20th Annual

Symposium on Undergraduate Research & Creative Activity

April 16, 2026

IOWA STATE UNIVERSITY

A Message from the Organizers

Welcome to Iowa State University's 20th Annual Symposium on Undergraduate Research and Creative Activity. The Symposium provides undergraduates across all academic disciplines with an opportunity to share their work with the greater university community. The more than one hundred students selected for the Symposium this year represent all of Iowa State University's colleges: Agriculture and Life Sciences, Business, Design, Engineering, Human Sciences, Liberal Arts and Sciences, and Veterinary Medicine. The Symposium represents part of a large effort by Iowa State University to enhance, support, and celebrate undergraduate research activity.

We hope you enjoy the day!

Nina VanDerZanden
Symposium Coordinator

Program Overview

9:00–3:00, Refreshments and Registration ..... Campanile Room

POSTER I 9:00–11:00 ..... Cardinal Room

SESSION I 9:55–10:45

- Kinesiology ..... Room 3310
- Psychology and Criminal Justice ..... Room 3512
- Design and Language ..... Room 3534
- Biology, Ecology, and Engineering ..... Room 3538

11:00–12:00, Faculty Speakers ..... Campanile Room

Stephen Gilbert, Industrial and Manufacturing Systems Engineering, 11:00–11:30

"The Pros and Cons of Interdisciplinary Research"

Merate Barakat, Architecture, 11:30–12:00

"Resonant Ecologies: Sound, Space, and the Creative Act of Research"

SESSION II 12:05–12:55

- Computer and Systems Engineering ..... Room 3310
- Cell Biology and Game Design ..... Room 3512
- Plant Pathology ..... Room 3534
- Mechanical Engineering ..... Room 3538

POSTER II 1:00–3:00 ..... Room 3560 and 3580

SESSION III 2:15–3:05

- Chemistry and Materials Science ..... Room 3310
- Biology, Health, and Technology ..... Room 3512
- Civil and Construction Engineering ..... Room 3534
- Math and Physics ..... Room 3538

Each presentation is allotted 10 minutes. Participants and guests are asked not to enter or leave session rooms during presentations.

POSTER I, 9:00–11:00

Cardinal Room

1. Generation of aquaporin mutants in Arabidopsis

Presenter

Kylie Estochen — Horticulture

Mentor

Kyaw Aung — Genetics, Development, and Cell Biology

Aquaporins are channel proteins that facilitate the diffusion of water and hydrogen peroxide across the plasma membrane. In the plant of interest, Arabidopsis, aquaporins known as plasma membrane intensive proteins (PIPs) are used to control the flow of hydrogen peroxide through the plasma membrane of the plant cell. The movement of hydrogen peroxide across these aquaporins is likely negatively regulated by plasmodesmata-related protein 5 (PDLP5).

My research focuses on generating CRISPR knockout mutants involving PIP1;4, PIP1;5, and PIP2;7. This is necessary because the lab has not yet completed this task with these specific aquaporins. In order to achieve this, gRNA was designed and cloned into a vector, which was then transformed into E. coli and Agrobacterium. The materials from the E. coli and Agrobacterium were generated by the lab, but I was involved in the design of gRNA and the CRISPR line. After this process was completed, Arabidopsis flowers were dipped in a solution containing the plasmids. The seeds from the floral dipping were then collected. These seeds were then sterilized by using a washing buffer . After sterilization, the seeds were then plated onto ½ LS and hygromycin plates, with 10 plates for each gene (KAG4651, KAG4652, and KAG4679). They were then left in a growing chamber for a week, and the transgenic plants were transferred to a different ½ LS and hygromycin plate.

For the rest of the semester, I will extract DNA from the resistant plants found on the Hygromycin plates and perform PCR on the DNA. I will then use the results from the PCR to confirm mutations in the CRISPR mutant lines relating to PIP1;4, PIP1;5, and PIP2;7. Once this knockout has been confirmed, the putative transgenic plants will be transferred to soil and seeds will be collected once the plants mature.

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2. TCellular Toxicity Assessment of Wildfire Smoke Using A549 Lung Epithelial Cells

Presenters

Thora Hegarty	Biology
Bailey Stewart	Biomedical Engineering
Ash Unsen	Biology

Mentors

Guowen Song Li	Apparel, Events, and Hospitality Management
Rui Li	Apparel, Events, and Hospitality Management

Wildfire smoke exposure is an increasing public health concern due to the rising frequency and severity of wildfires driven by climate change. Understanding how smoke affects human health at the cellular level is essential for identifying mechanisms of injury and improving prevention strategies. In this study, we investigated the effects of wildfire (pine) smoke on A549 lung epithelial cells. Smoke-conditioned media was generated by exposing culture media to wildfire smoke for 30 minutes using an advanced controlled consistent exposure simulation system (ACCESS), which simulates fire conditions under controlled environments. The conditioned media was then applied to the cells. Cellular responses were assessed at 2 and 24 hours using the MTT assay to evaluate cell viability, the ROS assay to measure oxidative stress, and DNA damage analysis. Negative (untreated) and positive (H_2O_2-treated) controls were included for comparison. Results demonstrated that oxidative stress and DNA damage peaked at 2 hours after exposure, while cell viability decreased significantly at 24 hours. These findings indicate that wildfire smoke induces early oxidative and genotoxic stress, followed by delayed cytotoxic effects in lung epithelial cells. This study provides insight into the cellular mechanisms underlying smoke-induced injury and highlights the importance of minimizing exposure to protect respiratory health.

POSTER I, 9:00–11:00

3. Influence of Media and Incubation Time on Antimicrobial Resistance of *Acinetobacter baumannii*

Presenter

Alexa Vazquez — Wildlife and Fisheries Conservation and Ecology

Mentor

Bryan Bellaire — Veterinary Microbiology and Preventive Medicine

Acinetobacter baumannii is resistant to antimicrobials; these drugs act by inhibiting pathways required for life. *A. baumannii* is a bacterium that can cause severe pneumonia and blood infections, and is categorized as an emerging public health threat. Our goal is to determine the sensitivity of *Acinetobacter* to antibiotics: rifampicin, an inhibitor of bacterial transcription, and tetracycline and gentamicin, inhibitors of translation. We evaluated antimicrobial sensitivity to these drugs using the Minimum Inhibitory Concentration (MIC) with several different nutrient conditions. Cultures were exposed to increasing concentrations of drugs and incubated for up to 1 week to evaluate microbial growth. After 24 hours of incubation, *A. baumanii* showed intermediate resistance to tetracycline and rifampicin and was resistant to gentamicin. At 120 hours of incubation, there was greater resistance to rifampicin, gentamicin, and tetracycline. Prior exposure to blood increased rifampicin resistance levels at 120 hours. These data suggest that prior growth of *A. baumanii* on agar media supplemented with blood enhances the development of antibiotic resistance. With infections inherently exposing the pathogen to blood, this response would make it more difficult to create a treatment regimen for *A. baumannii* infections.

4. Kinetic Facades: A Strategy for Reducing Building Energy Consumption

Presenter

Chloe Timmerman — Architecture

Mentor

Chengde Wu — Architecture

Heating and cooling systems account for a significant portion of global building energy consumption, and this project explores kinetic façade systems as a compelling strategy for improving building performance. Kinetic façade systems consist of movable panels on the exterior of a building that open and close in response to sensor data. This controls the amount of solar heat gain in a building and reduces overall heating and cooling demand.

In this project, multiple functional prototypes were constructed using Arduino-based microcontrollers, motors, and sensors that operate on solar power to support energy-efficient performance. Control algorithms were developed to balance energy performance with smooth mechanical operation. Fabrication included custom components, including 3D printed gears, bearings, tensioners, and pins to enable smooth movement across the system. Metal, textile, and wood panels were crafted and explored, each offering different shading

and thermal properties while contributing distinct architectural expressions. This project explores the intersection of architectural design, computational optimization, and mechanical systems, demonstrating how responsive technologies can support sustainability in buildings.

5.Laser enrichment setting of 6 minutes 6 times daily increased Ross 708 Broiler activity over days 0-6

Presenter

Payton Ann Taylor — Animal Science

Mentor

Elizabeth Bobeck — Animal Science

Environmental enrichment can be used to improve the physiological and behavioral state of poultry in productions settings. Some common broiler enrichment forms include elevated platforms, perches, hay bales, and pecking objects. Laser enrichment has been explored as a novel enrichment strategy to increase broiler activity and natural foraging behaviors. Previous research has shown that a 6-minute laser enrichment setting provided four times daily increased broiler activity (days 3 and 6) and time spent at the feeder (days 0, 3, and 4). Therefore, we were interested in investigating the impact of a similar laser enrichment duration of 6 minutes deployed 6 times a day. Day-old Ross 708 chicks were raised at the Robert T. Hamilton Poultry Teaching and Research Facility at Iowa State University for 49 days. Chicks were randomly assigned to one of two treatments; control (no enrichment) or laser enrichment five focal birds were randomly selected for behavioral analysis. Focal birds were marked with livestock safe paint (red, pink, orange, green, and blue). From placement onto trial (day 0) and for six consecutive days (day 1 to day 6) colour video was recorded for 24 hours in real-time (30 frames per second). Videos were edited into 6-minute enrichment sessions (5:30-5:36, 9:30-9:36, 1:00-1:06, 4:30-4:36, 8:00-8:06, and 11:30-11:36 respectively) for each day. Edited video clips were reviewed by one trained observer. The red focal bird (n = 2 per treatment) was continuously observed to be in a certain state using a pre-determined ethogram; inactive, active, feeder, drinker, other, and out of view for a set duration in seconds. Duration was converted to a percentage of time during the 6-minute periods. Results will be presented as mean percentages per day and defined descriptively. Control birds spent more time inactive on days 0-3 (differences ranging from 3.75-19.31%), while laser-enriched birds spent more time inactive on days 4-6 (1.48-13.03%). Laser-enriched birds spent more time active on most observation days (days 0-5, 0.83-7.99%) than control birds. Control birds spent more time at the feeder than laser-enriched birds on days 0-2, 5 and 6 (0.90-9.44%), with laser-enriched birds spending slightly more time at the feeder on days 3 and 4 (0.16-2.62%). However, laser-enriched birds spent more time at the drinker on days 0-3 and 5 (0.34-7.50%), whereas control birds spent more time at the drinker on days 4 and 6 (2.22% and 8.85%, respectively). Laser enrichment 6 times daily increased broiler bird activity that in-turn may improve gait and lameness issues in birds. Future work will include continued data collection on all focal birds to validate these preliminary findings.

6. Myo-Inositol-Derived Bananin Methacrylates for Sustainable High-Temperature Polymer Applications

Presenters

Thi Pham — Chemical Engineering

Tyler Schepanski — Chemical Engineering

Mentor

Eric Cochran — Chemical and Biological Engineering

High-performance polymers for extreme environments, i.e. elevated temperatures and pressures, are often petroleum-based and lack sustainability. To address this issue, we synthesized a bio-derived polymer using myo-inositol sourced from non-food-competitive crops. Inspired by the rigid diamondoid scaffold provided by adamantane, myo-inositol is ketalized to form a rigid condensate called “bananin” thereby producing a route to rigid processable biobased thermoplastics. We demonstrated scaled up synthesis of the monomer with yield exceeding 85% followed by regioselective acylation using differing functional groups to access a broad property space culminating in the installation of the polymerizable methacrylic handle. These monomers were then polymerized using free and controlled radical polymerization to gain control over monomer architecture and properties. The glass transition temperature of the polymer ranged between 120-130C despite an octanoyl spacer thus illustrating the rigidity instilled by the inositol core. Reversible addition-fragmentation chain transfer (RAFT) polymerization also enabled the synthesis of hard-soft diblocks polymers by combining rigid and rubbery segments, resulting in highly durable and tunable materials. The preserved ketal linkages also allow for facile post polymerization functionalization to modulate the hydrophilicity of the surface, and allow for self-healing. This combination of bio-renewable origin, competitive thermal performance and multimodal post-polymerization positions bananin methacrylates as a versatile platform for high performance coatings, thermoplastic elastomers, and surface active materials where sustainability and performance find consensus.

7. Pharmacological induction of inflammasome and cell death through LPS and Nigericin in bovine respiratory epithelial cells

Presenter

Miranda Klingler — Animal Science

Mentor

Fabian Diaz — Veterinary Microbiology and Preventive Medicine

Bovine Respiratory Disease (BRD) is highly prevalent in the U.S. cattle industry, leading to significant economic loses. Several viruses are implicated in BRD, including Bovine Herpesvirus-1 (BoHV-1), actively infect the respiratory tract of cattle, leading to inflammation and cell damage, which facilitates progression to

pneumonia. A report suggests that BoHV-1 activates the inflammasome in MDBK cells, a kidney-derived cell line, which results in secretion of interleukin-1β, a potent pro-inflammatory mediator. Our laboratory is investigating whether BoHV-1 can activate the inflammasome and induce pyroptosis in bovine ECs and alveolar macrophages (AMs), with the goal of developing alternatives to reduce inflammatory responses to BohV-1 and alleviate BRD. A combination of Lipopolysaccharide (a gram-negative endotoxin) and Nigericin (a compound derived from Streptomyces hygroscopicus which triggers NLRP3 inflammasome-dependent induction of IL-1β) was tested in Bovine turbinate (BT) cells from cattle to evaluate their ability to induce inflammasome activation in vitro. BT cells (n=3) were stimulated with LPS (1 µg/mL) and Nigericin at 2.5 or 5 µM (4h after LPS stimulation), or left untreated (UT, DMSO only). Some BT cells also received a pre-treatment with 4-OI, a synthetic drug shown to reduce inflammasome formation in human and murine cells, at 100 or 200 µM, 30 minutes before the Nigericin dose. Cells were incubated during 4h, and then cell viability was determined using a commercial XTT kit. On a separate experiment, cells were incubated for 48h to determine IL-1β secretion. LPS + Nigericin reduced (2.5 µM $p<0.001$, 5 µM $p< 0.01$) viability (quantified as absorbance at 450 - 650 nm) of BT cells after 4h compared to UT cells. 4-OI pretreatment did not reduce the cytotoxic effect of LPS + Nigericin. IL-1β secretion has not been quantified since the rapid decline in cell viability difficult the ECs ability to produce the cytokine. Similar results were obtained on MDBK cells. Next experiments will determine whether lower doses of LPS + Nigericin could be used to study inflammasome activation in bovine ECs and AMs, as well as the ability of 4-OI to reduce BoHV1-induced inflammasome activation and cell death.

8. Investigating Flatfoot Reconstruction Biomechanics Using Finite Element Analysis

Presenter

Phuong Tran — Software Engineering

Mentor

Sarah Bentil — Mechanical Engineering

Flatfoot deformity is a complex condition that alters foot biomechanics and often requires surgical correction to restore alignment and function. Lateral column lengthening procedures, including the Evans osteotomy and cuboid osteotomy, are commonly used to treat this deformity; however, the biomechanical effects of different osteotomy techniques and graft designs are not well understood. This study applies finite element analysis (FEA) to investigate stress distribution and load transfer in the foot following lateral column lengthening procedures. Three-dimensional models of the calcaneus, cuboid, talus, and navicular bones were constructed from medical imaging data and processed using segmentation and mesh refinement techniques. Computational simulations using FEA were performed to replicate Evans and cuboid osteotomies using a trapezoidal graft. Physiological boundary conditions were applied during the FEA to approximate loading during stance. Preliminary results demonstrate that osteotomy location and graft geometry significantly influence stress, strain, and deformity patterns. This work highlights the value of computational modeling as

a complementary approach to experimental and clinical studies and aims to provide biomechanical insight that may inform surgical planning and graft design for flatfoot reconstruction.

9. Compact Device for Electrochemical Sensing of Amyloid-β Peptide

Presenter
Isaac Van Zee — Electrical Engineering
Mentor
Long Que — Electrical and Computer Engineering

Alzheimer's Disease is a progressive neurodegenerative disorder affecting millions of individuals worldwide, predominantly the elderly population aged 60 or older. The abnormal accumulation and aggregation of the amyloid-β (Aβ(1–42)) peptide is regarded as the major contributing event in the progression of Alzheimer's disease. Herein, we demonstrate an electrochemical sensing device capable of detecting and quantifying the amount of accumulated Aβ42 via immunoassay. Aβ42 antibody/antigen pair was functionalized on the working electrode surface through EDC/NHS chemistry. Calibration curve derived from square wave voltammetry yielded a limit of detection (LOD) of 0.63pg/mL. This performance metric is competitive with the LOD of the commercially available ELISA kits and previously reported bulk electrode-based electrochemical immunoassays. This immunoassay-based approach enables direct measurement of $A\beta_{1-42}$ in human fluids. The compact design facilitates batch production for point-of-care (POC) testing. As a future direction, a conceptual electrode-integrated contact lens design is proposed for noninvasive diagnosis of $A\beta_{1-42}$ in human tears.

10. A Step-by-Step Guide for the Generation of a Reverse Genetics System of Influenza A Virus

Presenter
Serban Oancea — Biomedical Engineering
Mentor
Joaquin Caceres — Veterinary Microbiology and Preventive Medicine

Reverse genetics (RG) is the process of generating a virus entirely from cDNA with phenotypic characteristics identical to field isolates. RG is considered the "holy grail" of RNA viruses because it enables us to study how genetic changes affect viral function, analyze the roles of specific segments, and support vaccine development. Influenza A virus (IAV) poses a significant economic and public health burden. Subtypes of IAV are classified by the presence of the 2 viral glycoproteins: hemagglutinin (HA) and Neuraminidase (NA). Given the IAV's relevance, the use of RG is critical to developing strategies to mitigate or eliminate its negative impact. Here, we provide a clear, step-by-step understanding of the process to generate reverse genetic plasmids used at the Caceres lab using a swine IAV strain as a model (A/swine/Minnesota/A02245397/2020 (H1N1)). The workflow is divided into multiple condensed, simple steps, including the synthetic generation of

the DNA encoding each viral segment, amplification and purification of the viral gene segments by PCR and cloning, verification, and isolation of RG plasmids. We further validated the authenticity of the sequence information by Sanger Sequencing. Furthermore, we performed an RG transfection in MDCK/293T cells with similar plasmids derived from an H3N2 strain (A/swine/Iowa/A02861497/2023(H3N2)) for viral assembly and the recovery of infectious virus. Accurate completion of these steps ensures success for the reverse genetics process and viral rescue. This workflow can be adapted to support other IAV studies or used as a common virology methodology.

11. Educating the Public through Dairy Extension

Presenter

Ellie Larson — Animal Science

Mentor

Gail Carpenter — Animal Science

As public familiarity with modern agriculture practices continues to decline, opportunities for direct engagement between consumers and producers are essential for improving agricultural education. The "Educating the Public Through Dairy Extension" project creates the plans for our annual Iowa State Dairy Open House and will utilize it as a way to connect community members with current dairy production practices through hands-on learning and interactive outreach. The project will provide educational stations (milk house talk, commodity group stands, etc.) and guided tours (people-mover tours of the farm) designed to inform visitors about dairy cattle management, animal welfare, milk production, environmental sustainability, and the role of dairy farming in local food systems. The open house welcomes students, families, and community members, many of whom have limited prior exposure to agriculture. By creating an accessible and transparent learning environment, the project encourages conversations with our dairy farmers, addresses common misconceptions about dairy farming, and promotes trust between producers and consumers. Through extension-based education and experiential learning, the Iowa State Dairy Open House strengthens public understanding of the dairy industry while fostering meaningful connections between the university, agricultural professionals, and the broader community.

12. Pharmacological Characterization of *Brugia malayi* UNC-49 GABA Receptors

Presenter

Elle Wood — Biochemistry

Mentor

Shivani Choudhary — Biomedical Sciences

In this study, we investigate *Brugia malayi*, a small thread-like filarial parasitic nematode that infects human hosts. Transmitted by mosquitoes, this organism is a causative agent of lymphatic filariasis, a disease that

imposes serious health risks in tropical and subtropical countries. Once inside a host, the nematode matures in the lymphatic system, where it can survive for 6-8 years while producing microfilariae (larval stages). In severe cases, chronic symptoms include lymphatic dysfunction and extreme swelling of limbs and genitals. Current treatments have microfilaricidal effects but have limited efficacy against adult worms, which continue to reproduce. To address this limitation, we investigate potential pharmacological targets in adult nematodes, aiming to contribute to the development of potential adulticidal therapeutics for more streamlined control of lymphatic filariasis. We have focused on inhibitory GABA-gated chloride channels, which mediate the distinctive sinusoidal body movement of the nematodes. The gene unc-49 encodes the nematode body muscle GABA receptors that induce muscle relaxation during locomotion. We have identified and cloned three splice variants of the receptor subunit, UNC-49A, UNC-49B, and UNC-49C. The channels were expressed in Xenopus laevis oocytes, and we used two-electrode voltage-clamp (TEVC) recording to characterize the pharmacology of the UNC-49 GABA receptor as homomeric and heteromeric channels. All the UNC-49 subunits formed a functional GABA-gated homomeric channel. UNC-49AC, UNC-49BC, and UNC-49AB heteromeric channels were also activated by GABA, confirming their functional expression. Piperazine, an anthelmintic agent, produced potent activation of UNC-49C, UNC-49AC, and UNC-49BC, showing the significance of UNC-49C in mediating the effect. These findings also suggest that the UNC-49 receptor is a potential pharmacological target for disrupting adult nematode motility and ultimately advancing treatments for lymphatic filariasis. We are currently conducting experiments to further characterize the pharmacology of the UNC-49 receptors using various agonists and antagonists.

