate two loxP sites to flank one *PPL2* allele in *T. brucei*. Inducing Cre recombinase expression in these cells will delete the *PPL2* allele flanked by these two loxP repeats. Establishing a *T. brucei* strain with a floxed *PPL2* allele will provide an important genetic tool for investigating how PPL2 contributes to telomere maintenance and antigenic variation in *T. brucei*.

[2]*Hawken High School*

From Soil to Seedling: Linking Urban Mycorrhizal Communities to Tree Restoration in Cleveland, OH

College of Arts and Sciences

Student Researchers: Jarrod Robinson and Claudia Bashian-Victoroff

Faculty Advisor: Emily Rauschert

Abstract

As urbanization alters ecosystems worldwide, land managers face a range of challenges in identifying solutions to the unique pressures associated with anthropogenic land use. Urban environments are commonly associated with soil compaction, soil contamination, air pollution, increased temperature fluctuations through the urban heat island (UHI) effect, and habitat fragmentation, all of which can negatively affect tree establishment and interfere with their mutualistic relationships with soil fungi. Trees in urban areas are particularly important, as they provide many key ecosystem services, including mitigating the urban heat island. Cleveland has established a goal of increasing citywide tree canopy to 30% by 2040, making successful and sustainable urban forest restoration an important management priority.

This study examined relationships among urbanization, soil properties, plant composition, and mycorrhizal inoculum potential (MIP), the capacity of soil-borne fungi to form underground, symbiotic networks, in soils collected across an urbanization gradient in Northeastern Ohio. During the summer of 2026, soil samples were collected from sixteen forested and non-forested greenspaces representing differing levels of urban influence and analyzed for chemical properties including pH, organic matter, nutrient concentrations, and heavy metal content. Soil samples were then used in a greenhouse growth experiment with two native tree species, *Quercus rubra* and *Nyssa sylvatica*, to evaluate MIP and differences in germination, survival, and growth rate of the two species across varying urban soil conditions. Soil chemistry varied greatly across urbanized conditions; forest ecotype and tree species similarly influenced tree germination rate, though soil treatment did not.

Determining whether DNA break-induced phosphorylation promotes sister chromatid cohesion during C. elegans meiosis

College of Arts and Sciences

Student Researchers: Amy Washinger and Taharat Khandaker

Faculty Advisor: Aaron F. Severson

Abstract

Proper chromosome separation in meiosis is vital for accurate transmission of genetic material to progeny, ensuring that each gamete contains the correct complement of chromosomes. Nondisjunction during *C. elegans* meiosis results in increased male production, developmental defects, and embryonic lethality. Sister chromatid cohesion (SCC) mediated by the REC-8 and COH-3/4 cohesin complexes is essential to produce healthy gametes that contain the correct genetic material. COH-3/4 cohesin establishes SCC in response to double-stranded breaks in DNA (DSBs) that occur after DNA replication. Prior to our work, DSB-induced SCC has only been demonstrated in budding yeast mitosis; however, the pathway that initiates SCC in response to DSBs appears conserved in *C. elegans* meiosis: DSBs activate several DNA damage checkpoint kinases: ATM, ATR, and a CHK kinase. In budding yeast mitosis, the CHK kinase CHK1 phosphorylates serine 83 of Mcd1, the mitosis-specific yeast paralog of REC-8 and COH-3/4. Serine 81 (S81) and threonine 82 (T82) of COH-3/4 appear to be homologous to serine 83 of yeast Mcd1, although the amino acids surrounding S81/T82 match a consensus sequence for ATM/ATR rather than CHK kinases. To determine whether DNA break-induced phosphorylation promotes SCC via phosphorylation of S81/T82, we used CRISPR/Cas9 genome editing to create point mutations that replace S81 and T82 of COH-3 and COH-4 with alanine, which mimics unphosphorylated serine and threonine amino acids. Although the mutated strains did not present higher lethality or defects into adulthood, confocal imaging of oocytes stained with the DNA dye DAPI revealed that the sister chromatids of some oocytes were separated abnormally in the COH-3/4(S81AT82A) mutants, indicative of a lack of SCC. Our data are consistent with the model that the programmed DNA breaks that initiate meiotic crossover recombination establish SCC via a mechanism that involves the DNA damage checkpoint kinases ATM, ATR, and CHK2, leading to phosphorylation of COH-3/4 on S81 and/or T82.

Purification of Methanococcus jannaschii Dihydroorotase and Co-crystallization with Ligands

College of Arts and Sciences

Student Researchers: Daniel Sfeir and Ghudi Semaan

Faculty Advisor: Jacqueline Vitali

Abstract

Dihydroorotase catalyzes a reversible reaction that converts N-carbamoyl-L-aspartate to L-dihydroorotate and vice versa in the third step of de novo pyrimidine biosynthesis. The products of this pathway are the pyrimidine nucleotides that are the building blocks of DNA and RNA, and for this reason the enzyme is a target to determine drugs against cancer and parasitic infections. In this experiment we used the enzyme from an archaeon, *Methanococcus jannaschii*. We used the archaeal enzyme because it shares many cellular characteristics with eukaryotes. We purified the enzyme and tried to crystallize it with product analogs. We started with ready frozen cells. The purification included an ammonium sulfate precipitation step, a heat step, cation exchange and hydrophobic interaction chromatographies. The crystallizations used the hanging drop method. We used 24 well plates and we greased their tops. In each well we put 500 ul of a reservoir solution in a gradient of pH and precipitant concentration. On plastic coverslips we place 1 ul of the reservoir solution, 0.5 ul of the ligand solution, and either 1 or 2 ul of the protein solution depending on its concentration and we inverted them on top of the reservoirs. We check the crystals with an optical microscope to evaluate if they grow and get a sense of their quality. The crystals will be used to determine the structures of the complexes and give insight into how the product and product analogs bind to the protein and the mechanism of catalysis.

Characterization of Neuronal Injury Following Middle Cerebral Artery Occlusion Using TTC, Immunostaining, and Golgi Staining

College of Arts and Sciences

Student Researcher: Ali Allouzi

Faculty Advisor: Jingqi Yan

Abstract

Ischemic stroke causes significant neuronal and synaptic damage, with substantial synapse loss occurring during the reperfusion period following cerebral ischemia. Understanding the cellular and structural changes associated with ischemic injury is important for developing strategies to prevent or recover synaptic loss following stroke. Middle cerebral artery occlusion (MCAO) is commonly used as an experimental model of ischemic stroke. This study aimed to characterize neuronal and structural changes following MCAO in mice using TTC staining, immunostaining, and Golgi staining. MCAO was performed to induce focal cerebral ischemia, followed by reperfusion, and brain tissue was collected one day after MCAO. Brain regions, primarily the cortex and hippocampus, were compared between control and MCAO mice. TTC staining revealed distinct pale infarct regions in MCAO brain sections compared with the predominantly red-stained control sections, consistent with ischemic tissue injury. Immunostaining using DAPI, NeuN, and cofilin demonstrated irregular DAPI morphology, reduced NeuN staining, and the presence of cofilin rods in MCAO tissue compared with controls. Golgi staining demonstrated alterations in dendritic morphology and a reduction in dendritic spine density following MCAO. Mean spine density was approximately 3.30 spines/10 μm in control tissue compared with 1.83 spines/10 μm following MCAO, representing an approximately 44.5% reduction. Together, these findings demonstrate that MCAO produces measurable neuronal and structural alterations, including changes in cellular morphology, reduced neuronal marker expression, cofilin rod formation, and decreased dendritic spine density. These findings provide a foundation for future studies investigating the mechanisms underlying synaptic loss and potential strategies to prevent or recover synapses following ischemic stroke.

Lake Erie Hypoxia: Relationship Between DO and SOD

College of Arts and Sciences

Student Researcher: Perry Beerer

Faculty Advisor: Fasong Yuan

Abstract

If an environment has an imbalance of dissolved oxygen, it will cause issues within the ecosystem. A water body can become either hypoxic or anoxic if too little oxygen is present in the water body; the surroundings will become toxic for aquatic life. This study will determine the relationship between the reduction of dissolved oxygen and the sediment oxygen demand, also referred to as SOD. Samples were collected using a box cart on the USEPA Lake Guardian. These samples were placed into large tubes with a PreSens Fibox 4 sensor dot on the upper side. Each tube needed a constant temperature, so an isolation chamber was constructed using plywood and insulation of foam boards. An ice bath chiller was used to maintain a constant 12C. The sensor dots were used to measure the DO value for each sediment core using the PreSens Fibox 4. The DO was analyzed in relation to the elapsed time; the longest coherent declining interval for each sediment core was considered. This study is still in the preliminary phases; thus, no meaningful data has been found. There has been a noticeable decline in a west-to-east decline; groups from the western parts of Lake Erie have a higher DO value when compared to the Eastern regions. The sample S11 has shown a decline going from 4 mg/L to near anoxic in 60.5 hours. The next steps of this study will focus on the refinement of the methods used and an increase in replication. Mixing devices were used in prior tests, but they were found to be not efficient enough or strong enough to mix the water samples.

Novel Androgen Receptor (AR) degraders in prostate cancer

College of Arts and Sciences

Student Researchers: Katherine Suasnabar Quispe and Max Nguyen

Faculty Advisor: Bin Su

Abstract

Prostate cancer is largely driven by androgen receptor (AR) signaling, making AR a key therapeutic target for the development of new treatments. On the other side, there is heat shock protein 27 (HSP27) which is involved in stabilizing AR, disruption of HSP27 may promote AR degradation and suppress prostate cancer cell growth. This study tested HSP27-disrupting compounds to determine those that best inhibit prostate cancer cell growth. A total of 42 compounds were synthesized and screened in LNCaP cells, an androgen-sensitive, AR-positive prostate cancer cell line. Cell viability was assessed using an MTT cytotoxicity assay across a range of compound concentrations, and compounds were ranked based on their antiproliferative activity and ability to reduce AR expression. Ten compounds demonstrated the strongest inhibition of LNCaP cell proliferation and were selected for further evaluation. Among these, compound 17 showed the greatest potency, with an IC_{50} of 0.02271 μM. Structural comparison indicated that variations in aromatic substituents and functional groups may significantly influence biological activity. Compound 17 contains aromatic rings, methoxy/ether groups, carbonyl and sulfonyl functionalities, and a bromine substituent, which may contribute to its enhanced activity. These findings identify compound 17 as a promising lead candidate for further investigation as a potential AR degrader in prostate cancer.

