PROGRAM
and
PROCEEDINGS

THE NEBRASKA ACADEMY
OF
SCIENCES
1880-2025

145th Anniversary Year
One Hundred-Thirty-Fifth Annual Meeting

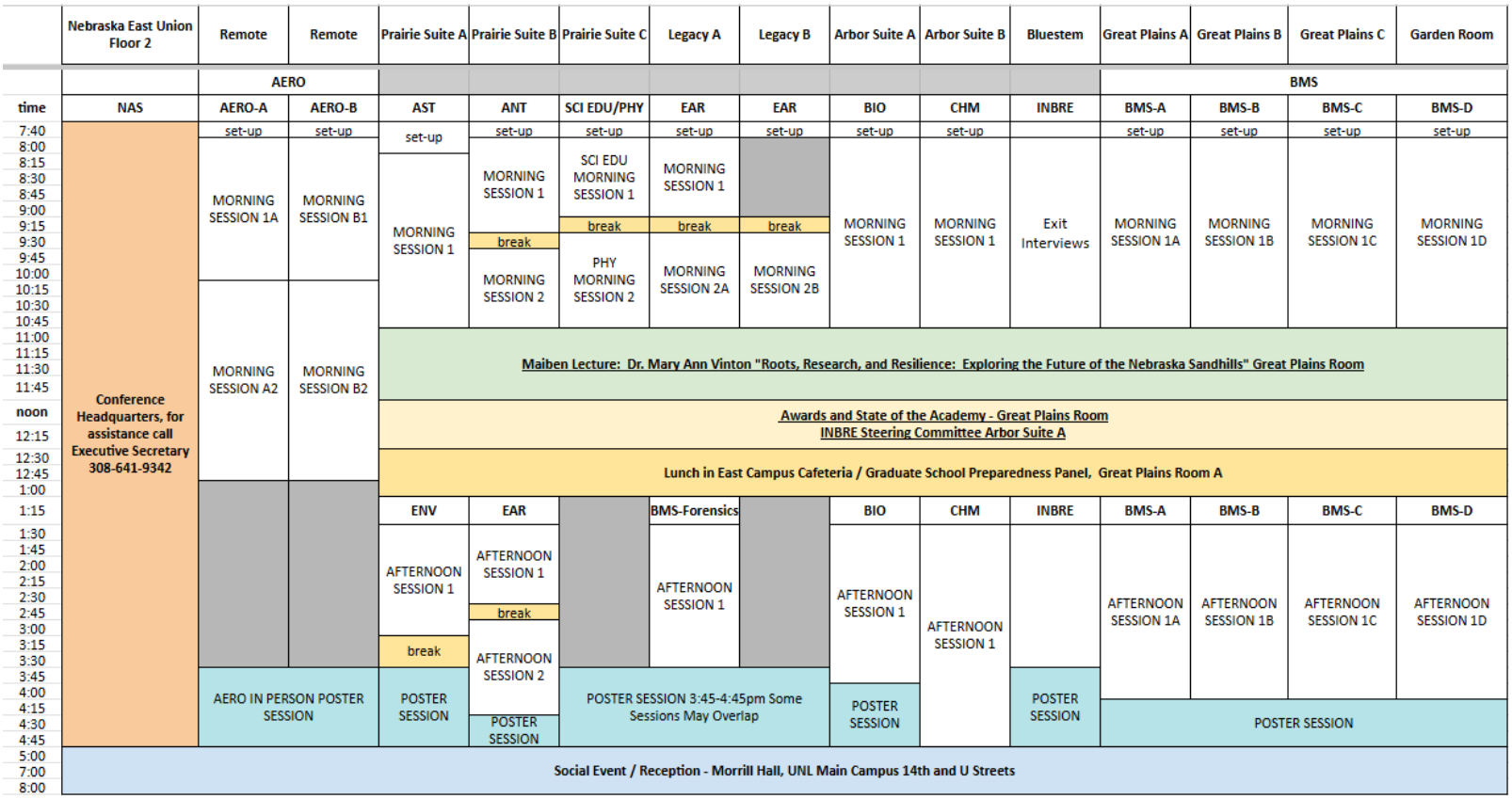
THE NEBRASKA ACADEMY OF SCIENCES, INC.

April 25, 2025
Hybrid Meeting
UNIVERSITY OF NEBRASKA EAST CAMPUS UNION |ONLINE

GENERAL INFORMATION

The Nebraska Academy of Sciences was organized on January 30, 1880. The Academy was reorganized on January 1, 1891 and annual meetings were held thereafter.

AUTHORS ARE INVITED TO SUBMIT MANUSCRIPTS OF THEIR WORK FOR PUBLICATION IN THE *TRANSACTIONS OF THE NEBRASKA ACADEMY OF SCIENCES*, a technical journal published periodically by the Academy for 56 years. Articles in all areas of science, science education, and history of science are welcomed, including results of original research as well as reviews and syntheses of knowledge.
The Transactions is kept on a digital format and is available to anyone through the Digital Commons at the University of Nebraska–Lincoln. Manuscripts should be submitted via the online submission system at http://digitalcommons.unl.edu/tnas/guidelines.html using the Submit your paper or article link.



Program and Proceedings of the 135th Annual Meeting

Friday, April 25, 2025 7:45am - 10:00am

AERONAUTICS AND SPACE SCIENCE MORNING SESSION- 1A

Aeronautics and Space Science **Chairperson: Scott Tarry**
Moderator: Derrick Nero

FRIDAY, APRIL 25 **Location: Zoom/Virtual**
https://unomaha.zoom.us/j/98581065199

MORNING SESSION - 1A

7:45 ZOOM Session opens for participants to join

8:00 WELCOME

8:05 AEROSPACE EXPERIMENTAL PAYLOADS. Vince Orsi and Nicholas Wayman

8:20 DEVELOPMENT OF AUTONOMOUS UAVS FOR PAYLOAD TRANSPORT AND FIRST AID APPLICATIONS. Gael Perez

8:35 UNIVERSITY OF NEBRASKA – LINCOLN DESIGN BUILD FLY. Sean Griffin

8:50 UNIVERSITY OF NEBRASKA – LINCOLN HUSKER ROCKETRY. Amber Tannehill

UNIVERSITY OF NEBRASKA – LINCOLN WOMEN IN AEROSPACE (WIA). Amber Tannehill

9:05 UNIVERSITY OF NEBRASKA – LINCOLN LUNABOTICS TEAM. Nicholas Witulski

9:20 SCIENCE ENRICHMENT WORKSHOP SERIES: WHERE TO GO FROM HERE. Amanda Roe

9:35 COLLEGE OF SAINT MARY ELEMENTARY OUTREACH PROGRAM 2024-2025. Kaitlin Smith, Clare Dahlhoff and Dr. Jennifer Grove

9:50 LESSONS LEARNED FROM A MINIATURE ROBOTIC SURGERY TECHNOLOGY DEMONSTRATION DURING ORBITAL SPACEFLIGHT. Rachael Wagner

10:00 **BREAK**

AERO sessions will continue with sessions 1B & 2B at 10:20am.

AEROSPACE EXPERIMENTAL PAYLOADS

Author
Vincent Orsi
University Nebraska-Lincoln

Co-Author
Nicholas Wayman
University Nebraska-Lincoln

Our team is dedicated to conducting experiments in space or in near space environments. Last fall, AXP applied for the Louisiana State University and NASA Wallops Flight Facility's High Altitude Student Platform (HASP) program and was accepted for a small payload position. The team is building a payload to test the National Renewable Energy Laboratory's cutting-edge perovskite solar cells. Perovskite solar cell testing has been the theme of AXP for the last five years through Nebraska's first orbital payload to the HASP program. Our team is sponsored by the NASA NE Space Grant. AXP is split into two sub teams, mechanical and electrical. The mechanical team builds the physical structure, ensuring that the payload meets the build specifications we were given and that the payload will be able to complete the mission successfully. The electrical team designs the data collection and management system to ensure the payload collects meaningful data. The perovskite solar cells have the potential to replace or work in tandem with traditional solar cells to improve the efficiency of spaceflight. Testing the solar cells in a near space environment will provide useful insight into how they would survive in an actual space mission.

COLLEGE OF SAINT MARY ELEMENTARY OUTREACH PROGRAM 2024-2025

Author
Clare Dahlhoff

Co-Author
Kaitlin Smith
College of Saint Mary

The College of Saint Mary (CSM) Elementary Outreach program has been in effect for over 10 years. It provides hands-on activities and interactive learning in math and science topics to elementary students (grades K-6) in Omaha and surrounding areas. This service is provided by CSM students who work in groups to teach the lessons according to Nebraska state science standards. The Outreach program incorporates fun, hands-on activity to demonstrate and enforce the material. The program works to reach as many students in the Omaha community as possible each year, as well as utilize student volunteers from all majors and backgrounds at CSM. Currently, the Outreach program houses eight science experiments each, for ages K-2 and 3-6. So far, a total of 2,932 students have been serviced in the Omaha area through the Outreach program as of February of 2025. This includes 1,578 students in grades K-2 and 1,423 students in grades 3-6. In the 2024-2025 school year, a total of 518 students have already been served, 274 in grades K-2 and 244 students in grades 3-6. These results came from the following elementary schools: Mockingbird, Ashland Park Robbins, Blumfield, Anchor Point, Heritage, Castelar, Miller Park, Wildewood, St. James Seton, G. Stanley Hall, and St. Gerald Elementary Schools. We have also done activities with Girls Inc., an afterschool program. New research has shown an 11-12 percent drop in interest in STEM careers, just in the last few years. The program has been found to promote a growing career path, interest in STEM subjects, and a chance to spark new interests in elementary students. The Outreach program allows children to experience projects they can take home and continue researching. CSM student volunteers from all backgrounds give positive feedback on their experiences and enjoy the opportunity to volunteer their time to benefit the community. They have the opportunity to experience how these activities are enjoyed by all the children involved. This project is funded by NASA Nebraska.

DEVELOPMENT OF AUTONOMOUS UAVS FOR PAYLOAD TRANSPORT AND FIRST AID APPLICATIONS

Author
Gael Perez Alvarez
University of Nebraska-Lincoln

The University of Nebraska–Lincoln (UNL) Unmanned Aerial Vehicles (UAV) Team is developing advanced drone technologies focused on autonomous payload transport, with a particular emphasis on first aid delivery. Currently, our team is participating in the GoAero Aerospace Competition, which challenges us to design and construct a UAV capable of efficiently transporting payloads under realistic mission conditions. In parallel, we are exploring the use of UAVs for emergency medical response, aiming to develop drones that can autonomously deliver first aid kits to remote or disaster-stricken areas. Our current project involves the construction of a hexacopter, optimized for payload transport and autonomous navigation. The team is in the process of assembling the drone by soldering electronic speed controllers (ESCs), programming an ArduPilot Mega (APM) flight control board, and integrating various sensors for stability and autonomous operation. The hexacopter's design prioritizes durability, lift capacity, and efficiency, utilizing lightweight composite materials to maximize flight endurance while maintaining high thrust-to-weight ratios. Additionally, the drone's modular payload system allows for quick adaptation to different transport missions, including medical supply drops. On the software side, the team is implementing autonomous waypoint navigation using Python and C++ in conjunction with the Robot Operating System (ROS) framework. Sensor fusion techniques, incorporating GPS, inertial measurement units (IMUs), and LiDAR, ensure precise navigation and object avoidance. For first aid delivery applications, we are developing computer vision algorithms using OpenCV and TensorFlow, enabling the drone to identify safe landing zones or detect human presence in emergency scenarios. Future iterations will integrate machine learning models to optimize delivery routes and adapt to dynamic environments. The UAV Team's research and development efforts are funded by the Engineering Student Advisory Board (eSAB), which has provided us with $2,600. However, this funding is insufficient to fully support our research into first response drone applications, which require additional resources for advanced sensors, improved power systems, and real-world testing. We are actively seeking additional sponsorships and grants, including potential funding from NASA Nebraska and other aerospace research organizations, to further our development of autonomous medical response UAVs. Beyond competition and research, our team is committed to STEM outreach and education, engaging with local schools and organizations to promote interest in UAV technology. We conduct hands-on workshops and demonstrations, allowing students to interact with drone systems and learn about aerospace engineering principles. Through these initiatives, we aim to inspire the next generation of engineers while advancing UAV capabilities for real-world humanitarian applications. By participating in the GoAero competition and pursuing first aid UAV research, the UNL UAV Team is at the forefront of autonomous aerial technology, developing drones that not only compete at high levels but also serve practical, life-saving purposes. Our interdisciplinary approach—combining hardware engineering, embedded systems programming, and artificial intelligence—prepares students for careers in aerospace, robotics, and autonomous systems while contributing to the advancement of UAV technologies on a global scale.

LESSONS LEARNED FROM A MINIATURE ROBOTIC SURGERY TECHNOLOGY DEMONSTRATION DURING ORBITAL SPACEFLIGHT

Author
Rachael Wagner
University of Nebraska-Lincoln

This research describes a technology demonstration that tested robotic surgery while aboard the Increment 70 expedition of the International Space Station (ISS). This demonstration utilized a research version of a new miniature surgical robot, Virtual Incision’s spaceMIRA. During the experiment, the robot performed surgical dissection exercises first autonomously controlled by the payload computer, and then remotely controlled (tele-operated) by surgeons on Earth. Robot data from these experiments has been compiled. Results will be presented on the impacts of microgravity and latency on robotic surgery. Robotic accuracy will be assessed, with comparisons made between one-g and zero-g environments. Additional findings related to usability and user competencies of telesurgery at high latencies will be shared. Finally, potential future applications and recommended techniques for this technology will be shared. Telesurgery has the potential to expand and revolutionize medical care and this experiment was a first step towards that goal.

SCIENCE ENRICHMENT WORKSHOP SERIES: WHERE TO GO FROM HERE

Author
Amanda Roe
College of Saint Mary

The overriding goal of this workshop series is to stimulate interest in STEM by increasing the number of activity and inquiry-based learning experiences children receive during primary education. To reach that goal, these workshops provide elementary teachers with authentic STEM experiences that enable them to increase and improve STEM experiences in their classrooms while allowing them the ability to earn higher education credit. Since the workshop’s inception in 2015, it has grown from one workshop option to three, has adapted to changes in science curricula, and has

seen a diverse set of participants. This presentation will cover the history of the series, the lessons that have been learned, and what the future holds for the series.

UNIVERSITY OF NEBRASKA - LINCOLN DESIGN BUILD FLY

Author
Sean Griffin

Design Build Fly (DBF) is a team of seventeen undergraduate students from the University of Nebraska-Lincoln (UNL) that work together to design and manufacture a remote control model airplane for the annual DBF competition. The students' majors include Mechanical Engineering, Electrical Engineering, Civil Engineering, and more. The team is organized into four different sub-teams: Aerodynamics, Structures, Electrical, and Special Systems. Aerodynamics performs calculations to ensure flight, structures ensure construction is organized and efficient, electrical handles propulsion and control, and special systems designs payloads. To construct the plane, we use manufacturing methods such as laser cutting, 3D printing, and purchasing commercial carbon fiber parts. The competition involves two main challenges, the first being a fuel holding system. This system is made up of a commercially available bottle to hold a mock fuel, which can be any non-volatile material we want such as water or sand. The second challenge is an autonomous glider with signal lights called the "X1 Test Vehicle." The X1 must be able to maintain steady flight, make a 180º turn, and land within a 200 ft square area. A proposal and design report were written and submitted to the American Institute of Aeronautics and Astronautics (AIAA), mimicking industry procedures. The competition this year will be held in Tucson, Arizona which brings forward more than just design challenges. We will have to think about how we are going to transport a model aircraft along with twelve other people while maintaining a budget, as well as keeping everyone safe in the desert heat.