13. Design of a Digital System to Improve Health Study Management

Presenter

Holden Smith — Software Engineering

Mentor

Seungmin Lee — Kinesiology

This project includes the development of a web platform that facilitates the management of a physical intervention study. As an undergraduate research assistant, I contributed to the implementation of specific requirements of Dr. Seungmin Lee to build a platform that guides users through a 150-day study which includes automated email messaging, an interactive course that teaches and encourages participants in their health journey, monitors progress, and records feedback. This allows kinesiology researchers to easily analyze information gathered by the website so that they may spend more time analyzing data instead of manually conducting every aspect of the study.

The system is built using a Python-based Django backend with a PostgreSQL database, and deployed via a unified cloud hosting service named Render. To support asynchronous processing and improve performance, Redis and Celery are integrated for task queue management, enabling automated email

notifications and scheduled interactions such as survey completion with study participants. These features reduce manual workload and help ensure consistent participant engagement throughout the study.

A key aspect of my work in this project has been time compression. To end-to-end test this application, we needed a way to simulate a 150-day study timeline in a much shorter timeframe. Therefore, we implemented a time-compression framework built into our program which allows researchers to simulate the study in any desired timeframe. This allows many tests to be completed more quickly while still being able to test all 150 days seamlessly.

This application demonstrates how web development can assist data collection and participant management in health studies, allowing researchers to address more health-related concerns, standardize the process for all participants, and provide an accessible option to participate in a study that can benefit their lives.

14. Preparing School Leaders for the Unpreparable: Key Questions of Current Leadership Practices around School Shootings

Presenter

Saylor Episcopo — Secondary Education: Biology

Mentor

Joanne Marshall — School of Education

School shootings in U.S. schools are ongoing and have become increasingly more alarming since Columbine in 1999. Current research does not include the perspective of educators, so the authors have been developing an open resource module for educators to prepare for the unpreparable, i.e., a school shooting. This presentation at the 2026 Symposium on Undergraduate Research and Creative Expression focuses on one element of this module, Key Questions of Current Leadership Practices. School shootings are complex and are influenced by social, cultural, and institutional factors, including the context of the school environment.

The module examined how school context, such as urbanicity, size, and student demographics, shaped the school community perceptions of safety and experiences with violence. For example, although highly publicized incidents have occurred in suburban communities, like Columbine, schools with students from higher socioeconomic backgrounds are less likely to experience school shootings and more likely to feel safe, potentially due to greater access to resources for mental health counseling and preventative programs. The module also explored who's empowered and who's marginalized within school systems and how these dynamics relate to violence. For example, perpetrators of school violence are frequently individuals who feel socially excluded. Cultural notions of masculinity associated with power and dominance have also been linked to the higher likelihood of male perpetrators. In addition, regional/cultural factors, such as "culture-of-honor" norms and community size, also may influence weapon-carrying behaviors. Small town environments may intensify feelings of marginalization due to stronger social norms and pressures to conform. School safety

policies themselves, such as greater security measures, may also raise ethical concerns, particularly when they have disproportionately affected students of color. Ultimately, this module considered the moral and ethical implications of current school safety practices, such as ensuring that safety policies do not unjustly target or exclude vulnerable groups.

15. Transportation Planning and Policing Power

Presenter

Sophia Glenn — Political Science

Mentor

Rob Pfaff — Urban Planning and Development

Transportation planning and policing have been hand in hand for many years, as systems deal with issues of crime and safety of operation. Transit affects almost all people, whether they use bus systems, subways, or trains; most urbanized places have some form of public transit. This research addresses how crimes are reported on these transit systems, and why some transit agencies feel a need to add police units to maintain a sense of order or safety. The goal of this research is to make transit policing more efficient through data analysis. This study includes primary source data collection from several different transit police systems from across the US, including Atlanta, Denver, Los Angeles, New Jersey, New York, San Francisco, Washington D.C., and Minneapolis-St. Paul. To analyze these agencies, we sort through the crime data that the agencies report through the FBI National Incident-Based Reporting System (NIBRS) database, and through the agencies' individual policing websites themselves. The crime data that we collect ranges from arrests to calls. We track the funding and agency force size also. We have collected data from the year 2019 through 2024. We find there are shocking discrepancies between the numbers, and the agencies report different numbers to NIBRS compared to the numbers that are in their agency database. Preliminary results suggest that the true number of crimes has been decreasing, but inconsistencies in data presentation make direct comparisons difficult. This research suggests the need for new policy on transit policing data collection practices that agencies should observe, to collect reliable and comparable data. Ultimately, we want to make sure that the agencies are getting the most out of their use of transit police and that public resources are being deployed efficiently for transit users.

16. Team Science in Undergraduate Psychology Education at Iowa State University: Students Conduct a Replication Study through the Collaborative Replications and Education Project

Presenters

Ally Holmes	Psychology
Elise Hubbard	Psychology, Sociology
Ryan Chew Wen Cong	Psychology

Mentor

Tess Neal	Psychology

Empathy is considered a virtue, yet people often avoid empathy. Why is this so? Our undergraduate research methods class (PSYCH 3020-5) at Iowa State University is conducting a replication project of a published study that offered an answer to this question, organized through the Collaborative Replications and Education Project (CREP). The goal is to teach research methods while simultaneously having students engage in actual research that will be published with data collected from other replication sites. Science needs replication projects – particularly highly-cited studies like the one we are replicating. And collaborative science is important for increasing power and confidence in published research findings. Our class is conducting a replication of the first study that appears in Cameron, Scheffer, Hadjiandreou, Hutcherson, Ferguson, and Inzlict (2019). The class consists of 18 undergraduate students, led by Professor Tess Neal and Graduate Teaching Assistant Maya Irvin-Vitela. The course is designed such that every student is engaged in writing a research paper reporting on our replication project, writing an ethics proposal for Institutional Review Board (IRB) approval, doing a preregistration through the Open Science Framework (OSF), and making an academic poster and presentation based on the project. As a class, we use the jigsaw method to combine work done by individual students into whole single projects (e.g., a single collaboratively written IRB proposal that we actually submit for approval, a single version of a collaboratively-written preregistration that we'll actually

submit and use). Our OSF project page, which publicly documents our process, progress, and outcomes, is: https://osf.io/vay9k/overview

17. Use of Formal Verification Techniques for the Dynamic Degradation of the GRIFEX CubeSat

Presenters

Erin Riley — Aerospace Engineering
Bella Brewer — Aerospace Engineering
Gustavo Abagge Luzzi — Aerospace Engineering

Mentor

Kristin Rozier — Aerospace Engineering

Small aerospace systems, such as CubeSats, have seen a sharp increase in adoption due to their low cost, short development cycles, and high availability. Space is a very demanding and adverse environment, and the hardware used within these systems typically include COTS components not designed for these challenges and thus is contributing to a higher failure rate.

The GEO-CAPE ROIC In-Flight Performance Experiment (GRIFEX) CubeSat developed by the Michigan eXploration Laboratory (MXL), is one such system, which began reporting an increase in off-nominal telemetry measurements in 2019. Having orbited the Earth since 2015, radiation is suspected to have caused this faulty behavior, but limited capabilities prevent developers from thoroughly addressing this issue. Runtime verification (RV) provides the capability to automatically detect faults in real-time and has been applied to small aerospace systems, and is adept at including space domain-specific constraints and considerations. As a proof of concept for inclusion on a follow-up mission to GRIFEX, we develop and validate 275 formal specifications in mission-time linear temporal logic (MLTL); MLTL's expressive power captures all of GRIFEX's requirements while remaining generic enough to extrapolate to other missions. We simulate RV with R2U2 across all 133 telemetry parameters, analyzing 11.8 GB of onboard data spanning 2015-2021 and capturing faults for 76 specifications. We demonstrate how our methods provide a greater understanding of GRIFEX's system degradation and help determine change-over points in the satellite's life cycle. We finish with a proposed roadmap for RV implementations in future CubeSat projects.

18. Custom Scanning Probe Microscopy Atomic Force Microscope

Presenters

Samantha Castro — Mechanical Engineering
Ethan Yarkosky — Aerospace Engineering

Mentor

Jigang Wang — Physics and Astronomy

An Atomic Force Microscope, or an AFM is a sensitive instrument that can scan a sample and create a topographical map, which allows scientists to analyze biological samples in further depth to investigate the interaction between pharmaceutical drugs and biological membranes, and opens the door to creating nanotechnology at the atomic scale, which can help create new nanodevices in the medical field. Chemical etching is used to dissolve tungsten wire, to create an atomically sharp tip. By applying different voltages to tungsten wire and varying molarities of sodium hydroxide and potassium hydroxide solutions, we will test which variables create the sharpest tip in the most effective manner. The tips will be glued to tuning forks, which will create a resonance frequency when a voltage is applied. Being able to graph these frequencies is the first step into creating a fully functioning AFM.

19. Project Joseph Hoane

Presenters

Elizabeth Conlin — Aerospace Engineering
Nikolay Silkin — Mechanical Engineering
Alden Schermer — Computer Engineering

Mentor

Bowen Weng — Computer Science

The project seeks to enable a robotic manipulator to play chess against humans or other robotic manipulators. The project is named after Joseph Hoane, an IBM engineer who physically moved the chess pieces during Deep Blue's matches against Garry Kasparov in 1996 and 1997. The match was a milestone in AI, showcasing cognitive intelligence in chess. However, with Joseph Hoane moving the pieces, it lacked the physical embodiment of intelligence, highlighting AI's gap in real-world interaction. It has primarily two components: (i) a chessboard configuration detection algorithm, and (ii) a pick-and-place algorithm executed by the So-101 Arm.

20. Relating the curvature of bow echo thunderstorms to their maximum wind speeds.

Presenter

Sean McMullen — Meteorology

Mentor

William Gallus — Earth, Atmosphere, and Climate

Bow echoes are arched lines of thunderstorms which often produce strong surface-level winds that account for a significant portion of structural damage caused by convective non-tornadic weather. A past study suggested a correlation between the curvature of these systems and their maximum wind speeds; however, this study utilized categorical bins based on wind intensity to achieve these results. This study omits these bins and examines bow echoes between 2020 and 2025 to determine if a generalized relationship exists across all systems regardless of intensity. Utilizing data from the NCEI Weather Radar Archive, and the NOAA Storm Events Database, roughly 100 cases were identified manually and processed through a python script to calculate curvature. Three distinct methods for measuring curvature were evaluated: inverse circumcircle radius, a normalized value using chord length, and the inverse of the apex angle. Results show that the inverse circumcircle radius method yielded no significant correlation (R^2=0.037) because this calculation was highly sensitive to the physical size of the bow. Normalizing this value with the chord length of the bow significantly improved results (R^2=0.280), but the strongest relationship was found using the inverse of the apex angle (R^2=0.771), which standardizes curvature across all storm scales. While findings to this point suggest a moderate to strong correlation between curvature of a bow echo and its wind intensity, the study remains ongoing to incorporate more data points and validate that this relationship holds as sample size increases.

21. Investigating the Potential of Biochar for Nitrate Ion Removal from Contaminated Water

Presenter

Maddox Purk — Environmental Science

Mentor

Patrick Johnson — Materials Science and Engineering

Iowa has a water quality crisis largely due to nitrogen runoff, primarily from farming practices. As nitrogen breaks down, it gets converted into nitrates, which pose several health hazards to humans. This means that nitrates must be treated to a safe level before the water is distributed to the public. The Des Moines Water Works does this by exchanging the nitrate ions with chloride ions obtained by saturating the resin with a salt solution. With limited capacity, it only treats 1,000 gallons per minute; it only treats some of the water, then blends it with the rest of the normally treated water to bring nitrate levels to safe consumption levels. This is a very expensive process, costing around $9,000 dollars a day for operation. To find ways to make the process

cheaper, some researchers have looked at graphene made from biochar as a promising material. Graphene has favorable properties such as its conductivity, porosity, and therefore its ability to be a catalyst in helping remove nitrate ions. Studies have shown that graphene is not only accurate at better detecting substances, but also in isolating and removing them as well.

22. Verbal Cue Training to Improve Credibility Assessments

Presenters

Graham Hilligoss — Psychology

Adarsh Nair — Statistics

Mentor

Christian Meissner — Psychology

Laypersons, including trained practitioners, tend to perform at or below chance levels when detecting deception, demonstrating the need for accessible, reliable, and evidence-based credibility assessment techniques. The present study evaluates a modified version of the Psychologically Based Credibility Assessment Tool (PBCAT) by assessing the efficacy of verbal cues in detecting deception across both narrative and opinion statements.

N = 4 undergraduate research assistants were trained to code 100+ recorded interview videos using five verbal cues (common knowledge, completeness, plausibility, fluency, and emotionality). Recorded statements varied by veracity (truthful vs. deceptive) and context (alibi vs. opinion) in a within-subjects design. Following group analyses to model longitudinal coding data (GEE), Cohen's d effect sizes were calculated to assess the effect of each verbal cue (i.e., which cues performed the best, and which cues performed the worst) in predicting veracity across alibi and opinion statements.

In the alibi condition, weaker effects were observed for common knowledge ($d \approx .17$, $p = 0.054$) and stronger effects for completeness ($d \approx .43$, $p < 0.001$) and fluency ($d \approx .42$, $p < 0.001$). The opinion condition yielded weaker yet notable effects for fluency ($d \approx 0.27$, $p < 0.003$) and stronger effect sizes for completeness ($d \approx .38$, $p < 0.001$) and common knowledge ($d \approx .36$, $p < 0.001$). Results in the opinion condition indicated larger discrimination effects across cues compared to the alibi condition.

These findings suggest that verbal cue frameworks may provide reliable and above-chance performance in detecting deception. The magnitude and variability of effect sizes suggests that cue effectiveness differs across cue types, with some cues showing higher contextual utility than others. Overall, these results support the validity of structured verbal cue frameworks to discriminate deceptive from truthful statements in both alibi and opinion contexts.

23. Exploring stable motif analysis for asynchronous attractor identification in gene regulatory networks

Presenter
Ishita Bhattacharyya — Computer Science
Mentor
Claus Kadelka — Mathematics

Boolean networks are used to model gene regulatory networks (GRNs) and predict cellular behavior. Modeling these networks using an asynchronous update scheme is realistic because gene expression in real biological systems is stochastic. Currently, our lab's Python toolbox, BoolForge, which excels at generating Boolean functions and networks, relies on exhaustive state-space enumeration for network analysis. This creates a computational bottleneck when identifying attractors, which correspond to cell fate or stable patterns of cell activity.

To avoid exhaustive enumeration, my work explores the use of stable motif analysis. A stable motif is a self-sustaining feedback loop that drives a cell to a specific fate. Identifying stable motifs can significantly reduce the state space and avoid computing every possible state transition. I am currently studying the pystablemotifs package to understand stable motifs and incorporate asynchronous attractor identification into BoolForge, based on methods from pystablemotifs.

In conclusion, studying and incorporating stable motif analysis complements BoolForge's network generation and analysis, helping scientists efficiently and realistically model complex gene interactions.

24. LLMs for FPGA Design

Presenter
Divya Lidder — Computer Engineering
Mentor
Joseph Zambreno — Electrical and Computer Engineering

As Large Language Models (LLMs) increase in usage and capability, LLMs for code generation are becoming increasingly prevalent in research and industry. Significant existing literature documents the performance of different LLMs on software testbench suites, however the analysis of LLMs for hardware HDL generation is less well-researched. This project presents a pipeline to evaluate LLM-generated hardware code and compare large language models in terms of their ability to generate functional, efficient HDL. The proposed framework is modular, built using OpenRouter and cocotb, in order to provide support for an HDL agnostic, LLM agnostic test suite. Within this framework, various LLMs, both fine-tuned for HDL generation, as well as out-of-the-box, are queried with a set of test vectors. The response generated is compiled and simulated, and

corresponding error messages loop back to the LLM for proposed edits. Multiple statistics including compilation success rate, pass@k rate, and token efficiency are captured for each tested LLM and reported on. This project fills a gap needed by the hardware design community and opens up a conversation about the potential for LLMs, whether fine-tuned or not, in improving the efficiency of HDL generation. Future extensions include incorporating the RISCV processor architecture and its accompanying test suite designed in CPRE 3810 into the pipeline in order to test LLM capabilities on larger and more realistic design problems.

SESSION I, 9:55–10:45

Kinesiology

Room 3310

1. **Integrating VR into Rehabilitation Services**

Presenter

Hannah McFadden — Software Engineering

Mentor

Michelle Rusch — Kinesiology

Virtual reality and assistive technology are becoming increasingly common tools in healthcare, particularly in rehabilitation settings. This project explores how virtual reality environments can be used to support upper-body motor skill development during rehabilitation programs. The goal of the project is to design and prototype a virtual reality environment that models a portion of a physical therapy rehabilitation program through interactive exercises and game-based activities.

Early stages of the project focused on reviewing VR development platforms, analyzing existing research on virtual rehabilitation, and conducting a needs assessment with healthcare professionals. Interviews with clinicians, including a physical therapist, an orthopedic surgeon, and a pediatric hospitalist, highlighted several common challenges in rehabilitation care. Time constraints, heavy workloads, and the need for patients to continue rehabilitation outside of clinical appointments were identified as major barriers to effective treatment. These insights helped shape the design direction of the project.

Based on this research, the proposed system models a six-week section of an upper-body rehabilitation program within a virtual reality environment. The environment will guide users through repetitive upper-extremity exercises using interactive prompts and simple game-based tasks designed to encourage patient engagement and consistent practice. The system will also explore the ability to collect performance data and monitor patient progress.

The initial prototype will be developed using the Unity platform and tested using VR resources available at the Student Innovation Center. The goal of the prototype is to create a basic virtual rehabilitation space that can demonstrate therapy movements and support repeated motor skill practice. By combining interactive virtual environments with rehabilitation exercises, this project aims to explore how virtual reality technology can support patient engagement and provide additional tools for clinicians working in rehabilitation settings

2. Interactive Tutorial Development in AI and Analytics for Health Strategies

Presenters

Ian Ressler — Data Science

Ryan Huckabee — Computer Science, Game Design

Mentor

Michelle Rusch — Kinesiology

Students often struggle to retain programming concepts in health data contexts. Python tutorials created using a user-centered, iterative systems design approach may offer a potential solution. Tutorials integrated into weekly learning modules can provide scaffolded, hands-on exercises using a real-world public health context to establish a foundation for data science in the medical field.

The design was guided by evidence-based learning strategies grouped into two key areas. Cognitive strategies (including spaced repetition based on the Ebbinghaus forgetting curve) and objectives defined using Bloom's Taxonomy support long-term retention and progression of knowledge. Feedback strategies, such as behavior-specific praise and immediate responses within branching scenarios, can reinforce both student engagement and decision-making. Together, these approaches address a gap in digital health education by providing structured opportunities for students to apply these learned concepts, supporting the development of long-term data literacy, critical thinking, and problem-solving skills, while receiving timely, targeted feedback.

This project addressed the lack of interactive, feedback-driven learning tools in digital health education. Specifically, it evaluated how structured repetition, active recall, and health-related scenario-based exercises influence student engagement and retention when applying Python skills. The effectiveness of this research was evaluated for observed improvements in both conceptual understanding and application skills. This work offers promise for increasing student satisfaction, depth of learning, and retention when learning technical coding skills in addition to developing professional skills. The approach used has potential as a model that can carry over to other courses.