Structure activity relationship (SAR) of nimesulide analogs as novel Androgen Receptor (AR) degraders in Glioblastoma

College of Arts and Sciences

Student Researchers: Christopher Staggs and Soha M. Bolbol

Faculty Advisor: Bin Su

Abstract

Glioblastoma (GBM) is a particularly aggressive form of glioma that is known for its difficulty in treatment and acquired drug resistance. We sought after both potential small molecule drugs based on a nimesulide scaffold to degrade Androgen Receptors (AR) in GBM by way of the molecular chaperone Heat shock 27 kDa protein (HSP27) and to establish a structure activity relationship (SAR) for future drug design.. Drug efficacy was determined using an MTT cellular proliferation assay. Cells were treated with the compounds in question and the number of cells killed was used to determine the half maximal inhibitory concentration (IC50). Ten total compounds were identified as promising agents (IC50 < 20 μM) across two different GBM models, T98g and U87MG. These results show promise for future treatment of GBM and for the establishment of an SAR for future drug discovery.

Dynamics of Desialylation and Sialidase Activity of Monocytes and Macrophages upon LPS Stimulation

College of Arts and Sciences

Student Researchers: Samuel Grigsby and Morgan Pychowycz

Faculty Advisor: Xue-Long Sun

Abstract

Sialylation is the process of attaching terminal sialic acids (also known as Sias) to glycans that cover the surface of the cell, a process which is involved with a wide range of biological processes. Desialylation is where terminal Sias is cleaved by sialidase. The four types of mammalian sialidase include Neu1, Neu2, Neu3, and Neu4 that are located in different regions of the cells are specific towards different glycan substrates. One component found in the outer membrane of gram-negative bacteria called Lipopolysaccharide (LPS) can induce endogenous sialidase expression in monocytes and macrophages. This process can lead to the desialylation of TLR4 (Toll-Like-Receptor-4), which in turn activates the LPS/TLR4 signaling pathway. In this investigation it was found that LPS-stimulated THP-1 macrophages contain higher cell surface expression of sialidases and the cell culture media contained higher levels of sialidase as well. This indicates sialidase secretion under LPS stimulation. Additionally, treating LPS stimulated monocytes and macrophages with 2,3-dehydro-2-deoxy-N-acetylneuraminic acid (DANA), reduced proinflammatory cytokine production by altering IKBα phosphorylation and downstream inflammatory signaling pathways. This studies purpose is to profile the desialylation of monocytes and macrophages upon LPS stimulation to better understand sialidase inhibitors effectiveness as an anti-inflammatory treatment through altering the LPS/TLR4 pathway.

Chondroitin Sulfate Oligomers: Enzymatic Synthesis and Characterization

College of Arts and Sciences

Student Researchers: Christopher C. Bolger and Corbin W. Wiley

Faculty Advisor: Xue-Long Sun

Abstract

Endothelial membrane surfaces contain proteoglycans such as Thrombomodulin (TM), which has a significant role in the protein C (PC) anticoagulatory pathway altering the activity levels of thrombin, the serine protease, from procoagulant to anticoagulant functions. The anticoagulatory activity comes from one of its five domains: the EGF-like domain, which is composed of six subdomains. EGF-like domains 4-6 (TM_{456}) dictate TM's thrombin-modulating activity. However, it is known that chondroitin sulfate's (CS) ability to participate in TM-thrombin interactions at TM's serine/threonine-rich domain, allowing for enhanced mediation of TM activated PC. Furthermore, it is believed that CS, a glycosaminoglycan (GAG), plays a role in the initial binding between TM and thrombin. CS exists in several isoforms (e.g., CS-A, -B, -C, -D, and -E) that differ in sulfation patterns. In our study, we enzymatically degraded CS-A, -B, and -C into oligosaccharides, which are expected to have enhanced binding activity of TM to thrombin and its protein C activation as well. Herein, we discuss the synthesis and characterization of various low molecular weight CS oligomers.

The Role of RNase L in Insulin-Induced IRS-1/AKT Signaling in Mouse Embryonic Fibroblasts

College of Arts and Sciences

Student Researchers: Ruebin Su and Xiaotong Zhao

Faculty Advisor: Aimin Zhou

Abstract

Insulin regulates glucose and lipid metabolism through a signaling cascade that includes insulin receptor substrate 1 (IRS-1), phosphoinositide 3-kinase, and AKT. Impaired signal transmission through this pathway is a central feature of insulin resistance. RNase L is an interferon-inducible endoribonuclease best known for its antiviral and antiproliferative functions, but emerging evidence suggests that it may also participate in metabolic regulation. This study examined whether RNase L is required for an appropriate cellular response to insulin. RNase L wild-type (RL+/+) and deficient (RL-/-) mouse embryonic fibroblasts (MEFs) were stimulated with 200 nM insulin for 0, 10, 30, or 60 min. Insulin-induced phosphorylation of IRS-1 at Ser302 and Tyr1222 and AKT at Thr308 and Ser473 was examined by Western blot; total IRS-1 and AKT served as protein controls. In RL+/+ cells, insulin produced rapid and sustained phosphorylation of IRS-1 and AKT. In RL-/- cells, phosphorylation at all four sites was markedly reduced, with the AKT Thr308 response appearing especially weak and delayed. Total IRS-1 and AKT levels remained relatively stable between groups. These findings indicate that RNase L is required for full and timely propagation of insulin signaling from IRS-1 to AKT and support a role for RNase L in maintaining cellular insulin responsiveness.

Digitization and ArcGIS Storymaps: Digital Humanities Undergraduate Summer Internship

College of Arts and Sciences

Student Researcher: Evelyn Lee

Faculty Advisor: Shelley E. Rose

Abstract

This Project examines how Digital Humanities interns can bridge the gap between museum collections and public education using traditional digitization practices and digital humanities tools. Focusing on the Education Art Collection (EAC) at the Cleveland Museum of Art (CMA), this research addresses a critical issue with museum collections, ensuring that thousands of historic teaching objects can remain accessible and integrated into active curriculum instead of disappearing into museum storage.

To achieve this, the methodology utilizes professional imaging software alongside spatialized storytelling platforms. During the internship 323 objects from the EAC were photographed using CaptureOne and processed using Adobe Photoshop, establishing a standardized workflow documented for future student intern use. Overcoming the limitations and formatting issues of previously used tools like StorymapsJS this project utilizes ArcGIS Storymaps. This shift allowed for the creation of highly customized, spatially focused digital exhibits to enrich user experience. Additionally, a template and documentation were developed to streamline future CMA and Cleveland State usage of this tool.

Ultimately this approach demonstrates that digitization and customizable web design can significantly improve collection visibility and databases. By transforming collection objects into dynamic digital exhibits, students and interns can amplify the Cleveland Museum of Art's mission to preserve and share cultural heritage "For the Benefit of All the People Forever."

Effect of Cap Thickness on Catalytic/Electric Field Mediated Active Janus Particles

College of Arts and Sciences

Student Researchers: Kazutada Nakao[3] and Muhammad Haroon[3]

Faculty Advisors: Shawn D. Ryan and Christopher L. Wirth[3]

Abstract

Micro-scale active matter systems are of great interest in developing micro-cargo transport, drug delivery, and environmental applications. Active platinum-polystyrene Janus particles near a boundary move as effective 2-D active matter systems. The effect of changing the thickness of the platinum cap from 7nm-40nm was investigated in two different systems. The first was constructed where the Janus particles would be suspended inside a hydrogen peroxide solution, where the platinum cap would catalyze a decomposition reaction, propelling the particle. Convection due to bubble formation from the hydrogen peroxide impeded any meaningful measurements. The second system was constructed by applying a uniform vertical AC electric field (E = 83kV/m) between the boundaries, causing the particles to move due to induced charge electrophoresis. We measured the frequency dependence of the speed of various cap thicknesses, finding that the speeds do not dramatically change. We found that the particles will move around 4μm/s at their peak around 2kHz and then drop off at higher frequencies to travel at ~0μm/s. We also found that at a set 2kHz, the speed of the particles scales with ~E^2. An agent-based numerical simulation was developed to model the interactions between particles in high concentrations, in hopes of potentially replicating in a lab environment.

[3]*Case Western Reserve University*

Analyzing Collaborative Annotation in the Introductory Physics Classroom

College of Arts and Sciences

Student Researcher: Josh P. Hoeflich

Faculty Advisor: Jessica E. Bickel

Abstract

While collaborative social annotation platforms like Perusall have been shown to improve reading compliance and exam performance in introductory physics at R1 institutions, their effectiveness requires further study at R2 institutions like Cleveland State University (CSU). Regional, public universities typically serve a different demographic of students than R1 (more commuters/Pell grant recipients), and previous work by Bickel (manuscript in preparation) has shown that students at CSU utilize such platforms differently than those at R1 institutions. This research focuses on the annotations to determine if there are types of annotations that are more indicative of learning, ultimately aiming to identify trends that will inform future student performance interventions. A qualitative scheme of applied tags was developed to classify the cognitive and social quality of student comments. The 9 resulting tags are partially based on previous work by Chi & Wylie that classifies learning into 4 quality tiers, known as the ICAP framework (interactive, constructive, active, and passive). We analyzed these tags by way of a Python script, which reads the annotations, tracks tag frequency, measures average word count, and calculates interrater reliability (IRR) using Krippendorff's alpha coefficient. Initial testing with two coders on a sample dataset shows that annotations can be reproducibly classified, yielding an overall IRR score of 0.6787 (acceptable) and revealing that certain tags naturally occur at higher frequencies. This pilot study successfully establishes a robust methodology and a workable tagging scheme, laying the groundwork for analyzing expanded, real-world datasets to evaluate correlations between annotation types, student effort, and overall course performance.

This work is covered under CSU IRB-FY2021-284.