UNIVERSITY OF NEBRASKA-LINCOLN HUSKER ROCKETRY

Author
Amber Tannehill
University of Nebraska-Lincoln

Husker Rocketry is a group of undergraduate students that design, build, and launch high powered rockets for annual intercollegiate rocket competitions. Members of our team learn the basics of rocketry and aerodynamics by utilizing OpenRocket and Solidworks, as well as gain hands-on experience working with composites, electronics, shop tools, 3D printing, and programming. This year, we are returning to the International Rocket Engineering Competition (IREC) (formerly called Spaceport America Cup), which will be held in Midland, TX in June. Our team is composed of four sub-teams: airframe, mechanical payload, electrical, and programming. These sub-teams each have their own team lead and are responsible for building all of the components of the airframe, payload, payload ground station, and avionics bay. We will be competing in the 10k COTS category at IREC, so our goal is to construct an airframe that hits a target simulated apogee of around 10,000 feet. This year, our goal was to fabricate our own airframe for the first time since the team restarted using carbon fiber and fiberglass composite layups. Our goal is also to launch the rocket as close to Mach 1 as possible. Our payload will have multiple cameras capturing footage of the rocket as it launches. This includes both a traditional camera that records to an SD card, as well as livestream footage from the payload bay that can be streamed to YouTube. This is something our team hasn't done before and requires us to construct a ground station that tracks the rocket in order to maintain the line of sight telemetry required for the livestream signal. So, we have members working on both the on-board payload as well as the ground station throughout the year. In addition to building the rocket, each year our team also submits written deliverables such as a proposal, preliminary design review (PDR), comprehensive design review (CDR), and a final presentation poster that we display at the competition.

UNIVERSITY OF NEBRASKA-LINCOLN LUNABOTICS TEAM

Author
Nicholas Witulski

The Lunabotics Club at the University of Nebraska-Lincoln is a design and construction group consisting of undergraduate mechanical, electrical, computer, and software engineers. Each year, our club builds a new lunar rover from scratch to compete in a competition hosted by NASA. The qualifying competition is held on the University of Central Florida campus, and the final competition takes place at Kennedy Space Center. The goal of the competition is for the rover to autonomously navigate a 5-meter by 7-meter arena, reach an excavation zone, dig simulated lunar regolith, and deposit the material in a designated construction zone to build a berm. The larger the berm volume, the more points a team earns. Additional points are awarded based on the rover's level of autonomy, weight and size, energy consumption, and dust tolerance. The University of Nebraska-Lincoln Lunabotics team is divided into seven sub-teams: hopper, excavation, drivetrain, programming, electrical, systems engineering, and outreach. Members can join multiple sub-teams if they are interested. During the first half of the academic year, our team designs the robot using CAD software, electrical simulation tools, and a small test rover for autonomy practice. In the second half of the year, we send our mechanical schematics to a machine shop for fabrication and assemble the rover. We conduct testing in our on-campus sand volleyball courts to refine navigation, excavation, and construction. This year, our rover will feature a single-trencher excavator, a dump-truck-style hopper, and a high-wheel tank track drivetrain. The electrical system will utilize a 15,000 mAh battery, and the programming team will use a Jetson Orin and Arduino Mega for processing. Last year, our robot placed 6th out of

approximately 50 teams in the qualifying competition and 10th in the final competition. This year, our team aims to place in the top 5 in the final competition.

UNIVERSITY OF NEBRASKA-LINCOLN WOMEN IN AEROSPACE (WIA)

Author
Amber Tannehill
University of Nebraska-Lincoln

Women in Aerospace (WIA) is a group that promotes professional development, workshops, community engagement, and a sense of belonging for women and other minorities within the field of aerospace engineering. We collaborate with industry partners to host speaker events, which allow our members to directly get in contact with aerospace engineers from a variety of different industries. We also attended two different national conferences this year: WE24 (the national Society of Women Engineers conference) and WAI (Women in Aviation International). Attending these conferences has directly resulted in our members getting aerospace internships and improving their networking skills. We also be presented at the No Limits conference hosted at UNL in March. Women in Aerospace also hosts skills-based workshops based on what members are interested in, which allows them to improve different skills (related to different manufacturing techniques). This not only allows members to gain skills in different areas of interest but also promotes bonding and collaboration with other aerospace members.

Friday, April 25, 2025 7:45am - 10:00am

AERONAUTICS AND SPACE SCIENCE MORNING SESSION- 2A

Aeronautics and Space Science **Chairperson: Michaela Lucas**
Moderators: Kendra & Michael Sibbernsen

FRIDAY, APRIL 25 **Location: Zoom/Virtual**
https://unomaha.zoom.us/j/95965040865

MORNING SESSION - 2A

7:45 ZOOM Session opens for participants to join

8:00 WELCOME

8:05 SEARCHING FOR THE MISSING PLANETS AROUND INTERMEDIATE-MASS. Evan Rich, Michael Baklyikov, and Linnea Ghazi

8:20 BRING ADVANCED CELLULAR NETWORKS FROM EARTH TO SPACE. Qiang Liu

8:35 MODELING OPTICAL VARIABILITY OF QUASARS BY SIMULATING LOCAL MASS ACCRETION RATES AS A CONTINUOUS AUTOREGRESSIVE PROCESS. Thomas Hare and Jack Gabel

8:50 USING SIMULATED MICROGRAVITY FOR CANCER TISSUE ENGINEERING. Natasha Ratnapradipa, Jacob Woolf, Jayce Hughes, and Andrew Ekpenyong

9:05 REMARKABLE MXENES: TRANSFORMING TEXTILE-BASED SUPERCAPACITORS. Abaigeal Aydt, Alyssa Grube, and Mona Bavarian

9:20 DEVELOPMENT OF A LAMP-BASED MICROFLUIDIC DIAGNOSTIC DEVICE. Emily Ciesielski, Prabin Sherpaili, Carson Emeigh, C. Fernando, Takayuki Shibata, and Sangjin Ryu

9:35 MECHANICAL CHARACTERIZATION OF ANTIMICROBIAL PLA FOR 3D PRINTED MEDICAL DEVICES IN SPACE. Liliana Delgado and Dr. Jorge Zuniga

9:50 ZERUMBONE AS A GLI-1 INHIBITOR IN TRIPLE-NEGATIVE BREAST CANCER CELLS. Alexis Kramer and Ann Buchmann

10:00 **BREAK**

AERO sessions will continue with sessions 1B & 2B at 10:20am.

BRING ADVANCED CELLULAR NETWORKS FROM EARTH TO SPACE

Author
Qiang Liu

Envisioning the on-the-horizon site-scale space missions in the next decades (e.g., mining and agriculture bases), advanced wireless technologies are indispensable to effectively connect different kinds of devices, such as robots and facilities. Existing space wireless solutions are manually customized (e.g., hardware and protocol) for specified space missions with limited interoperability and small-scale low-performance networking capabilities. In this work, we aim to bring state-of-the-art cellular network technologies on Earth (e.g., 5G and Beyond) to the space. The rationale is that, the ever-evolving cellular network development and worldwide deployment assured its superior networking performances, which would substantially outperform the existing one-mission-one-solution philosophy, in terms of reliability, robustness, and cost-efficiency. However, it is non-trivial to bring cellular networks to the space, which includes multiple scientific and engineering challenges, including complex environmental conditions (e.g., shock, temperature, radiation, and vacuum), unmanned operation and maintenance, and stringent device requirements, such as size, weight, thermal, and dimension. To address these scientific challenges, we propose a novel generic network customization framework to customize existing cellular networks according to the needs of specific space missions. This work is supported by the NASA Nebraska Space Grant (Federal Award #80NSSC20M0112).

DEVELOPMENT OF A LAMP-BASED MICROFLUIDIC DIAGNOSTIC DEVICE

Author
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Co-Author
Prabin Sherpaili

Co-Author
Sangjin Ryu

The Covid-19 pandemic revealed the need for a more efficient method of testing for infectious diseases. Though polymerase chain reaction (PCR) tests are highly accurate as the golden standard, they are very costly and resource intensive because they require precise control over temperature and time for DNA amplification. In contrast, loop-mediated isothermal amplification (LAMP) can amplify DNA at a constant temperature because the technique uses specific primers to identify target pathogens. As such, the integration of LAMP with microfluidics creates point-of-care test (POCT) devices that are highly effective, easy to use, and cheap. However, most of the LAMP-based microfluidic devices currently available are fabricated using master molds made with photolithography. Photolithography is a very time-consuming and expensive process, which negates the positives of this method. So, we created our device using a 3D printed mold and polydimethylsiloxane (PDMS). Our device featured five chambers and passive valves to allow for sequential dispensing of samples. We tested the device for cross contamination using dye and used plasma treatment to bond the device to its substrate. The device will be further optimized and tested for better flow control and then tested using a commercial LAMP test kit.

MECHANICAL CHARACTERIZATION OF ANTIMICROBIAL PLA FOR 3D PRINTED MEDICAL DEVICES IN SPACE

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University of Nebraska Omaha

Co-Author
Jorge Zuniga
University of Nebraska Omaha

The human immune system is highly responsive to physiological, psychological, and environmental stressors, making infection prevention critical for astronuants during space flight. 3D printing enables rapid, on-demand production of medical devices tailored to specific conditions. Antimicrobial materials, with copper-based biocidal composites, enhance this capability by reducing infection risks. However, deploying these materials requires

understanding their mechanical properties to ensure durability, safety, and functionality. The purpose of this project is to utilize antimicrobial 3D printing filament to develop medical devices to be used by astronauts in space flight. Mechanical testing was conducted on polylactic acid (PLA). Tensile properties, including ultimate strength and modulus of elasticity were measured following ASTM D638 standards. Compressive strength and modulus were determined using ASTM D695 protocols. Tests were performed using a Shimadzu AGS-X Universal Testing Machine (UTM) with a load range of 1N to 50kN. PLA exhibited an average compressive strength of *83.85 MPa* and a compressive modulus of *1,925.14 MPa.* The ultimate strength for PLA was *2,912.75 psi* and the modulus of elasticity was *73,410.50 psi*. PLA's stiffness and compressive strength make it suitable for rigid, load-bearing components. Seven medical device protypes were 3D printed using the antimicrobial PLA. Devices included, short finger splint, full finger splint, scissors, hemostat, scalpel handel, forceps, and a kidney tray. These devices highlight the usability of this material and its potential applications during space flight. The outcomes of this project provide safe, on-demand technology for astronauts on missions as well as promote the use of additive manufacturing for in space use.

MODELING OPTICAL VARIABILITY OF QUASARS BY SIMULATING LOCAL MASS ACCRETION RATES AS A CONTINUOUS AUTOREGRESSIVE PROCESS

Author
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Co-Author
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Quasars are super luminous objects located in the centers of galaxies. The energy they release is powered by the accretion disks of supermassive black holes. The luminosity of quasar accretion disks is variable, and this fundamental observation of quasars that can give insight into their physical characteristics. We have developed simulations of quasar accretion disks that produce variable light curves. Our goal is to use these simulations to characterize the physical parameters that affect the variability, such as black hole mass, Eddington ratio, and characteristic timescales. In our model, the temperature distribution of the disk directly determines the emissions. The variability in the emissions is caused by thermal fluctuations that are driven by random perturbations in the local mass accretion rate. Our simulations use a continuous autoregressive (CAR) process to model these local mass accretion rates. We can generate synthetic distributions of quasars and their light curves over a range of values for their physical parameters to test their impact on the amplitude of variability. Our objective is to simulate quasar observations of the upcoming Vera Rubin Observatory, which will provide large sets of data on AGNs, which will advance our understanding of accretion. We intend to develop statistical tests of its capabilities and its anticipated results. These tests will inform researchers on ways to improve accretion disk models to more accurately capture the nature of quasar optical variability.

SEARCHING FOR THE MISSING PLANETS AROUND INTERMEDIATE-MASS STARS

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Exoplanets are ubiquitous in our universe, with over 5,000 exoplanets have been confirmed to exist to date. These planets have been found in various environments, from low-mass stars to stars similar to the sun, and even actively forming planets around young stars! However, one glaring missing

environment is stars that are 3 to 8 times more massive than our own Sun. Only 16 exoplanets are known within this mass range. We are investigating ongoing planet formation around young 3-8 solar mass stars. We have worked to identify other systems within this stellar mass range by producing a catalog of current work that has been done on direct imaging of planet-forming disks and confirm the young age of 4 known systems that are young who's evolutionary age is disputed.

USING SIMULATED MICROGRAVITY FOR CANCER TISSUE ENGINEERING

Author
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Co-Author
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Co-Author
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Creighton University

Co-Author
Jayce Hughes
Creighton University

As space exploration grows, two major biomedical goals become more achievable: namely, understanding the impact of space travel on human physiology and using outer space conditions to generate solutions for health problems on Earth. The latter is the focus of an ongoing program of the International Space Station in collaboration with NASA's Division of Biological and Physical Sciences, titled "Igniting Innovation: Science in Space to Cure Disease on Earth". We have published two papers (2020, 2023) that illustrate this goal of "science in space to cure disease on Earth". We grow brain cancer cells lines (T98G and U87) in microgravity simulated using a NASA-developed Rotary Cell Culture System (RCCS), which transforms the cells into tissue-like spheroids. We have successfully transformed U87 and T98G glioblastoma cells into 3D tissue-like spheroids comprising tens and hundreds of cells. These are then grown in 3D hydrogels to mimic the in vivo 3D microenvironment in the body. The 3D tissues we have engineered using simulated microgravity are then used for further biomedical research including nanoparticle mediated radiotherapy, radioimmunotherapy and the physics of cancer, an attempt to use cell biophysical properties to develop anti-metastasis strategies against cancer.

This work was funded by a NASA Nebraska Space Grant (Federal Award #80NSSC20M0112).

ZERUMBONE AS A GLI-1 INHIBITOR IN TRIPLE-NEGATIVE BREAST CANCER CELLS

Author
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Co-Author
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Triple-Negative Breast Cancer (TNBC) is an aggressive form of breast cancer with a poor prognosis. The reason for TNBC's poor prognosis is the result of the cancer's lack of overexpressed estrogen receptor (ER), progesterone receptor (PR), and human epidermal growth factor receptor (HER2). ER, PR, or HER2 expression in other cancers serve as a therapeutic target, so TNBC's failure to present with over expression of ER, PR, or HER2 greatly reduces the treatment options available for TNBC patients. As TNBC does not overexpress one of the three receptors mentioned above, the mechanism behind TNBC cell proliferation is unknown. We propose that growth of TNBC is mediated by the Sonic Hedgehog (Shh)/Gli-1 signaling pathway. Gli-1 inhibitors are chemicals that can inhibit the Shh/Gli-1 pathway. The chemical zerumbone was considered as a Gli-1 inhibitor during this experiment. Zerumbone's legitimacy as a Gli-1 inhibitor was examined by comparing the effects of the zerumbone on TNBC cells to those of cyclopamine, a well-known Gli-1 inhibitor. To begin the experiment, an HBT-549 TNBC cell line was cultured. The cultured cells were then treated with either cyclopamine or zerumbone and examined using various methods. First, propidium iodide (PI) staining was conducted to determine the level of apoptosis among the cells, and the data was used to compare the apoptotic levels of cells treated with cyclopamine to cells treated with zerumbone.

Subsequently, Annexin V/PI staining was used to determine the stage of cell cycle arrest. Finally, RT-PCR was used to examine the levels of Gli-1 protein among the TNBC cells to determine if the Shh/Gli-1 signaling pathway was effectively inhibited.

Friday, April 25, 2025 7:45am - 10:55am

BIOLOGICAL AND MEDICAL SCIENCES MORNING SESSION- 1A

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains A**

MORNING SESSION - 1A **Subsection Chairperson: Dr. Kimberly Carlson**

7:45 Presenters upload Session talks onto room computer desktop.

8:00 ANALYSIS OF IGF-1 AND ANTI-INFLAMMATION ON *IN VITRO* MUSCLE HEALING. Bailey Scherbarth and Mary Keithl

8:15 ANALYSIS OF THE MICROBIOME OF ORNATE BOX TURTLES AND THEIR ENVIRONMENT. Blake Skoumal, Lindsay Adams, Victoria Martinez, Franziska C. Sandmeier, and Erin Doyle

8:30 APTAMER SELECTION AND DEVELOPMENT OF ELECTROCHEMICAL APTAMER-BASED SENSORS FOR NEUROPEPTIDE Y. Evelyn Carreto Guevara, and Rebecca Y. Lai

8:45 ASSESSING THE EFFECTS OF DNA EXTRACTION METHOD ON QUANTIFYING THE ABUNDANCE OF GUT BACTERIA IN A MOUSE MODEL OF OBESITY. Elizabeth Andersen, David Gomez Quintero, Ashley Toney, Kristin Beede, Jeff Price, Robert Schmaltz, and Amanda E. Ramer-Tait

9:00 BACTERIAL GROWTH IN THE PRESENCE OF GLMS RIBOSWITCH ANALOGS. Alessandra Kakish, Gigi Fong, Katherine Timboe, Alex Van Cleave, Clare Weber, and Juliane Soukup

9:15 BIOACCESSIBILITY OF MACRONUTRIENTS IN ORGANIC VS. CONVENTIONAL FOOD. Paige Boitz, Tim Keith, and Mary Keithly

9:30 **BREAK**- Presenters upload session talks onto room computer desktop.