3. Cardiovascular Risk Among Asian Americans: A Narrative Review

Presenter

Ikra Farah — Kinesiology and Health

Mentor

Sadia Anjum Ashrafi — Kinesiology and Health

Cardiovascular disease (CVD) remains a major cause of morbidity and mortality in the United States, and key risk factors including hypertension, diabetes, and obesity continue to increase. Asian Americans represent one of the most diverse and rapidly growing racial groups, yet much of the existing research aggregates them

into a single category, creating a significant literature gap that limits understanding of subgroup-specific CVD risk patterns. This narrative literature review explores current evidence on CVD prevalence, incidence, and major risk factors among Asian Americans while identifying how these patterns differ across subgroups. A systematic search was conducted using PubMed to locate peer-reviewed articles reporting trends, prevalence, incidence, or risk related to CVD among Asian Americans. Inclusion criteria required English-language studies presenting measurable CVD outcomes or risk-factor data for at least one Asian American subgroup; studies lacking relevant data or not focused on Asian Americans were excluded. A narrative synthesis approach was used to organize and interpret patterns across the literature. Three findings emerged from the reviewed studies. First, major CVD risk factors particularly hypertension, diabetes, and obesity remain prevalent within Asian American populations. Second, substantial subgroup variation exists: Filipino and South Asian Americans consistently show elevated levels of multiple CVD risk factors, whereas Chinese Americans demonstrate lower mortality but rising hypertension rates. Third, major gaps persist, including limited subgroup-specific reporting, underrepresentation of Southeast Asian and Pacific Islander Americans, and evidence that standard clinical risk-prediction tools may underestimate risk for certain Asian American subgroups. Overall, the literature indicates that CVD remains a significant concern among Asian Americans, with meaningful variation across subgroups. The continued lack of disaggregated data and subgroup-specific research limits accurate risk assessment and hinders the development of tailored prevention strategies, underscoring the need for more inclusive and culturally informed research.

Psychology and Criminal Justice

Room 3512

1. Trends in Assessment and Expert Judgment Methods in the U.S. Practice of Forensic Psychology Over the Past Decade

Presenters

Molly Sickels	Psychology
Kaitlyn Huwel	Criminal Justice, Psychology
Emily Butera	Human Development and Family Studies, Psychology
Rhya Larson	Psychology
Tavien Bragg	Psychology

Mentor

Tess Neal	Psychology

This project updates the data provided by Neal and Grisso (2014) by exploring forensic mental health evaluators' (FMHE) self-reported use of structured measures in their evaluations in civil and criminal cases.

As we preregistered, this descriptive observational study involves surveying forensic mental health evaluators about their two most recent evaluations. After securing IRB approval, we recruited 268 psychologist-participants from a database of 5,067 licensed psychologists in the U.S. with forensic interest maintained by our research lab. Participants provided informed consent and then responded to a questionnaire with a short series of questions about their two most recent forensic evaluations (e.g., referral question, sources of information used, how long the evaluation took, length of report, whether (and what) instruments were used, opinions about strengths and weaknesses of these instruments, demographics). The survey took about 20 minutes to complete. In the data collected thus far from 536 forensic evaluations, competence to stand trial is the most common referral question (39% of the referrals), reports were on average 16.91 pages (SD=15.43), took 53.09 days to complete (SD=64.14), and involved a broad range of information sources. Across all referral types (e.g., competence to stand trial, risk assessment, insanity, child custody, disability claims), about 65% of psychologists reported using some kind of structured assessment tool in their evaluation process, such as an IQ test or personality assessment instrument. This percentage is lower than the approximately 74% rate found in the previous 2014 study, suggesting that the field is, as a whole, relying less on structured psychological tools when psychologist form their forensic opinions. This finding is supported by a change in the rationale psychologists gave for not using tools as well, where in the current data 19% indicated they did not use any tools because they trust their clinical judgment (the comparison from 2014 data was just 10%). Implications of these findings will be discussed.

2. Charles Manson as a Prototype Psychopathic Offender: Rethinking Serial Homicide by Proxy

Presenter

Katoya Jepson — Psychology

Mentor

Matt DeLisi — Sociology and Criminal Justice

This project examines Charles Manson through the intersecting lenses of psychology, forensic psychology, and criminology to challenge the enduring cultural framing of him as merely a manipulative cult leader. The central research question asks whether Manson can be understood as a prototype psychopathic offender whose behavior aligns with the behavioral criteria for serial homicide despite the absence of direct physical participation in each killing. Grounded in psychological, forensic, and criminological theory, the study situates Manson within contemporary research on psychopathy, coercive control, and organized serial violence.

Methodologically, the project uses a qualitative behavioral case analysis drawing on archival evidence, psychological evaluations, court records, and secondary criminological sources. Historical assessments and documented behavior reveal traits of dominance, manipulativeness, lack of remorse, and coercive control consistent with established models of psychopathic offending. A comparative analysis with Ted Bundy highlights shared features of organized psychopathy, including planning, control, and instrumental violence,

while showing how Manson's orchestration of murder through subordinates may be understood as serial homicide by proxy.

Findings suggest that the officially recognized murders associated with Manson may not represent the full scope of his homicidal impact. Disappearances of associates, reports of desert burial sites, and patterns of symbolic and coercive violence align with the criminological concept of the dark figure of crime, in which documented offenses may underrepresent actual victimization. The study also identifies systemic investigative failures, including fragmented jurisdiction, neglect of marginalized victims, and failure to recognize escalating behavioral risk.

This study argues that Manson represents a critical behavioral and criminological prototype: a charismatic psychopathic orchestrator whose violence was organized, premeditated, and enacted through psychological domination. Reframing Manson as a contemporary warning rather than a cultural relic contributes to broader conversations about risk assessment, investigative coordination, and prevention of organized psychopathic violence.

3. **Profile of a Cybersecurity Fraudster**

Presenters

Anna McCleary — Accounting

Elizabeth Arens — Accounting

Mentor

Diane Janvrin — Accounting

In our research project, "Profile of a Cybersecurity Fraudster", we are investigating how cybersecurity hackers operate. Our study focuses on the fraud triangle which includes three categories, motivation, opportunity, and rationalization. First, we look for the motivation that drives hackers to take the risk of breaking the law, such as financial gain, gathering information, or looking for a challenge. Next, we examine how fraudsters identify opportunities to infiltrate company databases. Finally, we try to understand their rationalization to better comprehend their character and morals. When you know all these aspects of a cybersecurity crime, you are able to prepare for an attack and protect your company from security breaches. This assures that your customers are confident they found a company they can trust.

4. "You Can't Sit with Us!": The Cultural Heritage of Relational Aggression among Women

Presenter

Grady Sullivan — Psychology

Mentor

Susan Cross — Psychology

Cultures of honor emphasize reputation and encourage retaliation when reputation is threatened. In the US, honor orientations are most common in the South and Mountain West. Research has largely focused on men's aggression, while women have primarily been studied in relation to sexuality, with virginity, purity, and loyalty valued highly. However, recent findings show that women in US honor states are also more likely to endorse retaliation than women in non-honor contexts (Foster et al., 2022), and they tend to engage in relational rather than physical aggression. In cultures with strict gender roles, mothers are often the primary socializers of children and transmit cultural values. We hypothesize that women raised in honor states, and those who strongly endorse honor values, will recall greater maternal encouragement of relational aggression than women from non-honor states. Participants will be US-born women recruited online and from college campuses, all with ongoing relationships with their biological, living mothers. Using an adapted Relational Aggression Scale, we will measure recall of maternal socialization of behaviors such as gossip, ostracism, and bullying. The Honor Index for Women and Honor Values Scale will assess honor, while the Parental Styles Questionnaire will mask the study focus. Demographics will be collected. Data will be analyzed with regression, testing state-level honor orientation and personal endorsement as predictors, and their interaction. We expect women high in honor endorsement and from honor states to report more maternal socialization of relational aggression, suggesting women play a larger role in perpetuating honor values than previously recognized.

SESSION I, 9:55–10:45

Design and Language

Room 3534

1. Redefining the Vowels of Nawat

Presenter

Rivers Ludvicek — History, Anthropology, Spanish

Mentor

Hugo Salgado — World Languages and Cultures

This project aims to challenge and redefine the terminology used to describe the vowels of Nawat, an indigenous language of El Salvador with fewer than one hundred native speakers remaining. Current descriptions of Nawat sounds are limited and based more on listeners' perceptions than on empirical acoustic data. This project will redefine Nawat's vowels through acoustic analyses of high-quality recordings from Nawat elders. We will extract a variety of vowels from these recordings and measure their formant values—the frequency ranges that are amplified in each vowel. This will allow us to determine the position of the tongue during the articulation of each vowel.

2. Resilience Narratives: Exploring How Queer College Students Describe Growth After Adversity

Presenter

Kit Neel — Women's and Gender Studies, Psychology

Mentor

Alissa Stoehr — Women's and Gender Studies

Queer-identifying college students often face discrimination, bullying, and pressure to hide their sexual or gender identity, which can harm their mental health and academic progress. Although many studies focus on these risks, little is known about how these students develop resilience. This qualitative study, “Resilience Narratives: Exploring How Queer College Students Describe Growth After Adversity,” will examine the personal stories of resilience among queer undergraduate and graduate students at a large Midwestern university. The study asks three questions: (1) how participants describe resilience after experiencing adversity related to their sexual orientation or gender identity; (2) which coping strategies and sources of support they find most helpful; and (3) how they understand any personal growth or change that results. We will conduct semi-structured, one-on-one interviews lasting 45–60 minutes with 6–8 self-identified LGBTQIA+ students. Interviews will be audio-recorded with consent, transcribed verbatim, and analyzed using Braun and Clarke’s six-step thematic analysis to build a participant-driven model of resilience. Ethical protections include an informed-consent form, the option to skip any question, a debriefing session, and a list

of mental-health and LGBTQIA+ resources. We expect to identify key protective factors such as campus clubs, supportive peers and mentors, affirmation of identity, and meaning-making practices that help students grow after adversity. By centering the voices of queer students, the study adds a strengths-based view to minority-stress theory and offers practical insights for counseling services, student affairs staff, and policymakers who want to create more supportive campus environments.

3. Narrativizing Cults: How The Church in the Darkness Recreates Macro and Micro Stories of Jonestown

Presenter

Valerie Cook — Spanish, Secondary Education

Mentor

Jeffrey Wheatley — Religious Studies, Game Design

Modern popular media—including podcasts, documentaries, and literature—are full of representations of and debates over cults. Games, too, have recently begun engaging the fascination and horror of cults. This research examines The Church in the Darkness (2019), a narrative-rich video game inspired by the events of Jonestown and the People's Temple. The distinctive nature of digital games offers a unique and interactive way to engage with the history and nature of cults. This project examines how The Church in the Darkness intentionally structures historical events and branching narratives to guide players' perception, engagement, and understanding of cult dynamics.

Over five weeks of documented gameplay, including dialogue, screengrabs, decision pathways, and branching outcomes, this project investigates how starting characteristics and player decisions create unique narrative experiences. Special attention was given to side characters, environmental storytelling with sound and imagery, and the endings that highlight how the game humanizes individuals within the cult while addressing stereotypes. The game's design does not prioritize strict historical accuracy; instead, it focuses on ethical reflection and experiential learning that confronts the player's expectations of what makes a cult a cult.

Planned interviews with the developers aim to shed light on the research and design choices that informed the game's creation, including the extent of historical research involved. By analyzing both branching macro-narratives and dialogue-driven microstories, this project's results show how video games can offer individualized, participatory experiences that create a nuanced understanding of complex systems. The Church in the Darkness demonstrates how interactive storytelling allows players to inhabit dilemmas, turning historical events into a reflective and personal experience.

SESSION I, 9:55–10:45

Biology, Ecology, and Engineering

Room 3538

1.Following Collagen Deposition During Zebrafish Development Using CRISPR-mediated Integration.

Presenter

Shawn Slaymaker — Genetics

Mentor

Jeffrey Essner — Genetics, Development, and Cell Biology

Collagen IV (col4a1) is a key basement membrane protein whose localization informs its role in tissue development and function. Using CRISPR/Cas9-mediated fluorescent protein tagging in zebrafish (Danio rerio), we integrated the Venus reporter into the col4a1 locus via plasmid injection at the single-cell stage. Using fluorescent microscopy, we screened embryos at 48 hours post-fertilization and confirmed the expression in the targeted gene. We observed col4a1 deposition around muscle cells and blood vessels during early development, highlighting its contribution to extracellular matrix organization. Current efforts focus on isolating a stable transgenic line to track col4a1 dynamics during heart development and regeneration. This approach establishes a platform for visualizing collagen IV in vivo and advancing our understanding of its role in development.

2. Zein Protein in Vat Photopolymerization Scaffolding

Presenters

Leland Jeardeau — Materials Engineering

Tristan Westergren — Biomedical Engineering

Mentor

Alina Kirillova — Materials Science and Engineering

Natural polymers are increasingly favored in biomedical applications due to their accessibility, affordability, non-toxicity, chemical modifiability, biodegradability, and biocompatibility. Often, natural polymers break down into naturally occurring amino acids and peptides, making them safe for biological systems. These advantages position natural polymers as strong candidates for emerging biofabrication technologies, including additive manufacturing for personalized medical implants. Resins used in vat photopolymerization are an effective choice for additive manufacturing. However, many commonly used resins lack biodegradability or biocompatibility, making the development of resins with these characteristics an important challenge in materials science and the medical field.

Zein, a biocompatible and biodegradable prolamin protein derived from corn endosperm, has attracted attention as a bio-based polymer due to its abundance, renewability, and chemical functionality. The goal of our research is to leverage zein's biocompatibility and biodegradability to modify it into a resin suitable for structural applications. This is accomplished via the addition of methacrylate groups to functionalize zein for vat photopolymerization and the addition of functionalized cellulose nanofibrils for enhanced mechanical performance. We hypothesize that this resin will exhibit mechanical properties suitable for biomedical applications, such as bone scaffolds. This research will benefit the biomedical field by making personalized 3D printed implants more widely available to the public.

3. Needles and Nitrates: Exploring the Physical and Hydraulic Characteristics of Coniferous Wood Media in Bioreactors

Presenter

Cesar Martinez — Forestry

Mentor

William Beck — Natural Resource Ecology and Management

Excess nitrates in waterways pose a threat to aquatic ecosystems and human health. Woodchip bioreactors are an edge-of-field conservation practice used to treat nitrate (NO_3^-–N) loss from agricultural lands. Bioreactor performance depends on the physical and hydraulic properties of the wood media, which control water flow, retention time, and microbial habitat. Hardwood species are the standard woodchip media used in denitrifying bioreactors; however, coniferous species remain less tested and show mixed results in the literature. Previous studies lacked standardized testing methods and varied wood material, therefore the objective of this study is to assess two hardwood controls and 13 coniferous wood species to determine how their physical and hydraulic properties influence nitrate removal. Conifer logs were chipped using a consistent method to produce standardized bole-only woodchips with all twigs and foliage removed. Physical properties and particle size distribution were measured using manual caliper measurements and sieve-shaker analysis. Hydraulic characteristics, including drainable porosity, total porosity, particle density, dry and saturated bulk density, were measured using modified jar methods. Nitrate removal was tested using a batch kinetic study. Samples were inoculated with tile drainage water to establish a denitrifying microbial community before being filled with a nutrient solution containing 29.0 mg NO_3^-–N L^{-1}. The jars were destructively sampled after 9 hours. Remaining nitrate concentrations were measured using a spectrophotometer with the second-derivative UV method. All samples demonstrated nitrate reductions between 2.17–16.78 mg. Scots pine (Pinus sylvestris) and northern white-cedar (Thuja occidentalis) exhibited the highest nitrate removal at 57% and 56.08%, respectively, compared to hardwood controls, which ranged from 22.32% to 51.46%. Removal rates exceeded those of the hardwood controls. Although coniferous media often show high initial

nitrate removal in the literature, this study does not capture their long-term performance. Further research should evaluate long-term removal rates.

SESSION II, 12:05–12:55

Computer and Systems Engineering

Room 3310

1. Assisting in Planning the Electric Power System of the Future

Presenter

Pace Roedl — Electrical Engineering

Mentor

Colin Christy — Electrical and Computer Engineering

With the rapid growth of energy consumption, current power grids are struggling to keep up with demand. Regional grid operators such as the Midcontinent Independent System Operator (MISO), provide critical information about proposed generation projects and interconnections but often lack precise geographic coordinates as to where they will be constructed. This restricts the abilities of researchers and planners to analyze future power grid development.

This research develops a computational tool that processes projects in the MISO interconnection queue and estimates accurate geographical coordinates for future and proposed interconnection locations. The program extracts data from projects within the MISO queue and applies geographic matching techniques to infer the most likely locations for each project.

By obtaining these coordinates for future projects within the MISO queue, the tool will enable further improved mapping, planning, and analysis of the future power grids. This tool supports those in energy systems planning by providing them with a more detailed perspective of how the new electric power grid systems in the United States are expanding and evolving.

2. Comparing Large Language Model Performance Across Three Scientific Disciplines

Presenter

Deesha Deshmukh — Computer Science

Mentor

Deborah K. Holmes — Computer Engineering

Large language models (LLMs) have become essential tools in daily life, helping with tasks from coding to complex problem-solving. However, their accuracy varies across applications and models. This project examines how two open-source LLMs, Flan-T5-Base and Flan-T5-Large, differ in interpretation of peer reviewed research across three academic disciplines. We created a dataset of 180 questions from 15 peer reviewed research articles in three areas: Influenza, Environmental Engineering, and Phylogenetics and Evolution. For each paper, questions were created at three difficulty levels: easy, medium, and hard, to

facilitate analysis of how difficulty impacts model performance. Both models were accessed through HuggingFace and accuracy was evaluated using keyword-overlap matching to score answers as correct or incorrect. Accuracy was then compared across models, difficulty levels, and disciplines using one-way ANOVA. Early results indicate that both models struggle with domain-specific research questions, with accuracy declining as question difficulty increased. Flan-T5-Large showed modest improvements over Flan-T5-Base, particularly on medium-difficulty questions, but no statistically significant differences in accuracy were found across the three disciplines for either model.

3. Improving Software Refactoring Methods to Increase Efficiency and Maintainability

Presenter

Debojeet Bhattacharya — Software Engineering

Mentor

Judith Islam — Electrical and Computer Engineering

Refactoring is a vital component in the modern software development process. Refactoring enables developers to enhance the internal structure of software systems without affecting their external behavior. As systems continue to grow and implement new features, it is necessary to ensure that programs also continue to improve in both efficiency and maintainability. Otherwise, known issues such as bugs and scalability problems continue to grow, making it increasingly difficult to change the program. Our research project examines how implementing well-known refactoring methods in open-source Java projects can improve their efficiency and maintainability. Furthermore, applying refactoring methods can help identify ways to improve them and further enhance quality. This research aims to contribute to the field of refactoring by offering recommendations for improving existing refactoring approaches.

4. Analyzing reactions to cognitive attacks in augmented reality.

Presenters

Kiley Shahady — Mechanical Engineering

Spencer Ford — Mechanical Engineering

Mentor

Stephen Gilbert — Industrial and Manufacturing Systems Engineering

As mixed reality (MR) systems become more widely used, the risk of cyberattacks targeting MR users also increases. In the past, people have approached this issue by strengthening the cybersecurity of systems, creating a more secure virtual environment, and developing programs. However, these past systems fail to account for the users themselves and how they respond to failure and attacks. To develop safe augmented programs, it is necessary to holistically analyze the safety and competence of the machine and the user. Understanding these responses is essential to creating a secure and operationally effective environment. To

do so, the study plans to model and then predict users' reactions to certain attacks. Currently, data is being collected on attacks that create distrust in the reliability of a system or impose inattention from false positives in a task. Additionally, data is also being collected on observing how imposed latency on the user affects their physical well-being, or cybersickness, which is similar to motion sickness. By recording how the user feels about the system and any physical ailments from the machine, and comparing these factors to the user's efficacy in a simulated task. The end goal will be to establish methods to predict how users will react in MR environments that can be established universally, enabling new MR programs to be developed in ways that protect the user and allow programs to remain effective.

Cell Biology and Game Design

Room 3512

1. Dissecting the role of granulin during hematopoietic stem cell specification

Presenter

Emilee Clemensen — Biology

Mentor

Raquel Espin-Palazon — Genetics, Development, and Cell Biology

Perturbations in cell fate choices result in loss of tissue homeostasis and diseases like cancer and developmental disorders. A better comprehension of the molecular mechanisms that drive cell fate determination is necessary to reveal novel therapeutic interventions.

Progranulin (Grn) has been broadly implicated in cell growth, survival, and inflammatory processes, yet its specific role in the development of the hematopoietic system has remained unclear. Here, we demonstrate that Grn is a critical regulator of myeloid differentiation, particularly in the formation of macrophages and neutrophils. Using the zebrafish model, we performed loss-of-function studies by injecting Grna morpholinos at the one-cell stage, enabling assessment of hematopoietic development in the absence of Grna. Whole-mount in situ hybridization (WISH) was used to visualize and quantify hematopoietic markers.

Loss of grna resulted in a significant reduction in late hematopoietic stem and progenitor cells (HSPCs), indicating a requirement for Grna in definitive hematopoiesis. Mechanistically, we found that Grna promotes both transient and definitive waves of myelopoiesis through a Stat3-dependent pathway, in which Stat3 activity drives grna expression, establishing a regulatory feedback axis. Notably, this Grna–Stat3 myelopoietic mechanism is conserved in humans.

Together, these findings identify Grna as a key regulator of hematopoietic development and provide new insight into molecular pathways governing blood formation, with potential implications for understanding hematologic and inflammatory diseases.