Seasonal Accuracy of the MicroHH Large Eddy Simulation's Cloud Fraction Measurements

College of Arts and Sciences

Student Researchers: Jonathan Hammel and Girish Nigamanth Raghunathan

Faculty Advisor: Thijs Heus

Abstract

MicroHH is a program designed to simulate turbulent flows in the atmosphere using Large-Eddy Simulations (LES). It can simulate temperature, humidity, and velocities over a 3-D domain, from which atmospheric properties such as cloud top/base, liquid water path, latent heat flux, and cloud cover can be derived. For a couple of years, MicroHH has been conducting simulations of the Bankhead National Forest to provide physically consistent 3-D datasets to compliment ground observations. In this study, the frequency of each cloud cover reading from the LES is compared with observations from Bankhead National Forest to determine overall seasonal accuracy.

Parameterizing the Subsiding Shells of Clouds

College of Arts and Sciences

Student Researchers: Benjamin Besel Jr. and Girish Raghunathan

Faculty Advisor: Thijs Heus

Abstract

A strong understanding of the big-picture mechanisms behind the forces involved in clouds and their surrounding atmosphere is essential for creating accurate LES models and weather predictions. Some of the important forces in latest discussion of atmospheric science are vertical pressure gradients (VPGs) and buoyancy. Both buoyancy and pressure work together throughout a cloud's life cycle, but the question is which one is more dominant? If there is no dominant force, then at what areas of the cloud are they most effective? Two more elements to consider in this conversation are the subsiding shells surrounding the clouds and a cloud's entrainment and detrainment into the atmosphere or its shell. The subsiding shell is the region of falling air often neighboring a cloud or multiple clouds, and they are important as they take upon some of the characteristics of the cloud as well being a key party in the cloud's mixing into the atmosphere and vice versa. Entrainment and detrainment are two terms to describe this mixing behavior. Entrainment refers to the flow of an "other" body into the studied body while detrainment refers to the opposite. As an example, entrainment of the atmosphere into the cloud refers to the atmosphere flowing into the cloud.

In this study, the time averaged profiles of entrainment/detrainment, total VPG, VPG DL (dynamic non-linear VPG), VPG B (VPG due to buoyancy), buoyancy, and B eff (Effective buoyancy; the sum of both VPG B and buoyancy) were analyzed using the SEUS environment in the time range from July 2nd, 2025, 19:00 UTC to July 7th, 2025, 17:00 UTC. An immediately clear trend was that both entrainment and detrainment reached their peak at the cloud base and had diminishing large peaks above the cloud base. In an opposite manner, the other studied variables frequently reach their absolute peak near the cloud top and trend towards zero when it nears the cloud base. This may suggest that entrainment and detrainment play a large role in many of the variables and an area of further study could be determining whether this relationship is correlated or not. A less noticeable, but still important, trend was between B eff and VPG DL. It appears that the buoyant forces more consistently play the larger role in the system while VPG DL either varies (sometimes far below or far above the magnitude of B eff) or is nearly consistently playing a smaller role. This suggests buoyant forces are the more dominant driver of clouds in the SEUS environment.

Culturing, Genetic Modification, and Structural Imaging of Porcine Kidney Cells

College of Arts and Sciences

Student Researchers: Jennifer Do and Bailey Setele

Faculty Advisor: Andrew Resnick

Abstract

Epithelial cells are found throughout the body, and they line the surfaces of our organs and tissues. These cells allow researchers to study how the systems in living organisms function and respond to changes in their environment. Over the summer, we worked with "LLC-PK," pig kidney epithelial cells, to learn about cell growth, genetic modification, and cellular structures.The premise of our research was to grasp and better understand how kidney epithelial cells work through the processes of culturing, altering, and being studied in a laboratory setting.

Studying Polymer-Grafted Gold Nanorods using Depolarized Dynamic Light Scattering (DDLS)

College of Arts and Sciences

Student Researchers: Patrick Barrett, Tyler Harrison[4], Trevor Cower[3], and Nehal Nupnar[3]

Faculty Advisors: Kiril A. Streletzky and Michael J.A. Hore[3]

Abstract

Polymer-grafted gold nanoparticles (AuNPs) are a class of materials that combine the structural and optical properties of colloidal AuNPs with the stability of a polymer canopy. This unique combination allows for an array of potential biomedical applications such as drug delivery and catalysis. While some grafted AuNP geometries are well-studied (i.e. spherical), grafted anisotropic gold nanorods (AuNR) are not fully understood. Our goal is to study the effects of grafting polymer has on diffusive properties of the grafted AuNRs.

To achieve this, we used Depolarized Dynamic Light Scattering (DDLS) on two different setups to deduce the size of both bare and grafted AuNRs from their measured translational and rotational diffusion coefficients. This approach requires a multiangle DDLS experiment with critical analysis of the measured VV and VH correlation functions to yield the measured VV and VH decay rates of each system. To obtain the apparent dimensions of the particles, de La Tore's straight cylinder (SC) model was used. The absorptive and anisotropic nature of the AuNR leads to a variety of additional variables and challenges which must be carefully controlled to ensure consistent DDLS measurements. Several of these additional variables were studied to identify the optimal experimental parameters. This included testing different methods of sample preparation, comparing results across different DDLS setups, and multiple approaches to data analysis.

From this testing, two issues were concluded to be caused by the AuNR properties rather than experimental parameters. The first of these issues is the wavelength dependence shown in the VV data, where the number of modes seems to vary with the wavelength. This is believed to be a result of the plasmonic effects of gold. The second challenge arose when attempting to find the concentration dependence of the AuNR diffusive properties, particularly in the most dilute samples. This is likely due to the increased sensitivity to sample contamination at such concentrations. In order to obtain reliable size estimates via DDLS, these issues must be better understood.

[3]*Case Western Reserve University*
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The Dynamics of Microgels with Varying Crosslinker Concentration

College of Arts and Sciences

Student Researchers: Jaxon Storm, Andrew Scherer, Samantha Tietjen, Patrick Herron, Patrick Barrett, Samantha Hudson, and Krista Freeman

Faculty Advisor: Kiril A. Streletzky

Abstract

The effect of crosslinker concentration on the structure and dynamics of microgels was studied below and above the volume phase transition. When relative amount of crosslinker was varied by two orders of magnitude, three apparent behavioral regimes emerged from static and dynamic light scattering measurements. At low crosslinker concentrations, the microgels exhibited behavior consistent with homogeneously crosslinked microgels, undergoing uniform deswelling above the transition temperature — as the temperature increased, the microgels became denser and more diffusive. However, at high crosslinker concentrations, the microgels exhibited an anomalous temperature dependence indicative of inhomogeneous crosslinking.

Rather than deswelling, microgels increased in size, becoming less dense and less diffusive with increasing temperature. At intermediate crosslinker concentrations, the microgels exhibited minimal temperature dependence, with size and density remaining largely unchanged across the temperature range. This behavior suggests the observed regimes arise from a nonuniform crosslinker distribution within the microgel, resulting in spatially heterogeneous network densities, particularly at large crosslinker concentrations. Light scattering data was analyzed within the Flory-Rehner model and compared with predictions for various microgel architectures.

Confinement Effects in Polymer-Grafted Nanorod Solutions

College of Arts and Sciences

Student Researchers: Trevor Cower[3], Nehal Nupnar[3], Patrick Barrett, Tyler Harrison[4], Mithun K. Debnath[3], and Metin Karayilan[3]

Faculty Advisors: Michael J. A. Hore[3] and Kiril A. Streletzky

Abstract

Polymer-grafted nanoparticles have a wide range of applications from drug delivery and cancer treatments to industrial pollutant filters. While the conformation and relaxation dynamics of polymers grafted to planar surfaces and spherical cores are well modeled, these properties are less understood for anisotropic shapes such as nanorods. To investigate the grafting effects on nanorods, poly(methyl acrylate) (PMA) was grafted-to and from the surface of gold nanorods (AuNRs). The grafting-to approach took advantage of the chain transfer agent (CTA) used to form the PMA in reversible addition-fragmentation chain-transfer (RAFT) polymerization. This CTA contained a trithiocarbonate group that was isolated on chain ends via aminolysis to form thiol-terminated PMA that readily bonded to the AuNR surface. The grafting-from approach utilized surface-initiated reversible addition-fragmentation chain-transfer (SI-RAFT) polymerization using lipoic acid functionalized chain transfer agents to control grafting density.

Depolarized dynamic light scattering (DDLS) of the resulting polymer-grafted AuNRs provided translational and rotational diffusion coefficients, from which their dimensions before and after grafting were estimated. Comparisons were made with DDLS results and scanning electron microscopy (SEM) measurements on bare nanorods. The DDLS and SEM results suggest that both the grafting-to and grafting-from approaches produced grafted aggregates of AuNRs and provided measurements that were within agreement of each other.

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Called to Work or Called Elsewhere? The relationships between perceived callings, religiosity, work schedules, and preferences

College of Arts and Sciences

Student Researchers: Deborah Odetoye and Saywrane Williams

Faculty Advisor: Michael Horvath

Abstract

Research demonstrates that perceiving standard employment as a career calling correlates with positive occupational outcomes like job satisfaction, yet less is understood regarding how other types of calling (such as to religious activity) relate to workplace factors, as well as how one's religiosity affects these relationships. Building on prior work investigating the interplay between vocational calling and religiosity, we investigated how intrinsic religiosity interacts with vocational and religious callings to predict job satisfaction, the amount of autonomy one has over scheduling their hours, and the importance of such autonomy when choosing a job. Adults (n=293) recruited via CloudResearch completed measures assessing intrinsic religiosity, vocational calling, religious calling, scheduling autonomy, and autonomy preferences. Moderated regression analyses revealed significant interaction effects on several autonomy-related variables, but not job satisfaction. Vocational and religious calling interacted similarly, such that calling had its strongest effect on autonomy and autonomy preferences for individuals low in religiosity. Furthermore, religiosity appeared to have a positive effect on control and preferences for individuals with a weak perception of calling, and a negative effect for those with a strong perception of calling. These findings suggest that understanding one's workplace outcomes and preferences require consideration of both one's religiosity and calling.