9:40 EXAMINING THE EFFECTS OF TRADITIONAL CULTURING TECHNIQUES ON FILAMENTATION ASSAYS IN THE FUNGUS *CANDIDA ALBICANS.* Ethan Funke and Jill Blankenship

9:55 EXPLORING *DROSOPHILA MELANOGAST*ER AS A MODEL FOR PEANUT ALLERGY RESEARCH: IMMUNE PATHWAY RESPONSES AND GENE REGULATION. Carlos Hernandez, Adelaide Buhlke, Alexis M. Hobbs, Joseph J. Dolence, and Kimberly A. Carlson

10:10 EXPLORING SELECTIVE INTERACTIONS OF PRPC AND PRPSC TO THE LIPID MEMBRANE USING COARSE-GRAINED MOLECULAR DYNAMICS. Noah Greenwood and Patricia Soto

10:25 GENOMIC DIVERSITY REDUCES SEVERITY OF MICRORNA LOSS OF FUNCTION. Clare Dahlhoff and Garrett Soukup

10:40 SHAPE ANALYSIS OF *CRASSOSTREA GIGAS* OAZ-PK RNA. Ellie Alberts and Juliane Strauss-Soukup

ANALYSIS OF IGF-1 AND ANTI-INFLAMMATION ON IN VITRO MUSCLE HEALING

Author
Bailey Scherbarth
Chadron State College

Co-Author
Mary Keithly
Chadron State College

Research shows that skeletal muscle injuries are the most common injures in sports. Scar tissue is formed from these types of injures and take time to recover but are also easy to reinjure. The analysis and effects of IGF-1, anti-inflammatory, and analgesic on skeletal muscle myoblasts is studied and experimented. Cryopreserved skeletal myoblasts were acquired from a company, Zenbio, and will be cultured. Cells will be differentiated until reaching a confluence of 80-90% and then placed on plates to be scratched. The healing process is activated and the IGF-1, anti-inflammatory, and analgesic will be added to the injury site. Photo-contrast imaging will be used to capture the healing process and effects of IGF-1, anti-inflammatory, and analgesic while the scratch closes. The expected results are the IGF-1 will have a positive impact on the healing process and migration of myoblast causing the inflammatory phase to be stop. The anti-inflammatory and analgesic will inhibit the inflammatory phase of healing. Analyzation of how IGF-1, anti-inflammatory, and analgesics affect the healing process and migration of myoblast to see if one could be used on a potential future treatment of skeletal muscle injuries. The early use of anti-inflammatories and analgesic can inhibit the growth factors in the body. IGF-1 is used in the process of healing to activate the satellite cells to migrate to help with the damage at the injury site.

ANALYSIS OF THE MICROBIOME OF ORNATE BOX TURTLES AND THEIR ENVIRONMENT

Author
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The ornate box turtle (*Terrapene ornata*) is a species of North American turtle known for its distinctive and intricate shell patterns, which vary among individuals. Due to their asocial and isolated lifestyle as well as the lack of non-gastrointestinal microbiome studies of reptiles, we are very curious where their nasal microbiomes' originate. The microbiome of an organism is classified as the assortment of microorganisms found on or within an organism's cells and/or biofluid. Shotgun metagenomic sequencing data from ten turtle nasal lavage samples and four samples of the air surrounding the turtles' burrows were run through a digital workflow in Kbase. We used the data generated by Kaiju, an application in Kbase used for sample comparison to graphically determine the correlation between microbiomes of different turtle samples and between the turtle samples and the aerobiome. Using R, we produced alpha diversity visualizations of Shannon and Simpson diversity indexes. Additionally, we created beta diversity metrics including Bray-Curtis dissimilarity-based dendrograms and PCoA charts to compare diversity between samples, all with the end goal of answering if the ornate box turtle possess a common nasal microbiome and whether or not the aerobiome surrounding these organisms play a factor in the microbiota present.

APTAMER SELECTION AND DEVELOPMENT OF ELECTROCHEMICAL APTAMER-BASED SENSORS FOR NEUROPEPTIDE Y

Author
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UNIVERSITY OF NEBRASKA-LINCOLN

Neuropeptide Y (NPY) is a highly abundant peptide transmitter that affects various physiological functions. These functions include energy homeostasis, appetite, stress, and anxiety. Dynamic monitoring of NPY levels is crucial for better understanding behaviors in individuals with neurological disorders associated with NPY. Aptamers are synthetic oligonucleotides obtained through a selection process called Systematic Evolution of Ligands by EXponential enrichment (SELEX) which have a binding affinity to a target of interest when in their secondary structure. A library consisting of 2 primers and a random domain region of 30 bases for a total of 73 bases was used to identify aptamers for NPY. The initial library went through the process of selection, amplification via Polymerase Chain Reaction (PCR),

and purification through denaturing Polyacrylamide Gel Electrophoresis (PAGE). Upon the completion of 13 SELEX cycles, cloning and sequencing led to 19 individual sequences. Four (E64, E66, E67, E74) were chosen based on secondary structure stability and predicted secondary structure for further characterization. Two sequences were truncated and investigated further. Kinetic experiments showed a higher signal suppression towards the longer sequences (E64-T2, E74-T2) indicating a more effective binding occurring. These truncated sequences and two original sequences (E64, E74) were thiolated for immobilization on 2 mm diameter gold disc electrodes. Preliminary data showed promising results for the four sequences with nM range binding affinities**.** Characterizing an aptamer that specifically and selectively binds to NPY will aid in the development of in vivo monitoring for enhancing the understanding of neurological disorders.

ASSESSING THE EFFECTS OF DNA EXTRACTION METHOD ON QUANTIFYING THE ABUNDANCE OF GUT BACTERIA IN A MOUSE MODEL OF OBESITY

Author
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More than 40% of adults in the United States have obesity, and the rates of obesity are rising. Several health risks are associated with obesity, such as type 2 diabetes and cardiovascular disease. Previous studies have shown that people with obesity possess a distinct gut microbial composition compared to healthy individuals. Therefore, novel approaches to treating obesity have focused on modifying the gut microbiome. The use of probiotics (beneficial bacteria) has been shown to mitigate obesity-related symptoms such as adipose mass accumulation, elevated blood glucose levels, and increased bodyweight in a non-invasive manner. Studies from our lab have shown that mice receiving the gut bacterium *Gordonibacter urolithinfaciens* gained less weight compared to controls in a diet-induced obesity mouse model. Additionally, treatment with G. *urolithinfaciens* increased the abundance of *Lactobacillus* species and lowered blood glucose levels compared to the control treatment. These results suggest a potential beneficial relationship between *G. urolithinfaciens* and the *Lactobacillus* species in the mouse gut microbiome. To properly assess these microbe-microbe interactions, we developed a QPCR assay to quantify the abundance of our target bacteria from previous studies. In this project, we are specifically assessing the degree of consistency in bacterial quantification via qPCR across three different DNA extraction methods. We expect that DNA extraction method will not significantly influence bacterial quantification via qPCR. Knowing the outcome of our validation studies will further support our efforts to better understand the potential relationship between *G. urolithinfaciens* and *Lactobacillus* species in mediating metabolic health benefits.

BACTERIAL GROWTH IN THE PRESENCE OF GLMS RIBOSWITCH ANALOGS

Author
Alessandra Kakish

Antibiotics are becoming more ineffective as bacteria adapt to drugs that were devised to kill them. However, researchers have identified riboswitches, non-coding segments of mRNA that affect the expression of downstream genes, as a new target for antibacterial agents, one of which is the highly extensive *glmS* riboswitch.

The *glmS* riboswitch controls the gene expression of fructose-6-phosphate amidotransferase, which synthesizes glucosamine-6-phosphate (GlcN6P) in bacterial cells. GlcN6P is a precursor in bacterial cell wall biosynthesis, and therefore, its synthesis is essential. The *glmS* riboswitch is also a catalytic ribozyme, which self-cleaves upon binding to GlcN6P. This cleavage degrades the mRNA, inhibiting *glmS* gene expression and preventing bacterial cell wall synthesis. Because the *glmS* riboswitch can control cell viability, it’s a potential target for new antibiotic development.

This project focuses on identifying analogs with structural similarity to GlcN6P that can affect the riboswitch as an agonist or antagonist. To determine whether GlcN6P ligand analogs can inhibit bacterial growth, assays are performed to monitor *Bacillus subtilis* and *Staphylococcus aureus* growth in the presence or absence of potential GlcN6P analogs. Preliminary data suggests that L-serine decreases bacterial growth at concentrations of ~31.3 mM for *B. subtilis* and 62.5 mM for *S. aureus.* Optimization of RT-PCR is also being conducted to verify whether the *glmS*

gene and *glmS* riboswitch RNAs are downregulated. Future studies will verify that the analogs are decreasing growth via interaction with the *glmS* riboswitch and will investigate the effects of L-serine on mutant strains of *B. subtilis* and *S. aureus.*

BIOACCESSIBILITY OF MACRONUTRIENTS IN ORGANIC VS. CONVENTIONAL FOOD

Author
Paige Boitz

The bioaccessibility of macronutrients in peanut butter were compared between two different types, conventional and organic. Organic farming is the use of natural process to operate the farm as opposed to man-made processes which is known as conventional farming. A macronutrient is described as the substances that are needed in large quantities that provide humans with energy. Both types of peanut butter were put through stomach digestion, which was created by mixing pepsin, HCl, and NaHCO3. Samples were analyzed using a Glycerol assay kit. The glycerol assay kit determined the glycerol level in the peanut butter after digestion to ensure fatty acids were digested and if lactate was created during the process. From the Glycerol assay changes in glycerol were calculated. For conventional peanut butter, pepsin 0.0113g/L, HCl 0.406g/L, stomach 0.816g/L, duodenum -0.547g/L. For organic peanut butter, pepsin -0.389g/L, HCl -0.443g/L, stomach 0.041g/L, duodenum 0.526g/L. HPLC analysis is in process to measure the amounts of bioaccessible amino acids, sugars, and fatty acids. This experiment will provide insight as to what type of food would be better to consume before a practice or competition and will last the duration of the practice or competition. The higher the bioaccessibility the higher the absorption into the body, which adds to the longevity of products making it better for athletes to intake.

EXAMINING THE EFFECTS OF TRADITIONAL CULTURING TECHNIQUES ON FILAMENTATION ASSAYS IN THE FUNGUS CANDIDA ALBICANS

Author
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University of Nebraska at Omaha

The fungus *Candida albicans* is both a commensal organism of the human microbiome as well as a major human pathogen. The ability of this fungus to switch between yeast-like and filamentous forms of growth is linked to pathogenesis. Our group has demonstrated that there are problems with the *in vitro* methods used to study this process. One of these issues, which our lab had not investigated in depth, was the standard use of culture tubes in liquid filamentation assays. Anecdotal evidence from our lab suggested that inducing filamentation in microscopy dishes yields higher rates of filamentation than the standard practice of growing cells in a culture tube and pipetting them onto a glass slide. This work quantifies discrepancies between the methods and the possibility that this discrepancy is due to a preferential selection of *C. albicans* in its yeast-like form when pipetting. We compare the use of each technique under ideal filamentation conditions, along with pipetting samples from both conditions to microscope slides, after different time points of incubation. The data appears to support our hypothesis that pipetting skews the ratios of yeast:filamentous cells.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant #5P20GM103427

EXPLORING DROSOPHILA MELANOGASTER AS A MODEL FOR PEANUT ALLERGY RESEARCH: IMMUNE PATHWAY RESPONSES AND GENE REGULATION I

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The use of *Drosophila melanogaster* for the study of peanut allergies is not common, although it is effective, and budget friendly. *D. melanogaster* is useful for human studies due to similarities between disease-related genes and immune response pathways. The objective of this study was to determine if the immune-regulated genes within the *D. melanogaster* genome were affected by the exposure to peanut. For this study, eight hundred female flies were collected and placed into cages, one hundred per cage. The flies were fed cornmeal-molasses food with water or 5% peanut on top, with water being the control. Every 72 hours, the dead flies were collected, and food was replaced. qRT-PCR was performed at three-day intervals across the lifespan of the flies. These results show a significant down-regulation of *Dorsal* and an up-regulation of *Dif, Cactus,* and *Relish*. This shows that the Toll pathway is potentially involved in allergic reactions, as well as the Immune Deficient (IMD) pathway. The experiment was repeated, and females were collected on days 0, 15, and 30 for Next Generation Sequence (NGS). The results show at day 15 an upregulation of the genes: *Cp18* (Chorion protein 18), which is involved in chorion formation, and *Jon25Bi* (Jonah 25Bi), which enables serine hydrolase activity. Day 30 shows an upregulation of *Npc2e* (Niemann-Pick type C-2e), which is involved in immune signaling via LPS, lipid A, peptidoglycan, and lipoteichoic acid, and the IMD pathway, and a downregulation of the genes: *Jon25Bii* (Jonah 25Bii), which enables serine hydrolase activity, *Gnmt* (glycine N-methyltransferase), which encodes enzyme that catalyzes methylation of glycine to N-methylglycine (sarcosine), and *rib* (ribbon), which encodes a BTB-domain protein required for the development of salivary gland and trachea, also the potential for regulation of PIWI interacting RNAs (piRNAs; i.e., viral infection fighting). *In toto*, this data demonstrates that *D. melanogaster* provokes an immune response to peanut exposure and can potentially be used as a model for peanut allergy. The project described was supported by grants from the National Institute for General Medical Science (GM103427 & 1U54GM115458).

EXPLORING SELECTIVE INTERACTIONS OF PRPC AND PRPSC TO THE LIPID MEMBRANE USING COARSE-GRAINED MOLECULAR DYNAMICS

Author
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Creighton University

The prion protein is the key molecular marker of incurable prion diseases affecting mammals, including humans. Notable examples include Creutzfeldt-Jakob Disease in humans and Chronic Wasting Disease (CWD) in cervids. According to the protein-only hypothesis, the misfolding, accumulation, and deposition of prion protein play a central role in disease toxicity. The misfolding of PrPC to PrPSc in mammals is characterized by a conformational transition from a predominantly ?-helical structure to a ?-sheet-rich aggregation-prone form, which resists proteolytic degradation, promotes self-templated propagation, and leads to neurotoxic accumulation in prion diseases. This misfolding is hypothesized to occur through protein scaffolding in the presence of PrPSc leading to a cascading effect. To develop a structural model of the prion protein fibril conformational dynamics, it is essential to understand the biophysical forces governing both

PrPC-lipid interactions and PrPSc-lipid interactions under physiological conditions. Our study investigates the interactions of globular PrPC and fibrillar PrPSc with membrane surfaces and their distinct responses. Using coarse-grained molecular dynamics simulations, we examine how protein sequences, structural topologies, and GPI anchoring influence protein-membrane associations. Our results reveal that protein-lipid interplay, combined with conformational constraints imposed by GPI anchoring, drives preferential binding of PrPC via loops adjacent to ?-helix 2. Specifically, polar side chains within PrPC loops interact with the membrane through functional group-specific interactions, leading to varying degrees of insertion. We discuss the implications of these binding modes on PrPC misfolding and aggregation, how PrPSc interactions may modulate disease progression, and potential protective mechanisms against misfolding. Future experimental studies, utilizing techniques such as atomic force microscopy and spectroscopy, will be instrumental in further probing prion protein-induced membrane remodeling.