SESSION II, 12:05–12:55

2. The Chronic Autoimmune Loop in Hashimoto's: Mechanisms, Pathology, and Future Directions

Presenter

Sophia Easton — Genetics (Pre-Med)

Mentor

Hala Bastawros — Genetics, Development, and Cell Biology

Hashimoto's thyroiditis (HT) is a chronic autoimmune disease where the immune system slowly destroys thyroid follicular cells, reducing the gland's ability to produce hormones T3 and T4. My project explains how this loss of immune tolerance develops, how it creates a self-sustaining autoimmune loop, and why this loop leads to the long-term hypothyroidism seen in HT.

The disease begins when immune tolerance to thyroglobulin (Tg) and thyroid peroxidase (TPO) breaks down, allowing autoreactive T and B cells to target thyroid follicular cells. Dendritic cells and stressed follicular cells themselves can present self-antigens and activate $CD4^+$ T cells. The inflamed environment strongly pushes these $CD4^+$ T cells toward Th1 and Th17 subsets. Th1 derived IFN-γ increases MHC-II expression on thyrocytes, while Th17 derived IL-17 recruits neutrophils and promotes fibrosis of thyroid tissue. These pathways reinforce each other, forming a chronic autoimmune loop in which Th1 and Th17 cytokines damage follicular cells, and these damaged cells release more antigen, and newly activated $CD4^+$ T cells continue differentiating into pathogenic subsets.

The histology reflects this cycle through lymphocytic infiltration, germinal centers, colloid loss, and collapsing follicles. As more follicles fail, T3 and T4 levels fall, leading to symptoms such as fatigue, cold intolerance, weight gain, dry skin, constipation, and cognitive slowing. Diagnosis relies on elevated TSH, low free T4, high anti-TPO/anti-Tg antibodies, and abnormal thyroid ultrasounds.

Current treatment focuses on levothyroxine synthetic T4 replacement, which restores hormone levels but does not stop the initial autoimmune attack. Future therapies may target costimulatory signaling, Th1/Th17 cytokines, Treg stability, and abnormal MHC-II expression approaches aimed at interrupting the autoimmune loop and preserving thyroid function.

SESSION II, 12:05–12:55

3. Game-Based Learning for a Safer Digital World

Presenters

Noah O'Connell	Software Engineering
Mason Malooley	Computer Science
Ibrahim Younas	Computer Engineering

Mentor

Aaron Yang	Graphic Design

Online scams are becoming more common every year, and many people still struggle to recognize them or practice safe habits online. To help address this problem, we are developing an educational game in Unity that teaches players how to spot scams and make safer decisions in digital spaces. Our goal is to create an interactive experience that feels engaging while also giving players real-world skills they can use outside the game.

The game walks players through different situations based on real online scams, including phishing emails, sketchy messages, and fake login pages. Players look at the information they're given and decide what to do next. After each scenario, the game shows which choices were safe or unsafe, which helps players see the common tricks scammers use, and how to avoid them.

By letting players actively practice identifying threats, we hope to improve both awareness and confidence when dealing with potential scams. Overall, this project aims to create a fun and accessible way for people of all ages to learn safe online practices. With cybersecurity becoming more important in everyday life, we believe that interactive tools like this can play a meaningful role in helping users stay informed and protected.

Plant Pathology

Room 3534

1.Monitoring soybean relay cropping system with oil and cereal crops with UAV-based spectral Indices

Presenter

Brady Kammeyer	Agricultural Engineering

Mentor

Silvina Arias	Plant Pathology, Entomology, and Microbiology

This research study seeks to evaluate the effectiveness of planting different winter/spring crops with soybean in Iowa. This innovative practice, relay cropping (RC), in which soybeans are planted before the first crop is harvested, has potential benefits, including breaking disease cycles, promoting biodiversity, and protecting

soil from erosion and nutrient runoff. The field experiment was established at the ISU Agronomy and Agricultural Engineering Sorenson Research Farm near Boone in strip trials. Winter crops were planted in the fall of 2024, and spring cereals and oilseeds were planted in early spring of 2025. Soybeans were interseeded into the living crops. No-till fallow/soybean monoculture was included as a control. The goal of this study was to use remote sensing in collaboration with Iowa State's Remote Sensing and Imaging Laboratory to investigate potential differences among treatments in a strip RC system during different growth stages. Imagery will be used to characterize crops and plot environment conditions before soybean emergence. For instance, as proxy for plant competition, we will measure reflected red:far-red (R:FR) ratio and canopy coverage at soybean planting. Complementary assessments will include proxies for moisture and overall crop conditions with NDWI, NDVI, VARI and EVI. Data analysis will now proceed to compare the effectiveness of different relay crops in enhancing soybean health and subsequent yields.

2. Yeast Inhibition by Volatiles on Bee-Associated Pathogens

Presenter

Nicholas Larsen — Biology

Mentor

Amber Crowley-Gall — Plant Pathology, Entomology, and Microbiology

Many symbiotic yeasts are associated with social bees like bumblebees, and some of these yeasts are known to have a positive impact on bee health. Our previous work identified a subset of these symbiotic yeasts that can inhibit growth of the bee pathogen Ascosphaera apis. However, the mechanisms underlying these impacts are still largely unknown. Volatile organic compounds (VOCs) have been shown to play a role in yeast inhibition of pathogens. Here, we test the effects of VOCs produced by bee-associated yeasts on the fungal pathogen Ascosphaera apis. We examined the impacts of VOCs from 13 strains of yeasts, chosen based on their previously identified pathogen inhibition activity (including strong inhibitors, weak inhibitors, and variable inhibitors). We tested their inhibition activity against three strains of Ascosphaera utilizing a double-dish culture system. In this set up, candidate yeasts and the Ascophaera pathogen are grown in separate but connected petri dishes that share a sealed airspace, allowing only VOCs to diffuse[CA1.1]. The set up was incubated at 25°C for five days, and pathogen growth (cm) measured on days three through five. Preliminary results have shown a variety of differences between the original plate inhibition project and the volatile assays, with some yeasts showing a complete reversal in pathogen inhibition activity. Our results[CA2.1] suggest that the examined yeasts may utilize multiple and distinct mechanisms to combat pathogen growth. These findings could help us understand differences between yeast strains and provide insight into the mechanisms underlying relationships between these yeasts and their bee associates.

3. Elucidating the role of mosquito extracellular vesicles in Dengue virus dissemination and amplification

Presenter

Jolcey Santana — Microbiology

Mentor

Ryan Smith — Plant Pathology, Entomology, and Microbiology

Mosquito-borne viruses are a rapidly growing threat to public health, causing hundreds of millions of infections annually, with Dengue virus (DENV) alone causing an estimated 100 million symptomatic cases and about 100,000 life-threatening cases yearly. Over half of the world's population is at risk for transmission, highlighting a need for new strategies to combat DENV. For DENV to be transmitted to a new host through the bite of a mosquito, DENV must disseminate from the initial site of infection in the gut to the mosquito saliva, traversing physical barriers and evading mosquito immune responses. Currently, we lack an understanding of how DENV evades the mosquito immune system and how it infects the salivary glands, events that are critical for transmission. Extracellular vesicles (EVs) are key components of cell-to-cell communication, but preliminary studies suggest that DENV can also be packaged into EVs, potentially facilitating its spread within the mosquito. This project assesses the role of mosquito EVs in viral infection in exploring whether these EVs facilitate the spread of virus infection throughout the mosquito. In this study, we demonstrate that an EV inhibitor depletes EV populations in a mosquito cell line. We then examine the shift in EV size and quantity in response to infection. Finally, to assess whether EV depletion affects virus infectivity, we measured infectious virus in the supernatants of DENV-infected cells treated with varying concentrations of an EV inhibitor. We expect that inhibition of EVs in infected cells results in less EV-bound virus circulating in the supernatant and lower infectivity. Therefore, we expect the packaging of DENV into EVs to increase its overall infectivity, supporting that EVs may be a route of viral spread within mosquitoes. Unraveling these objectives is key to understanding DENV infection in mosquitoes and is necessary in identifying targets to interrupt this process.

SESSION II, 12:05–12:55

Mechanical Engineering

Room 3538

1.Current Development and Characterization of a Large-Animal Tubular Biaxial Tissue Testing System

Presenter

Kanishk Bhati — Mechanical Engineering

Mentor

Abhay Ramachandra — Mechanical Engineering

Mechanical characterization of vascular tissue is critical to its response to different physiological loading conditions within the body. While in-vivo studies provide an accurate representation of physiological behavior, they are limited by biological safety constraints, restricted control over loading conditions, and challenges in measuring mechanical variables, which prevent a full assessment of a tissue's intrinsic properties. Ex-vivo testing addresses these limitations by allowing repeatable, high-accuracy experiments with greater control over both dynamic and quasi-static loading. This approach allows direct study of the intrinsic behavior of vascular tissue under applied tensile forces.

Data from ex-vivo studies can then inform anatomical models derived from CT and MR imaging, enabling more accurate simulation of tissue hemodynamics and improving understanding of disease mechanisms.

This project focuses on the development of a Large Animal Tubular Biaxial Tissue Testing System (LATBTTS) to facilitate ex vivo studies of tubular vascular tissue. The system is designed to apply both quasi-static and dynamic loading conditions by varying pressure and axial force, allowing characterization of tissue properties in both circumfential and axial directions. The LATBTTS system is organized across three subsystems: Pressure, Force–Length, and Diameter Tracking. Each subsystem requires dedicated instrumentation, hardware interfacing, and software control, managed through a centralized LabVIEW interface with a National Instruments data acquisition system. Subsystem development has included comprehensive documentation, mechanical component design for fabrication via manufacturing methods, and initial implementation and testing of motor actuation and load cell signal acquisition within LabVIEW, which has been validated through dedicated test programs. Data collected from LATBTTS will directly contribute to refining computational simulation models and support the development of more accurate biomechanical prosthetics for the replacement of diseased vascular tissue.

2. A Comparative Analysis of Factors Affecting SLAM Accuracy on Autonomous Vehicles

Presenter

Anthony Baston — Computer Engineering

Mentor

Phillip Jones — Electrical and Computer Engineering

Simultaneous Localization And Mapping (SLAM) is a well-studied problem in which a vehicle uses various sensors (often a combination of LiDAR and wheel encoders) to build a map of its environment and its location within it, often used in robotics applications such as factory floors or search-and-rescue. Several algorithms exist to solve this problem, therefore selecting the proper one for a given situation is important. While there have been works comparing these in different contexts, few have quantified the effects of environmental factors on the accuracy of the resulting maps. This work studies 4 popular algorithms: Fast SLAM 2.0, Cartographer, Hector SLAM, and Graph-Based SLAM, with various speeds, sensor accuracies, and environments. We propose a method of procedural and stochastic map generation on which to evaluate these algorithms and a benchmark for comparing processor- and sensor-imposed limitations. Algorithms were simulated in a ROS environment with artificial sensor noise. Results indicate a positive correlation between an algorithm's computational load and its accuracy. Fast SLAM 2.0 tends to be the most accurate at the cost of CPU time, while Hector SLAM was the least computationally expensive. Widespread robustness to significant sensor and environmental noise across all tested algorithms indicates that the processor is the limiting factor for SLAM accuracy. This indicates future SLAM work could benefit from improved hardware acceleration of Fast SLAM 2.0.

POSTER II, 1:00–3:00

Room 3580

1.Cytological analysis of maize meiocytes in parallel spindle gene (Zmps1) mutants and quantification of abnormalities found during meiosis

Presenter

Abby Ingersoll — Horticulture, Environmental Studies

Mentor

Thomas Lubberstedt — Agronomy

This project focuses on observing maize meiocytes at anaphase I, metaphase I, and telophase II to document the impact of the maize parallel spindle gene (Zmps1) in meiosis. Samples of immature tassels from the wildtype control(W22) and the mutant (Zmps1-1) were collected from the field, then fixed in Carnoy's Solution, a 3:1 mixture of ethanol and acetic acid. Along the immature tassel are spikelets which contain anthers undergoing meiosis. Spikelets were collected from the tassel and the anthers were removed. Anthers between 1.5 and 2 mm in length were chosen for meiocyte extraction. The extracted maize meiocytes were stained with DAPI and preserved in a Vectashield mounting medium. The meiocytes were imaged using an Olympus BX40 light microscope using brightfield and fluorescence microscopy. Images were captured at the anaphase I, metaphase I, and telophase II stage of meiosis and were classified as abnormal or normal. Abnormal cells presented with lagging chromosomes in both metaphase I and anaphase I and with micronucleation at the tetrad stage following telophase II.

2. Follicular size effects on porcine oocyte quality and meiotic competence

Presenters

Brooke Askren — Animal Science

Abby Leaders — Biology, Psychology

Mentor

Aileen Keating — Animal Science

Oocyte quality is positively associated with the diameter of the surrounding follicle, with larger follicles generally producing higher-quality oocytes. The current protocol utilized by the Iowa State University porcine in vitro fertilization (ICF) laboratory collects oocytes from every healthy-appearing antral follicle, regardless of the size. The goal of this study was to determine if differences exist in oocyte maturation, quality grade, and collection metrics from follicles of differing size. The hypothesis tested was that follicle size would impact quality and maturation rate of porcine oocytes. Treatment groups were determined by follicle diameter: small (4-6 mm), medium (8-10 mm), large (12-14 mm), and mixed (4-14 mm). Cumulus-oocyte complexes collected from follicles within these categories were graded for quality on a scale of 1-5 and cultured in

maturation medium at 38.5°C for 41-44 h at 5% CO2. One-way ANOVA was conducted with a significance level defined as $P < 0.05$. It was discovered that follicle size did not affect the total number of oocytes collected ($P > 0.05$) or maturation rate ($P > 0.05$). Two-way ANOVA was conducted for quality grading data with statistical significance defined as $P < 0.05$. The overall oocyte quality grades yielded from small, medium, large, and mixed follicle size categories were not different ($P > 0.05$). There was no difference in recovered grade 1 and grade 4/5s ($P > 0.05$) oocytes from large follicles had no difference but there were fewer grade 2 and 3 oocytes than grade 4/5s ($P < 0.05$). The mixed follicle category had no difference in the ratios of grade 1, 2, and 3 oocytes ($P > 0.05$) but had more grade 4/5 oocytes ($P < 0.05$). There was no within-group quality difference among small follicles ($P > 0.05$) or among medium follicles ($P > 0.05$). These findings demonstrate potential interactions between follicle size and oocyte quality, but further studies are warranted. In summary, this study contributes to the scientific literature related to IVF processes in production animals and women.

3. Owl Lure--Mechanical Engineering With Biology in Mind

Presenter

Henry Sodey — Mechanical Engineering

Mentor

Gunnar Kramer — Animal Science

Over the course of a semester, a mechanical owl decoy has been designed and built. The decoy started as an idea, then morphed into an actual design, making tens of revisions along the way. The design was extremely similar to the classic ship of Theseus, with every single part having had an entirely revised design to either improve efficacy or to improve manufacturability. After the design phase, parts were ordered and the skeleton was printed. Following, even more revisions were made. The code, being very simple, was done with little aid. Now, a tangible, working owl decoy exists, and real-world tests are being conducted soon.

4. Evaluating the Relationship Between Calsequestrin in the Low-Ionic Strength Fraction and Purge of Fresh Pork Loins

Presenter

Morgan Yahr — Mechanical Engineering

Mentor

Steven Lonergan — Animal Science

Previous research has identified a greater abundance of calsequestrin in the low-ionic strength fraction (LISF) of high-quality pork loins, suggesting that calsequestrin could be a predictive biomarker of pork quality. While extracting the LISF from pork loins is destructive, the purge fraction provides a noninvasive sampling method for detecting calsequestrin abundance. This study aimed to evaluate the relationship between calsequestrin presence in the LISF and the purge of fresh pork loins. A subsample (N=24) was

selected from prior western blot data to contain high, medium, or low abundance of calsequestrin in the purge from a population of pork loins initially characterized for quality attributes, including color, proximate composition, pH, Warner-Bratzler shear force (WBSF), drip loss, and cook loss. The LISF was extracted using a low-ionic strength buffer. A western blot analysis was performed in duplicate on the samples using a pooled purge reference sample, incubated using a primary polyclonal rabbit anti-calsequestrin antibody and secondary goat anti-rabbit-HRP conjugated antibody, and imaged. The data were analyzed in R (v4.4.1) using a Spearman Correlation and Wilcoxon Rank Sum using an established significance of $P < 0.05$. A moderate-to-strong relationship ($\rho = 0.60$ and $P = 0.002$) was identified between calsequestrin abundance in the purge and the LISF. Additionally, the abundance of calsequestrin in the purge and LISF was moderately to strongly correlated with 24- and 48-hour pH, L and b values, cook loss, WBSF, and drip loss (LISF) ($P < 0.05$). Calsequestrin was significantly more abundant in the low ionic strength fraction than in the purge ($V = 0$ and $P < 0.001$). These results indicate that calsequestrin abundance in purge reflects its relative abundance in the LISF and supports the use of purge as a practical, noninvasive sample for predicting fresh pork quality.

5. Using Australian stalagmites to understand the Austral-Asian monsoon system over the last 2000 years

Presenter

Brianna Redmond — Environmental Science

Mentor

Diana Thatcher — Earth, Atmosphere, and Climate

The Indonesian-Australian Monsoon (IAM) system impacts international trade, fisheries, agriculture and the people of this region and has been impacted by changes to global climate. The IAM system has experienced shifts in rainfall patterns over the last 1000 years as well as on longer timescales. Recent studies have used geological records to examine climate and rainfall patterns using stalagmites from caves. These data can aid in understanding past monsoon variability and can be further used to make predictions about future climates and potential shifts in the monsoon system.

To examine the data hidden inside the Australian stalagmites in this study, samples were collected using a micromill (MM2) and then analyzed for isotopes using mass spectrometry. Oxygen isotopes ($\delta^{18}O$) have an inverse relationship with precipitation levels, providing a useful relationship for understanding past precipitation changes due to monsoon variability. Uranium and Thorium ratios are used for dating of stalagmites and show that the stalagmite KNI-154-7 was deposited approximately 62,000-65,000 years ago. One series of events that has potentially created oscillations in monsoon patterns is Dansgaard/Oeschger (D/O) events. Over the last glacial cycle, D/O events were characterized by sudden periods of warmth followed by gradual cooling over millennial timescales. These events are shown in speleothem records globally, which show similar timelines to the East Asian and Indian monsoons. While past studies have

allowed a better understanding of the monsoon system's history, the full effects and geographical imprint, particularly effects in Australia, of D/O events are still not fully known. This work aims to develop a time series of δ18O values using a stalagmite from a new cave in Australia to better understand monsoon variability in Australia as a result of D/O events.

6. Illuminating the impacts of SynGAP isoforms on scaffolding and phase separation

Presenter

Megan Uehlein — Biochemistry

Mentor

Eric Underbakke — Biochemistry, Biophysics, and Molecular Biology

SynGAP is a neuronal signaling protein with critical roles in scaffolding and organizing synaptic proteins. SynGAP exhibits a long, disordered tail region with a C-terminal trimerization motif. SynGAP has also been shown to interact with another scaffolding protein, PSD-95. Reconstitutions of SynGAP and PSD-95 demonstrate liquid-liquid phase separation (LLPS). LLPS is a cellular phenomenon wherein networks of protein interactions cluster and concentrate collaborative teams of proteins. SynGAP-mediated LLPS has been detected in neuronal cells. Understanding the LLPS properties of SynGAP is a frontier in synaptic plasticity research. To date, the SynGAP trimerization and PSD-95 interactions that underlie LLPS have focused on one SynGAP isoform. However, humans express four SynGAP isoforms with distinct C-terminal tails. We aim to test the consequences of mixed SynGAP isoform trimers on PSD-95 interactions and LLPS. Our preliminary results validate that our fusion of a fluorescent protein with the SynGAP tail recapitulates PSD-95 interactions and LLPS. We are now generating the other three isoform constructs to test the impacts of mixed isoform trimers on PSD-95 binding avidity.

7. Protocol development of mixed method whole body dissection of canine for specimens replication

Presenter

Elliott Small — Animal Science

Mentor

Zoe Lambert — Biomedical Science

Comparative veterinary anatomy is a foundational discipline for students pursuing careers in veterinary medicine, animal science, and related biological fields. Anatomy is a high-volume subject dependent on language acquisition and spatial understanding. Comparative veterinary anatomy requires an additional layer of complexity by understanding multiple species.

An increasing number of first-year students in the Doctor of Veterinary Medicine (DVM) program experience difficulties in their anatomy coursework, leading to increased failure rates. Current efforts to

address gaps in anatomical preparation include pre-matriculation approaches, namely coursework that occurs prior to entering the first-year curriculum.

Currently, the impact of pre-matriculation laboratory modalities on student outcomes in comparative veterinary anatomy and the DVM curriculum is unclear. This study develops and investigates a mixed-methods approach to veterinary anatomy laboratories that combines systems and region-based instruction to create novel, hands-on, specimen-based learning opportunities.