Disease-SpecificFall Risk Across Living Environments in Lewy Body Dementia and Alzheimer's Disease

College of Arts and Sciences

Student Researcher: Elisha Sledge

Faculty Advisor: Robert Hurley

Abstract

Abstract not provided

**Supported by the McNair Scholars Program*

Personality and Intrinsic Academic Motivation: Correlations with Openness Facets and Conscientiousness

College of Arts and Sciences

Student Researcher: Jessica Cavalier

Faculty Advisor: Kathleen Reardon

Abstract

Underachievement is a significant and complex issue in higher education. A lack of intrinsic academic motivation is one factor leading to underachievement and subsequent premature college departure. This study examined how the personality traits of openness to experience and conscientiousness are related to intrinsic academic motivation. It also studied whether conscientiousness had a moderating effect on the relationship between facets of openness to experience and intrinsic academic motivation. A sample of students from Cleveland State University (N = 216) completed a self-report survey on Qualtrics through the Sona system. The data was analyzed correlationally and through linear regression. Results showed significant positive correlations for intellectual curiosity, creative imagination, and conscientiousness with intrinsic academic motivation. Intellectual curiosity showed the strongest positive correlation. There was no significant moderating effect of conscientiousness on either openness to experience facet when it came to predicting intrinsic academic motivation. Intrinsic academic motivation has been shown to be an important factor in higher education but is more strongly associated with the intellectual curiosity facet than with the creative imagination facet. Additionally, while conscientiousness is often linked with academic achievement, it was only weakly associated with intrinsic academic motivation. This may indicate that for students higher in intellectual curiosity, interventions that focus on their interests in order to support intrinsic academic motivation may be beneficial.

Keywords: intrinsic academic motivation, personality, openness, conscientiousness

**Supported by the McNair Scholars Program*

Sequential Effects in the Color-Word Contingency Paradigm

College of Arts and Sciences

Student Researcher: Daemon C. Williams

Faculty Advisor: Albert F. Smith

Abstract

Participants identify the color in which a word is printed. The word is irrelevant, but response times are faster when it predicts its color. This is called the color-word contingency effect. In this experiment, **perfect-contingency (P)** words always appeared in one color and **no-contingency (N)** words appeared equally often in either of two other colors. Prior analysis suggested an attenuated contingency effect when all items occurred equally often, although responses still remained faster to P words rather than N words. To investigate this difference, we examined how response time depended on the immediately preceding trial. Forty-eight individuals participated in the experiment over four conditions varying the number and frequency of P and N words while holding response probabilities constant. Correct trials following a correct response in the same block were classified into eight sequence types according to the current item's contingency, the preceding item's contingency, and whether the word and color/response repeated. What happened on the preceding trial shaped the response time, and it did so the same way in all four conditions. Across all four conditions, responses were fastest when both the word and response repeated, slower when only the response repeated, and slowest when the response changed. P and N targets did not differ reliably when an item was preceded by itself. They also did not differ when the word changed but color/response repeated, although this comparison was possible only in one condition. However, when both word and color/response changed P targets preceded by N items were 10 to 28 ms faster than N targets preceded by P items.

Influence of Aspect Ratio on the Edit in Film

College of Arts and Sciences

Student Researchers: Graceanne Koster and Daniel Vas

Faculty Advisor: James B. Joyce

Abstract

In film, *aspect ratio* refers to the **width to height** ratio the film resides in, regardless of what screen it is being viewed on. This is usually represented in ratios such as 4:3 or 16:9. These ratios are to accommodate differences in formats and presentation (i.e. viewed in a cinema vs home televisions). This project tests the hypothesis that wide-screen aspect ratios (2.35:1) makes the captured movement in the frame feel slower than aspect ratios associated with social media (1:1 and 9:16) as well as affecting the intended emotional and character beats outlined in the script due to frame composition. To do this, we took the same scene that was shot in 16:9 then cropped and re-edited it in different aspect ratios to see what effect would be had on timing and coherency of plot and characters.

As was expected, the wider aspect ratio had the longer runtime to accommodate characters taking more time to move in and out of frame. Inversely, the narrower aspect ratios had reduced runtimes as the characters took less time to move in and out of frame. Interestingly, the two middle aspect ratios of 1:1 and 43 were in the closest adherence to the original character beats, going against our assumption to have been 2. 351.

Because the footage was not composed to be in any of these aspect ratios other than 16:9, they all suffer at one time or another feeling too zoomed in on the characters, causing them to feel boxed in and claustrophobic.

From Script to Screen – Visual Research in the Cinematic Arts

College of Arts and Sciences

Student Researchers: Kylie Cavasinni, Alyssa Randles, and Jack Gollon

Faculty Advisor: Nicholas Morr

Abstract

This visual research project was decidedly practical and experiential. It was designed to immerse the researchers, both professor and students, in novel film work that was previously unfamiliar to them. Three distinct projects in commercial and narrative formats presented various problems to be solved across the technical, the collaborative, and the artistic. The challenge was to create, in a short span of time, professional-grade work using the resources readily available to us at the School of Film & Media Arts; conceivably repeatable in our own student work. We spent the month of June shooting what is called "Tabletop"; AKA food commercials. This taught us highly specialized principles in cinematography and production design. In July, we transformed several locations at Cleveland State into an NYPD station and a pediatric ER as host to dramatic scenes from the television shows "Law & Order: SVU" and "The Pitt", featuring a cast of professional actors and an all-student crew. While we were not asking scientific questions in this study and this kind of practice-as-research is difficult to quantify, the visual results achieved are noteworthy and obvious to even a casual viewer. Our growth as artists and technicians through this study are not easily measured, but the proof is in the pudding. Or the yogurt, as it were.

Link to the commercial: https://vimeo.com/1198458870

Documenting the Rainey Institute: History, Community, and Arts Education in Cleveland

College of Arts and Sciences

Student Researchers: Gabriel Cummings and Bella DePasquale

Faculty Advisors: Cigdem Slankard and Mark Slankard

Abstract

This project entails the production of a short documentary film developed through a collaboration between Cleveland State University and the Rainey Institute, a Cleveland-based arts education organization approaching its 125th anniversary. Originally founded as a settlement house serving immigrant families, the Rainey Institute has evolved into a vital community arts institution providing music, dance, and performance education to young people across Cleveland neighborhoods.

Through archival research, interviews with organizational leaders and community members, and observational footage of current programs, the documentary will examine how Rainey's mission has changed while remaining rooted in service, access, and community engagement. The film intends to preserve an important but under-documented chapter of Cleveland's cultural history, connect the Institute's settlement-house origins to its present-day work, and demonstrate how community arts organizations can adapt to changing neighborhood needs while maintaining a strong sense of identity and purpose. By centering the voices and experiences of those connected to Rainey, the documentary will highlight the role arts education plays in fostering creativity, belonging, mentorship, and opportunity for young people. The completed film will serve both as a public-facing historical record and as a resource for celebrating the Rainey Institute's legacy and ongoing impact.

Archaeological & Geophysical Investigations at the Fort Hill Earthwork Complex 2026

College of Arts and Sciences

Student Researchers: Elise Bednar and Wilder Rigel

Faculty Advisor: Phil Wanyerka

Abstract

Archaeological investigations were conducted at the Fort Hill Earthwork Complex this past summer by archaeologists from Cleveland State University. Our previous investigations have revealed that the earthwork was created by the Adena culture between 360 and 156 BCE and that this earthwork complex likely represented a cosmogram of the Adena world. This year's research was aimed at following up on new non-invasive geophysical surveys that identified 13 magnetic anomalies within the earthwork complex itself. Thus, the archaeological investigations carried out in 2026 were designed to investigate these anomalies through targeted archaeological excavations in order to determine their age and cultural affiliation.

Collected samples for investigation of locus coeruleus induced IL-1beta concentrations in control vs. stimulated mice

College of Health

Student Researchers: Abdulrahman Ali, Amana Ahmad, Ammani Hamdan, Retaj Mohamad, and Sumaiya Mahfu

Faculty Advisors: Michael D. Hammonds and David J. Anderson

Abstract

Scientists have determined that stress is the body and mind's natural reaction to danger or damage. Pre-existing auditory impairment can become exacerbated by stress. One of the ways to determine the stress impact is to investigate whether pro-inflammatory compounds rise above normal in blood serum. Here, the stress agent is likely the surgical stimulation leading to further release of damaging cytokines. This exacerbation in the cochlea is predicted to be caused by inducing additional proinflammatory cytokines being released into blood that reaches the cochlea. To find supporting evidence that this neuromechanism occurs, biomarkers are quantified using brainstem stimulation under stereotaxic surgical methods. Interleukin-1 beta, is a pro-inflammatory cytokine protein that activates local microglia during stress. Research Question: Will brain stem stimulation increase proinflammatory compounds detected in blood serum? Preliminary evidence suggests that brainstem stimulation may exacerbate preexisting auditory conditions in the cochlea and be detectible through a rise in serum IL-1 beta.

A pilot assay tested feasibility of detecting IL-1beta concentrations in blood serum of control vs stimulated mice

College of Health

Student Researchers: Abdulrahman Ali, Amana Ahmad, Ammani Hamdan, Retaj Mohamad, and Sumaiya Mahfuz

Faculty Advisors: Michael D. Hammonds and David J. Anderson

Abstract

Scientists have successful methods to measure the amount of protein, such as interleukin 1 beta (IL-1β), in blood serum. Antibodies capture active sites on the IL-1β protein to pull it from the rest of blood serum components. Captured proteins are used in enzyme-linked immunosorbent assay (ELISA) to measure concentrations in blood serum against known standards of that protein. Here, in blood serum assayed from control and brainstem-stimulated mice, the concentration of IL-1β was to be determined using a commercial kit and protocol (Invitrogen). The assay was expected to test our feasibility of an enzyme-linked immunosorbent assay (ELISA) to precisely measure mouse IL-1β protein, a small signaling protein involved in triggering inflammation and immune responses. For this assay a measurable color change should occur depending on how much of the IL-1β protein is present in a sample. In this pilot, IL-1β ELISA with a reported sensitivity of 8 pg/mL and standard curve range of 8-1000 pg/mL, made it suitable to detect small concentrations of IL-1β.

Research Question: Is ELISA in our hands able to accurately detect and distinguish serum IL-1β concentrations between control and brainstem-stimulated mice?

Result: Results are inconclusive at this time. The experiment should be further optimized

Exploring Music in Manual Therapy: Insights from an Initial Interview

College of Health

Student Researcher: Melina Taylor

Faculty Advisors: Deborah Layman and Carol Olszewski

Abstract

Background: Music is commonly present in therapeutic environments, yet little is known about how manual and body-based practitioners intentionally use and experience music within clinical practice. This ongoing qualitative study explores how practitioners select and use music, its perceived functions, and factors influencing decisions to use music or silence.