GENOMIC DIVERSITY REDUCES SEVERITY OF MICRORNA LOSS OF FUNCTION

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The neurosensory microRNA-183 family is expressed in epithelial cells and ganglion neurons in sense organs and tissues and is required for proper cell development, survival, and/or function. Several different studies of knockout mice in crossbred lines show clear sensory deficits in otherwise viable animals. Our study of an inbred microRNA-183 knockout mouse line demonstrates neonatal lethality. We hypothesize that greater genomic diversity increases tolerance of microRNA-183 family loss of function and viability of knockout mice. To test this hypothesis, we outbred our line to a Diversity Outbred mouse line to introduce genomic diversity, and subsequently line bred heterozygous offspring for 15 generations to examine knockout survival phenotype, mendelian inheritance, and genomic sequence diversity. This strategy resulted in viable F2 homozygous microRNA knockout mice. However, continued line breeding demonstrated that knockout mouse survival decreased substantially by the F10-F15 generations. Furthermore genotypic ratios were significantly different from the expected Mendelian inheritance ratio of 1:2:1 wild-type:heterozygous:knockout throughout an analysis of early to late generations. Examination of genome sequences of selected animals of each genotype from early generations showed that the initial outbreeding introduced 50 times more site variants into the line compared to the mouse reference genome. An analysis of high-quality site variants showed that approximately 85% were single nucleotide polymorphisms (SNPs) and the remainder were insertions/deletions (INDELs). Furthermore, homozygous site variants increased ten-fold from F1 to F4 mice, demonstrating decreasing genomic diversity with line breeding. These results strongly suggest that knockout survival and genomic diversity correlate. In the human population, site variants exist within microRNA-183 family members at low frequency that are not known to be clinically significant. Our study suggests that genomic diversity within the human population might lessen the effects of microRNA loss of function caused by such site variants.

SHAPE ANALYSIS OF CRASSOSTREA GIGAS OAZ-PK RNA

Author
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Creighton University

A riboswitch is a piece of non-coding RNA that functions in downstream gene expression when bound to a metabolite. When a riboswitch interacts with its metabolite, it will undergo a conformational change that will affect downstream gene expression. The result is a change in production of the

binding metabolite. The Soukup lab is researching the potential eukaryotic riboswitch in the Ornithine Decarboxylase Antizyme pseudoknot (OAZ-PK) RNA segment. Known bacterial riboswitches have an effect on various metabolic pathways, providing a way to develop antibiotic treatments. Identification of a similar non-coding RNA in eukaryotic species may provide a way to develop anti biological agents. I study a potential riboswitch in *Crassostrea Gigas*, a species of oyster. Selective 2'-Hydroxyl Acylation analyzed by Primer Extension (SHAPE) is being used to analyze structural changes of the OAZ-PK segment when it interacts with various polyamines. Analyzing these structural changes will aid in identifying this RNA segment as a eukaryotic riboswitch.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

Friday, April 25, 2025 7:45am - 10:55am

BIOLOGICAL AND MEDICAL SCIENCES MORNING SESSION- 1B

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains B**

MORNING SESSION - 1B **Subsection Chairperson: Dr. Paul Denton**

7:45 Presenters upload Session talks onto room computer desktop.

8:00 BLACK CUMIN AS AN ANTIMICROBIAL AGENT. Aubree Quast, and Mary Keithly

8:15 CAPTURING THE VIROME DIVERSITY IN TICKS FROM SURVEILLANCE TESTING PROGRAMS. Jason T. Franklin, Jennifer L. Bushing MS, Alex L. Welch MPH, Griffin M. Dill, Thomas F. Rounsville Ph.D., and Shaun T. Cross Ph.D

8:30 CHARACTERIZATION OF THE NUCLEAR LOCALIZATION SIGNAL (NLS) OF ORF1 OF NORA VIRUS. Belle Turk, Amanda J. Macke, Darby J. Carlson, Alexis M. Hobbs, and Kimberly A. Carlson

8:45 CLPP AGONISTS DISRUPT MITOCHONDRIAL PROTEOSTASIS DEMONSTRATING THERAPEUTIC POTENTIAL IN TRIPLE-NEGATIVE BREAST CANCER. Oleh Khalimonchuk, Gunjan Purohit, George Hao, Paul Tripper, and Michael Macabobby

9:00 HUMAN NK CELLS PERFORM ANTIBODY-DEPENDENT CYTOTOXIC ACTIVITY AGAINST TARGET CELLS EXHIBITING SURFACE HIV-1 ENVELOPE. Jaden L. Nienhueser and Paul W. Denton

9:15 IDENTIFYING THE MOLECULAR DETERMINANTS OF METASTATIC ADAPTATION IN PROSTATE CANCER. Grace Waldron, Chrystal Nathan, Diane Costanzo-Garvey, James Talaska, Borum Ryu, Heather Jensen-Smith, and Grinu Mathew

9:30 **BREAK**- Presenters upload session talks onto room computer desktop.

9:40 IMPACT OF A VITAMIN E DIET ON OXIDATIVE STRESS IN *DANIO RERIO*. Areem Zahid and Ryan Wong

9:55 IMPACT OF CELL SPLIT TIMING ON STAINING EFFICIENCY IN FLOW CYTOMETRY USING DAUDI AND K562 CELL LINES. Kelly A. Kahwadi and Paul W. Denton

10:10 *IN VITRO* ACTIVITY OF MARINOPYRROLE A AND DERIVATIVES ON *NAEGLERIA FOWLERI*, PATHOGENIC AMOEBA. Brianna N. Davis, Jeffrey Zimmerly, and Paul H. Davis

10:25 ISOBOLOGRAM ANALYSIS OF DRUG INTERACTIONS AGAINST THE LETHAL PARASITE *NAEGLERIA FOWLERI*. Jeffrey M. Zimmerly, Brianna N. Davis, Nicholas A. Armstrong, and Paul H. Davis

10:40 USE OF FLUORESCENT BIOSENSORS FOR THE DETECTION AND CHARACTERIZATION OF PHYSIOLOGICAL HYDROGEN SULFIDE. Sunayn Cheku, Blase Rokusek, Haishi Cao, and Kimberly A. Carlson

BLACK CUMIN AS AN ANTIMICROBIAL AGENT

Author
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The oil extracted from black cumin seeds, which come from the *Nigella sativa* plant, has been recognized for a long time for medicinal properties and used as a natural remedy for various illness and diseases. The antimicrobial potential for black cumin oil has yet to be explored. To investigate the antibacterial properties of black cumin oil against *Escherichia coli, Staphylococcus aureus, Serratia marcescens D1, Kocuria rhizophila, Halobacterium salinarum, Lactococcus lactis, Lacticaseibacillus casei, Rhodospirillum rubrum, Aquaspirillum itersonii,* and *Bacillus megaterium,* disc diffusion assays were performed. Inhibition occurred in *S. aureus, L. lactis, L. casei, R. rubrum, and A. itersonii*. The antimicrobial effects of two separate store-bought oils were preformed and more research is being done on the active ingredient thymoquinone (TQ). The size of the zone of inhibition was recorded with a caliper and the values were averaged. The two separate store-bought oils were compared to see if the oil promoted towards the health fad side of the internet was more potent and this will be further analyzed. Further analysis will include concentration-based assays, disc diffusion assays on different hemolytic bacteria, and assays with TQ standard. These findings will be beneficial in finding a new more natural alternative to antibiotics and to find many future uses of black cumin oil in the health and medical field.

CAPTURING THE VIROME DIVERSITY IN TICKS FROM SURVEILLANCE TESTING PROGRAMS

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Tick-borne diseases are highly prevalent, accounting for nearly 75% of all vector-borne diseases in the United States. Of these, Lyme disease, caused by the bacterium *Borrelia burgdorferi* and vectored by the deer or blacklegged tick (*Ixodes scapularis*), causes over 400,000 estimated cases each year in the United States, with high prevalence in the Northeast and upper-Midwest regions. The maintenance and transmission of pathogens in ticks are influenced by a number of environmental, host, and microbial factors. Of the microbial factors, studies have traditionally focused on the perspective of bacterial members of the tick microbiome. This is despite the fact that viruses (collectively called

the virome) can be more prevalent and abundant than their bacterial counterparts. Two viruses of particular interest in *I. scapularis* ticks are South Bay virus (SBV) and blacklegged tick phlebovirus-1 (BLTPV-1). We previously identified statistically supported interactions between these viruses and other microbes, including *B. burgdorferi*, in ticks. However, our data is from a single population of ticks, thus requiring further exploration across geographic populations. Traditionally, researchers have collected tick samples through active surveillance (e.g., tick flagging) for virome screening, but these studies are often geographically restricted due to staffing and coordination for the fieldwork needed. However, passive surveillance strategies, where individuals submit ticks, provide a unique opportunity to access samples across broader geographical frameworks. Here, we screened ticks collected through the University of Maine Tick Lab (Orono, Maine, USA) surveillance program, which collects ticks across the entire state. We hypothesized that we could identify and measure the prevalence of these viruses and identify similar polymicrobial interactions using passive surveillance-acquired ticks. Screening 175 ticks, we were successful in identifying SBV and BLTPV-1 in these samples and captured statistically significant relationships between microbes, including some found in our prior study. Furthermore, this study provides proof of concept for leveraging passive surveillance strategies to better understand the diversity, prevalence, and polymicrobial interactions of tick-associated viruses. Such knowledge strengthens our understanding of how tick-associated viruses affect ticks' ability to acquire and harbor other harmless and pathogenic microbes.

CHARACTERIZATION OF THE NUCLEAR LOCALIZATION SIGNAL (NLS) OF ORF1 OF NORA VIRUS

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Nora virus is a picorna-like virus that is endemic in Drosophila melanogaster and referred to as D. melanogaster Nora virus (DmNV). The genome of DmNV contains four open reading frames (ORFs) known as ORF1, ORF2, ORF3, and ORF4. ORF1, the focus in this study, has a role in RNA interference, RNAi, suppression through inhibition of the RNA induced silencing complex, RISC. This allows Nora virus to remain persistent in its host. Sequence analysis of ORF1 shows not one, but four potential putative bipartite nuclear localization signal (NLS) sites. The NLS 2 and 3 sites overlap and are considered together as one NLS or NLS 2. Knockout mutations for NLS 1, 2, 3, 1 & 2, 1 & 3, 2 & 3, and all three knockout mutations together (1, 2, & 3), were created and cloned into the pCR-TOPO vector. DNA sequencing verified that the intended mutations were created. The verified mutants were subcloned into pEGFPN3 for transfection into S2 cells. The S2 nucleus will be stained with DAPI, and cells visualized using confocal microscopy. This study will let us determine the identity of the ORF1 NLS responsible for translocation of DmNV to the nucleus. The project described was supported by grants from the National Institute for General Medical Science (GM103427 &

1U54GM115458).

CLPP AGONISTS DISRUPT MITOCHONDRIAL PROTEOSTASIS DEMONSTRATING THERAPEUTIC POTENTIAL IN TRIPLE-NEGATIVE BREAST CANCER

Author
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Mitochondria perform a multitude of critical functions in cellular physiology and metabolism, including providing energy for growing cells, making them a conspicuous target for cancer therapeutics. Mitochondrial caseinolytic protease (CLPP), a key component of the CLPXP protein complex, is essential for mitochondrial protein homeostasis, and has emerged as a potential target in cancer therapy. While imipridone-based CLPP agonists have shown promise in acute myeloid leukemia, their broad pharmacological activity limits clinical application. To overcome this, we tested two novel cyclic acyldesipeptide (ADEP)-based compounds, 1-118-P and 1-126-P, derived from natural product antibiotics. Our goal was to evaluate their efficacy against triple-negative breast cancer (TNBC) cells.

IC_{50} analysis of 1-118-P and 1-126-P enabled us to quantify their potency in inducing CLPP activation-mediated cell death. We compared their effects in breast epithelial cell lines 76N-TERT and MCF10A. Regression analysis showed that 1-118-P had an IC_{50} of 129.98 µM in 76N-TERT cells and 101.03 µM in MCF10A cells, whereas 1-126-P exhibited IC_{50} values of 160.99 µM in 76N-TERT and 109.80 µM in MCF10A. When compared to cancerous cell lines, 1-126-P was more cytotoxic to cancer cells than 76N-TERT but also exhibited significant cytotoxicity in non-cancerous MCF10A cells. By contrast, 1-118-P exhibited the highest cytotoxicity in the MDA-MB231 TNBC cell line with reduced toxicity in non-cancerous cells. This suggests it may be selectively toxic to TNBC tumors.

Additionally, a gel-based in vitro CLPP protease activity assay demonstrated that only 1-118-P effectively activated CLPP, leading to increased casein protein degradation. Densiometric analysis confirmed significant CLPP activation, comparable to the known CLPP activator TIC-10. These results show promise in the ability of 1-118-P compounds to disrupt protein homeostasis in the mitochondria.

Our findings highlight the potential of mitochondria-targeted CLPP agonists as a new class of TNBC therapeutics. Through selective targeting of mitochondrial CLPXP, 1-118-P offers an attractive platform for further drug development, particularly in refractory triple-negative breast cancer treatment.

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HUMAN NK CELLS PERFORM ANTIBODY-DEPENDENT CYTOTOXIC ACTIVITY AGAINST TARGET CELLS EXHIBITING SURFACE HIV-1 ENVELOPE

Author
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A primary goal of the Denton Immunobiology laboratory is to evaluate immunotherapy strategies with the goal of improving the killing capacity of human natural killer (NK) cells. To date, this work has been in the context of killing cancer cells. Malignancy is a paradigm of disease with a near-immeasurable scope. However, infectious diseases operate in a similarly large sphere. This project's goal is to determine whether immunotherapy findings in cancer can span paradigms and similarly impact treatment approaches in infectious disease. Our goal is to perform infectious disease-related experiments without incorporating fully infectious agents into our approach. To do this, we obtained cells that express human immunodeficiency virus (HIV) envelope proteins constitutively. HIV was chosen as the pathogen to represent the infectious disease paradigm because its treatments exist, but are not curative. Our goal is

to contribute to many research efforts focused on helping to “train” the immune system to fight HIV in the absence of other treatments (e.g., antiretroviral therapy). Our target cells expressing HIV envelope protein appear as “infected” to human NK cells. To allow NK cells to recognize the presence of HIV protein, we utilize an antibody that is specific for HIV-1 envelope, an antibody capable of directing NK cells to perform the killing function known as antibody-dependent cell-mediated cytotoxicity (ADCC). Accordingly, we developed an assay to observe human NK cell ADCC activity in this context. Data to date will be presented. The project described was supported in part by an Institutional Development Award (IDeA) from the NIGMS of the National Institutes of Health under Grant # 5P20GM103427.

IDENTIFYING THE MOLECULAR DETERMINANTS OF METASTATIC ADAPTATION IN PROSTATE CANCER

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Prostate cancer (PC) is the number one diagnosed cancer in men in the US and the second most common cancer among men worldwide. It was estimated that approximately 299,010 men in the US will be diagnosed with PC in 2024. Understanding metastasis is crucial due to its impact on disease morbidity. The sites of PC metastasis, such as the bone and visceral organs play key roles in disease morbidity. While bone metastasis is common, visceral metastases is associated with poor survival. The microenvironmental suitability for cancer cells in both bone and visceral organs strengthens their impact on disease progression and treatment outcomes. Understanding the complexities of metastatic PC (mPC), including the molecular mechanisms and adaptation factors, is pivotal for developing effective therapies.

Published literature and genetic approaches have uncovered that aggressive mPC display genetic loss of the tumor suppressors *PTEN* and *TP53*. To identify the molecular signature of metastatic *PTEN/TP53*^{NULL} cells we performed rigorous multiOmic/ and biochemical analysis of cells derived from tumors at various stages of disease evolution (*Pten/Trp53*^{NULL} mouse model; RapidCaP). This analysis revealed that loss of receptor tyrosine kinase Axl is tightly correlated with metastatic spread to bone and visceral organs. AXL is a member of the **T**yro3**A**xl**M**ertk family of kinases and has shown to be necessary for inducing dormancy like state in PC cells *in vivo*. Integrating CRISPR-Cas9 technology with robust immunocompetent syngeneic models, our lab has successfully demonstrated that *Axl* knockout promotes a metastatic phenotype in *Pten/Trp53*^{NULL} cells. However, we lack the mechanistic insight on how of *Axl* knockout cells adapt and grow within the metastatic site.
We hypothesize that the loss of Axl will promote a metastatic phenotype and play an essential role in metastatic adaptation. We propose that understanding the biological dependencies of Axl^{NULL} *cells will be crucial for therapeutic targeting of metastatic PC.*

To explore this hypothesis we generated a mPC model with *Axl* knockout (KO; CRISPR) in RapidCaP derived cell lines. To determine if the tumor cells are present and proliferating within the lung tissue we generated a lung metastasis model (syngeneic) via tail vein injection of *Axl* KO or control *Axl* WT cells. These *in-vivo* trials enabled the exploration of biological differences between *Axl* KO and WT cell lines using transcriptomics, immunohistochemistry and multiphoton-photon microscopy-based collagen imaging.