We are developing a detailed canine prosection, specifically for pre-matriculation instruction. The region-based method was chosen in conjunction with the traditional vet school approach because undergraduate learners often have limited prior exposure to anatomical terminology and spatial relationships. Studying systems helps students understand overall function, while regional organization helps them integrate structural relationships and develop a coherent understanding of the body.

The prosection highlights key anatomical structures while preserving relationships between muscles, nerves, vasculature, and organs. This method emphasizes visual and spatial learning, allowing students to connect anatomical components and understand functional relationships. The resulting specimen will serve as a teaching resource for the comparative anatomy course and may provide a model for adapting veterinary-level anatomical material to undergraduate audiences. This study marks an important milestone in our ability to make data-driven decisions regarding future anatomy instruction at the undergraduate, graduate, and professional levels at Iowa State University.

8. **Animation based Teaching Tool mentor program**

Presenter

Michelle Bendersky — Computer Science

Addison Valletta — Software Engineering

Mentor

Simanta Mitra — Computer Science

This research project explores the development of an animation-based teaching tool designed to improve the learning experience for students studying Python programming. Traditional methods of teaching coding often rely heavily on text-based instruction, which can be difficult for beginners to understand and stay engaged with. This project proposes the use of animated visualizations to demonstrate key programming concepts such as loops, conditionals, variables, and functions in a more interactive and intuitive way.

POSTER II, 1:00–3:00

9. An Experiment to determine if lowering temperature in drosophila flies at some specific stages of their development can improve the life span

Presenter

Marie-Claire Ndefua — Genetics

Mentor

Ping Kang — Genetics, Development, and Cell Biology

Drosophila melanogaster has an optimal developmental temperature of 25 °C but can develop within a broader range of 13 °C to 31 °C. Lower temperatures slow development, while higher temperatures can cause physiological stress. Previous research has shown a strong relationship between developmental time and maximum lifespan in many organisms. For example, a study on Drosophila demonstrated that mutating the prothoracicotropic hormone (PTTH) delayed developmental time and significantly increased lifespan compared to non-mutated flies (Ping Kang et al., 2025).

Related research has also connected these findings to humans. One study found that females who experience menarche before age 11 and childbirth before age 21 have a higher risk of several aging-related diseases, whereas childbirth at a later age is associated with reduced risk (Yifan Xiang et al., 2025). Additionally, some forms of dwarfism in humans, particularly those involving growth hormone deficiency, are linked to longer lifespans and lower rates of age-related diseases such as cancer and diabetes (Aguiar-Oliveira et al., 2019). These studies support the broader idea that slower developmental processes may contribute to longer lifespan and improved health outcomes.

The purpose of this experiment was to determine whether delaying developmental time in ywR and w1118 Drosophila flies could increase their lifespan. This was done by lowering the developmental temperature from 25 °C to 18 °C for 48 hours at specific life stages: L3-72, L3-96, white pupa (WP), pupa 1 (P1), and pupa 2 (P2). If lifespan increased, the results would support previous findings that extended developmental time can lead to longer adult lifespan.

In the experiment, equal numbers of pure-bred w1118 and ywR flies were divided into six groups: L3-72, L3-96, WP, P1, P2, and a control group. Each treatment group was placed in an 18 °C incubator for 48 hours during its assigned developmental stage and then returned to 25 °C, while the control group remained at 25 °C throughout. Mortality was recorded every two days until all flies died, around 50 days.

The results partially supported the hypothesis. Flies treated during the P1 and L3-96 stages showed significantly increased lifespans compared to the control group. However, treatments at P2, L3-72, and WP either reduced lifespan or produced no significant difference. These results suggest that the timing of developmental delay plays an important role in influencing lifespan.

10. Mechanism of Aging and how it Disrupts Lens Homeostasis and Crystallin Stability, Resulting in Cataracts

Presenter

Samantha Aagard — Biology, Global Resource Systems

Mentor

Hala Bastawros — Genetics, Development, and Cell Biology

Cataracts are the leading cause of blindness worldwide, primarily affecting middle- and low-income regions with limited access to treatment. The human eye lens is a highly specialized, transparent tissue that focuses light onto the retina. Its function depends on maintaining precise biochemical and structural equilibrium to remain clear. The lens is primarily composed of proteins α, β, and γ crystalins, water, cytoskeletal, and membrane components. Lens fiber cells, derived from epithelial cells at the equator, undergo differentiation characterized by the loss of organelles to preserve transparency. Over time, these fibers become densely packed, particularly in the nucleus, where the oldest cells reside and are not replaced throughout life.

Aging disrupts protective mechanisms within the lens, leading to protein aggregation and loss of transparency. Oxidative stress plays a critical role in cataract formation because reactive oxygen species (ROS) accumulates in the eye and modifies crystallin proteins. Glutathione (GSH) is a critical antioxidant produced by lens epithelial cells that helps mitigate this damage. Its concentration is lowest in the lens nucleus, increasing the susceptibility of damaged fibers in the oldest part of the lens and leading to nuclear cataract. Other forms include cortical cataracts, characterized by structural fiber damage and spoke-like opacities located at the outer region of the lens. Posterior subcapsular cataracts (PSC) result from cell migration and differentiation of epithelial cells into opaque clusters at the back of the lens.

Current treatments are primarily surgical, with phacoemulsification being the most widely used technique. Other treatments include femtosecond laser-assisted surgery and extracapsular extraction for cases where the eye cannot withstand phacoemulsification. Studying molecular mechanisms underlying age-related lens degeneration could be the future of identifying the pathways that decline with age and exploring therapeutic strategies to restore antioxidant defenses, potentially preventing or delaying cataract formation.

POSTER II, 1:00–3:00

11. The Effects of DNA Modification During the Developmental Stage of Drosophila

Presenters

Kaley Claiser	Biology
Ethan Logston	Business Analytics
Charlie Edwards	Genetics
Isaac Lehman	Forestry
Conner Below	Biology

Mentor

Ping Kang	Genetics, Development, and Cell Biology

Our group of five, first-year honors students, are working together in the Molecular Biology Building under Professor Ping Kang, testing the genetics of aging in flies. Together, the team tackles many responsibilities that requires almost daily attention. We are responsible for the production of the food for the flies, filling the necessary number of bottles and vials with food for the flies, collecting virgin flies for a pure breeding, then collecting males when necessary, crossing the parent generation, transferring the parent generation adult flies to new bottles to obtain enough eggs, transferring the F1 generation adult flies to new bottles to support mating, and monitoring the F1 generation's lifespan from all 8 developmental stages. We take on these responsibilities to reach our overarching goal. The overarching goal of our research is to determine if a change in gene expression will affect the adult lifespan of our flies. We are testing 11 different histone modification genes within 8 different developmental stages in hopes of identifying genes that regulate the flies' lifespan through the developmental stages. We are about to gather our data of how long each group of flies live and we will compare this with the other genes as well to observe how modifying different genes effects the aging. We will gather this data by monitoring all the flies daily and recording how long each of the groups (based off their genes) of flies live. Once we gather all our data, we will use J.U.M.P. (an analysis software) to help us analyze all the data we recorded into a more readable and professional report. Our hard work and research could eventually be used as preliminary data that would allow us to present a hypothesis and propose further research into the genetics of aging.

12. Genetics and breeding of summer-dormant perennial groundcover

Presenter

Grace Harty	Horticulture

Mentor

Shui-zhang Fei	Horticulture

In the Midwest, farmers have traditionally relied on annual cover crops, such as cereal rye, during the off-season to prevent soil erosion and reduce nutrient leaching. However, these systems present challenges,

including recurring seed and labor costs each year. Perennial cover crops, such as Kentucky bluegrass, offer a promising alternative in Midwestern cropping systems, as they provide these ecosystem services continuously over multiple years, acting as a persistent barrier to surface runoff and nutrient loss into groundwater while substantially reducing input costs. However, their use raises concerns about competition with the main crop for water and nutrients, and efforts to suppress them during the growing season often increase reliance on herbicides, further intensifying chemical inputs. To address these limitations, our research focuses on Poa secunda, a cool-season grass exhibiting vegetative summer dormancy, as a potential perennial cover crop interplanted with corn. This trait may help minimize competition during the growing season while still providing ecosystem services in the off-season. However, Poa secunda is a facultative apomictic species, which can complicate hybridization and breeding efforts. Therefore, the objective of this study is to quantify the level of apomixis in ten geographically diverse genotypes of Poa secunda using flow cytometry, enabling more informed decisions for future crossing and breeding strategies.

13. Gardens Across Iowa!™ Model Garden and App

Presenter

Sondra Wilson — Political Science

Mentor

Cynthia Haynes — Horticulture

Gardens Across Iowa™ is a modular, automated garden system designed to make small-scale food production accessible to households, schools, churches, and community organizations. Many people want to grow food but feel overwhelmed by seed selection, conflicting gardening advice, or companion-planting charts that are often inconsistent or unsupported by research. This project replaces trial-and-error gardening with a structured, research-informed design that embeds best practices directly into the garden layout.

Each garden module is pre-designed with compatible crop groupings, ecological support plants, and a built-in three-year crop-rotation pattern that protects soil health automatically. Rather than requiring users to track plant families or manage rotation schedules, the system organizes planting into Zones and Guilds that function as modular building blocks. Garden sites can begin with a single module and expand gradually as space, time, or resources allow.

The system also incorporates automated irrigation infrastructure. Each zone is equipped with timer-controlled watering that maintains consistent soil moisture while allowing optional rain sensors to pause irrigation during rainfall. Because irrigation hardware remains fixed while plant guilds rotate annually through planting positions, the system maintains crop-family separation and reduces pathogen buildup without requiring charts or specialized horticultural knowledge.

A companion mobile application provides location-responsive notifications for germination, transplanting, irrigation adjustments, and harvest timing. These reminders simplify seasonal management

and make the system particularly useful in settings with rotating volunteers or inconsistent maintenance schedules, where traditional gardens often decline.

By combining ecological design, automated irrigation, and digital scheduling support, Gardens Across Iowa™ presents a scalable model for resilient community food production. The project demonstrates how thoughtful system design can transform gardening from a specialized skill into accessible food infrastructure capable of improving food access, environmental stewardship, and community engagement across Iowa.

14. Bio-inspired Character Design and Speculative Game Narratives

Presenters

Sarah Jefferson	Wildlife and Fisheries Conservation and Ecology
Aidan Prouty	Architecture
Zach Wood	Architecture
Nathaniel Moberg	Aerospace Engineering

Mentor

Miray Boga	Industrial Design

Games are widely recognized as effective learning facilitators across a broad range of topics, including ecological awareness and environmental education. Various aspects of games -such as genre, narrative, components, and mechanics- can contribute to learning experiences both explicitly and implicitly. This research project explores younger generations' engagement with nature through bio-inspired speculative narratives and game-based experiences, aiming to foster ecological awareness. The study consists of three main activities:

Gaming Sessions

First Year Honor students engage with ecology-themed board games to understand core mechanics and reflect on their impact on gameplay experience and nature engagement. These include Wingspan (focused on birds), Finspan (focused on fish), and Wyrmspan (focused on fictional dragons).

Nature Observation Diaries

Students keep a diary based on regular observations of a selected natural area, enabling real-time engagement with nature.

Speculative Design Sessions

Participants meet weekly to develop speculative game narratives and design fictional, nature-inspired characters grounded in cause-and-effect relationships observed in nature. This process includes research using biological databases and nature documentaries to build informed and meaningful connections between ecological systems and game narratives.

The study aims to explore multiple media at the intersection of nature and games within a bio-inspired design framework, highlighting natural processes and raising awareness of often-overlooked living systems in

everyday life. In this symposium presentation, students will present highlights from their gaming reflections, nature observation diaries, and design session notes and drawings as a group.

17. Diagnostic Assays For Corn Stunt Pathogens

Presenter
Lauren Kubicek — Kinesiology
Mentor
Alejandro Olmedo-Velarde — Plant Pathology, Entomology, and Microbiology

Corn is a critical component of the economy in the United States that contributes significantly to agriculture, food production, and exports. Its production, however, is threatened by insect and pathogen pests, which makes integrated pest management a vital priority. Among several diseases affecting corn production, corn stunt has become a new concern for the U.S. after its problematic impact in Mexico, Brazil, and Argentina. The disease is transmitted by the corn leafhopper and is caused by two pathogens, maize bushy stunt phytoplasma (MBSP) and corn stunt spiroplasma (CSS), which cause similar symptoms, thereby complicating diagnosis. Currently, tools for diagnostics for these pathogens have not been established in the U.S., causing a need for method development. This study focuses on the development and improvement of diagnostic methods for both MBSP and CSS. The different techniques used include recombinase polymerase amplification (RPA) and quantitative polymerase chain reaction (qPCR). These approaches can provide reliable detection of corn stunt pathogens and support effective disease management strategies. The results of this research will be presented at the symposium.

18. Discovery and characterization of novel bacteriophage

Presenter
Abigail Matson — Biology
Mentor
Nicholas Peters — Plant Pathology, Entomology, and Microbiology

The discovery of Penicillin was a huge breakthrough in overcoming bacterial infections, and from that, other antibiotics were born. Their biggest downfall: antibiotics often kill both good and bad bacteria. Biophages, or commonly phages, have a unique property: they have evolved to attack a narrow range of bacterial hosts. These non-living bio-machines are found everywhere. According to the NIH, there are 10^31 phages on Earth. The phage's ability to target very specific bacteria makes them incredibly useful in medicine; we can use a specific phage to kill a specific bacterium without harming helpful species. Our research looks at phages that kill LF82, a bacterium found at the end of the small intestine in people with Crohn’s disease. We collect fecal samples from ISU farms, filter them, and expose different bacteria to their contents. We know a phage that kills that bactera is present when there is a plaque or hole in the bacterial lawn. We individually pick the lawns

and put them in Phage buffer so we can test them on other types of bacteria. Currently, we have yet to find a phage that is extremely specific. We plan to use electron microscopy on a phage with an interesting property, whether that be the size of its plaque or its host range. Globally, phages could be used to treat several bacterial diseases in people with weakened immune systems and may be an alternative to antibiotics. The future is exciting and coming fast, and it may have novel phages built to kill just what we need them to.

19. Quality of information about raw milk on social media

Presenter

Samuel Jackson — Political Science

Claire Maddy — Journalism and Mass Communication

Mentor

Filip Viskupič — Political Science

Interest in the consumption of unpasteurized milk has significantly increased in recent years. Unpasteurized milk has been frequently discussed on social media, with a sharp increase in short videos. Given that much of the social media content on unpasteurized milk is produced by influencers and advocates, questions have been raised about its quality and accuracy. The goal of this project is to systematically analyze the quality of information about unpasteurized milk on Instagram and TikTok. Using newly created accounts, we used the phrase “raw milk” to search Instagram and TikTok for content regarding unpasteurized milk. The 100 most popular videos from each platform were selected for analysis. One coder recorded information about the popularity of a video, its position on the consumption of unpasteurized milk, and presenter characteristics, including age, occupation, and gender. In the next step, two coders will independently assess the videos using the Journal of the American Medical Association Benchmark Criteria for reliability and the Accuracy in Digital Information tool for factual correctness. The findings will provide novel insights into the accuracy of social media content on unpasteurized milk consumption and inform the evolving discussion on this topic.

20. The Effect of Music Tempo on Word Memorization Performance

Presenter

Hajin Jung — Psychology

Mentor

Martin Acerbo — Psychology

In this study I investigated how background music with different tempos affects memory performance. To that end I designed an experiment where undergraduate students completed a word memorization task under two conditions: a) fast-tempo and b) slow-tempo music. Memory performance was measured using a free-recall test following each condition. Results showed that participants performed numerically different, however these differences were marginally significant. Giving that the power analysis and the small sample size, further

research is needed. Overall, this study highlights how study habits, like listening to music, might influence learning outcomes.

21. Can Students Effectively Study Using Generated Questions?

Presenter

Ryan Johnson — Psychology

Chew Wen Cong — Psychology

Mentor

Jason Chan — Psychology

Taking a quiz on previously learned material enhances memory retention when compared to rereading (the testing effect; Roediger & Karpicke, 2006; Rowland, 2014). Similarly, the generation effect shows that information is better remembered when learners generate it rather than studying it. However, it is still unclear whether students benefit from testing with their own generated questions (Foos et al., 1994; Myers et al., 2023). We were interested in examining how question generation, with or without AI-assistance (ChatGPT), affects learning.

We compared learning outcomes of answering self-generated questions, peer-generated questions, and rereading. Participants were 248 students from Iowa State University. The study followed a 2 (assistance: AI-assisted, unassisted) x 2 (question source: self-generated, peer-generated) + 1 (rereading) mixed-design. Participants read two STEM passages. After reading each passage they either generated questions, answered peer-generated questions, or reread the passage. Additionally, participants either generated questions with or without AI-assistance. At the end of Session 1, participants self-tested with their generated questions. All participants took a criterial test over each passage and returned 48 hours later for a final test. Findings show that students can benefit from self-testing with generated questions compared to reading, but only when questions are generated without AI-assistance and when they match the content targeted by questions on the final test.

22. Marital Status and Its Non-Significance in Studies of Prison Misconduct

Presenter

Anna Erickson — Criminal Justice

Mentor

H. Daniel Butler — Sociology and Criminal Justice

Marriage is theorized to help individuals desist from crime through the process of prosocial relationships and the development of a strong social bond. Applied to behaviors among incarcerated persons (IPs), marriage provides an avenue for individuals to cope with the pains of imprisonment (e.g., communication with a loved one). However, findings from systematic reviews of prison rule violations show that marital status does not

significantly affect prison misconduct once other variables are considered in multivariable models of data. This poses challenges for certain criminological theories, such as life-course theory and social control theory, which state that strong social bonds, such as marriage, can reduce criminal behavior. Using nationally representative data of incarcerated persons (Survey of Inmates in State and Federal Correctional Facilities, 1997 and 2004), we seek to explore whether different types of relationship statuses are associated with prison misconduct, such as divorced, separated, single, and married. Bivariate analyses provide comparisons between different types of relationship status and prison misconduct. Policy implications include the need to examine indicators of relationship status outside of dichotomous yes/no measures of marriage.

23. Game Design in Research and Urban Planning

Presenter

Samuel Coventon — Game Design

Mentor

Alenka Poplin — Urban Planning and Development

I am currently involved in the development of The Emotions Geogame, an interdisciplinary and international project for creating a mobile game that brings citizens to be involved in their city and collects data on emotional ties to locations. The purpose of the game is to give citizens a method to input their emotional response to locations in their city. This data would lead to a greater understanding of urban planning and even point out areas of cities that are especially favorable or unfavorable in the eyes of the citizens. A strength of the video game approach is that it creates an incentive for people to become involved in the urban planning of their local area and makes participating in research fun.

I have been a part of this project for about six months as a game designer. My role on the team is to develop the story, work on mechanics, and keep the game balanced. This means that I would document and finalize our ideas for player interaction, create leveling and reward systems, write dialog, and make sure the game systems feel right for the player. I will be presenting on the incentives and rewards system, the game design document, and goals of the project. I would also like to describe the challenging design problems with this project, such as creating a research focused game that is fun or maintaining viable data collection practices, and our game's approach to solving those problems. Additionally, my poster will include personal takeaways so far**.**

24. Testing Antibiotic Effectiveness Against Bacillus cereus

Presenter

Miley Vermilyea — Biology

Mentor

Bryan Bellaire — Vet Microbiology and Preventative Medicine

Bacillus cereus is a Gram positive bacterium that is commonly found in the soil and can cause severe foodborne illness in both humans and animals. It is especially difficult to control because it is spore forming and those spores are highly resistant to heat and chemical treatments. Once the spores are germinated, B. cereus produces toxins that can lead to gastrointestinal disease, making effective treatments essential to limit damage caused by actively growing cells.

In this study, we tested how *B. cereus* responded to different antibiotics using a broth culture assay, which measures the bacterial growth in increasing concentrations of each drug. We also examined whether growing the bacteria in blood before testing changed their sensitivity to the treatment provided.

Our results showed that *B. cereus* was especially sensitive to carbapenem antibiotics, which target the cell wall, and moderately resistant to rifampicin, which inhibits the protein production. Bacteria grown in blood before testing became more sensitive to all antibiotics.

These findings suggest that *B. cereus* does not have broad antibiotic resistance and that environmental factors, such as exposure to blood, can affect drug sensitivity. Understanding these effects would help improve treatment strategies and guide further research into managing infections caused by this opportunistic pathogen.