Methods: Semi-structured interviews are being conducted with manual and body-based practitioners who incorporate music into their work. This poster presents preliminary observations from the first interview with a craniosacral therapist with more than 10 years of clinical experience. The transcript was reviewed using preliminary inductive coding to identify concepts and patterns within the participant's account.

Results: Five initial areas of interest emerged: practitioner regulation, familiarity and perceived safety, embodied attention, intentional music selection, and responsiveness to client needs, including the use of silence. The participant described music as supporting grounding, focused attention, and embodied presence during therapeutic touch, while consistent music contributed to environmental continuity and perceived client settling. These observations suggest that music may operate through interconnected practitioner and client/environment pathways within the therapeutic encounter.

Conclusions: Findings from this single interview are preliminary and are not intended to represent manual or body-based therapists broadly. Continued data collection will examine whether these concepts recur, change, or are contradicted across participants and will inform development of themes from the larger dataset.

Socioeconomic Disparities and Educational Outcomes: A Comparative Study of High-Wealth and High-Poverty School Districts in Cuyahoga County

College of Health

Student Researcher: Amani Spicer

Faculty Advisor: Elaine Harper

Abstract

In 1997, the Ohio Supreme Court ruled that using local property taxes to fund schools was unconstitutional because it tied educational quality to local wealth. To address this, Ohio introduced the bipartisan Fair School Funding Plan (FSFP) in 2021, which uses a needs-based formula. This study looks at whether more state spending has improved educational outcomes and reduced socioeconomic gaps in Ohio's school districts. It compares Rocky River City Schools, a low-poverty district, with Cleveland Metropolitan City Schools, a high-poverty district. The data shows that while increased funding has helped narrow income-related gaps, bigger differences remain in property wealth, student success, and achievement. Money alone has not fixed the core inequity. In the FY26-27 budget, lawmakers reduced the FSFP before it was fully in place, providing only part of the funding the formula called for. The new budget also added a performance-based funding system that mostly benefits wealthier districts, which get two-thirds of this funding even though they have less than half the students. These results show that Ohio's school funding issues are not just about the amount of state money, but also about how funding formulas are created, put into practice, and maintained over time. Achieving real educational equity in Ohio will take not only enough funding, but also a long-term commitment to policies that address both income and wealth differences between districts.

**Supported by the McNair Scholars Program*

A CSU That Isn't Afraid to Talk (and Learn)

Levin College of Public Affairs and Education

Student Researchers: Mya Cordova, Christian Jensen, and Sophia Laudato

Faculty Advisor: Clayton Wukich

Abstract

Civil discourse can help students engage respectfully across differences and learn from those competing perspectives. This project examines how universities institutionalize and scale civil discourse across their organizations. We created a theory-informed, 27-measure coding instrument and identified 162 university-sponsored civil discourse initiatives across the country. The analysis identifies four markers of institutionalization: symbolic framing, structural embedding, operational routines, and capability building. These categories are rooted in the institutional theory literature. Findings include strategies such as presidential endorsement, formal centers and curricular programs, recurring courses and events, and specific faculty training programs. We recommend that CSU incorporate these best practices to better facilitate rigorous dialogue and open inquiry.

Content Appeals and Messaging Used by TikTok Influencers Promoting Peptides

Levin College of Public Affairs and Education

Student Researchers: Hannah R. Gunter, Jack Dominick, Allison Komosa, Alexis Zeidner, and Aida Calo

Faculty Advisor: Richard M. Perloff

Abstract

Peptides are becoming increasingly popular and have transformed weight loss and obesity care. Social media influencers, particularly on TikTok, have emerged as a major source of information on these small protein-like molecules. This research was among the first to examine the ways influencers promote peptides on TikTok via a systematic content analysis. Five categories of peptide messages, spanning appeals from the male streamer Calavicular, gym women, and male influencers, were created, and 133 messages were coded by four trained coders. The results indicated that 95% of women influencers promoting health through physical activity were skinny, and messages appealing to women with Polycystic Ovarian Syndrome emphasized weight loss. One young bikini-clad female influencer claimed that "Peptides really do have us aging in reverse," without offering a shred of evidence for this highly questionable claim.

As few as 15 percent of videos from self-proclaimed medical experts encouraged users to seek advice from a physician, and only 10 percent of these influencers' videos mentioned side effects that could occur from peptides. But side effects are real and can be severe. They include accelerated heart rate, vision problems and intense stomach pain.

Collectively, the study showed influencers' appeals promote peptides as healthy and effective, while providing little information on medical considerations and potential risks, raising concerns about their effects on vulnerable individuals.

"I Can Do That Too:" Empowerment, Activism, and Skill Building Through Youth Participatory Action Research

Levin College of Public Affairs and Education

Student Researchers: Zoe Guilonard and Hannah Dennis

Faculty Advisors: Katherine Clonan-Roy, Shereen Naser, Elizabeth Goncy, and Kimberly Fuller

Abstract

The identities of queer youth have historically been erased and silenced, especially in today's sociopolitical landscape (Willingham-Jaggers, 2026). Over 500 proposed anti-LGBTQ+ bills have been introduced across the U.S. as of August 2026, with many being directed at youth (ACLU, 2026). These bills jeopardize the health, wellbeing, and futures of queer youth even if they fail to be passed into law.

Queer youth are the experts of their own experiences (Asakura et al., 2020; Wernick et al., 2014) and because these policies impact them the most, their voices should be involved at the forefront of research and decision-making processes. Youth participatory action research (YPAR) offers that opportunity as an approach that allows youth to lead the process by identifying issues that affect them, researching them, and taking action based on their findings (Wagaman, 2015).

Our research team, THRiVE, developed a youth participatory action research (YPAR) program called Youth Research for Social Change (YRSC) in collaboration with the LGBT Community Center of Greater Cleveland. From 2023 to 2024, our team worked with 7 queer youth researchers (YRs) in conducting original, empirical research on topics related to gender, sexuality, and justice. In the summer of 2026, we followed up with these YRs to explore how they perceived YRSC to have impacted their lives and trajectories, how they are experiencing the current socio-political moment, and how they experience queer joy. Our qualitative research illuminates the ways that YRSC fostered growth in practical skills, activism, advocacy, self-efficacy, and hope for the future.

Portraits of Practice: What Teachers Bring to Refugee Education

Levin College of Public Affairs and Education

Student Researcher: Latifa Zakaria

Faculty Advisor: Grace H.C. Huang

Abstract

Students from refugee backgrounds (SRBs) face multiple challenges during resettlement, including language barriers, cultural adjustment, unfamiliar school systems, interrupted or limited formal education, and the lasting effects of pre-migration trauma. These experiences often influence both their academic achievement and social-emotional well-being as they navigate new educational environments. While schools play a critical role in supporting successful integration, many educators report feeling unprepared to meet the complex and diverse needs of refugee learners. Existing research suggests that teacher preparation programs provide limited training related to refugee education, leaving teachers to develop their knowledge and approaches largely through experience and practice. By examining teacher portraits and thematic patterns, this study explores how teachers' attitudes, identities, and relationships influence classroom practices that support SRBs. Drawing 34 focus groups and interviews with 56 participants, including teachers, administrators, and nonprofit staff in Ohio. Each interview or focus group session lasted approximately 90 minutes. Using thematic analysis, six interrelated themes were identified: (1) Professional Mindsets and Beliefs, (2) Personal Dispositions, (3) Personality Traits, (4) Relational Orientation, (5) Responsive Practice, and (6) Teacher Background and Lived Experience. Together, these themes illustrate how educators' identities, values, and experiences shape their approaches to refugee education. Findings highlight the importance of relationship-building, empathy, adaptability, and culturally responsive practices in supporting refugee students' visibility, belonging, and educational success. The study underscores the need for professional learning opportunities that equip both pre-service and in-service educators with the knowledge and skills needed to effectively support students from refugee backgrounds.

**Supported by the McNair Scholars Program*

The Impact of Artificial Intelligence on the Labor Market for Entry-Level Accounting Positions

Monte Ahuja College of Business

Student Researcher: Gisela Cortez

Faculty Advisor: Hamilton Galindo Gil

Abstract

Artificial intelligence (AI) is changing the accounting profession by helping complete repetitive tasks faster and more accurately. This study examines how AI is affecting entry-level accounting jobs in the Cleveland area and what skills employers expect from new accountants. The research uses surveys and job postings to collect information from accounting students, professionals, accounting firm partners, and recruiters. The results indicate that AI is starting to influence entry-level accounting jobs although it is not changing the need for accountants. Employers are still appreciating traditional accounting expertise as well as such skills as analytical abilities, critical thinking, professional judgment, communication, teamwork, and adaptability. The research also shows that new accountants need to become comfortable using technology while being able to review and validate technology-generated information. These findings may help students understand the skills they need for their careers and help colleges adjust accounting programs to better prepare students for changes in the profession. Overall, AI appears to be changing how entry-level accounting work is completed while increasing the importance of both technology and human skills.

**Supported by the McNair Scholars Program*

Refugee Community Center Wellbeing, Satisfaction, and Unmet Needs

Monte Ahuja College of Business

Student Researchers: Nasende Lobobi and Mariah Eckliff

Faculty Advisors: Vickie C. Gallagher and Grace H. C. Huang

Abstract

Refugees and immigrants often experience difficulties such as language barriers, lack of resources, and adjusting to a new environment. Resettlement centers often help by offering support, education, and networking opportunities. This qualitative study is the first phase of a broader mixed-methods project that will investigate the well-being, satisfaction, and unmet needs of clients and staff at a refugee and immigrant community center in Northeast Ohio. Focus groups and interviews were conducted with 15 participants, including staff and clients. The data were analyzed using inductive thematic analysis. Four key themes were found: belonging, well-being, support, and unmet needs. Participants described the center as a comfortable and welcoming environment in which they felt accepted, supported, and confident. A number of individuals said that the center improved their quality of life by offering English classes, emotional support, and useful services. However, participants noted several unmet needs, such as transportation, childcare services, larger facilities, more job opportunities, and English course certifications. These findings will be used to create a culturally applicable survey for roughly 100 clients in Phase 2. The study will help strengthen the community center's services, while also contributing to future studies on refugee and immigrant well-being.