From the current data, we have been able to demonstrate that *Pten/Trp53/Axl*^{NULL} PC cells display faster growth of overt lesions and increased metastatic burden when compared to *Axl* WT cells; based on immunohistochemical presentation within mouse lung tissue. On the contrary, the *Axl* WT cells formed fewer and smaller lesions and prolonged the overall survival of tumor bearing mice. Transcriptomic analysis of *Axl* KO vs WT cells revealed an enrichment of inflammatory response pathway, increased MTORC1, KRAS signaling and upregulation of protein secretion pathways.

Overall, we have been able to establish a metastatic disease model and began characterizing the biological differences of the model. We have observed that *Axl* KO cells developed overt metastasis within three weeks whereas the *Axl* WT cells remain repressed, exhibiting disseminated tumor cells as detected by GFP staining. Further studies need to be conducted to understand the role of the microenvironment and immune systems role in the maintenance of metastatic disease within this model.

IMPACT OF A VITAMIN E DIET ON OXIDATIVE STRESS IN DANIO RERIO

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Stress and anxiety disorders have a significant impact on human health, affecting millions of individuals globally. These conditions are influenced by various factors, including an individual's stress coping style, genetics, and oxidative stress levels, all of which can affect neuroendocrine stress responses. Oxidative stress, in particular, arises from an imbalance between free radicals and the body's antioxidant defenses and has been linked to modulating the neuroendocrine stress response and development of anxiety-related behaviors. Preliminary data suggest that oxidative stress damage and antioxidant capacity differs between stress coping styles in response to an acute neuroendocrine stressor. Vitamin E is widely recognized for its antioxidant properties and, research suggests that vitamin E supplementation may reduce anxiety-related behaviors. In this study, I investigate how altering antioxidant state levels (via vitamin E) in zebrafish with distinct stress coping styles modulates anxiety-related behaviors and brain redox state. I will test the hypothesis that vitamin E influences stress resilience by reducing anxiety-related behaviors and maintaining coping strategy homeostasis through its effects on oxidative stress and neuroendocrine regulation. Specifically, I predict that vitamin E supplementation will decrease anxiety-like behaviors in both proactive and reactive coping styles, with a potentially greater effect in the reactive phenotype due to its heightened sensitivity to oxidative stress. To assess these effects, zebrafish lines selectively bred to display either the proactive or reactive stress coping style will be fed either a vitamin E-deficient or vitamin E-sufficient diet for 5 months. Afterwards, I will expose fish to an acute novelty stressor assay (open field test) and quantify anxiety-like behaviors and oxidative and antioxidant biomarker levels in the brain to assess if changes in redox state can explain any changes in anxiety-like responses. Unlike prior studies that have focused on the impact of vitamin E on anxiety alone, this study uniquely examines how vitamin E interacts with stress coping phenotypes, providing new insights into its potential role in improving stress coping and mitigating stress-related neurological effects.???

IMPACT OF CELL SPLIT TIMING ON STAINING EFFICIENCY IN FLOW CYTOMETRY USING DAUDI AND K562 CELL LINES

Author
Kelly Kahwadi

Natural killer (NK) cells play a critical role in the immune system by eliminating malignant and infected cells through two primary mechanisms: direct killing and antibody-dependent cell-mediated cytotoxicity (ADCC). Both pathways contribute to immune defense and are of interest in the Denton Immunology lab. This lab focuses on studying and optimizing NK cell function by assessing factors that influence these killing mechanisms using Daudi and K562 cancer cell lines. Flow cytometry is a key tool in these investigations, providing insight into NK cell activity and target cell characteristics. However, variations in cell culture conditions, such as the timing of cell splits before an assay, may impact staining quality and data interpretation. To evaluate this, staining data from Daudi and K562 cells that were split either one or two days before flow cytometry will be analyzed. Statistical comparisons will determine whether split timing significantly affects staining intensity and overall data quality. It is hypothesized that cells split two days before the assay will exhibit better staining quality due to more stable surface marker expression and reduced cellular stress. If confirmed, this finding could help refine best practices for cell culture preparation in flow cytometry experiments. These findings could provide guidance on whether cell splits should be standardized at a specific time before assays to ensure optimal staining quality and data consistency. If split timing is shown to have a significant impact, this information could help the lab and others refine experimental workflows, improving reproducibility and reliability in flow cytometry-based studies. The project described was supported in part by an Institutional Development Award (IDeA) from the NIGMS of the National Institutes of Health under Grant # 5P20GM103427.

IN VITRO ACTIVITY OF MARINOPYRROLE A AND DERIVATIVES ON NAEGLERIA FOWLERI, PATHOGENIC AMOEBA

Author
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UNO

Naegleria fowleri is a free-living amoeba that causes a rare brain infection known as primary amebic meningoencephalitis with a 95% fatality rate. Though the infections are normally isolated to warmer climates such as the southern United States, the first two cases of Naegleria infection in the Midwest occurred in Iowa and Nebraska in 2022 and more are predicted due to the rise in global temperatures. Current drug recommendations have only resulted in 4 out 170 survival cases in the United States, emphasizing the need for drug discovery efforts. Marinopyrrole A, a drug-like small molecule (MW=510.1 g/mol) with broad-spectrum activity against bacteria and at least one protozoan parasite was assessed for activity against pathogenic amoebae. This compound and its derivatives showed promising in vitro activity for two *Naegleria spp*. and with *Acanthamoeba castellanii*, with inhibitory concentrations less than 10uM for marinopyrrole A and less than 5uM for its derivatives. Further mechanistic testing, especially on its effect on *Naegleria fowleri*, is needed to determine how this compound leads to the inhibition of the amoeba to then optimize the compound before future in vivo studies.

ISOBOLOGRAM ANALYSIS OF DRUG INTERACTIONS AGAINST THE LETHAL PARASITE NAEGLERIA FOWLERI

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Naegleria fowleri, a thermophilic, free-living amoeba causes primary amoebic meningoencephalitis (PAM), a rare but devastating central nervous system infection with a mortality rate exceeding 95%. Despite the use of multiple anti-infective agents, treatment remains largely ineffective. Drug interactions in PAM therapy have been poorly characterized. Drug antagonism, a known challenge in antimicrobial treatment, may contribute to poor clinical outcomes. To address this gap, we have utilized isobologram analysis to evaluate the interactions between drugs commonly used to treat PAM. Our findings reveal both synergistic and antagonistic interactions, highlighting the importance of combination therapy optimization. Identifying synergistic combinations may enhance therapeutic efficacy, while recognizing antagonistic interactions can prevent ineffective treatment strategies. Future research will focus on in vivo validation of promising drug combinations

USE OF FLUORESCENT BIOSENSORS FOR THE DETECTION AND CHARACTERIZATI ON OF PHYSIOLOGICAL HYDROGEN SULFIDE

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Endogenous hydrogen sulfide is an integral component of normal cellular functioning regulating key processes, such as cell signalling and cellular stress response, and physiological processes, such as vasodilation and inflammation. Previous studies have observed a dysregulation of hydrogen sulfide mediated pathways in neurons to be a characteristic feature of neurodegenerative diseases such as Parkinson's disease (PD) and Alzheimer's disease (AD). However, studies on endogenous hydrogen sulfide activity have been limited due to lack of effective techniques to do so. This study attempts to use fluorescent hydrogen sulfide sensing compounds to detect endogenous hydrogen sulfide within PC12 cells, S2 cells, and D. melanogaster brain tissue. We further compare fluorescent signals between healthy Drosophila brain tissue and Drosophila PD model brain tissue to evaluate the utility of the fluorescent sensors as a potential diagnostic tool for PD. The results of this study will demonstrate that these sensors provide a robust and reliable means for detection of hydrogen sulfide in biosamples. The project described was supported by grants from the National Institute for General Medical Science (GM103427 & 1U54GM115458).

Friday, April 25, 2025 7:45am - 10:55am

BIOLOGICAL AND MEDICAL SCIENCES MORNING SESSION- 1C

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains C**

MORNING SESSION - 1C **Subsection Chairperson: Dr. James Fletcher**

7:45 Presenters upload Session talks onto room computer desktop.

8:00 INVESTIGATING THE ROLE OF PEP8 IN FILAMENTATION FOR CLINICAL STRAINS OF *CANDIDA ALBICANS*. Lucian Hadford and Jill R. Blankenship

8:15 DETERMINING THE EFFECTS OF THE TYPE SEVEN SECRETION SYSTEM IN *STAPHYLOCOCCAL* INNATE IMMUNE INTERACTIONS. Caleb Rother, Kyle Dittmer, Mariam Garcia Escobar, and Austin Nuxoll

8:30 DEVELOPMENT OF I*N VITRO* ORGANOTYPIC SKIN TO STUDY THE LYME DISEASE PATHOGEN. Jaxon J. Kramer, Trenten Theis, Carley M. Conover, and Amanda J. Brinkworth

8:45 DISRUPTING PGC-1ß-HCF-2 AS A STRATEGY AGAINST K-RAS-MUTANT COLORECTAL CANCER. Hadassha M.N. Tofilau, Kamryn Reynolds, Robert Svoboda, and Kurt W. Fisher

9:00 EFFECT OF CHRONIC HIV INFECTION ON BRAIN-DERIVED MITOVESICLES. Luke J. Hamilton, Mark Bausch, Vicki Schaal, Austin Gowen, Jessica Ware, Gurudutt Pendyala, and Sowmya V. Yelamanchili

9:15 EFFECT OF GYY4137 ON INTRAOCULAR PRESSURE AND RETINAL NEURONS IN CARBOMER-INDUCED OCULAR HYPERTENSIVE RABBITS, *IN VIVO*. John Borgmeier

9:30 **BREAK**- Presenters upload session talks onto room computer desktop.

9:40 INHIBITION OF METASTASIS OF TRIPLE NEGATIVE BREAST CANCER CELLS BY BLACK SEED OIL AND THYMOQUINONE. Emily M. Flowers and Surabhi Chandra.

9:55 INVESTIGATING HUMAN LAPTM5 GENE AS A RESTRICTION FACTOR TO HSV-1 INFECTION. Natalee Keodouangdy and Dane Bowder

10:10 INVESTIGATING THE DYNAMICS OF EXTRACELLULAR VESICLE DIFFUSION THROUGH A 3D HYDROGEL SUPPORTING PIG EMBRYO ELONGATION. Max Carlson, Benjamin T. Vyzourek, and Angela K. Pannier

10:25 INVESTIGATING THE POTENTIAL SURVIVAL ADVANTAGE OF *STAPHYLOCOCCUS AUREUS* PERSISTERS WITHIN A MACROPHAGE ENVIRONMENT. Carter Moss, Emma Weis, Alexis Hobbs, Kimberly A. Carlson, and Austin Nuxoll

10:40 DECIPHERING THE FUNCTIONAL SIGNIFICANCE OF CHITIN METABOLISM IN TICKS. Claire Garman, Savannah Armendariz, Faith Kozisek, Vinai Thomas, and Sujata S. Chaudhari

INVESTIGATING THE ROLE OF PEP8 IN FILAMENTATION FOR CLINICAL STRAINS OF CANDIDA ALBICANS

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Candia albicans is the most common fungal organism within the microbiome in humans, typically existing in the mouth, throat, and gut. However, in the right environment, *C. albicans* can overgrow and lead to superficial candidiasis, presenting as oral thrush or vaginal infections. Overgrowth can also lead to the spread of the fungus in the bloodstream or organs, and these systemic infections can have a mortality rate of approximately 25%. There are limited drugs available to treat systemic fungal infections and with resistance to available treatments rising, novel targets for antifungal therapy are desperately needed. Filamentation, the ability of *C. albicans* to transition between rounded yeast-like cells and elongated filamentous cells, is linked to pathogenesis, making it an ideal process to target with novel antifungal drugs. In this study, we deleted the *PEP8* gene in two divergent *C. albicans* wild type backgrounds using a transient CRISPR Cas9 system. Genetic and phenotypic differences are known to exist between divergent strains, and filamentation phenotypes are known to vary across the species. So far, we have seen defects in filamentation for the *pep8*?/? mutants in the clinical strain P87, as well as SC5314, indicating its role as a potential drug target. In the future, we plan to use FM 4-64 to analysis the effects of Pep8 in endosomal protein sorting. The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

DETERMINING THE EFFECTS OF THE TYPE SEVEN SECRETION SYSTEM IN STAPHYLOCOCCAL INNATE IMMUNE INTERACTIONS

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Staphylococcus aureus is an opportunistic pathogen that leads to upwards of twenty thousand deaths and five billion dollars in healthcare-related costs in the United States annually. While many virulence factors within *S. aureus* are well characterized, the type VII secretion system (T7SS), a protein secretion system found within many bacterial species, remains poorly understood. Studies within *Streptococcus intermedius* indicate the T7SS is responsible for secreting proteins that allow the pathogen to evade immune responses. To investigate whether the T7SS in *S. aureus* was important in survival to innate immunity, a *Drosophila melanogaster* sepsis model was utilized. A knockout in the *essC* gene encoding the T7SS ATPase was studied for differences in *D. melanogaster* survival. *D. melanogaster* infected with the *essC* knockout exhibited significantly increased survival compared to flies infected with wild-type *S. aureus*. Survival within a macrophage cell line was explored further to elucidate the mechanism behind the differential survival. RAW264.7 macrophages were infected with an *essC* knockout and wild-type *S. aureus* at a multiplicity of infection of 25. 24 hours post-infection, macrophages infected with the *essC* knockout exhibited a 1-log reduction in bacterial burden compared to macrophages infected with wild-type. To explore the differential macrophage survival, a reactive oxygen species (ROS) assay was performed, as ROS is a primary method of killing within macrophages. No significant difference in survival was found. The T7SS of *S. aureus* remains a poorly understood virulence factor that may play a pivotal role in bacterial survival to components of the innate immune system.

DEVELOPMENT OF IN VITRO ORGANOTYPIC SKIN TO STUDY THE LYME DISEASE PATHOGEN

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Lyme Disease is caused by the bacteria *Borrelia burgdorferi* and is transmitted via tick-bites. According to the CDC, there were 62,551 confirmed cases with around 476,000 estimated cases in 2022. Acute manifestations include an *erythema migrans* rash and flu-like symptoms, while chronic symptoms such as arthritis, cardiological, and neurological impairments can remain even after antibiotic treatment. Current models to study *Borrelia* transmission include murine models as well as *ex vivo* human skin. Murine skin differs greatly in structure as well as cellular content, while *ex vivo* human skin is the gold standard, but availability is limited, and patient-to-patient differences exist. *This presents a need for a laboratory-generated human skin model that is reproducible and can be used to detect pathogen transmission and dissemination following a tick-bite.* We have developed a novel tick feeding system that builds upon a well-described *in vitro* 3D-organotypic human skin model that is composed of epidermal and dermal

layers. Both ticks and *Borrelia* are affected by immune cells during tick feeding, thus we have introduced macrophages derived from $CD14^+$ monocytes into the dermal layer for up to 20 days. Additionally, we have added MaxGel to the dermal layer which contains a variety of ECM components that are abundant in human skin and can affect skin structure, immune cell function, and pathogen adhesion. To mimic re-colonization of the skin following a disseminated infection, *B. burgdorferi* were placed under the transwell holding the organotypic skin and left static over the course of 3 days. Monocyte-derived macrophages introduced into the model lived up to 20 days and displayed markers similar to *ex vivo* human and porcine skin biopsies, such as CD163, but had elongated morphology. This contrasts with *in vitro* cultured macrophages that started rounding up by Day 10 in culture. The addition of MaxGel increased fibroblast proliferation and keratinocyte differentiation compared to our base model. Upon dissemination into the model, *B. burgdorferi* exhibited differing morphologies with “round bodies” being found near the epidermis and normal spirochetal shape in the lower dermis. Overall, we have developed a human skin model that can be used for studies of dissemination of tick-borne pathogens and their associated immune responses. Comparisons between our model and human *ex vivo* and porcine skin have shown similarities, but differences do exist and show the need to further improve the model. Future studies will involve addition of other immune cells and development of vasculature in our organotypic model, which will enable us to dissect the factors required at the tick-skin-pathogen interface for colonization and dissemination.