25.Building the Maya City-States Through Worship: A Comparative Religious Study of Izapa and Copan

Presenter

Rivers Ludvicek — History, Anthropology, Spanish

Mentor

Serena Wheaton — World Languages and Cultures

This project will focus on the relationship between religion and the Maya city-states, specifically on how religion relates to the city-states' urbanization and growth as powerful polities. With the wealth of physical evidence through the stelas and inscription, as well as their famed status as major Maya sites, Izapa and Copan will be the primary subjects of study. They offer a comparative temporal analysis of how Maya states used religion in the Formative and Classic periods. Each site has unique aspects that make it a fantastic place to study in terms of its religious significance. Izapa, a Formative period site, offers insight into early developments in Maya cosmology, its linkages to Olmec predecessors, references to the Popol Vuh, and the origin of the Maya Calendar; make Izapa an excellent location, rich in evidence for how Maya religion developed throughout the Formative period and began to relate to Maya society, as well as for how it was used to control labor in the construction of the ceremonial structures and art at Izapa. Copan, on the other hand, will offer insight into the Classic period and how rulers built on the Formative period’s foundations and used religion to validate their status. With the famous Divine Stairway and the iconography of the lineage of Divine Kings used to validate their reigns and legitimacy, Copan offers insight into how Maya religion shaped stratified Maya society, especially the nobles’ status above others. Together, these two sites, studied in tandem, will

contribute to the discussions on how Maya religion gained a foothold in the Formative period as a tool to control labor and construct urban centers, and how, in the Classic period, it acted as a tool to define and justify the social classes of Maya society, especially the Divine Kings and religious leaders.

Room 3560

26. Evaluating Cyclic Strength Degradation through Activation and Accumulated Energies

Presenters

Claire Little — Civil Engineering

Patrick Murphy — Civil Engineering

Mentor

Beena Ajmera — Civil, Construction, and Environmental Engineering

The cyclic and post-cyclic behavior of fine-grained soils can be framed in terms of the activation and accumulated energies. The activation energy represents the threshold energy required to initiate irreversible soil deformation, while accumulated energy describes the total energy dissipated into the soil mass during cyclic loading. Previous work showed that activation and accumulated energies computed from cyclic simple shear tests on a range of fine-grained soils could elucidate the cyclic and post-cyclic behavior as well as the degradation in undrained shear strength as a result of cyclic loading. The use of the energy framework provided an alternative approach to describe soil behavior addressing inconsistencies in observations stemming from stress-controlled versus strained-controlled cyclic testing. In this study, the energy framework is extended to evaluate the effects of multiple cyclic loading events based on the results from cyclic simple shear tests on kaolinite samples. The expected outcomes highlight how the degree of consolidation between cyclic events on the capacity of kaolinite to accumulate energy and resist deformation during a second cyclic load. It is anticipated that differences between the activation and accumulated energies would be used to describe the reductions in undrained shear strength resulting from of the repeated cyclic loads.

27. Evaluation of Occurrence, Distribution, and Potential Sources of PFAS in Iowa Lakes and Rivers

Presenter

Stockton Huether — Forestry

Mentor

Joe Charbonnet — Civil, Construction, and Environmental Engineering

Perfluoroalkyl substances and polyfluoroalkyl substances (PFAS) are a group of chemicals commonly used in industry and commerce. They are toxic and highly persistent in the environment. Due to these properties, concerns over the human health and ecological effects of PFAS are growing. The objective of our research is to identify sources of PFAS in Iowa by analyzing samples of aquatic sediment and comparing them to overlying

lake water. Because of the surface activity of PFAS and the abundance of lakes in Iowa, aquatic sediment is an important matrix to study. We used extraction and liquid chromatography-mass spectrometry methods based on EPA Method 1633A to isolate PFAS and determine concentrations. This process involved four general stages: initial sample analysis (1), chemical preparation of samples (2), solid phase extraction (3), and mass spectroscopy (4). After completing this process and calculating PFAS concentrations for each sample, we will relate PFAS concentrations to environmental conditions. Each aquatic sediment sample belongs to a specific geographical location with a unique set of environmental circumstances, so trends regarding PFAS and geographical data can be statistically deduced. With our results, governments in Iowa and beyond can make informed decisions about how to minimize environmental exposure to PFAS. Land use, industrial activities, natural ecology, climate, and other geographic factors may affect PFAS levels differently, so our research can shed insight into the best regulatory practices for protecting human health and local ecology.

28. **3D Printing With Soil**

Presenter

Avery O'Gara — Mechanical Engineering

Mentor

Cassandra Rutherford — Civil, Construction, and Environmental Engineering

Flooding is a common natural disaster in the U.S. that leads to lost lives and in particular damage to infrastructure. My research sought to discover the durability and strength of clay columns when exposed to flood-like conditions, to determine if it is a viable building material for areas exposed to frequent flooding. The materials used in this research were 3d printed Kaolinite clay columns comprised of 1% Xanthan gum powder. These columns were submerged in water (fresh and salt) for twenty-four hours and then put through an unconfined compression strength test.

29. **AI-IADSSCHHM**

Presenters

Alex Pallan — Cyber Security Engineering
Jongmin Lee — Software Engineering
Z Harvey — Software Engineering
Andres Lopez — Computer Engineering
Camden Senneff — Software Engineering
Caleb Zea — Software Engineering
Srdan Kopunovic — Software Engineering

Mentor

Md Maruf Ahamed — Electrical and Computer Engineering

The AI-IADSSCHHM is a fully autonomous crop health monitoring system, designed to provide detailed and easy-to-use metrics on the growth of corn or soybeans, including growth rates, harvest readiness, and disease metrics, all with an easy to use interface and low-price off-the-shelf hardware. It uses a drone to collect visual data from above a field on a regular schedule, then processing data with an AI vision model to classify crops in growth stages and detect problematic areas that have visual indicator of disease, aggregating these and notifying the user of metrics in a frontend application.

30. Analysis of Network Traffic Using Artificial Intelligence for Security Classification

Presenter

Garrett Thompson — Cyber Security Engineering

Mentor

Shana Moothedath — Electrical and Computer Engineering

As packet encryption becomes increasingly secure, it becomes more complex to identify network packets. As a result, a blanket level of encryption is typically applied, leaving some information over- or under-protected. My project uses artificial intelligence to determine the type of information the packet contains and applies encryption, balancing security needs and existing encryption. This decreases transmission times and power usage.

31. Cymath as a Cross-Cultural Learning Space in STEM Education

Presenter

Amreen Chhina — Aerospace Engineering

Mentor

Namrata Vaswani — Electrical and Computer Engineering

This project explores the CyMath Program's mission in fostering learning and student engagement through a “Give-and-Take” approach. As an international student, I find my role in CyMath both as a learner and a tutor, where I have gained new perspectives on mathematical thinking and contributed to making math more fun for 3rd-12th graders.

Through observations of learners from various age groups, I found that younger students (elementary and middle schoolers) benefit more from step-by-step and visual explanations, while older students (high schoolers) prefer more direct solutions and steps. These differences highlight how engagement with math varies across learning stages and experiences. This project also reflects on how cultural background influences problem-solving approaches and communication in STEM and related fields. By tailoring explanations to different learners and sharing the math knowledge and concepts I learned in a different country, I developed more effective and inclusive ways to not only teach math concepts but also learn the American way of math, which helps me adapt to my engineering classes. Overall, this study shows that tools

like Cymath can enhance not only problem-solving but also communication and engagement in mathematics, especially in diverse learning environments.

32.Enhancing Biomolecule Immobilization via Surface Functionalization in Microfluidic Blood Vessel Systems

Presenter

Benjamin Kasner — Electrical Engineering

Mentor

Iqbal Kabir — Electrical Engineering

This paper reports on the experimental evaluation of the behaviors of biomolecules immobilized on the surface of blood vessels on microchip under pulsatile flow conditions, which include velocity profiles of the fluids and shear stress profiles around the biomolecules. Using fluorescent BSA, FITC conjugates mimicking biomolecules, the behaviors of the biomolecules can be optically observed, facilitating the quantitative studies and analysis.

In this work, a new assay has also been introduced to enhance the immobilization of biomolecules on the surface of a blood vessel microchip, significantly improving their binding to the microfluidic channel surfaces. This improvement enables the study of biomolecule behaviors, such as platelets, across a broad range of flowing shear stresses from normal physiological to extreme pathological conditions.

33. Accessibility Diagnostics and Auto-Patching Tool (ADAPT)

Presenter

Allison Castro — Computer Engineering

Mentor

Joseph Zambreno — Electrical and Computer Engineering

The Web Contact Accessibility Guidelines (WCAG) 2.2 are the most recent federal accessibility standards for digital content and documents. The regulations on alternative text, color contrast, headings, and other areas allow people with cognitive and visual disabilities to have access to web content. Ally is an add-in for the Canvas Learning Management System that is intended to process Canvas documents and score them for accessibility based on the WCAG 2.2 guidelines, in which the specific violations are listed for the user to fix. However, the Ally system is currently limited by 1) being usable only through files uploaded into Canvas, 2) requiring manual user interaction to determine scores and corrective actions, and 3) necessitating cycles of offline edit and manual upload to confirm that corrective actions have the intended effect. To address these limitations, in this project we have developed an alternative to the Ally scoring system that can be run outside of Canvas. We generated a benchmark set of files with a range of WCAG 2.2 accessibility issues and corresponding scores. Using this benchmark and alternative scoring method as a base, we then developed an

automated tool for accessibility diagnosis and scoring of common document types (e.g. PDF, Microsoft Office), which was then extended as a framework for fully automated patching of accessibility issues. Our initial prototype indicates that addressing common WCAG 2.2 compatibility issues can be automated with minimal user interaction.

34. Rapid Annealing of Block Copolymer Films for Nanomanufacturing Enabled by P4VP(PDP) Supramolecular Assembly

Presenter

Greta Hansen — Materials Science and Engineering

Mentor

Boyce Chang — Materials Science and Engineering

Block copolymer (BCP) thin films have emerged as promising pathways for nanoscale patterning in advanced nanomanufacturing applications, particularly as templates for inorganic hard masks in next-generation microelectronics. However, conventional BCP systems typically require prolonged annealing times to achieve well-ordered morphologies, limiting their practical scalability. In this work, we investigate supramolecular assemblies based on poly(styrene-block-4-vinylpyridine) [PS-b-P4VP] complexed with 3-pentadecylphenol (PDP), which enable rapid morphology evolution through hydrogen-bond-driven interactions.

The incorporation of PDP selectively modifies the effective volume fraction and mobility of the P4VP domain, significantly reducing annealing times from hours or days to minutes under solvent vapor annealing (SVA). By systematically tuning PDP loading, film thickness, solvent activity, and annealing duration, we establish clear processing–structure relationships governing morphology evolution. While distinct morphologies are observed in PS-b-P4VP(PDP) thin films, the transition pathways and precise processing windows that govern these structures have not yet been fully established. Preliminary results for the PS-b-P4VP(PDP) (33-b-6) system suggest a transition from parallel lamellar to vertically oriented lamellar structures with increasing PDP ratio under specific SVA conditions.

The next stage of this work focuses on identifying and verifying the processing conditions that reliably produce each targeted morphology on this PS-b-P4VP(PDP) (33-b-6) system, followed by selective infiltration and etching of the nanostructured polymer films.

35. Investigation of 3D Microstructural Evolution in 40Pb–60Sn Solder under Microgravity and Terrestrial Conditions

Presenter

Keaton Colby — Mechanical Engineering

Mentor

Sid Pathak — Materials Science and Engineering

As humanity moves toward long-duration space missions and in-space manufacturing, understanding how materials behave in microgravity becomes increasingly critical. This study investigates the three-dimensional (3D) microstructural differences between 40Pb–60Sn solder samples solidified under terrestrial and microgravity conditions. The focus is on characterizing key features such as void distribution, dendritic morphology, and phase evolution, which directly influence the mechanical performance and reliability of solder joints.

In this work, new 40Pb–60Sn solder samples were prepared and solidified under controlled terrestrial conditions to serve as a baseline for comparison. Microgravity samples were obtained from the In-Space Soldering Investigation (ISSI) conducted over 20 years ago, providing a unique opportunity to directly compare space-processed materials with newly fabricated terrestrial counterparts. The preparation of terrestrial samples involved alloy fabrication, substrate machining, and controlled solidification using ground-based experimental setups designed to replicate flight conditions. High-resolution X-ray micro-tomography datasets obtained from the Advanced Photon Source (APS) at Argonne National Laboratory are being utilized to analyze the internal microstructure of both microgravity and terrestrial samples. Using 3D visualization and analysis tools, such as Dragonfly, this study aims to quantify differences in porosity distribution, dendritic growth patterns, and phase separation between the two environments. It is expected that microgravity conditions will exhibit distinct solidification behavior due to the suppression of buoyancy-driven convection and the increased influence of surface tension.

In addition, the analyzed 3D datasets will contribute to the development of immersive virtual reality (VR) environments, enabling intuitive visualization of complex microstructures and enhancing both research interpretation and engineering education. This work provides valuable insight into the relationship between processing conditions and microstructural evolution in solder materials. The findings will contribute to improved understanding of defect formation in space environments and support the development of more reliable materials for future space applications.

36. A Study of Affordable Earth Based Simulants to Lunar Regolith

Presenter

Hayden Reynolds — Mechanical Engineering

Mentor

James Heise — Mechanical Engineering

Robotic systems intended for lunar exploration must be tested in environments that closely replicate the physical and mechanical properties of lunar regolith. High fidelity lunar regolith simulants exist, but they are often expensive, limited in availability, and difficult for many research groups to obtain in large quantities. This limits the ability of student teams, small laboratories, and early stage projects to conduct meaningful testing of robotic systems designed to operate on the lunar surface.

This research explores the feasibility of identifying Earth based materials that exhibit similar physical and mechanical characteristics to high fidelity lunar regolith simulants. The goal is to find accessible and cost effective alternatives that can approximate key properties such as particle size distribution, angularity, bulk density, and shear behavior. By evaluating commonly available terrestrial materials and comparing their properties to established lunar simulants, this work aims to determine whether practical substitutes can be developed for preliminary robotic testing.

Creating reliable terrestrial alternatives would significantly increase the accessibility of lunar robotics testing environments. Researchers could perform early stage experiments involving traction, excavation, mobility, and dust interaction without requiring specialized simulant materials. These substitutes would not replace high fidelity simulants for final validation, but they could provide a valuable intermediate testing medium that enables more frequent experimentation and iteration.

Ultimately, expanding the availability of suitable testing materials could accelerate the development of robotic systems designed for lunar exploration and infrastructure construction. By lowering the barrier to entry for meaningful regolith interaction testing, this work supports broader participation in the development of technologies that will contribute to sustained human and robotic activity on the Moon.

37. Forced immersion cooling for improved thermal management of cylindrical lithium-ion batteries

Presenter

Kristi Bez — Mechanical Engineering

Mentor

Todd Kingston — Mechanical Engineering

Temperature plays a critical role in the electrochemical performance, degradation rate, and overall reliability of batteries. During operation, batteries generate heat due to internal resistance and reaction kinetics. If the heat is not effectively dissipated, localized temperature rises can accelerate side reactions, cause uneven cell aging, and, in extreme cases, lead to thermal runaway — a major safety hazard. Forced immersion cooling using a dielectric fluid significantly influences the heat removal rate, thereby affecting the temperature distribution within the cell. In this work, commercial cylindrical batteries are directly immersed in a flowing dielectric fluid using a custom-built flow loop. We vary the fluid temperature and velocity and evaluate their impact on battery performance. The findings contribute to a deeper understanding of forced immersion cooling based thermal management of lithium-ion batteries, offering a framework for optimizing battery safety, reliability, and electrochemical stability in energy storage research.

38. Computational Modeling and Analysis of Ross Procedure Cardiovascular Systems

Presenter

Ella Meyer — Biomedical Engineering

Mentor

Abhay Bangalore Ramachandra — Mechanical Engineering

The Ross Procedure is a complex cardiac surgery where a diseased aortic valve is replaced with the patient's own pulmonary autograft. While effective, the long-term success of the surgery depends heavily on the structural integrity and remodeling of the aorta. This project utilizes SimVascular, an open-source pipeline, to generate high-fidelity 3D cardiovascular models from patient medical imaging. By establishing precise center-line paths and anatomical segmentations, we produce patient-specific models that allow surgeons to visualize complex geometries during pre-operative planning. Furthermore, this research tracks longitudinal changes in the size and mechanical strength of the aorta before and after the procedure. By quantifying these morphometric shifts, the project aims to provide clinicians with data-driven insights into autograft behavior, ultimately improving surgical predictability and patient outcomes.

39. Exploring Aerosol Jet Printing

Presenter

Hal Griswold — Mechanical Engineering

Mentor

Ethan Secor — Mechanical Engineering

Aerosol jet printing is a form of additive manufacturing in which metal in solution is deposited onto a surface using an aerosol system. We use two gases, a sheath gas and a carrier gas, to move and deposit the metallic solution. The carrier gas picks up an agitated droplet of the solution from a vibrating cartridge. The droplet then flows into a nozzle system, where it is combined with a sheath gas (a faster-flowing gas mixed with some Xylene, which helps wet the droplet and straighten its path). The droplet then flows out of a 150-200 micrometer nozzle head, where it is then deposited onto our surface. We then measure the precision and accuracy of the lines, as well as the droplet flow rate, using a Zygo imaging machine and a laser system embedded in the flow system. This printing method has a multitude of applications, but our current focus is on creating small-scale sensors and antennas. In the future, we plan to use the aerosol-depositing system to connect electronic chips. Furthermore, because the material is deposited via aerosol rather than in a solid form, it reduces a common problem in 3D printing: clearance between the nozzle system and the surface where we want to print. The aerosol system allows us to print away from the surface, meaning we can print in spaces we previously did not have clearance for. Currently, much of my personal work in the lab has focused on the conformal jet printing machine and on determining the most accurate flow rates for both the sheath

and carrier gases. I do this by using a sheath-to-carrier gas ratio of 2-8, and I am trying to find which ratio gives us the most consistent and accurate lines and depositing rates across the silver-based and polyamide inks.

40. Development of High-Throughput Experimental Testing of Mechanical Properties

Presenter
Duy Bui — Mechanical Engineering
Mentor
Ashraf Bastawros — Aerospace Engineering

Understanding how materials respond to various loads is essential in fields such as aerospace, manufacturing, and engineering design. Traditional methods for measuring mechanical properties, such as tensile testing, are often destructive, require large samples, involve extensive preparation, and can be time-intensive. These limitations can slow material evaluation, especially when only small samples are available or rapid testing is required. This project explores an alternative approach using profilometry-based indentation plastometry (PIP), a technique that estimates material properties by analyzing the shape of small surface indentations. Compared to conventional testing methods, PIP has the potential to reduce material requirements, minimize sample preparation, and enable higher-throughput testing. The primary focus of this work is the design, fabrication, and integration of a custom experimental setup to support PIP testing. A mechanical fixture was developed to enable controlled indentation, and a displacement transducer was integrated using LabVIEW to accurately measure indentation depth during experiments. To ensure repeatability, a repositioning method was also designed so that samples could be removed for surface scanning and then precisely realigned for subsequent indentations at the same location; this is a critical step in maintaining consistency across measurements. Future work will involve conducting systematic indentation experiments across different materials and applying inverse finite element analysis (FEA) to extract material properties from measured indentation profiles. The long-term goal is to develop a more efficient and scalable method for material characterization that complements or, in certain applications, potentially replaces traditional testing techniques.

41. Unsteady Aerodynamics

Presenter
Justin Kasa — Aerospace Engineering
Mentor
Paul Durbin — Aerospace Engineering

This research investigates the predictive performance of a modified k-ω turbulence model (k-ω_0) in steady RANS simulations using OpenFOAM, focusing on highly separated flows. The study compares k-ω_0 to the traditional k-ω model in terms of skin friction coefficient (Cf) predictions and numerical stability. Simulations

of the canonical periodic hill case at low flow speeds, with both steep and shallow slopes, were conducted alongside near-wall mesh refinement studies. For the steep slope, the standard k-ω model became unstable at finer meshes, with Cf values diverging from typical ranges of 0.01–0.04 to extreme values on the order of 10–100, while k-ω_0 maintained stability and consistent predictions. For the shallow slope, both models remained stable across mesh refinements. Supersonic flow simulations over a flat plate and in a compression corner explored shock–boundary layer interactions, where differences in Cf were small (~0.001–0.002) with k-ω reporting slightly higher values. These results demonstrate that k-ω_0 improves numerical stability without sacrificing accuracy, enabling more reliable boundary layer and friction predictions in both subsonic and supersonic regimes. By reducing the risk of divergence at fine near-wall meshes, this model offers significant potential for advancing aerodynamic predictions in fundamental and applied CFD studies.