Keywords: refugees, immigrants, community centers, resettlement centers

**Supported by the McNair Scholars Program*

Refugee Community Center Wellbeing, Satisfaction, and Unmet Needs (Phase 2)

Monte Ahuja College of Business

Student Researchers: Mariah Eckliff and Lobobi Nasende

Faculty Advisors: Vickie C. Gallagher and Grace H. C. Huang

Abstract

This research program examines how community-based services support the well-being and integration of refugees, immigrants, and other displaced individuals. Building on findings from earlier qualitative research, Phase 2 uses a quantitative survey to examine whether participation in Hope Center services is related to psychosocial well-being. 100+ participants from diverse refugee and immigrant backgrounds will take part in the study.

Participants will complete an in-person paper survey, with interpreter assistance available when needed. The survey will ask about participants' experiences with the Hope Center and assess social connection, sense of belonging, empowerment, self-confidence, trust, and life satisfaction. The study will also collect information about participants' backgrounds, service use, and length of time in the United States. Researchers will use t-tests, analyses of variance (ANOVA), chi-square tests, and regression analyses to examine patterns in the data.

The study will help determine whether Hope Center engagement is associated with stronger social connections, greater belonging, and improved psychosocial well-being. The findings may also identify unmet needs and provide information that can guide the development and improvement of programs serving refugee and immigrant communities.

Divalent Cation-Mediated Stabilization of Aqueous Cholesteric Liquid Crystal Shells

Washkewicz College of Engineering

Student Researchers: Elly Obondo and Tanner L. Larson

Faculty Advisor: Geyou Ao

Abstract

Abstract: Cholesteric liquid crystals (ChLCs) composed of cellulose nanocrystals (CNCs), pectin-wrapped boron nitride nanotubes (P-BNNTs), and excess free pectin offer significant promise for advanced optical coatings and photonic devices. While current methods enable spontaneous self-assembly of ChLCs in aqueous environments, practical applications still require mechanically reinforced ChLCs to withstand rigorous downstream processing conditions. In this study, we evaluated select divalent cations (i.e., Zn^{2+}, Ca^{2+}, Mg^{2+}) to stabilize ChLCs through interfacial reinforcement. Salt concentrations where systemically varied to control a molar ratio (R) of cations to available carboxylate anion groups in pectin while maintaining a constant salt solution:ChLC = 1:10 Volume ratio. Increasing salt concentration produced a more robust ChLC interface. However, higher concentrations also induced bulk gelation of the surrounding CNC-pectin matrix, entrapping the ChLC shells. To overcome this limitation, we investigated aqueous two-phase extraction (ATPE) using a polyethylene glycol (PEG) and dextran (DEX) system as a method to partition and recover ChLC shells prior to divalent cation-mediated stabilization. Preliminary results indicate that intact ChLC shells preferentially partition to the DEX-rich phase, although trapping at the PEG/DEX interface remains a challenge. These findings suggest that ATPE shows strong potential to partition intact ChLC shells into the DEX phase, enabling isolation before cation cross-linking.

Acknowledgments: We would like to thank the National Science Foundation (CMMI-2118416 and CAREER-2142579), and the Undergraduate Summer Research Award Program for their contributions in making this project possible.

Experimental and Numerical Analysis of Multiphase Mixing Dynamics in Catalytic Waste Gasification

Washkewicz College of Engineering

Student Researchers: Hannah M. Karberg and Madeline Greco[5]

Faculty Advisor: Jorge E. Gatica

Abstract

Waste gasification is a method for converting carbon-based waste into usable fuel using catalysts in a high-pressure stirred-tank reactor. This process has the potential to address both waste management and fuel production challenges in space missions where waste disposal options are limited. This study used a finite-element-based environment to model fluid flow and particle dynamics in an unbaffled stirred-tank reactor representative of a waste gasification system. The effects of impeller type, impeller clearance, tank diameter, and particle properties on mixing performance were investigated. Vertical velocity profiles were extracted from four regions of the tank and incorporated into a particle force model accounting for drag, buoyancy, and gravity. Results showed that reactor geometry and impeller configuration significantly influence circulation patterns, with the Rushton impeller producing stronger flow velocities than a pitched-blade impeller. Additionally, smaller particles were more strongly influenced by fluid motion, reducing transport limitations in gasification kinetics. The study highlights how impeller type and size can significantly influence mixing efficiency, empowering engineers to optimize reactor performance and waste-to-energy gasification systems.

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Mechanistic Modeling of Ventricular Wall Kinematics and Simulated LVAD Unloading for Heart Failure Severity Assessment

Washkewicz College of Engineering

Student Researcher: Joshua Lining

Faculty Advisors: Reza Harirforoush and Hannah Cebull

Abstract

Heart failure (HF) is defined by progressive ventricular dilation, diminished contractility, impaired ventricular–arterial coupling, and reduced cardiac output. While clinical measures such as ejection fraction (EF) and pressure–volume (PV) analysis commonly assess cardiac function, these metrics do not directly quantify ventricular wall mechanics or ventricular–device interaction. In response, we developed a reduced-order MATLAB and Simulink model to integrate left ventricular mechanics, systemic circulation, and left ventricular assist device (LVAD) support to evaluate heart failure severity and mechanical unloading.

We modeled left ventricular pressure using time-varying elastance, with mitral and aortic valve equations governing ventricular inflow and outflow. Systemic afterload was represented by a two-element Windkessel model, and mechanical circulatory support was simulated using a pressure-dependent LVAD flow term. The model computed ventricular volume, arterial pressure, radial wall strain, EF, end-diastolic volume (EDV), end-systolic volume (ESV), native cardiac output, and total forward flow. We validated the model using published echocardiographic data from patients with preserved, moderate, and severe systolic dysfunction.

The model accurately reproduced heart failure progression, with EF decreasing from approximately 60.1% to 35.4%, EDV increasing from 176 to 309 mL, and ESV increasing from 70 to 200 mL. Simulated EF values closely aligned with reported clinical data. LVAD support increased total forward output and reduced native ventricular workload, indicating effective unloading. This computationally efficient framework offers a practical tool for evaluating heart failure severity, ventricular mechanics, and ventricular–device interaction, with potential for future expansion to larger patient-specific datasets. Subsequent work will incorporate ventricular dimensions, wall thickness, and strain to enhance specificity and reduce reliance on assumed parameters.

Design and Synthesis of a Zinc Finger-Elastin-Like Polypeptide Fusion Protein for Plasmid DNA Purification

Washkewicz College of Engineering

Student Researchers: Yelyzaveta Strilets, and Grace Curtician

Faculty Advisor: Nolan Holland

Abstract

Plasmid DNA purification typically involves silica-binding spin columns, ion exchange methods, or alcohol precipitation. However, these standard methods require multiple processing and washing steps and unable to selectively recognize a specific plasmid sequence within a mixture of DNA molecules. This project focuses on a sequence specific approach using a fusion protein composed of the DNA-binding protein Zif268 and an elastin-like polypeptide (ELP40). Zif268 contains zinc finger domains that recognize a specific DNA sequence, while ELP40, consisting of 40 GVGVP repeats, undergoes a reversible temperature-dependent phase transition that may allow recovery and DNA plasmid purification. The Zif268 protein sequence was reverse- translated and codon-optimized for expression in Escherichia coli and inserted into a pET20b- ELP40 expression vector. The plasmid was also designed to contain a Zif268 recognition site, allowing the expressed Zif268–ELP40 fusion protein to potentially bind its own plasmid. Plasmid construction involved restriction digestion, HiFi DNA assembly, and transformation into *E. coli*. Prior to protein expression, the assembled construct will be verified via DNA sequencing. Future experiments will involve Zif268 DNA binding and determine whether the reversible phase-transition properties of ELP40 can be used for selective plasmid recovery. This work is dedicated to investigating a protein-based method for the purification of plasmid DNA that is more selective and sequence-specific.

Modeling a Small-Scale Continuous Maple Syrup Evaporator

Washkewicz College of Engineering

Student Researcher: Denzel Murungi

Faculty Advisor: Noland Holland

Abstract

Maple syrup is made by boiling raw sap of about 2.25 °Brix down to 66 °Brix, evaporating roughly 97% of the incoming mass. Evaporation is therefore the largest cost and energy demand in syrup making and the step most worth improving. This project developed a MATLAB model of a continuous multi-chamber evaporator to answer a simple question: where along the evaporator does the concentration actually happen? Sap flows through a train of fixed-volume chambers; in each, water evaporates and the liquid overflows to the next while sugar is retained. The model tracks sugar and water mass in every chamber over time, closes density with a Greenwood Brix– density curve interpolated by piecewise cubic Hermite polynomials, and holds each chamber volume fixed with a backward-sweep fzero solve, closing the mass balance to better than 10^{-9}%. Two layouts were compared at identical feed (40 mL/hr), holdup (450 mL), and boil-off (38.7 g/hr): a nine-chamber cascade of 50 mL chambers and a three-chamber traditional pan of 150 mL chambers. Both reached 66 °Brix, and their steady-state profiles fell on one curve, matching a closed-form solution in which chamber volume does not appear. Seven of nine chambers stayed below 10 °Brix; the last two produced 57 of the 64 °Brix rise. Merging the seven dilute chambers into a single 350 mL boiling chamber left every downstream value unchanged, reproducing the flue-pan-plus-syrup-pan design of commercial rigs from mass balances alone. Volume affected only start-up time (266 vs. 737 hr), so finishing chambers should stay small. The result is a simpler, cheaper evaporator that home producers could build.

Keywords: *maple syrup, continuous evaporator, mass balance, MATLAB, process design, Brix*

Toward Conjugation of Elastin-Like Polypeptides to Antimicrobial Peptides

Washkewicz College of Engineering

Student Researchers: Ella Kleybort and Özge Can

Faculty Advisor: Nolan Holland

Abstract

The increasing prevalence of antibiotic-resistant bacteria has created a need for new approaches to treating bacterial infections. Antimicrobial peptides (AMPs) are promising alternatives to conventional antibiotics because they can rapidly disrupt bacterial membranes and are active against a broad range of microorganisms. However, their use can be limited by poor stability, rapid diffusion, and potential cytotoxicity. Elastin-like polypeptides (ELPs) are genetically engineered protein polymers that undergo reversible temperature-dependent phase transitions and may serve as useful carriers for improving the stability and retention of antimicrobial peptides.