DISRUPTING THE PGC-1B-HCF-2 INTERACTION AS A STRATEGY AGAINST K-RAS-MUTANT COLORECTAL CANCER

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Colorectal Cancer (CRC) is a global crisis and is the second leading cause of cancer-related death worldwide. Approximately 40% of CRC patients that harbor K-Ras mutations have a greater risk of mortality and advanced disease stage than patients with wild-type K-Ras. Despite great efforts into targeting K-Ras proteins, K-Ras-directed therapeutics in CRC remain experimental, highlighting the urgent need for improved therapeutic approaches. A downstream effector of the oncogenic K-Ras signaling cascade, peroxisome proliferator-activated receptor-gamma coactivator 1 beta (PGC-1?), is a promising therapeutic target. PGC-1? is a transcriptional coactivator that requires associated proteins to promote CRC growth through transcriptional regulation of metabolic genes. Unbiased proteomic experiments identified Host Cell Factor 2 (HCF-2) as a critical effector of PGC-1? signaling. We hypothesize that inhibiting HCF-2 could block downstream activation of gene transcription required for CRC survival. Our previous findings demonstrate that ShRNA-mediated depletion of HCF-2 significantly decreased anchorage-independent growth in a panel of K-Ras mutant CRC cell lines. Our current work focuses on identifying HCF-2-associated proteins and key amino acid motifs on HCF-2 necessary for critical protein-protein interactions. Unbiased proteomic profiling of HCF-2 via mass spectrometry-based proteomic profiling suggests that transcription factors, CREB-ZF, ZBTB-2 and ZNF-639, facilitate HCF-2 recruitment of the SETD1A-COMPASS complex, initiating PGC-1?-dependent gene transcription. Finally, using immunoprecipitation experiments with 16 HCF-2 mutant proteins, we identified a small motif on HCF-2 that, when mutated, disrupts the interaction of HCF-2 with CREB-ZF, ZBTB-2 and ZNF-639 entirely and prevents the recruitment of members of the SETD1A complex. In summary, our study identifies

HCF-2 as a key regulator of the PGC-1? signaling axis and elucidates critical protein-protein interactions essential for CRC progression. These findings suggest that transcription factors CREB-ZF, ZBTB-2 and ZNF-639 may be critical determinants in regulating the PGC-1?-HCF-2 signaling axis and identified a motif that could be a potential target to inhibit its function. Ongoing studies are evaluating whether disrupting these interactions reduces the expression of genes essential for CRC growth, potentially providing a novel therapeutic strategy for targeting K-Ras mutant CRC.

EFFECT OF CHRONIC HIV INFECTION ON BRAIN-DERIVED MITOVESICLES

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The advent of combined antiretroviral therapy and accompanying rise in the number of older people living with HIV has precipitated a rise in prevalence of a set of mild forms of dementia, collectively called HIV-associated neurocognitive disorders (HAND). Mitochondrial dysfunction has been described in several animal models of HAND. In people diagnosed with HAND, impaired mitochondrial fission and distribution have also been reported. Recently, we and others have shown the role of extracellular vesicles (EVs) in exacerbation of HIV neuropathology. A novel class of EVs from mitochondria, namely, “mitovesicles,” were recently shown to play important roles in inflammation and neurodegeneration. Here, we investigated the effect of chronic HIV infection on mitovesicle composition. Mitovesicles were isolated from wild type (WT) and HIV-transgenic (Tg) rat brains by Optiprep density gradient ultracentrifugation techniques. Isolated mitovesicles were characterized by TEM, western blotting, and high-throughput proteomics. Results revealed significant alterations in mitochondrial proteins. A majority of these were part of mitochondrial membrane and inner mitochondrial membrane protein complexes. Functional Seahorse analysis showed that mitovesicles isolated from HIV-Tg animals increased basal respiration and ATP production in B35 neuroblastoma cells. In summary, our data reveal a significant alteration in brain mitovesicle proteins isolated from HIV-Tg rats indicating mitochondrial distress and dysfunction as a potential underlying cause for neuronal dysfunction in HIV infection.

This work was supported by Yelamanchili Development Funds from the Department of Anesthesiology of the University of Nebraska Medical Center.

EFFECT OF GYY4137 ON INTRAOCULAR PRESSURE AND RETINAL NEURONS IN CARBOMER-INDUCED OCULAR HYPERTENSIVE RABBITS, IN VIVO

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Background: Primary open-angle glaucoma (POAG) causes retinal degeneration due to increased intraocular pressure(IOP) of the eye's anterior segment. Hydrogen sulfide(H2S) can reduce IOP(Han et. al, 2019) and reduces neuronal injury, in vivo(Sone et. al, 2018). Purpose: Investigate the pharmacological actions of a H2S-producing compound, GYY4137 on IOP and retinal degeneration in carbomer-induced ocular hypertension(OHT) in New Zealand albino rabbits. Methods: OHT was induced by bilateral intracameral injection of carbomer (100 µL; 0.3%) into rabbit eyes. In acute studies, GYY4137 (2%; 50?l) was instilled into one eye while the contralateral eye received normal saline. IOP was assessed hourly until it returned to baseline. In chronic studies, 3 groups(N=5) were treated twice daily: Group I: normotensive-saline; Group II: OHT-saline; Group III: OHT-GYY4137. IOP was assessed daily for 28 days before humane euthanasia and retina isolation. Results: Intracameral injection of carbomer into rabbit eyes induced OHT was sustained for 28 days, achieving a significant ($p<0.001$) elevation of 123.62 ± 19.25% on the 9th day. In acute studies, GYY4137 treated eyes had a reduction in IOP with a significant ($p<0.001$) reduction of 29.27 ± 5.23% at 5 hours. In chronic studies, a significant decrease in IOP was observed in OHT-GYY4137 rabbit group compared to untreated eyes. The maximum % decrease in IOP measured was 29.27 ± 5.23 % ($p>0.001$, n=5) at 5 hours. Moderate improvement in RGC survival was observed in GYY4137 (2%) group compared to OHT control. Conclusion: GYY4137 (2%) reduced IOP and protected neurons from OHT-induced damage in rabbit eyes, in vivo.

INHIBITION OF METASTASIS OF TRIPLE NEGATIVE BREAST CANCER CELLS BY BLACK SEED OIL AND THYMOQUINONE

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Patients with breast cancer have a higher chance of cancer metastasis throughout the body, including to bones, lymph nodes, lungs, liver, and brain. Diabetic individuals experience a 10-20% higher risk of breast cancer development and subsequent metastasis. There has been limited success in finding methods of reducing this metastatic behavior of cells. We studied black seed oil (BSO) as well as its active compound, thymoquinone which have been used as over-the-counter health supplements with anti-cancerous properties. Thymoquinone is active as an anticancer agent, and BSO can reduce inflammation and diabetes, therefore we hypothesized that both will reduce migration and metastasis of breast cancer cells. To test this hypothesis, scratch wound assays were performed with MDA-MB-231 cells (late-stage metastatic triple negative breast cancer cells), treated with thymoquinone or BSO. After 24 hours, the area of the scratch wound was analyzed and compared to a control group. Transwell migration assays were also performed with cells after 24 hours of treatment, and migratory cells were counted and compared to a control group. Normal glucose (5G) and elevated glucose (25G) media were used to simulate non-diabetic and diabetic environments. The scratch wound healing assay showed limited inhibition of metastasis using Black Seed Oil at 6µg/ml and 12µg/ml. Total cell death was observed at 10µM Thymoquinone treatment. Findings of the transwell migration assays showed a limited inhibition of metastatic ability of cells with 1µM Thymoquinone in 5G and 25G environments, but further investigation is necessary to determine the extent of the inhibition. Although our final results are not conclusive, treatment with black seed oil and thymoquinone has not yielded results to support that they significantly reduce triple negative breast cancer cell metastasis.

INVESTIGATING HUMAN LAPTM5 GENE AS A RESTRICTION FACTOR TO HSV-1 INFECTION

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Herpes Simplex Virus type 1 (HSV-1) is a very common infection prevalent in 50-80% of American adults. The virus causes recurrent painful oral sores and fevers and can exhibit a period of latency between active infections. Currently there is antiviral medication that can reduce the number of outbreaks, but resistance mutants are beginning to become a larger concern. LAPTM5 is a lysosomal membrane protein which regulates cell death, helping with immune response. LAPTM5 has been implicated in cancer, viral infections and immune diseases., LAPTM5 has shown antiviral activity against HIV-1 through interactions with the envelope, indicating it may be a viral restriction factor.. It is unknown whether LAPTM5 plays a restrictive role in HSV-1 infection. We hypothesize that overexpression of LAPTM5 in a cell line will inhibit HSV-1 infection, because several other viral restriction factors exhibit cross-virus restriction. Here we present our progress in exploring this hypothesis. This work is important because it could uncover new viral life cycle targets for the development of novel therapies.

INVESTIGATING THE DYNAMICS OF EXTRACELLULAR VESICLE DIFFUSION THROUGH A 3D HYDROGEL SUPPORTING PIG EMBRYO ELONGATION

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Early embryonic development in pigs features a restructuring of the embryo from a spherical (~1mm) to a filamentous (>100mm) morphology within a 3-day period prior to implantation. This process, called elongation, is heavily dependent on maternal-embryonic crosstalk and is critical to successful pregnancy outcomes. Asynchronous or failed embryonic elongation leads to significant decreases in pig litter sizes due to early embryonic mortality. Extracellular vesicles (EVs) are nanoscopic (~60 nm – 1000 nm) lipid-membrane-enclosed vesicles that are secreted by all cells and are known to contribute to intercellular communications. These secreted vesicles encapsulate cargo such as nucleic acids or proteins and cross intercellular space, delivering signaling molecules to targeted cells. A substantial amount of EVs have been found in reproductive fluids and are hypothesized to play an important role in the regulation of embryonic development, facilitating the essential crosstalk between maternal and embryonic tissues. Previously, encapsulation of spherical pig blastocysts in Arg-Gly-Asp peptide (RGD) conjugated alginate hydrogels provided a viable culturing method for studying the factors influencing embryo elongation *in-vitro*. Compared to 2D culture and unmodified 3D alginate hydrogel culture, the RGD-modified alginate hydrogel enhanced embryonic elongation, and embryos within these hydrogels secreted estradiol-17b consistent with embryonic development. This improved embryo culturing method has enabled more consistent replication and more efficient study of this pre-implantation stage of development in real-time. To investigate the role of EVs in pig embryo elongation, the goal of this study was to determine optimal EV dosing parameters for the hydrogels and investigate the diffusion dynamics of EVs within the hydrogel to evaluate how their distribution and concentration influence biological responses. This study established a model to evaluate EV diffusion through a 3D scaffold and could aid in identifying key signaling molecules responsible for regulating morphological changes. Discoveries from these investigations could be used to improve embryo development, ultimately improving reproductive outcomes and increasing the efficiency of porcine production.

INVESTIGATING THE POTENTIAL SURVIVAL ADVANTAGE OF STAPHYLOCOCCUS AUREUS PERSISTERS WITHIN A MACROPHAGE ENVIRONMENT

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Staphylococcus aureus is an opportunistic pathogen that is a leading cause of nosocomial infections associated with foreign devices. Often, *S. aureus* is associated with relapsing infections thought to be mediated by persister cell formation, a dormant-like subpopulation tolerant to antibiotic treatment. Recently, persister cell formation was shown to depend on a reduction in tricarboxylic acid (TCA) cycle activity, as a knockout in the fumarase gene results in increased tolerance (fumC:: N?). In turn, we found persister cells also conferred a survival advantage to antimicrobial peptides, LL-37, and human ?-defensin 3, leading us to hypothesize a similar advantage to macrophages. To investigate, we monitored survival of fumC:: N? and wild-type *S. aureus* in a macrophage cell line. Interestingly, those infected with fumC:: N? exhibited increased bacterial burden. To determine whether macrophages infected with persisters exhibited a difference in reactive oxygen and nitrogen species (RONS) production, macrophages were stained with 4-amino-5-methylamino-2', 7'- difluoroflurescein and CM-H2DCFDA. No significant difference in RONS production was observed between macrophages infected with fumC:: N? and wild-type S. aureus, indicating persisters confer a fitness advantage through other means. Altogether, our results suggest that persisters hold an advantage in macrophage interactions.

DECIPHERING THE FUNCTIONAL SIGNIFICANCE OF CHITIN METABOLISM IN TICKS

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Ixodes scapularis, commonly known as the black-legged tick, plays a significant role in transmitting various human pathogens. At every post-embryonic stage of its development—larva, nymph, and adult—the tick relies on consuming a substantial blood meal to progress to the next stage. This feeding behavior also increases the risk of acquiring pathogens from infected hosts. During blood feeding, ticks undergo a remarkable expansion of their cuticle, allowing them to engorge and gain up to 100 times their original body weight. Yet, the precise ultrastructural changes and mechanisms stabilizing the cuticle against the increasing turgor pressure from the ingested blood are not fully understood. Our research focuses on the role of chitin, a key component of the arthropod cuticle, in maintaining structural integrity during blood ingestion. Traditionally, chitin synthesis in arthropods has been observed mainly during the molting process. However, our findings reveal a unique biphasic pattern of chitin synthesis in ticks: occurring first during feeding and subsequently during molting, challenging established paradigms and offering new insights into tick physiology and adaptation mechanisms. Moreover, our work sheds light on the molecular mechanisms of cuticular chitin remodeling in ticks during feeding and underscores the significance of targeting chitin metabolism as a strategy for innovative vector control methods.

Friday, April 25, 2025 7:45am - 10:55am

BIOLOGICAL AND MEDICAL SCIENCES MORNING SESSION- 1D

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Garden Room**

MORNING SESSION - 1D **Subsection Chairperson: Dr. Joseph Dolence**

7:45 Presenters upload Session talks onto room computer desktop.

8:00 EFFECTS OF APPLE CIDER VINEGAR ON BMI. Hunter Wiebelhaus and Mary Keithly

8:15 ELUCIDATING THE IMPACT OF VAPING ON PEANUT ALLERGY. Marissa Hoover, Joseph Roeder, Zane Carlson, and Joseph J. Dolence

8:30 ELUCIDATING THE ROLE OF EHD1 IN THYROID TUMORIGENESIS. *Santosh Shrestha*, Bhopal C. Mohapatra, Haitao Luan, Matthew D. Storck, Robert Bennett, Vimla Band, Hamid Band, and Anupam Kotwal

8:45 EVALUATING OPIOID WITHDRAW SEVERITY AND DURATION AFTER TREATMENT WITH MORPHINE ALONE OR MORPHINE/KETAMINE MIXTURES. Jakob Schmit, Cece Nikodem, Ellen Benz, Chris Kang-Harris, Erika Germinario, Amelia Moser, Lucy Kohara, Charlotte Young, and Vanessa Minervini

9:00 EVALUATING THE ANTI-MICROBIAL EFFECTS OF MARINOPYRROLE A ON BACTERIA SPECIES. Clare F. Euteneuer, Brianna N. Davis, LeeAnna M. Lui, Andrew J. Neville, and Paul H. Davis

9:15 INVESTIGATING THE STRUCTURAL AND DYNAMIC BASIS OF GENE-SILENCING PROTEIN INTERACTIONS. Emily Ekstrum,

Evan Veltri, Zachary Frevert, Ian Hall, and Lynne Dieckman

9:30 **BREAK**- Presenters upload session talks onto room computer desktop.