42.A Practical Pipeline for Hex-Dominant Meshing of CAD Solids via Global Parameterization and Void Recovery

Presenter

Joshua DeJohn — Mechanical Engineering

Mentor

Sidharth GS — Aerospace Engineering

This project investigates a method for generating a hexahedral dominant mesh using an IGES geometry file utilizing a Python-based pipeline. The motivation for this work comes from the difficulty and time that it takes to produce a structured hexahedral mesh for irregular or complex shapes. On a high level, the method uses parameterization-driven hex extraction: a tetrahedral mesh is initially formed from the input geometry, using the gmsh OCC kernel, then a global volumetric parameterization is defined over the tetrahedral mesh. The parameterization for the program is first approximated using a harmonic grid solver which enables a structured integer lattice to be implemented in parameter space. This program was designed to be a modular tool for research purposes and not a production or open source application. The core of the program utilizes four stages: CAD fragmentation, parameterization, boundary remeshing, and void filling. These stages are confined to separate modules so they can be replaced with more advanced solvers. Additionally, this allows for independent improvements and audits of each function when troubleshooting. The result is a configurable framework for studying the transition from tetrahedral meshes to structured hex-dominant discretizations on CAD-based geometries.

43.Comparative Study of Carbon Nanotube and Carbon Onion-Based Superhydrophobic Self-Heating Coatings for UAV Icing Protection

Presenter
Mayank Ranjan — Aerospace Engineering
Mentor
Hui Hu — Aerospace Engineering

In-flight icing presents a critical safety hazard for unmanned aerial vehicles (UAVs), resulting in ice accumulation on propeller surfaces that compromises aerodynamic performance and operational integrity. While sprayable self-heating superhydrophobic coatings have demonstrated promise in addressing this challenge, the influence of carbon nanomaterial geometry on coating performance and durability remains insufficiently understood. This study presents an experimental investigation into fluorine-modified carbon-based superhydrophobic coatings for UAV icing mitigation, comparing carbon nanotubes (CNT) and carbon onions (CNO) as candidate electrothermal materials. Four coating configurations are evaluated: an uncoated baseline, CNT-only, CNO-only, and a 50-50 CNT-CNO blend. Wettability characterization is conducted through apparent, advancing, and receding contact angle measurements, while electrothermal performance is assessed using infrared thermography. The best performing coating will subsequently be evaluated on a rotating UAV propeller under glaze icing conditions, with potential application to smaller drone propellers where icing poses a proportionally greater challenge relative to available power. This work aims to determine whether CNOs or a hybrid CNT-CNO blend can match or complement CNT performance in anti-icing effectiveness and durability, contributing to the advancement of sprayable icing protection technologies for unmanned aerial systems operating in adverse weather conditions.

44. Optimizing High-Fidelity Multiple-Gravity Assist Trajectories in GMAT

Presenter
Alexander Davis — Aerospace Engineering
Mentor
Simone Servadio — Aerospace Engineering

General Mission Analysis Tool (GMAT) is a powerful, high-fidelity, open-source software developed by NASA for space mission design, optimization, and navigation. However, interplanetary mission design in GMAT is unreliable without proper initial guesses; this can lead to infeasible trajectories, infinite propagation, error messages, and software crashes. Our approach integrates MATLAB and GMAT to construct end-to-end optimized mission scenarios. MATLAB is first used to propagate low-fidelity solutions, generating initial estimates for burn magnitudes, launch conditions, B-plane targets, and related parameters. These values are then used to formulate a leg-by-leg optimization mission in GMAT, transitioning the trajectory from low- to

high-fidelity. Finally, MATLAB's fmincon refines the solution by optimizing the leg-by-leg trajectory while calling GMAT as the high-fidelity propagator, producing a fully optimized end-to-end mission solution.

45. Data-Driven Prediction of Airfoil Flow Separation Using Symbolic Regression

Presenter
Caden Nadler — Aerospace Engineering
Mentor
Anupam Sharma — Aerospace Engineering

This project develops a data-driven symbolic regression model capable of predicting the onset of airflow separation over an airfoil. Experimentally collected data, including pressure distributions, velocity profiles, and angle-of-attack sweeps, serve as the foundation and training data for the model. Symbolic regression is used to discover compact, human-interpretable expressions that represent complex physical behavior. In this particular case, the link between flow conditions and the onset of separation is the target. The resulting model is tested against real-world, experimentally collected data, and compared with established aerodynamic theory to assess accuracy, generalizability, and physical plausibility. This approach aims to provide a clear connection, interpretable by humans, to assist as a tool that enhances the understanding of fluid dynamics.

46.Precision Livestock Farming: Potential to Increase Beef Sustainability for Cattle Feeding Operations

Presenter
Lizabeth Hamann — Business Analytics, Agricultural Studies
Mentor
Kurt Rosentrater — Agricultural and Biosystems Engineering

Global population growth and increasing demand for meat requires improvements in the sustainability and efficiency of beef production systems. Precision Livestock Farming (PLF) technologies offer data driven approaches to enhance productivity while addressing environmental, economic, and social concerns associated with cattle feeding operations. This study evaluated selected PLF technologies applicable to feedlots, including Precision Livestock Technologies, C-Lock, and Performance Livestock Analytics. Information was collected through structured interviews with company representatives and supplemented with economic breakeven analyses to assess feasibility for commercial producers. Technologies examined targeted feed efficiency, rate of gain, emissions monitoring, herd health, labor reduction, and data management. Results indicate that while PLF systems vary widely in cost, scale, and intended impact, many have potential to improve operational efficiency and contribute to sustainability if implemented appropriately. Further on-farm performance and return-on-investment studies are recommended to quantify benefits and guide informed adoption decisions by beef producers.

47. Reaching a More Sustainable Food System in Peru

Presenter
Cristina Esteban — Biological Systems Engineering
Mentor
Kurt Rosentrater — Agricultural And Biosystems Engineering

Peru's food system faces structural constraints that limit its capacity to deliver equitable outcomes for all. Smallholder, rain-fed family farming dominates over industrial agriculture, but low productivity, post-harvest losses, and lack of response plans to natural phenomena constrain the sector's sustainability. These challenges are intensified by geographic fragmentation, weak rural connectivity, and unequal access to markets, credit, and technology. As a result, family farmers in the Highlands and Amazon have limited participation in dynamic value chains, constraining the sustainability of the food system as a whole. Moreover, these disparities also manifest in nutritional gaps, with high chronic child malnutrition in rural areas, widespread anemia, and rising obesity in urban centres.

This report outlines several national and international initiatives, including MIDAGRI's Register of Agricultural Producers, INIA's research programs, the CITE technology-transfer network, AGROIDEAS, and FAO's Hand-in-Hand Initiative, that provide entry points for reform, strengthening producer formalisation, expanding access to technical assistance, promoting sustainable technologies, and enhancing climate resilience.

It is argued that advancing a sustainable food system in Peru requires coordinated, multisectoral policy action, including territorial planning, investment in rural infrastructure, improved disaster preparedness, and the creation of inclusive value chains that elevate family farmers, women producers, and indigenous communities. Furthermore, strengthening governance and institutional capacity is essential to building a more equitable and sustainable agrifood system, as these will maintain the economic, social, and environmental foundations that support it, ensuring a sustainable food system for future generations.

48. Characterizing and Testing of the agricultural rubber track system

Presenter
Nick Large — Mechanical Engineering
Mentor
Brian Steward — Agricultural and Biosystems Engineering

The increasing size and engine power of modern agricultural vehicles have intensified the need for traction systems that can deliver power efficiently while minimizing soil compaction.

Rubber tracks reinforced with polymeric fibers (such as nylon or aramid) or steel cables arewidely adopted, yet their detailed mechanical properties remain insufficiently characterized. This study establishes

an experimental and analytical framework to quantify the tensile and bending behavior of reinforced rubber track materials and to translate laboratory-scale measurements into full-track parameters. Controlled tests were conducted on polymeric fiber- and steel-reinforced specimens using a Universal Testing Machine (UTM) with custom-designed clamps. Both tensile and bending models achieved strong statistical fits ($R^2 > 0.99$), demonstrating the consistency and robustness of the experimental design. A scaling methodology based on series–parallel spring analogies was then applied to extrapolate specimen results to full-scale tracks. These experimentally measured and statistically estimated parameters for multibody dynamic (MBD) modeling of rubber track systems.

49. Insights into the impact of discarded textiles on soil health

Presenter

Sadie Richter — Agricultural Business, International Agriculture

Mentor

Rachel Eike — Apparel, Events, and Hospitality Management

Active composting typically requires temperatures between 120 and 150 °F to be most effective, but maintaining this range can be challenging in colder climates. That is why increasing the mass of compost improves insulation. We hypothesize that certain discarded textiles can be used as supplemental insulating materials without disrupting the properties of the compost/ future applications in soil. The key soil nutrient levels measured in this study are pH, nitrogen (N), phosphorus (P), and potassium (K). As the primary macronutrients in fertilizers, N, P, and K are the major building blocks of all fertilizers. pH levels are also essential to plant growth, as many plants can only thrive within a narrow pH range. That is why the objective of this research is to evaluate how different textile types contribute to or interact with soil nutrients as they break down during the composting process. Three fabric categories were tested: bleached cotton (white, 100% cotton), dyed cotton (red, 100% cotton), and polycotton (brown, 50/50 cotton–polyester). Each textile type was composted under three controlled conditions, along with a control sample. The resulting soil samples were analyzed to determine nutrient changes and overall soil health. Across all conditions, results have shown no significant divergence between compost containing textiles and the control compost. These findings suggest that certain discarded textiles can be incorporated into compost without negatively affecting nutrient profiles, offering a promising way to utilize large quantities of textile waste.

50. Wildland-Urban Interface (WUI) Fires: How Biomass Mixed with Synthetic Materials Transforms Ultrafine Smoke Emissions and Soot Toxicity

Presenters

Allison Richter	Chemical Engineering
Braedan Flaker	Chemical Engineering
Leo Luense	Chemical Engineering
Maria Monestina	Chemical Engineering
Hailey Pena	Chemical Engineering
Jordan Shah	Mechanical Engineering
Lucas Turnis	Mechanical Engineering

Mentors

Guowen Song	Apparel, Events, and Hospitality Management
Rui Li	Apparel, Events, and Hospitality Management

Wildland-Urban Interface (WUI) fires frequently combust biomass mixed with synthetic polymers from buildings and consumer products, dramatically altering smoke emissions and soot behavior. This undergraduate research project systematically examines how polystyrene (PS) and polyvinyl chloride (PVC), representative synthetic materials used in biomass, simulate mixed-fuel packages typical of WUI fires to characterize the resulting ultrafine smoke emissions and soot toxicity.

Four controlled fuel blends, 100% Pine, 95% Pine + 5% PS, 95% Pine + 5% PVC, and 90% Pine + 5% PS + 5% PVC, were combusted under 50 kW/m^2 radiant heating in a chamber under normoxic conditions in a lab-based smoke tunnel. Smoke emission dynamics were quantified using a condensation particle counter for ultrafine particle (UFP) number concentration and gravimetric filters for particle mass. Soot chemistry was characterized by X-ray Photoelectron Spectroscopy (XPS) for elemental composition and oxidation states, and Raman spectroscopy for carbon bond hybridization, crystallinity, and degree of structural disorder. Physical transformations of soot particles were imaged at the nanoscale using Transmission Electron Microscopy (TEM) to examine morphology and surface features, while Atomic Force Microscopy (AFM) measured adhesion forces between soot particles and clothing fibers to assess real-world contamination and removal challenges.

Preliminary results indicate that even 5% synthetic content markedly increases bond disorganization in soot, elevating chemical reactivity and potential toxicity compared to pure pine. By integrating emission profiling with multi-technique soot characterization, this study provides a comprehensive framework for predicting health risks from WUI fires involving biomass-synthetic fuel mixtures and supports improved exposure models for firefighters and downwind communities.

51. Adapted Outcome Expectations Scale for Adults with Obesity

Presenters

Sophia Reece — Data Science, Applied Mathematics

Ellie Bollinger — Kinesiology and Health

Mentor

Seungmin Lee — Kinesiology

Physical activity is the most prescribed tool for weight management, yet people with obesity often struggle to get enough exercise. According to Social Cognitive Theory (SCT), the motivation to embrace healthy habits is primarily influenced by a person's Outcome Expectations around physical activity. Adults with obesity report experiences and outcome expectations that differ from the general population, leading to inconsistencies in data collected with standard tools. The objective of this study is to modify the existing SCT-based outcome expectation assessment to better capture the unique perspectives of adults with obesity. Specifically, the current scale developed by Wójcicki et al. (2009) was modified based on responses from an open-ended survey of thirty adults with obesity. Participants' responses were categorized using an inductive reasoning approach, and three independent research assistants reviewed the categorization to ensure objectivity. The scale items were refined based on the survey analysis. Following the revisions, the assistants independently proofread the modified items to maintain objectivity and clarity. In total, nine items across three subdomains were modified, and two items were deleted due to little support from survey respondents. The updated scale consists of thirteen total items that better reflect the experiences of people with obesity. The modified scale will be evaluated using data collected via Qualtrics to ensure that it accurately and consistently captures the perspectives of adults with obesity regarding physical activity. The revised scale is expected to improve future research surrounding the psychology of obesity by increasing data accuracy. Ultimately, this more accurate data will contribute to advancements in obesity interventions utilizing physical activity.

52. Associations of cardiorespiratory fitness and muscular strength with central blood pressure in firefighters

Presenter

Nolan Bishop — Kinesiology and Health

Mentor

Elizabeth Lefferts — Kinesiology and Health

Introduction: Firefighters (FF) have high cardiovascular disease risk, often related to their exposure to high-intensity physical occupational demands, environmental hazards, stress, and heat. Elevated central blood pressure (BP) is considered to be a key risk factor for cardiovascular disease. Whether protective factors, such as strength or fitness, are associated with lower central BP in FF is unclear. Objective: Examine the

relationship of cardiorespiratory fitness and muscular strength with central BP in active FF. Methods: Forty-eight FF (6 Females; 42 11 yrs; BMI 29.1 4.9 kg/m2) participated in this study. Cardiorespiratory fitness (n=48) was measured as VO2peak (ml/kg/min) utilizing a graded maximal exercise test. Grip strength (n=24) was measured via handheld dynamometry and calculated as the average of the peak force from each hand after 3 trials. Grip strength was made relative to body weight (kg/kg) to account for differences in body size. Central systolic BP (cSBP) was measured via carotid artery tonometry. Results: VO2 peak was weakly correlated with the cSBP (r = -0.15, p=0.23), after adjusting for age. Relative grip strength was moderately correlated with the cSBP (r = -0.18, p=0.03). Conclusion: In this study, only greater relative grip strength was associated with lower central systolic BP. No significant relationship was observed for VO2 peak, which may be related to the FF's well-maintained health. Overall, both cardiorespiratory fitness and muscular strength may contribute to lower central blood pressure in FF, however, stronger investigations with larger sample sizes are needed.

53. Associations of Grip Strength and Muscle-Strengthening Activity with Cardiovascular Disease in Older Adults with Hypertension

Presenter

Grace Ulberg — Biology

Mentor

Elizabeth Lefferts — Kinesiology and Health

Introduction: Cardiovascular disease (CVD) is the leading cause of death globally. Hypertension is a leading contributor to CVD, with approximately 7 in 10 older adults reporting hypertension. Grip strength (GS) and muscle strengthening activity (MSA) are both protective factors to lower CVD risk, however, the benefits of each are rarely compared within samples or examined in exclusively hypertensive individuals who have elevated CVD risk.

Methods: 602 older adults ≥65 years (74.0±5.8 years, 52.3% female) with hypertension were included in this sample from the Physical Activity and Aging Study. Relative GS was measured as the average maximum force produced (kg) by each hand, using a handheld dynamometer, then divided by body weight, and classified into sex-specific tertiles. MSA was self-reported and categorized as 0, 1-59, or 60+ minutes/week. CVD was defined as history of self-reported myocardial infarction, stroke, or congestive heart failure. Multivariable logistic regression was used to determine the odds ratios (OR) and 95% confidence intervals (CI) of CVD across GS tertiles and MSA groups, after adjusting for age, sex, education, smoking, alcohol, aerobic physical activity, body mass index (MSA models only), high cholesterol, diabetes, cancer, and GS for MSA or MSA for GS.

Results: There were 64 cases of CVD (10.6%). Compared to the weakest tertile of relative GS, the ORs (95% CI) of CVD were 0.47 (0.24-0.90) and 0.41 (0.19-0.85) for the moderate and strongest tertiles, respectively, after adjusting for all covariates. Compared to those performing 0 minutes of MSA, the ORs (95%

CI) were 1.60 (0.77-3.34) and 1.66 (0.79-3.45), for 1-59 and 60+ minutes/week of MSA, respectively, after adjusting for all covariates.

Conclusion: Greater relative GS, but not MSA, was associated with lower prevalence of CVD in a sample of older adults with hypertension. Longitudinal analysis is warranted to address issues with reverse causation.

54. Promotion and Evaluation of the Spring Into Summer Initiative

Presenters

Raygan Meehan — Kinesiology and Health
Conner Brinkmeyer — Kinesiology and Health
Kasey McIlrath — Kinesiology and Health
Megan Walters — Kinesiology and Health

Mentor

Greg Welk — Kinesiology

Iowa is 43/50 in state health rankings nationally, with only 25.9% of Iowans meeting the National Physical Activity Guidelines. The 'Spring into Summer' initiative is a statewide effort to address the public health challenge of physical inactivity, a key contributor to chronic diseases such as obesity, diabetes, and heart disease, through partnership with Healthy Iowans. This initiative combined two evidence-based programs, the 'Move Your Way' campaign (developed by the U.S. Department of Health and Human Services) and the Walk With Ease (WWE) program (developed by the Arthritis Foundation). Through community-focused promotion, it provided an opportunity for Iowans to develop skills and confidence to lead active lifestyles through means of the Self-Directed WWE program. We contacted county leaders and health officials through emails, zoom calls, flyers, and social media programming. The programming used Iowa-branded 'Move Your Way' messages and highlighted the benefits of increased physical activity across the state. Registration ended with 208 enrollments from 40+ counties, something to build off when repeating and improving the initiative next year. County leaders will receive a report on data to continue interest and strengthen professional relationships. Future implementations might aim for higher registration through earlier and more personal promotional efforts.

55. Spring Into Summer/ Move Your Way IA Program

Presenters

Eric Mome — Biomedical Engineering

Eva Jansen — Advertising, Political Science

Mentor

Gregory Welk — Kinesiology

Sadia Anjum Ashrafi — Kinesiology

Physical inactivity and obesity remain major public health concerns in the United States, with Iowa ranking among the lowest states for physical activity participation. It is well known that obesity and a lack of exercise have been linked in many instances to premature health failure and other severe health issues. The Spring into Summer program works hand in hand with Iowa's Move Your Way IA initiative to help solve this issue. Our program focuses on reaching out to every county in Iowa through either their Iowa State Extension Office or public health department. Working hand in hand with their county leaders, we promote a program that encourages people of all ages to sign up for the physical activity program. Depending on their preference, participants have the option of exercising in groups or on their own. Through GivePulse, we can easily reach out to all the participants and county leaders in the program for the various needs of the initiative: promoting events, tracking progress, and ensuring a clear line of communication. The evaluation will include interviews with the participants during and after the program is over. Another way of reaching out to Iowans is through our social media marketing where we have been using Instagram and Facebook to use these techniques to reach out to the everyday person. This is another way to achieve our goals of educating Iowans to start moving and start exercising to promote benefits within their own lives. We used these platforms and tactics to help push this initiative further in terms of knowledge and to make this program continue to grow over the next years to come. This initiative demonstrates how statewide partnerships, digital communication platforms, and targeted outreach can support increased physical activity participation across Iowa communities.

56. Sex-Differences in the Association between Grip Strength and Bone Density in Older Adults: A Cross-sectional Study

Presenter

Caitlin Bare — Dietetics

Mentor

Elizabeth Lefferts — Kinesiology and Health

INTRODUCTION: Approximately 4 in 10 older adults in the United States have osteopenia, a condition characterized by low bone mineral density (BMD). Grip strength (GS) has been established as a protective factor against low bone density, but few studies have examined the effect of biological sex on this relationship.

POSTER II, 1:00–3:00

The purpose of this study was to determine the effect of sex on the relationship between GS and bone density in older adults. METHODS: 821 older adults ≥65 years (44% female, 72±5 yrs) with <2 artificial joints from the Physical Activity and Aging Study (PAAS) underwent assessments. GS was assessed via handheld dynamometry as the average peak force (kg) from each hand. Bone density was assessed via dual-energy x-ray absorptiometry as whole body BMD (excluding head) and total body t-score. b-values were calculated using multivariable linear regression to evaluate the relationship between a 5-kg increase in GS and bone density, after adjusting for confounders. Logistic regression was used to estimate the odds ratio (OR) and 95% confidence interval (CI) of osteoporosis (t-score <-2.5) per 5-kg increase in GS. The moderating effect of sex was further assessed via an interaction between sex and GS. RESULTS: Osteoporosis was present in 41 (5%) older adults. Each 5-kg increase in GS was associated with greater bone density (BMD: b=0.013, p=<0.001; t-score: b=0.128, p=<0.001) and 27% lower odds of osteoporosis [OR (95%CI): 0.73 (0.55-0.97)]. Sex moderated the relationship between GS and both BMD and total t-score (interaction p<0.001). In females, sex-stratified analyses suggest GS is more strongly associated with BMD (females: b=0.014, p=<0.001; males: b=0.013, p=<0.001) and total t-score (females: b=0.149, p=0.006; males b=0.117, p=0.002). CONCLUSION: Higher absolute GS was associated with greater bone density for both sexes, however, the magnitude of the relationship was stronger in females for every 5 unit increase in GS.