The goal of this project was to produce and characterize ELP constructs for future conjugation to the antimicrobial peptide TN6. Three ELP constructs of different lengths, H20, H40, and 60C, were expressed in *Escherichia coli* and purified using inverse transition cycling (ITC). This method uses the reversible temperature-responsive behavior of ELPs through repeated hot and cold cycles. Protein samples collected during purification were analyzed using SDS-PAGE, and UV-Vis spectroscopy was used to evaluate temperature-dependent phase transition behavior under different solution conditions. TN6 was separately synthesized and characterized using chromatographic and mass spectrometry methods. The 60C construct contains a C-terminal cysteine that can be used for future conjugation with TN6.

The ELP constructs demonstrated temperature-responsive behavior and were successfully recovered following purification. These results support the continued development of an ELP-based platform for antimicrobial peptide delivery. Future work will focus on conjugating TN6 to the ELP carrier and evaluating whether the resulting system can improve peptide stability, retention, and antimicrobial activity.

Inactivation of Salmonella During Poultry Scalding: efficacy of pH and temperature under simulated commercial conditions

Washkewicz College of Engineering

Student Researchers: Elias Saab and Vince Palombo

Faculty Advisors: Chandra Kothapalli, Shawn D. Ryan, and Daniel S. Munther

Abstract

Salmonella related outbreaks and prevalence in poultry products pose significant public health risks and create financial burden. There is a critical need to examine the poultry processing practices and standards more closely. Using our experimental data, we developed a model for *Salmonella* inactivation as a function of temperature and pH in scald water. *Salmonella* inactivation on contaminated chicken as well as cross-contamination dynamics was tracked during scalding conditions. Our results demonstrate the importance of pH modulation for pathogen control and yield insights to develop a comprehensive model of *Salmonella* cross-contamination during scalding.

Reducing Pathogen Cross-contamination During Air-chilled Poultry Processing

Washkewicz College of Engineering

Student Researchers: Vince Palombo, Elias Saab, and Chloe Christman

Faculty Advisors: Shawn D. Ryan, Chandra Kothapalli, and Daniel S. Munther

Abstract

Air chilling is an effective method to cooling poultry down during processing, yet pathogen cross-contamination through circulating air and/or liquid droplets can occur. This study tested the efficacy of Peracetic Acid (PAA) misting in reducing bacterial load on the surface of the chicken and preventing cross-contamination from infected chicken. In the experiments, 5 chicken legs were hung in a scaled-down air chilling apparatus. Chickens 2 and 4 were inoculated with a 5-strain *Salmonella* cocktail while chickens 1, 3, and 5 were uninoculated. Airflow was maintained throughout the duration of the experiment at a constant speed. A fine spray of PAA mist was programmed to turn on above each hung chicken leg every 10 minutes for 5 seconds at a time until the internal temperature reached 4°C. Serial dilutions of the stock cocktail confirmed the initial bacterial loads. Droplets from each chicken leg were swabbed at the first 10 minutes from the start of the experiment, and once more at 10 minutes from the end. Post-chilling rinse analysis in Neutralized Buffered Peptone Water (NBPW) of each chicken leg showed that the PAA could not fully eradicate the initial bacterial load on the inoculated chicken. However, at concentrations between 50 and 75ppm of PAA, cross-contamination was completely mitigated as no bacteria was present on uninoculated chicken. Furthermore, bacteria were found in the droplets coming from each chicken. Droplets also showed a downward trend in bacterial recovery with increased PAA concentration.

Porous Electrode Kinetics and Field Response of a 3D-Printed Zero-Resistance Ammetry Sensor for Sediment Redox Monitoring

Washkewicz College of Engineering

Student Researcher: Abdul Fattah Geith

Faculty Advisor: Chelsea Monty-Bromer

Abstract

Fine-scale redox processes in sediments regulate iron reduction, methane production, and other biogeochemical reactions, yet conventional field tools often lack the spatial and temporal resolution needed to track these changes continuously. This study evaluates a low-cost, field-deployable zero- resistance ammetry (ZRA) sensor using 3D-printed carbon-PLA electrodes for sediment redox monitoring. Electrode geometries were compared under previously optimized surface-area and characteristic-length conditions, while cyclic voltammetry and COMSOL Multiphysics were used to investigate transport and reaction behavior. Simulations incorporated a porous-electrode description with an effective diffusivity set to 0.25% of the bulk-electrolyte value and cyclic potential sweeps over multiple scan rates. Experimental geometry comparisons showed no statistically significant difference among the tested shapes (one-way ANOVA, $p \approx 0.4$), indicating that geometry alone was not the dominant control under the tested conditions. COMSOL results further indicated that surface-only kinetics could not reproduce the experimentally observed scan-rate dependence. Instead, internal pore utilization combined with an overpotential-dependent enhancement of the effective reaction rate was required to match the experimental response, while Marcus-Hush- Chidsey kinetics did not account for the observed behavior. Field-deployed ZRA electrodes produced repeatable responses to major hydrologic events, with response magnitude and environmental correlations varying substantially with sediment depth. These results identify porous- electrode utilization and electrode placement as important factors governing sensor response and motivate independent validation of effective kinetics, porosity, diffusivity, and long-term field stability.

Coating Adhesion on Corroded Surfaces: Influence of Corrosion Severity, Coating Type, and Surface Treatment

Washkewicz College of Engineering

Student Researchers: Olivia Bogna, Antoinette Berry-Snowden, and Stephen Asare

Faculty Advisor: Josiah Owusu-Danquah

Abstract

Corrosion significantly reduces the durability and service life of steel infrastructure, while coating performance can be strongly affected by substrate condition. This study investigates the influence of corrosion severity and coating type on coating adhesion and corrosion resistance. Steel specimens with varying corrosion levels were exposed to ASTM B117 salt spray and coated with alkyd enamel or zinc-rich primer. Results showed that increasing corrosion severity generally reduced coating adhesion and protective performance. Alkyd enamel performed well on lightly corroded surfaces but developed blistering and localized corrosion at higher severity. Zinc-rich primer provided sacrificial protection but exhibited buildup, cracking, and reduced adhesion on severely corroded surfaces. The findings highlight the importance of corrosion severity, surface condition, and coating selection in extending the service life of aging steel infrastructure.

Crash Retrieval-Augmented Generation (Crash-RAG) Pipeline for Traffic Safety Countermeasure Suggestion: A Case Study of Ohio Crash Data

Washkewicz College of Engineering

Student Researchers: FNU Maria, Abdul Ngereza, and Ntemi Masanja

Faculty Advisor: Emmanuel Kidando

Abstract

Objectives: Crash narratives written by law enforcement officers contain mechanism-level detail on driver behavior, environmental conditions, and event sequence that coded crash fields may not capture, yet such text remains underused because manual review does not scale. This research develops and evaluates CrashRAG, a retrieval-augmented generation (RAG) framework that converts crash narratives into structured queries linked to published safety evidence.

Methods: The CrashRAG pipeline extracts crash type, location, human factors, and environmental factors from each narrative using a large language model, then retrieves supporting literature through an ensemble of dense embedding similarity, BM25 lexical matching, token overlap, and knowledge-graph centrality. Evaluation used 100 narratives drawn from only 2023 Ohio crash data and a bounded two-document corpus. Extraction was scored against expert-reviewed references using BLEU, ROUGE-L, BERTScore, and BLEURT, and responses using faithfulness, answer relevancy, context precision, and GPTScore, common evaluation metrics.

Findings: Semantic agreement with expert references reached 0.89 for crash type, 0.86 for location, and 0.75 for human factors, far exceeding lexical agreement of 0.08 and indicating recovery of meaning rather than surface wording. Across 51 rear-end narratives, faithfulness averaged 0.22 with narrow dispersion. At the same time, answer relevancy, context precision, and GPTScore remained higher and more stable, locating the shortfall in evidence supply rather than pipeline logic. Where retrieved literature did not address a crash mechanism, synthesis halted without recommendation.

Novelty: To the best of the authors' knowledge, this study presents the first retrieval-augmented pipeline that generates evidence-based countermeasure recommendations directly from unstructured crash narratives, and the bounded corpus allows any grounding shortfall to be attributed rather than inferred.

Practical Applications: The framework gives transportation agencies a traceable route from unstructured crash reports to evidence-linked countermeasure recommendations, supporting network screening and defensible documentation of safety investments.

A Machine Learning Analysis on How Driver Impairment Influences the Progression of Fatal Crashes in Ohio

Washkewicz College of Engineering

Student Researchers: Aubrey Testroet, Caroline Bikuba, and Abdul Ngereza

Faculty Advisor: Emmanuel Kidando

Abstract

The study examines how driver impairment influences the progression of fatal crashes and the events leading to the Most Harmful Event (MHE). Crash data from the Ohio Department of Public Safety (2020-2022) were used to compare 396 impaired and 346 non-impaired drivers. Sankey diagrams were used to visualize crash-event sequences, while random forced models evaluated whether roadway conditions, driver context, an event sequence information could predict the MHE. Including event-sequence information improved classification for both groups, with the combined model achieving the highest balance accuracy of 65.6% for impaired drivers, and 61.4% for non-impaired drivers. The findings show that impaired and non-impaired crashes can follow different event pathways and demonstrate how crash sequence analysis may help identify opportunities for targeted crash prevention strategies.

Evaluating Tool Use in LLM-Based Autonomous Driving

Washkewicz College of Engineering

Student Researcher: William Stella

Faculty Advisor: Hongkai Yu

Abstract

LLM decision layers for autonomous driving are usually built with a tool for every quantity the model might need. Each tool is an extra calculation, and those costs stack, yet whether an exactly computed number actually changes a driving decision has not been tested directly. In this work we show that giving the model one exact number changes which trajectory it picks but not how safely it drives. Across 334 risk-relevant scenes from a state-of-the-art driving benchmark, a baseline planner generated eight candidate trajectories per scene and a language model chose one, either from raw sensor data alone or with a tool returning the exact distance and time-to-collision of the nearest obstacle. The tool changed the model's pick in 53% of scenes, but the overall driving score moved only −0.016 (95% confidence interval −0.044 to 0.012) and neither pre-registered safety target showed a reliable change, even though the model called the tool in 97.3% of eligible scenes. Mining all 334 transcripts from the no-tool condition explains why: the model stated an explicit distance only half the time, those numbers carried a median error about as large as the true value, and their accuracy bore no relationship to how well the chosen trajectory scored. Even after rewriting the model's own stated numbers, on a more limited sample, its choice changed in only 2 of 23 cases. Choosing among pre-filtered candidates therefore appears to be settled qualitatively rather than arithmetically, which is why an exact number has nothing to improve. More broadly, agentic driving systems should choose their tools deliberately, because some precision is simply lost inside the model.