9:40 INVESTIGATION OF MAMMALIAN IFITM1 GENES AS VIRAL RESTRICTION FACTORS OF HSV-1 INFECTION. Devin Avedissian and Dane Bowder

9:55 INVESTIGATION OF MAMMALIAN IFITM3 GENES AS VIRAL RESTRICTION FACTORS OF HSV-1 INFECTION. Hayden Klaus and Dane Bowder

10:10 INVESTIGATION OF METABOLIC CHANGES OF CANCER CELLS CULTURED IN HYPOXIC AND ATMOSPHERIC CONDITIONS VIA SEAHORSE. Abraham J Saks, Reese Kolar, Greer Porter, Jalen Ramos, Kenton Reeh, Jinann Shoshara, and Michael Nichols

10:25 INVOLVEMENT OF PUTATIVE MEMBRANE RAFT PROTEINS IN C. ELEGANS INNATE IMMUNE RESPONSE TO PATHOGENIC S. MALTOPHILIA. Minjae Song and Michael A. Herman

10:40 REAL-TIME ELECTROMYOGRAPHY FOR BIOMECHANIC ACTUATION: SIGNAL PROCESSING AND CONTROL IMPLEMENTATION. Ryan Gallo and Dr. Jorge Zuniga

EFFECTS OF APPLE CIDER VINEGAR ON BMI

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Apple cider vinegar has been used for years for the health benefits that are apparent with apple cider vinegar consumption. Acetic acid, a component found in apple cider vinegar, is thought to be an agent that could cause weight loss. Three forms of apple cider vinegar were tested to see if the apple cider vinegar causes weight loss. Homemade, store-bought, and the pill form of apple cider vinegar were analyzed and compared. Weight loss was measured with biweekly monitoring of body weight and BMI of the participants. A four-week period with participants following their normal diet and exercise routines serves as a control. During the experimental period, the participants took their assigned apple cider vinegar for a six-week period while following their normal diet and exercise routines. The apple cider vinegars were also titrated with standardized sodium hydroxide to compare the amounts of acetic acid levels that are found in each of the vinegar types. Data collection is currently underway, and results will be analyzed to determine if there is a correlation between weight loss and the type of apple cider vinegar and the amount of acetic acid.

ELUCIDATING THE IMPACT OF VAPING ON PEANUT ALLERGY

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The health effects of vaping remain unclear, especially how it impacts immune responses that originate in the lung. In this study, we examined whether vaping can influence the ability of the immune system to mount allergic responses against PN. First, we showed that mice sensitized using PN solution containing vape juice displayed decreased PN-specific IgE responses and milder anaphylaxis. Next, we sensitized mice using electronic conditioned media (ECM) to expose mice to vapor. To make ECM, we bubble vapor into media used to expose the mice to PN and ask whether vapor itself alters allergic responses. Mice sensitized with PN solution containing 6 mg/mL nicotine ECM displayed severe reductions in PN-specific antibodies when compared to PN alone. The suppressive effect of ECM on PN-specific antibody responses decreased when ECM without nicotine was used during PN sensitization. This suggests that nicotine within ECM drives inhibition of PN-specific antibody responses. We are currently developing an assay to measure IL-4 secretion to elucidate how ECM suppresses PN-specific immune responses. This knowledge is important because our data suggests that vaping may inhibit immune responses against common respiratory infections.

ELUCIDATING THE ROLE OF EHD1 IN THYROID TUMORIGENESIS

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University of Nebraska Medical Center

Background, Significance, Hypothesis: Work from our laboratory has established that Epidermal Growth Factor Receptor (EGFR) Pathway Substrate 15 (EPS15) Homology Domain-containing protein 1 (EHD1) plays a crucial role in ensuring high cell-surface expression of various receptor tyrosine kinases (RTKs). A pro-tumorigenic role of EHD1 overexpression has been demonstrated in Ewing sarcoma, breast cancer, and non-small cell lung cancer. A previous study found EHD1 overexpression in thyroid cancers, correlating with larger size and lymph node spread, however, whether EHD1 overexpression represents a tumor cell intrinsic modulator of thyroid cancer cell oncogenesis has not been investigated. We hypothesized that EHD1 overexpression plays a pro-oncogenic role in thyroid cancer and that its genetic downregulation in EHD1 overexpressing thyroid cancer cell lines will impair their oncogenic traits.

Experimental design: To test this hypothesis, we generated EHD1 knockout (KO) or knockdown (KD) in EHD1-overexpressing thyroid cancer cell lines (TPC-1, KTC-1, and BCPAP) using the CRISPR/Cas9 Knockout approach or stable expression of doxycycline–inducible shRNAs, respectively. Western blotting was performed to confirm the loss or downregulation of EHD1 protein expression in KO and KD cells, respectively. To assess the impact of EHD1 KO or KD on thyroid carcinogenesis, we compared control and KO/KD cell lines for cell proliferation, migration, and tumorsphere forming ability.

Data and Results: First, to establish the pro-oncogenic role of EHD1 and its specificity, we generated CRISPR-Cas9 EHD1 Knockout (KO) derivatives. EHD1-KO markedly and significantly reduced the magnitude of cell proliferation, measured using the Cell-Titer Glo assay in TPC-1, KTC-1 and BCPAP cell lines. Furthermore, EHD1-KO in these cell lines induced a significant reduction in transwell cell migration and tumorsphere forming ability. To further validate these findings, we utilized a Doxycycline - inducible EHD1 knockdown (KD) system where we demonstrated the Doxycycline-inducible downregulation of EHD1 in EHD1 shRNA-expressing thyroid cancer cell lines but not in control shRNA-expressing cell lines. Functional analyses using KD cells produced results consistent with those observed in EHD1-KO models, reinforcing the pro-oncogenic role of EHD1.

Conclusion: Our results support the hypothesis that EHD1 overexpression plays a crucial tumor cell intrinsic pro-oncogenic role in thyroid cancer progression. The CRISPR-Cas9-mediated knockout (KO) and doxycycline-inducible shRNA knockdown (KD) in thyroid cell models provides a suitable approach to further examine the role of EHD1 in tumorigenesis and metastasis in vivo as well as to dissect the signaling pathways altered by EHD1 overexpression, including potential crosstalk with receptor tyrosine kinases. The tools generated here should also facilitate further research on the potential role of EHD1 in modulating the tumor cell cross talk with tumor immune microenvironment which is altered in thyroid cancer**.**

EVALUATING OPIOID WITHDRAW SEVERITY AND DURATION AFTER TREATMENT WITH MORPHINE ALONE OR MORPHINE/KETAMINE MIXTURES

Author

Jakob Schmit
Creighton University

Opioids are considered the gold standard treatment for moderate to severe pain. However, opioids have adverse effects such as addiction and withdrawal symptoms. Safer medications for treating pain are needed. One approach is to use drug mixtures (opioid/non-opioid), such as morphine and ketamine. Previous data found that small doses of morphine and small doses of ketamine in a mixture treat pain as well as large doses of the drugs given alone. The current study determined withdrawal severity after treatment with morphine alone or a morphine/ketamine mixture in adult male Sprague-Dawley rats. Rats were given twice daily injections of either morphine/ketamine or morphine alone for 19 days to engender dependence. Then naltrexone was administered to precipitate opioid withdrawal, and withdrawal symptoms were observed for 5 days. Rats treated with morphine alone and rats treated with the morphine/ketamine both showed increased withdrawal symptoms after naltrexone administration, but the groups were not significantly different from one another. There was no significant difference in withdrawal duration between rats treated with morphine alone and morphine/ketamine mixtures; however, weight gain was significantly faster in the rats treated with morphine/ketamine versus morphine alone. Overall, ketamine appears to enhance the therapeutic effects of morphine but not the adverse effects, so morphine/ketamine mixtures might be considered advantageous for treating pain compared to morphine alone.

EVALUATING THE ANTI-MICROBIAL EFFECTS OF MARINOPYRROLE A ON BACTERIA SPECIES

Author
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University of Nebraska at Omaha

Antibiotic resistance is one of the leading causes of concern for the world health community. Current antibiotic treatments are now becoming easier for bacteria to resist due to mutations and plasmids conferring resistance. One way to combat this problem is new drug discovery, which can help alleviate this concern. Marinopyrrole A, a compound once tested as an anti-cancer agent, is known to have efficacy against gram-positive bacteria species. We have tested this compound against a panel of gram-positive and negative bacteria and can confirm its efficacy against gram-positives as well as against a subset of gram-negative bacteria, including one identified as a priority pathogen by the WHO. We found this susceptibility of select gram-negative bacteria to be correlated with a difference in outer membrane structure. We are continuing to test to better understand the target species' range of marinopyrrole A, as well as its mechanism.

INVESTIGATING THE STRUCTURAL AND DYNAMIC BASIS OF GENE-SILENCING PROTEIN INTERACTIONS

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Following DNA replication, newly synthesized DNA strands are packaged into nucleosomes by wrapping around histone proteins. This process, called replication-coupled nucleosome assembly, involves two key proteins:

proliferating cellular nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1). PCNA acts like a sliding clamp to encircle newly synthesized DNA and recruits CAF-1 to the replication fork. CAF-1 binds to PCNA and deposits histone proteins onto the synthesized DNA to begin nucleosome assembly. This interaction between PCNA and CAF-1 is crucial for DNA packaging and gene-regulation, yet the structural basis of this binding event is unknown. This study aims to determine the structure and dynamics of the interaction between PCNA and CAF-1 using a combination of structural methods, including small angle X-ray scattering (SAXS), and computational Langevin-based dynamics (LD) molecular simulations. We have carried out these structural studies with multiple PCNA-CAF-1 complexes, including a SUMO-modified form of PCNA. Thus far, we have generated scattering curves, dimensionless Kratky plots, and pair-wise distance distribution (P(r)) curves from both SAXS and LD simulations of several PCNA-CAF-1 complexes. These plots suggest the simulation PCNA-CAF-1 model has greater molecular compaction and rigidity compared to SAXS PCNA-CAF-1 protein complex dynamics. We are currently working to optimize the simulation parameters to better fit SAXS experimental plots. The comparison of these plots will validate SAXS data and support the simulation-based modeling of the structural ensemble determination between PCNA and CAF-1. Together, these studies will provide a comprehensive analysis of the structure and dynamics of the complexes formed between PCNA and CAF-1 to better understand how these proteins regulate nucleosome assembly and gene silencing.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

INVESTIGATION OF MAMMALIAN IFITM1 GENES AS VIRAL RESTRICTION FACTORS OF HSV-1 INFECTION

Author
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Doane University

Herpes Simplex Virus type 1 (HSV-1) is one of the most prevalent viral infections in humans worldwide. One strategy HSV-1 employs is to establish latency within its host to evade the immune system. Though there are drugs available to treat herpesvirus infections, resistance mutants are continuing to rise and become a problem, indicating a need for new therapeutics. In response to viral infections, host cells produce viral restriction factors to block the virus at various steps in the replication cycle. One key defense mechanism involves the expression of interferons, which enhance the production of restriction factors. Understanding restriction factors may help to identify vulnerabilities in the viral life cycle that can be used as drug targets. Among the viral restriction factors expressedare the interferon-induced transmembrane (IFITM) protein family, which can inhibit entry of enveloped viruses at the cell membrane. Previous research has shown that IFITM1 is the most potent of the IFITM genes at inhibiting HSV-1, but is however less effective at inhibiting other viruses than IFITM3. It is unknown whether other non-human mammalian IFITM1 orthologs are effective at inhibiting HSV-1. We hypothesize that when the IFITM1 gene from cat, cow, goat, and flying fox is overexpressed in Vero cells it will inhibit HSV-1 infection based on similarity at the amino acid level between these genes. Here we report our progress on this project as we construct and verify overexpression plasmids for these experiments. Our next objective is to conduct overexpression and viral challenge experiments using quantitative PCR to measure infectivity.

INVESTIGATION OF MAMMALIAN IFITM3 GENES AS VIRAL RESTRICTION FACTORS OF HSV-1 INFECTION.

Author
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Co-Author
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?Herpes Simplex Virus type one (HSV-1) infections are some of the most common viral infections of humans in the world. HSV-1 is an enveloped virus which establishes latency in its host as a way to evade the host's immune system. During viral infections host cells express viral restriction factors to halt infection to other cells. Cells express interferon in response to viruses and as a result increase expression of viral restriction factors, one such group of restriction factors is known as interferon-induced transmembrane (IFITM) family of proteins . Many stages of the viral replication cycle are inhibited by viral restriction factors; IFITM3 is thought to modulate cell membranes or antagonize viral structure and inhibit entry. IFITM3 specifically has been linked to potently restrict enveloped viruses like Human Immunodeficiency Virus and Influenza. Both human IFITM1 and IFTIM3 have been shown to strongly inhibit HSV-1 infection in vitro. Previous studies have shown that non-primate mammalian genes have significantly inhibited HIV and SIV infections which is the basis of our experiments on the inhibition of HSV-1. Initial experiments have shown that overexpression of IFITM3 did not have a significant impact on plaque size but we found that rates of expression were low. To circumvent this we explored alternative transfection methods resulting in a higher yield of expression as well as utilized a more accurate quantitative PCR method.

INVESTIGATION OF METABOLIC CHANGES OF CANCER CELLS CULTURED IN HYPOXIC AND ATMOSPHERIC CONDITIONS VIA SEAHORSE

Author
Abe Saks
Creighton

Twenty percent of all non-melanoma skin cancers in the US are squamous cell carcinomas (SCC). Specifically, cutaneous SCC is attributed with worse prognoses with around 1-5% of cSCCs metastasizing. Studies of in vitro cancer cells are largely done at atmospheric oxygen conditions. Our lab's approach is novel as we understand there is alteration to a cell's metabolism in hypoxic conditions. This is critical to developing a better characterization of cancer metabolism as tumors often end up in hypoxic environments. Using a primary tumor cell line and a metastatic tumor cell line, SCC74A and SCC74B respectively, our goal was to identify metabolic changes associated with cancer in hopes of improving cancer diagnosis efficacy. Metabolism of SCC74 cell lines cultured in 21% and 2% O_2 was characterized with the Agilent Seahorse XFe24 Analyzer in conjunction with the use of NADH Phasor FLIM. We hypothesized that prolonged growth in a hypoxic environment would result in a shift from aerobic to anerobic metabolism, with less reliance on the electron transport chain (ETC). We monitored cellular respiration by applying ETC inhibitors in both environmental conditions. A two-way ANOVA (cell line, oxygen condition) revealed that oxygenation significantly affected ATP-linked respiration. In agreement with the NADH Phasor FLIM results, Seahorse revealed a reduction in cellular metabolism based on the environment cancer cells are found in. The results from Seahorse and the in vivo FLIM are promising that there is application for NADH Phasor FLIM as a noninvasive, optical method of biopsy to diagnose cancer.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

INVOLVEMENT OF PUTATIVE MEMBRANE RAFT PROTEINS IN C. ELEGANS INNATE IMMUNE RESPONSE TO PATHOGENIC S. MALTOPHILIA

Author
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Co-Author
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Stenotrophomonas maltophilia is an emerging, opportunistic pathogen that has shown increased prevalence in clinical infections (Brooke JS, 2021). It is a gram-negative, multidrug-resistant bacterium capable of biofilm formation, making infections in immunocompromised patients difficult to treat and exhibit high mortality rates. *Caenorhabditis elegans* is an excellent model organism in which to investigate the pathogenic mechanisms of *S. maltophilia*, as members of the *Stenotrophomonas* genus are naturally found in association and as part the gut microbiome. Genes differentially expressed in *C. elegans*' innate immune response to *S. maltophilia* were previously identified through RNA-sequencing analysis (Radeke and Herman, 2020), three of which encode for membrane raft proteins *irg-8*, *dod-19*, and?*B0024.4*. These genes were upregulated during the pathogenic response, and loss-of-function analysis using mutant strains revealed increased susceptibility. Furthermore, all three genes share significant sequence similarity and *irg-8* and *dod-19* lie directly adjacent to each other in the *C. elegans* genome. We chose these genes for further characterization to investigate both their possible redundant functions and the roles of membrane raft proteins in innate immunity, which has been unclear. Current efforts focus on examining these genes further through additional loss-of-function analyses and the generation of fluorescent fusion proteins. The loss-of-function analysis seeks to elucidate the functional involvement of these genes during *S. maltophilia* pathogenicity, which will be accomplished through the generation of double and triple knockout mutants. Fluorescent fusion proteins, on the other hand, will directly enable the observation of expression and localization activity, including subcellular localization. All genes have been successfully tagged with the mVenus Yellow Fluorescent Protein and examined for expression patterns, and the double and triple knockout strains have been generated. We observed that fluorescence localizes to the intestine and is significantly brighter upon exposure to pathogenic *S*. *maltophilia*, supporting the results of the RNA-seq study. Interestingly, *Pseudomonas aeruginosa* PA14, a pathogenic control, did not induce expression of *irg-8*, suggesting specificity in response to *S. maltophilia*. Future work will focus on examining these lines under greater magnification for visualizing subcellular localization, and characterizing the loss-of-function mutant strains.