SESSION III, 2:15–3:05

Chemistry and Materials Science

Room 3310

1. Novel Recycling Method for Epoxy Composites with Microwave and Iron-based Magnetic Microparticle Degradation

Presenter

Theodore Oswald — Biomedical Engineering

Mentor

Alina Kirillova — Materials Science and Engineering

Epoxy composites are becoming an increasingly important material in modern engineering applications. Cured epoxy resin, a key component in such systems, is a thermoset polymer. This means the polymer chains which comprise the resin are chemically crosslinked. This gives the material excellent resistance against degradation and corrosion but makes the material difficult and costly to recycle. In epoxy composites, the epoxy resin surrounds reinforcement fibers which give strength and rigidity to the material. When the service life of a component is up, the composite material must be replaced. The resin itself is inexpensive and can be discarded. However, if the more costly reinforcement fibers in the composite material could be harvested, they could be reused in future composite matrices. Because epoxies require difficult and sometimes destructive recycling methods, such processes tend to damage the fibers and thus are unsatisfactory for this purpose. The method being studied is a novel way to weaken the structure of the epoxy resin while maintaining the properties of the fibers so they may be used in future composite materials. The method involves the incorporation of iron-based magnetic microparticles into the epoxy resin prior to curing. This initially has the effect of increasing the strength and hardness of the epoxy. Importantly however, when this iron-rich epoxy is irradiated with microwave radiation, the microwaves effectively “shake” the iron microparticles dispersed within the resin. The motion of the microparticles create cracks and voids within the epoxy effectively reducing its mechanical properties. As a result, the resin can easily be separated from the valuable fibers. Therefore, this could potentially reduce the cost of recycling but also protects the fibers from damage during the recycling process and ensures they can be used in future composite materials without a decrease in their mechanical properties.

2. Surface Driven Defect Migration in Ge and GeSn Slabs

Presenter
Ellie Albertoni — Chemical Engineering
Mentor
Luke Roling — Chemical and Biological Engineering

In recent years, germanium-tin (GeSn) alloys have gained significant attention for semiconductor and optoelectronic applications due to their tunable direct bandgap, a characteristic not seen in silicon-based devices. Despite this promise, a major challenge in GeSn integration lies in the limited solubility and lattice mismatch between Ge and Sn, which can lead to phase separation, defect formation, and overall instability in the alloy. Addressing these issues requires a fundamental understanding of defect formation and migration at the atomic scale.

In this work, we utilize density functional theory (DFT) to examine how the formation and diffusion of germanium vacancies are influenced by the surface orientation, surface termination, applied strain, and proximity to the surface. Additionally, we examine the pathway of vacancy-mediated tin diffusion and how the energetics vary with surface orientation and strain. These insights provide a theoretical foundation for controlling defect behavior during synthesis and optimizing the structural stability of GeSn-based materials for optoelectronic device applications.

3. Optimization of Laser-Induced Graphene for Anti-icing Properties

Presenter
Gabriel Winandar — Aerospace Engineering
Mentor
Carmen Gomes — Mechanical Engineering

Icing is a hazardous weather phenomenon that impacts many industries, including transportation (aviation) and power (wind turbines), leading to issues such as increased drag and friction, reduced lift, and reduced power generation. Graphene holds tremendous promise for creating low-cost, scalable anti-/de-icing surfaces, in addition to myriad electronic applications, owing to its advantageous material properties, such as extremely high in-plane electrical and thermal conductivity, a high specific surface area, tunable hydrophobicity, and rich surface chemistry. Laser-induced graphene (LIG) is a rapid and scalable method that, by adjusting the CO2 laser parameters, can create LIG substrates with tunable surface properties, including wettability, surface chemistry, and morphology. The resulting LIG also exhibits a high surface area and is porous with nano- to micro-scale structures. This project aims to optimize the structure, thermal and electrical conductivity, and wettability of LIG for anti/de-icing properties. We will measure the tunable surface properties and correlate them with the resulting anti-/de-icing properties. We hypothesize that LIG's highly

hydrophobic properties and thermal and electrical conductivity can serve as a hybrid approach that combines active and passive methods for icing mitigation.

4. Polymers in Biomedical Applications

Presenters

Gianna Fazio — Biomedical Engineering

Claire Nefzger — Chemical Engineering

Mentor

Alina Kirillova — Materials Science and Engineering

The highly customizable nature of polymers has led to them being a highly preferred material for biomedical engineers. Their versatility allows them to be used for anything from drug delivery to wound care and everything in between. They are especially useful in soft tissue applications where their precision is crucial for patient comfort. This versatility also lends itself to a many number of ways that polymeric structures can be produced, namely through cross-linking. Crosslinking allows for structures to be produced using additive manufacturing techniques, which tend to be faster, cheaper, and less wasteful than subtractive manufacturing techniques. Another crucial trait that polymers can possess is their ability to biodegrade, which eliminates the need for a removal surgery and allows for their placement in areas where the missing tissue is expected to grow back. Lastly, polymers can form porous structures through a process known as vat polymerization. This porosity is ideal for temporary implants or wound dressings as this porosity allows for the exchange of oxygen and nutrients between cells, which is crucial for healing. Our lab is looking at both the 3D printing of biocompatible polymers for bone scaffolds as well as polymer films for wound dressings. For the bone scaffolds, our goal is to find a combination of PLCL, Thiol, and a photo-crosslinker that will result in a biocompatible, biodegradable, and structurally sound bone scaffold. Similarly, a bi-layer polymer film made with methyl methacrylate (MMA), acrylic acid (AA), and benzophenone acrylate (BPA) is being fine-tuned to have the proper flexibility, mechanical strength, swelling capabilities, and cell encapsulation needed for effective wound healing.

SESSION III, 2:15–3:05

Biology, Health, and Technology

Room 3310

1. Early-Life Environmental Effects on Telomere Length in Migratory Songbirds

Presenter

Jairo Yepez Mujica — Wildlife and Fisheries Conservation and Ecology

Mentor

Gunnar Kramer — Natural Resource Ecology and Management

Telomeres, non-coding DNA sequences located at the ends of chromosomes, are essential for protecting genetic material and are closely associated with key cellular processes such as senescence. In birds and other taxa, relative telomere length (RTL) is positively associated with an individual's physiological condition and lifespan. Evidence suggests that oxidative stress can accelerate telomere degradation, including environmental stressors such as high temperatures, UV radiation, and variable weather. Shorter telomeres, particularly during an organism's early developmental stages, are associated with reduced lifespan and fecundity. Increasing evidence suggests that telomere degradation, combined with environmental stress, contributes to declines in wildlife populations. Understanding how environmental change affects organismal physiology and the extent to which these effects scale up to adaptive behaviors remains a key knowledge gap. We examined variation in RTL among nestlings of two migratory bird species, the Common Yellowthroat and Dickcissel, to evaluate how early-life environmental conditions influence physiological condition. We tested whether RTL differed between these species across various environmental and ecological conditions during their developmental period (e.g., UV radiation exposure, temperature, precipitation, nest microhabitat). Telomere length was quantified using quantitative PCR, comparing the ratio of telomeric repeat sequences to an amplified single-copy reference gene (GAPDH). We hypothesize that nestlings raised in nests with greater environmental exposure will exhibit shorter RTL, reflecting elevated physiological stress. Additionally, we predict seasonal patterns in telomere dynamics: nestlings that develop later in the breeding period show reduced RTL. By analyzing species-specific patterns in telomere dynamics, this study provides insight into

how microhabitat structure and environmental conditions influence the early-life physiological state of migratory songbirds.

2. Developing Computer Vision Tools for Farrowing Detection to Improve Lifetime Sow Productivity

Presenter

Sabrina Kyper — Animal Science

Mentor

Juan Steibel — Animal Science

The purpose of this research project is to decrease the mortality rate of piglets in the farrowing window using computer vision technology. During the time of a sow farrowing, or the farrowing window, the mortality rate is high for various reasons. Dystocia and sow behavior are two reasons that piglets either do not survive birth or die shortly after. As pig production is huge in Iowa, low death rates would positively impact production.

To decrease mortality rates in piglets, the use of technology is needed. It is impractical to directly observe sows every moment up to and through farrowing. However, computer vision can detect dystocia early to enable early intervention without the need for live observation. By using computer technology to detect and measure farrowing problems, productivity for both sows and piglets can improve. Sows will wean more piglets, and piglets will have an increased growth and long-term survival rate.

To make this happen, a computer program must be trained to recognize farrowing signs and piglets. It is necessary to evaluate the properties of all available algorithms to decide which one would work best. It is important to quantify the accuracy of each algorithm's ability to detect the onset of farrowing and count piglets as they are born. A developed algorithm with the ability to perform computer vision on farrowing sows to detect dystocia and count piglets will greatly impact the mortality rate of piglets during the farrowing window and pig production in Iowa and throughout the industry.

3. Impacts of Resource Environment on Bee-Yeast Interactions

Presenter

Stevie Pogue — Biology

Mentor

Amber Crowley-Gall — Plant Pathology, Entomology, and Microbiology

The bee microbiota is comprised of not only the gut microbiome, but also environmental microbes encountered during foraging and those associated with nests and provisions. While there is some overlap in microbiome composition across these environments, each distinct microhabitat can provide vastly different nutritional resources for microbes, which may impact bee-microbe interactions. For example, microbial utilization of floral resources and the subsequent modification of floral signaling and rewards has been increasingly recognized as an important contributor to plant–pollinator interactions. Previous work in our lab

has examined bee–yeast interactions by screening a wide diversity of bee- and floral-associated yeasts for their effects on Bombus impatiens (common eastern bumble bee) feeding behavior using a standard 30% sucrose solution. This study aims to determine how environmental context impacts bee-yeast interactions by testing bumble bee feeding behaviors in response to yeasts grown in two ecologically relevant medias: artificial nectar and a honey mimic. Preliminary results show effects of both yeast species and media type on bee feeding behaviors, with bumble bee responses to nectar and honey varying from those previously observed in response to sucrose alone for some isolates. This suggests that yeast effects on bee foraging behavior depend strongly on the resources available and the environmental context of the interactions. The results from this study will add to our understanding of the impacts of yeasts in plant-pollinator interactions and set the stage for future work examining the mechanisms underlying bee foraging decisions.

4. Addressing health disparities through online simulation-based training on social determinants of health

Presenters

Hannah Harvey — Kinesiology
Alli Vander Zee — Biology
Jordan Harvey — Performing Arts

Mentor

Michelle Rusch — Kinesiology

Social determinants of health (SDOH) have a major impact on a patient's health, well-being, and quality of life. However, national reports show a limited standardized SDOH curriculum. The use of online standardized simulations offers a promising approach to strengthening a resident's confidence and skills in addressing SDOH.

This project assesses whether an online resident-focused simulation can improve recognition and management of SDOH in a standardized patient (SP) encounter. We hypothesize that residents with limited baseline SDOH knowledge and awareness would experience post-simulation gains in reasoning, communication, and confidence.

The simulation case begins with pre-screening questionnaires to assess SDOH awareness. Participants then proceed through a series of branching pathways that involve patient-provider interactions. Upon completion of the patient encounter, the provider completes post-test questions to deepen their understanding of SDOH and to evaluate their experience with the patient. This case was complicated by food insecurity and homelessness. Pre-simulation surveys measure baseline SDOH knowledge and confidence, compassion, and mindfulness. Post-simulation surveys evaluate situation awareness, SDOH knowledge, and simulation effectiveness using quantitative and qualitative data.

We predict that providers will improve communication skills related to SDOH. Our goal is to increase recognition that SDOH factors are highly important and need to be considered when dealing with all patients. Further, we aim to educate providers of the importance of paying attention to contextual details while being considerate and sensitive at all times, especially when a patient is affected by SDOH.

Findings will show whether online simulation-based training has the potential to improve clinical reasoning, communication, and confidence addressing food insecurity and using community resources, supporting the idea that simulations are valuable for advancing health disparities education. Limitations include constraints inherent to a preliminary pilot design.

Civil and Construction Engineering

Room 3534

1. **Eliminating Forever Chemicals in Wastewater**

Presenter

Cooper Vander Ploeg — Chemical Engineering

Mentor

Joe Charbonnet — Civil, Construction, and Environmental Engineering

Per and Polyflouroalkyl Substances (PFAS) are chemicals that form extremely strong bonds, are used widely in many products, and do not break down readily in the environment. In our research, we attempt to remove PFAS and about 40 of its variations from wastewater samples using a pyrolysis system developed on campus. My primary role in this research is to perform solvent extraction of PFAS to get an accurate reading on the amount of PFAS in our samples so that we can properly measure how much of it we are removing with the pyrolysis.

2. **Engineered Media for Water Recycling**

Presenter

Isabelle Dahlstrom — Political Science

Mentor

Joe Charbonnet — Civil, Construction, and Environmental Engineering

Stormwater and rainwater runoff can contain organic contaminants such as BPA, 6PPD-q, and Fluoranthene. These compounds can enter bodies of water, posing risks to water quality and to the health of humans and animals. Small towns and communities oftentimes lack water treatment systems with advanced technology, so they cannot filter out these contaminants or recycle the water easily. Cheap and effective filtration methods are important for improving water reuse and contaminant removal. We are testing whether

manganese oxide-coated sand can be an effective medium for removing organic contaminants from various water matrices. In our research, we are testing the effectiveness of manganese oxide–coated sand in removing BPA, 6PPD-q, and Fluoranthene in simulated water samples. We evaluated the contaminant removal efficiency by comparing the initial concentrations of each of the organic contaminants in water samples with those measured after treatment with manganese oxide-coated sand. Experiments were conducted using stormwater and rainwater samples with known contaminant concentrations. We added 1g of coated sand to each water sample, along with 1g of regular Ottawa sand to the control samples. Each sample was exposed to manganese oxide–coated sand for 30 minutes, and triplicate trials were performed to ensure our data were accurate and consistent. Concentrations before and after treatment were used to calculate normalized concentration ratios (C/C_0) and percent removal. Our results so far show reductions in the organic contaminant concentrations after filtration with manganese oxide-coated sand. The sand's efficiency in removing contaminants varied across water matrices and by compound, but consistently showed decreased concentrations of BPA, 6PPD-q, and Fluoranthene after treatment. This suggests that manganese oxide-coated sand has potential as a simple and cost-effective filtration material.

3. Progressive Collapse of Structures during Earthquake Events

Presenter

Sean Pritchard — Mechanical Engineering

Mentor

Hartanto Wibowo — Civil, Construction, and Environmental Engineering

Structural failures induced by earthquakes pose significant risks to human life and can result in substantial socioeconomic consequences. Earthquake-related damage may include cracking, partial collapse, or complete structural failure. Systematic investigation of such damage is essential for improving identification, interpretation, and prevention of failure mechanisms. This research processes and analyzes post-earthquake LiDAR survey data, transforming point cloud data of collapsed structures into 3D-printed physical models. These models enable closer examination of damage patterns and may serve as educational tools for identifying common structural failure mechanisms. The study ultimately seeks to enhance understanding of structural response under seismic loading, contributing to improved awareness and informing the development of more resilient design practices.

SESSION III, 2:15–3:05

4. Effects of Graphene on 3D Printed Concrete

Presenters

Cameron Matejicka — Construction Engineering

Leo Thornton — Industrial Engineering

Mentor

Kejin Wang — Civil Construction and Environmental Engineering

Additive manufacturing with cementitious materials has gained significant attention for its potential to transform construction through automation and material efficiency. This study investigates the mechanical performance of 3D-printed concrete modified with graphene oxide additives. The primary objective is to evaluate the effects of graphene oxide on compressive strength, shrinkage behavior, and flexural performance compared to a control mix.

Initial efforts focused on developing a reliable control mixture suitable for extrusion-based 3D printing. The optimized mix consists of cement, fine aggregate (2 mm sand), water, viscosity modifying admixtures (VMAs), and superplasticizers. Multiple batches were successfully printed, demonstrating consistent printability and structural stability. Standardized specimens were fabricated from these prints, including 1-inch cubes for compressive strength testing and 1’ by 1’ prisms for shrinkage measurements. Flexural strength testing is planned for future evaluation.

Following the establishment of the control group, graphene oxide was introduced as a nano-scale additive to enhance material properties. The graphene oxide dispersion is prepared using a sonication process to promote uniform distribution within the cement matrix. Two experimental mixtures, with different graphene-to-binder ratios, will be printed and tested under the same conditions as the control.

By comparing mechanical performance across these mixtures, this research aims to quantify the potential benefits of graphene oxide in 3D-printed concrete. The findings are expected to contribute to the development of stronger, more durable printed structures and provide insight into the role of nano-materials in advancing construction technologies.

SESSION III, 2:15–3:05

Math and Physics

Room 3534

1. Investigation of the Pi Clumping Boundary in the Streaming Instability

Presenter
Aydean Bejtovic — Physics
Mentor
Jacob Simon — Physics and Astronomy

The streaming instability is a proposed mechanism by which particles in protoplanetary discs coalesce into planetesimals in a process engendered by the experienced effects of drag from dust and gas in the disc. In order to investigate this phenomenon, large computer simulations are run across many cores in parallel, which simulate portions of the disc in two or three-dimensional regions called shearing boxes. These simulations involve complex simulations of gas and dust interactions in the disc. Two dimensionless parameters are often used in research on the streaming instability to model different initial conditions of the protoplanetary disc: the dust-to-gas density ratio (called the metallicity, Z) and the ratio of orbital velocity to the sound speed in the disc (called the "pressure gradient"). Differences in the pressure gradient change the critical (minimum) metallicity required for planetesimals to begin forming, which is also described as “strong clumping.” It has been previously predicted that the critical metallicity for a pressure gradient value of 0.1 lies between 0.003 and 0.004. Simulations were run using the Athena code library for magnetohydrodynamics for several values of the metallicity (Z = 0.001, 0.002, 0.003, 0.004). The results are then analyzed to find the density throughout the simulation region (called a shearing box) to find indicators of strong clumping. The analyzed data is then compared with the predictions of the critical metallicity.

2. Macaulay Distributive Lattices

Presenter
Kelvin Ma — Mathematics
Mentor
Jason McCullough — Mathematics

Given a collection of elements, we are interested in ordering them. When this collection with its order satisfies particular conditions, we call it a partially ordered set. An example is the positive divisors of an integer, ordered by divisibility. In particular, we consider lattices, which are posets with the additional condition that for any two elements in our collection, there exists a smallest possible element that is greater than our chosen two elements and there exists a biggest possible element that is smaller than our chosen two elements. Our

research is on finding lattices that satisfy the Macaulay property, where we have both a partial order (not all elements can be compared) and a total order (all elements can be compared) on our collection. We show that all distributive lattices of height 3 are Macaulay. We construct non-Macaulay distributive lattices of height 4 and more.

3. BoolForge: Constrained Generation and Analysis of Random Boolean Functions and Networks

Presenter

Benjamin Coberly — Computer Science

Mentor

Claus Kadelka — Mathematics

Boolean networks provide an intuitive and widely used framework for modeling gene regulatory networks, capturing complex regulatory logic through binary state variables and update rules. Many Boolean functions exhibit a strong degree of canalization, a structural property that constrains state transitions and contributes to the stability of network dynamics. However, current software tools offer limited support for generating Boolean functions and networks with specific canalizing characteristics. To address this gap, we introduce BoolForge, a Python software package for the random generation and analysis of Boolean functions and networks with an emphasis on canalization. BoolForge enables users to generate functions under user-defined constraints, construct networks with controlled topologies and regulatory properties, and analyze dynamical features such as canalization, modularity, and attractor structure. This toolkit facilitates systematic ensemble-based investigations of structure-dynamics relationships, benchmarking theoretical predictions, and the construction of biologically grounded models.

4. Uniformly Sampling of Different Functions to Model Gene Regulatory Networks (GRNs)

Presenters

Grant Charette — Statistics, Mathematics

Joshua Lewis — Computer Science

Mentor

Claus Kadelka — Mathematics

Genetic Regulatory Networks (GRN's) are systems of interacting genes, proteins, and other molecules that control gene expression and determine cellular function. These systems can be modeled using Boolean and multistate functions, where each gene is represented by an update rule. Our research is based around uniformly sampling different models fitting the degenerate criteria along with helping find ways to translate advances in boolean modeling to multistate modeling in hopes to make the existing programs more efficient and accurate for testing purposes in the genetics field. Sampling these functions at random can be done fairly

simply through code, but bigger network sizes of specifications such as canalized, non-canalized, degenerate, and non-degenerate functions can take significant amounts of time to compute.

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