Agentic Reward Optimization for Autonomous Highway Driving

Washkewicz College of Engineering

Student Researcher: Benson Ta

Faculty Advisor: Hongkai Yu

Abstract

Reinforcement learning (RL) relies on meticulously designed hand-written reward functions providing feedback to the agent. This is an iterative, time consuming, and error prone process that is a bottleneck of reinforcement learning. This study investigates the effectiveness of using Large Language Model (LLM)-based agents to autonomously design, rewrite, and optimize the reward function to improve autonomous driving behavior. We propose a closed-loop system where previous results are passed to a Claude Code (Fable 5) Agent which iteratively rewrites the reward function for a PPO policy inside a simulated highway environment (highway-env). Each candidate reward function is trained from scratch across 4 seeds. Each iteration is scored on the same fixed measures of real driving quality (crashes, off-road time, lane keeping, steering smoothness, and speed) and is screened by a safety check that rejects rewards that drives worse than any previous ones and reverts to the best-known reward. Over the 10 iterations averaged across 4 seeds, the LLM turned a poorly performing starting policy with high off-road rate (17.5%) with unsafe driving behavior, into a policy that only crashed in 7.5% of its episodes with greatly improved lane keeping.

**Supported by the McNair Scholars Program*

Comparison Study of Consumer-Grade Wearable Devices

Washkewicz College of Engineering

Student Researcher: Het Vishnubhai Patel

Faculty Advisor: Ye Zhu

Abstract

This study compares two consumer-grade wearable devices — the Samsung Galaxy Watch 8 and RingConn Gen 3 — across seven physiological metrics, with particular focus on the signals most relevant to sleep apnea risk screening: SpO2, heart rate, and heart rate variability. Since neither device has an airflow or EEG sensor, both must estimate apnea-relevant risk indirectly, typically through the Oxygen Desaturation Index (desaturation events per hour) combined with heart-rate-derived signals such as cyclic variation in heart rate, an autonomic reflex first documented by Guilleminault et al. (1984). A real-time data pipeline (FastAPI with Server-Sent Events) was built to ingest live sensor exports, since neither Android Health Connect nor Apple HealthKit expose a cloud API. Using a matched 7-day, two-device dataset (3,937+ readings), cross-device agreement was quantified via Pearson correlation, bias, and Bland-Altman limits of agreement. Heart rate and step count showed the strongest agreement ($r = 0.997$ and 0.990), while SpO2 and HRV — the two signals most relevant to sleep-apnea estimation — showed strong but comparatively noisier agreement ($r = 0.915$ and 0.992), consistent with these being estimated rather than directly measured quantities. These findings align closely with recent published validation studies of smartwatch-based oxygen desaturation index and AHI estimation: Kim et al. (2025) report 87% intraclass correlation and 92% sensitivity for a Samsung Galaxy Watch AHI algorithm, while Browne et al. (2024) report 78–86% severity-classification accuracy for the Galaxy Watch 4. Together, these results support the conclusion that consumer PPG wearables can provide a reasonable, non-diagnostic sleep-apnea risk signal grounded in explainable sensor physiology.

Upgrading Industrial PLCs with AI-Supervised G-PID Control

Washkewicz College of Engineering

Student Researcher: Keroles Beshay

Faculty Advisor: Zhiqiang Gao

Abstract

Forward Deployed Engineers commissioning control systems across diverse, poorly modeled plants face a scaling problem: PID requires manual per-plant tuning, while model-based methods resist deployment on legacy hardware. This paper presents a deployment framework built on Generic PID (G-PID), a frequency-domain realization of Active Disturbance Rejection Control in which the plant dynamics are inverted model-free and replaced by an integrator chain, so the engineer tunes a normalized plant, not a physical one. We verify the inversion by reproducing the G-PID design on the two-mass system benchmark in simulation, then deploy a first-order G-PID law natively on a Rockwell Automation PLC, avoiding closed-source instruction blocks so that the control law remains auditable. A Python bridge over EtherNet/IP exposes the design's two free parameters — the loop-gain crossover frequency and the input-gain estimate — to a Large Language Model supervisor that interprets plain-language operator goals and tunes online, while hardcoded ladder-logic clamps ensure that no value it writes can drive the actuator outside a safe bound. A physical torsional rig commissions the framework; closed-loop experiments then run controller-in-the-loop on emulated ControlLogix firmware against software plant models over the identical interface, making trials repeatable across plants.

On a first-order plant of unity input gain, the supervisor recovered the correct input-gain estimate from an uninformed start in five of six replications ($b_0 \approx 1.00$, settling 0.85–0.97 s), and produced goal-dependent tunings: a request for maximum speed yielded $\omega_c = 5.0$ rad/s, one for smooth actuation $\omega_c = 1.0$ rad/s.

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Enhancing STEM Pedagogy through RAG-Enabled LLM Agents

Washkewicz College of Engineering

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Abstract

Large Language Models (LLMs) show promise for STEM education, but their tendency to hallucinate limits their reliability as tutors. Retrieval-Augmented Generation (RAG) offers a solution by grounding LLM responses in course content. This research investigates whether a RAG-enabled LLM can provide accurate, grounded, and pedagogically useful responses to algorithm-related questions.

We developed a RAG-based STEM tutor using a Computer Science textbook on algorithm design. The system uses chunk-based retrieval, definitional content boosting, query expansion for technical terms, and self-consistency verification. We evaluated the system on 28 questions covering definitions, algorithms, comparisons, complexity theory, and open-ended queries.

The system achieved an 89% success rate. Average latency was 8.97 seconds. The system retrieved relevant sources for 25 of 28 questions. Key findings include: retrieval quality, not generation quality, is the primary bottleneck; 100% grounding scores do not guarantee factual accuracy; and term-concept mismatches can cause retrieval failures that degrade pedagogical quality.

RAG-enabled LLMs can provide grounded STEM tutoring when retrieval succeeds. However, retrieval limitations remain significant challenges. Manual page mapping and query expansion can overcome these limitations in principle, allowing us to show a proof of concept. However, this is not a scalable solution. This suggests that improved retrieval mechanisms could unlock the full potential of LLMs for STEM education.

Machine Learning-Based Wind Speed Prediction in Urban Environments

Washkewicz College of Engineering

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Abstract

Accurate wind speed prediction is important for weather monitoring, renewable energy planning, and other applications that depend on changing wind conditions. This research investigates the use of machine learning to predict wind speed using historical weather data from Cleveland, Ohio. Hourly weather data from 2014 to 2025 were used to train, validate, and test the models. The data included wind speed and other weather conditions, along with additional features created from previous wind speed values and time-based patterns.

Two machine learning models, Artificial Neural Network (ANN) and XGBoost, were compared to determine how well they could predict wind speed. The models were trained using data from 2014–2023, validated using 2024 data, and tested on unseen 2025 data. A persistence model, which assumes future wind speed will remain similar to the current wind speed, was also used as a baseline for comparison.

Both machine learning models were able to capture wind speed patterns and performed better than the persistence baseline. On the unseen 2025 dataset, XGBoost achieved an R^2 of approximately 0.81, while the ANN achieved an R^2 of approximately 0.80. These results show that machine learning can provide useful wind speed predictions and that XGBoost and ANN performed similarly, with XGBoost showing slightly better prediction accuracy.

Development of a Flexible Microfluidic Platform for the Generation of GelMA and Alginate Microgels

Washkewicz College of Engineering

Student Researchers: Alec Suehrstedt, Kaelyn Kraley, and Layan Hamidi Nia[6]

Faculty Advisors: Jan Claesen[6] and Liqun Ning

Abstract

This project primarily consists of the development of a relatively simple and user-friendly microfluidic system. Consolidating the many components of our microfluidics setup enables much faster and more consistent setup for each experiment run using it. This system combines controls for three syringe pumps, a custom resistive heater, and a UV lightbox into a single MATLAB-based user interface. At the same time, this system brings these components into a smaller footprint, significantly reducing unnecessary tubing lengths. Our 3D-printed microfluidic chips also enable a variety of uses, though we have focused on droplet formation thus far.

We have already used this system to characterize our alginate microgels under a wide variety of differing flow rates, alginate concentrations, surfactant concentrations, calcium chloride concentrations, and microfluidic geometries. It has also been used to produce alginate microgels carrying a bacterial payload, enabling the delivery of these bacteria to the gut in rodent models. These early experiments have already demonstrated the efficacy and usefulness of our system.

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Ethanol Dehydration of GelMA-PEGDA Scaffolds

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Abstract

Hydrogels are very soft and easy to damage during commercial transportation, therefore it is common practice to dehydrate them to increase their strength and durability for the road. This has already been accomplished using Lyophilization (freeze-drying). But the lyophilization process is harsh on the hydrogel, and is not a suitable process for smaller and more delicate hydrogel structures. Therefore this study looks into dehydrating hydrogels through replacing the PBS with ethanol and then air-drying. Since ethanol has a lower surface tension than PBS, it possibly can escape through the pores of the hydrogel without damaging the microstructure, unlike the PBS. The air drying process is a significantly gentler process on the hydrogel as well. In this study, ethanol dehydration is used to dehydrate gelatin-methacrylate-poly(ethylene) diacrylate (GelMA-PEGDA) structures. Multiple different sizes are compared to ensure that the geometry of the scaffold does not affect the effectiveness of the ethanol dehydration process. The scaffolds are measured before and after dehydration to determine the change in size, if any. The microstructure of the hydrogels are compared using SEM imaging, to ensure the pores are maintained. In this study it was determined that ethanol dehydration is indeed a good process to dehydrate delicate hydrogel structures for commercial transportation.