REAL-TIME ELECTROMYOGRAPHY FOR BIOMECHANIC ACTUATION: SIGNAL PROCESSING AND CONTROL IMPLEMENTATION

Author
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Co-Author
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Due to the difficulty in interpreting muscle activity, the majority of current myoelectric and hybrid prosthetic systems are not able to provide smooth and intuitive motion to their users at an accessible price point. Electromyography (EMG) is a method of measuring electrical potential differences during contraction of the muscle, providing information on muscle function and control. A potential solution which allows users to operate prosthetics with natural muscle movement could be found with the use of EMG in prosthetics. With the financial assistance from the Fund for Undergradute Scholarly Experience (FUSE) grant, we are developing an EMG based control system that processes neuromuscular signals to control the grip strength of a prosthetic hand. A Myoware Muscle Sensor 2.0 will be placed on the biceps brachii for the recording of EMG signals. Preprocessing of the neuromuscular signals includes a process of filtering, rectification, and enveloping which removes low frequency noise and ensures relevant information is received. The data will be mapped from an analog signal to pulse width modulation (PWM) using an ESP32 microcontroller, allowing direct communication with a linear actuator. This device will be tested on its grip strength and time of a maintainable grip. We hypothesize that an accurate interpretation of real-time neuromuscular data through

an EMG controlled prosthetic system will provide a stable and responsive grip while maintaining affordability to users. The findings from this project could provide a foundation for future assistive technology advancements, leading to the further development of intuitive and reliable prosthetic devices.

Friday, April 25, 2025 7:45am - 10:55am

BIOLOGY MORNING SESSION- 1

Biology **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Arbor Suite A**

MORNING SESSION - 1 **Subsection Chairperson: Dr./Fr. John Shea**

7:45 Presenters upload Session talks onto room computer desktop.

8:00 A REVIEW ON MACHINE LEARNING ADVANCEMENTS IN EARLY DETECTION OF ATRIAL FIBRILLATION. Adya Dhuler and Steven L. Fernandes

8:15 THE EFFECTS OF CALCANEAL PRONATION AND SUPINATION ON THE POSTURE OF THE SHOULDERS. Xavier Harrell and Rachelle Rider

8:30 DEVELOPMENT OF A CITIZEN SCIENCE PROJECT TO BETTER UNDERSTAND NEST SITE CHARACTERISTICS OF EASTERN SCREECH-OWLS. Ran Hirosawa and Letitia Reichart

8:45 INVESTIGATING TOOTHBRUSH HYGIENE PRACTICES: STORAGE AND DECONTAMINATION METHODS FOR DISEASE PREVENT IN DAILY ORAL CARE. Kaylea Geiser and Jeffrey Kiiskila

9:00 GEOTAXIS IN AN UNKNOWN TENNESSEE HAIRWORM COMPARED TO THE AQUATIC HAIRWORM, *PARAGORDIUS VARIUS* . Colin S. Fague and John F. Shea

9:15 QUANTIFICATION OF YEAST IN THE HONEY BEE GUT MICROBIOME THROUGHOUT DEVELOPMENT. Colin MacKelly, Evalina Sain, and Carol Fassbinder-Orth

9:30 **BREAK**- Presenters upload session talks onto room computer desktop.

9:40 Presentation moved to Biology Poster Session. INFLUENCE OF THE PREVALENCE OF APARAVIRUSES ON HONEYBEE MORTALITY. Alexa K Kozlak, Woolpert J. Autumn, and Carol Fassbinder-Orth

9:55 CHANGING THE COURSE OF HISTORY, ONE GENE COPY AT A TIME. Sophia Pacheco and Soochin Cho

10:10 MANIPULATION OF ANTIOXIDANT GENE GPX1B AND ITS EFFECT ON STRESS AND ANXIETY. Cherylynn R. Gibson and Ryan Y. Wong, Ph.D

10:25 EVALUATION OF SITE CHARACTERISTICS TO IDENTIFY CHANGES NEEDED TO INCREASE USEFULNESS OF EXISTING WATERFOWL HABITAT. Hailey Fuqua, Letitia Reichart, Jayne Jonas, and Gregory Pec

10:40 NEST SITE CHARACTERISTICS OF GREAT HORNED OWLS (*BUBO VIRGINIANUS*) IN NEBRASKA. Tyler D. Matrangos

A REVIEW ON MACHINE LEARNING ADVANCEMENTS IN EARLY DETECTION OF ATRIAL FIBRILLATION

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Co-Author
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Atrial fibrillation, the most common cardiac arrhythmia worldwide, significantly raises the risk of stroke and heart failure, increasing healthcare burden and costs. Early detection is imperative for prevention and intervention. This has been provided by advancements in machine and deep learning, which has provided resilience even against noise or short durations. This systematic review, spanning eleven studies on PubMed, found that incorporating signal preprocessing (wavelet filtering, independent component analysis) and symbolic representations of RR intervals improved average sensitivity (up to 96.8%) and precision (up to 94%). While robustness and classification were improved by de-noising strategies like Stationary Wavelet Transform, phase-driven attention mechanisms, generative topographic mapping, and novel feature-selection strategies (filter-based ?-metric), synergizing convolutional neural networks (CNNs) and hybrid architectures (CNN–LSTM ensembles) is additionally beneficial. Wearable and contact-free monitoring (e.g., facial video–based pulse extraction) allow for continuous and opportunistic detection, which aids screening. Non-linear clustering (using GTM) with phenotyping methods improves risk stratification to support more focused risk management. With limited or non-human data, weak labels and uncertainty estimation improve model calibration and reliability. For paroxysmal AF episodes, dynamic symbolic assignment (DSA) captures transition patterns in RR intervals. Advancements in machine learning have significantly improved early detection of atrial fibrillation across scenarios. As this healthcare burden persists, hopefully, these innovations will improve prediction.

THE EFFECTS OF CALCANEAL PRONATION AND SUPINATION ON THE POSTURE OF THE SHOULDERS

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Co-Author
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The musculoskeletal system is a complex system that is responsible for maintaining the structure and function of different parts of the body, as well as maintaining the most energy-efficient posture. The system is susceptible to injuries and structural imbalances and will adjust the body as needed to compensate for the imbalances. Compensation is significant for this system to ensure that the body maintains itself in the most energy efficient position. Unnatural pronation and supination of the calcaneus have been found to affect the natural posture of the knee and hip, as well as other adjacent structures. These unnatural rotations are common conditions in which pronation is referred to as flat feet, and supination refers to overarching feet. However, very few studies examine how calcaneal rotation affects structures distally located from the foot, like the shoulder. Postural deficits in the shoulder often lead to discomfort and limited range of motion through the various movements facilitated by the shoulder joint. This study examines the magnitude of AC joint postural change that occurs from the pronation and supination of the calcaneus. Postural data was collected by photographing the AC joint posture of eight participants. Each participant was photographed while standing flat-footed, standing on a wedge that pronates their right calcaneus, and standing on a wedge that supinates their right calcaneus. Results were recently collected, and analysis of results has yet to occur. Results will be analyzed using statistical methods to analyze the AC joint positioning of participants in the three different positions. The posture recorded while participants stand flat-footed will be used as the control to which the other two positions will be compared. A comparison of these results will indicate if calcaneal pronation and supination influence the posture of the AC joint.

DEVELOPMENT OF A CITIZEN SCIENCE PROJECT TO BETTER UNDERSTAND NEST SITE CHARACTERISTICS OF EASTERN SCREECH-OWLS

Author
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University of Nebraska at Kearney

Eastern Screech-Owl (*Megascops asio*) is a species native to Nebraska that prefers to nest in tree cavities and can be observed in areas with open understories, such as farms, suburban landscapes, and city parks. Thus, this makes the Eastern Screech-Owl a great species for developing a citizen science program to study nest site characteristics within a suburban community. Our study took place in Kearney, Nebraska where we initiated a citizen science program to request owl sightings from the public. We used social media to encourage individuals to report local sightings which allowed us to locate screech-owl nests. Once nests were located, we identified nest site characteristics. In addition to studying nest site characteristics, we also developed educational lesson plans, for use in schools and community centers, to raise awareness about screech-owls. With assistance from local sightings and sightings reported on eBird, we identified at least three nest sites with the following characteristics: an approximate height of 3m, an entrance diameter of 7.62cm, and a preference for hackberry trees (*Celtis occidentalis*) in Kearney, Nebraska. Future research will use eBird to analyze historically recorded nest locations. Lesson plans will be disseminated in educational programs in Kearney and surrounding areas. By fostering community participation, we anticipate increased engagement with the public, and a better understanding of a species able to exist in both human dominated-landscapes and native habitat. Specifically, we will gain a better understanding of Eastern Screech-Owl nesting behavior in south-central Nebraska and encourage the public to learn more about a native species in Nebraska.

INVESTIGATING TOOTHBRUSH HYGIENE PRACTICES: STORAGE AND DECONTAMINATION METHODS FOR DISEASE PREVENT IN DAILY ORAL CARE

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Toothbrush contamination poses significant risks to oral and overall health by serving as a potential vector for pathogenic bacteria. Previous studies have highlighted the role of improper storage and insufficient decontamination in promoting bacterial growth. Moist environments, such as bathrooms, can intensify contamination, with serious implications for vulnerable populations in settings like hospitals. This study investigated optimal toothbrush hygiene practices, focusing on storage and decontamination methods, to identify the most effective strategies for reducing bacterial growth and preventing disease transmission. The research was conducted in two stages. In the first stage, toothbrushes were stored under different environmental conditions: in a non-toilet containing room, in a cupboard in a toilet-containing room, and on a countertop with and without protective covers in a toilet containing room. Bacterial contamination was quantified through identification by colony formation, colony counts and the Shannon-Wiener Diversity Index. In the second stage, the efficiency of four decontamination methods—UV light exposure, antiseptic mouthwash baths (Listerine and 0.2% chlorhexidine), and a tap water rinse—was tested using the same metrics. Future findings from this research could have important implications for improving everyday oral hygiene practices, especially in settings where health risks are elevated, such as hospitals and households with vulnerable individuals. This research highlights the importance of toothbrush hygiene as a simple yet impactful measure for improving overall health outcomes.

GEOTAXIS IN AN UNKNOWN TENNESEE HAIRWORM COMPARED TO THE AQUATIC HAIRWORM, PARAGORDIUS VARIUS

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The adult stage of parasitic freshwater hairworms [Nematomorpha] inhabit aquatic environments. In 2019, a terrestrial hairworm was described in Oklahoma, named *Gordius terrestris*, defying the commonly held assumption that all nematomorphs were aquatic. A potential second example of terrestrial worms was collected from Tennessee. This project assesses the geotaxis response of an unknown Tennessee hairworm, especially in comparison to the aquatic hairworm *Paragordius varius*. If the unknown hairworm is terrestrial, then it would both exhibit greater movement out of an aquatic environment as well as exhibiting negative geotaxis (would tend to direct movement up). To test this, worms were placed on caps floating in jars of water or laying on top of moist paper towels, and movements were observed for 20-minute trials. Preliminary analysis suggests that while there may not be an isolated geotaxis response in the terrestrial worms, there may be a climbing response exhibited when in contact with a firm structure and/or when in contact with water. These results differ greatly from *P. varius*, where no directed movement was observed at all. Though sample sizes were small (n=8 for Tennessee worms, n=20 for lab-reared *P. varius*), these results may indicate that the behavior of the Tennessee hairworms differ greatly from *P. varius*, suggesting that the Tennessee hairworm may be terrestrial.

QUANTIFICATION OF YEAST IN THE HONEY BEE GUT MICROBIOME THROUGHOUT DEVELOPMENT

Author
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European honey bees (*Apis mellifera*) are the primary pollinator for agricultural crops, thus their health is crucial to human society, in addition to their ecological value. However, honeybee colonies are experiencing massive and unexpected losses. One understudied part of honeybee resilience is their gut microbiome. The levels of such microbes as well as the relationship between these microbes and host health remains largely unknown, especially for yeast species. This study aimed to investigate yeast dynamics across honey bee developmental stages. Levels of yeast DNA in the honey bee digestive tract were quantified using digital droplet PCR (ddPCR). Developmental stages included larval, pupal, pharate, pre-eclosed, nurses, and foragers. We found that yeasts are present in the larval gut at significant levels. During the pupal stage, yeast levels decreased dramatically, becoming nearly undetectable pre-eclosure. This observation supports the hypothesis that the yeast microbiome is purged during metamorphosis. Notably, in adult nurse bees, yeast levels increased to more than three times the levels observed in the larval stage, suggesting a restoration of the gut mycobiome post-metamorphosis. Additional research is underway to quantify specific yeast genera and further understand their functional roles in the honey bee.

CHANGING THE COURSE OF HISTORY, ONE GENE COPY AT A TIME

Author
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Evolution is important for the survival of a species because it allows the species to adapt to environmental changes. This can occur through mutations, natural selection, or other mechanisms such as gene duplication. Gene duplication allows the original version of a gene to be maintained in the genome, while a copy of that gene can undergo genetic changes without affecting the function of the original gene. One group of genes that have evolved through gene duplication are the primate alpha-amylase genes. Alpha-amylases are crucial enzymes for starch digestion because they allow for the cleavage of complex sugars, such as starch, into simpler sugars that can be more easily absorbed through nutrient uptake. During human evolution, gene duplication gave rise to three types of alpha-amylases: salivary amylase (AMY1) and pancreatic amylases (AMY2A and AMY2B). The pancreatic amylases are expressed in the pancreas and travel to the small intestine, while the salivary amylase, expressed in the salivary glands, travels to the oral cavity and then to the stomach. Since these amylases are found in different environments, they evolved to function optimally in differing pH conditions. Previous studies in our lab have shown that AMY1 (salivary) has higher enzymatic activity than AMY2A (pancreatic) in acidic environments (pH 3-6), but low activity in neutral environments. Although these observations have been made, it is unclear how each amylase changed its function to adapt to different pH environments. From this, I hypothesize that after gene duplication AMY1 and AMY2A evolved independently to maximize their activities in acidic and neutral pHs, respectively. To test this hypothesis, I resurrect the enzyme ancestral to AMY1 and AMY2A and will compare its properties with those of present-time enzymes (AMY1 and AMY2A). For this, I use the gene sequence of the ancestral gene determined by statistical inference. This sequence is chemically synthesized and inserted into the yeast (*Pichia pastoris*) genome. Then, its proteins are expressed, purified, and tested for their activities in acidic and neutral pHs using an enzymatic assay. With this data, we will elucidate the evolutionary history of the human alpha-amylase genes that contributed to our adaptation to a higher starch diet.

MANIPULATION OF ANTIOXIDANT GENE GPX1B AND ITS EFFECT ON STRESS AND ANXIETY

Author
Cherylynn Gibson

Stress and anxiety disorders are a common class of mental illnesses that impact a large portion of the human population. Several factors contribute to stress and anxiety within individuals such as their genetics, stress-coping style, and oxidative stress and antioxidant capacities. Prooxidants promote oxidative stress through the generation of reactive oxygen species (ROS) or the inhibition of antioxidants that actively work to neutralize ROS. Studies have shown that oxidative stress can directly alter the neuroendocrine stress response and influence anxiety-like behaviors. Compounds with antioxidant capabilities mitigate the negative effects of neuroendocrine stress-induced oxidative damage. These insights have laid the foundation for antioxidant therapy used as a treatment course alongside standard pharmacological approaches. Glutathione peroxidases are enzymatic antioxidants that are a part of our defensive mechanisms against ROS-induced stress. Oxidation states of glutathione show significant alterations in relation to ROS and stress levels pointing out the relationship and role they play in redox homeostasis. Previous work has shown differences in a glutathione peroxidase's (gpx1b) baseline gene expression between proactive and reactive stress-coping phenotypes, which suggests that antioxidant capacity may be linked to display of the stress-coping phenotype. However, it is unclear whether antioxidant activity through gpx1b directly influences stress and anxiety-like behavior in response to an acute stressor. I hypothesize that inhibiting the gpx1b gene and its antioxidant capacity will result in increased oxidative damage and reactive stress-coping style behavior in both the proactive and reactive phenotypes. To test this hypothesis, I will manipulate the expression of gpx1b to modulate the antioxidant's capacity and assess changes in stress and anxiety-like behavior. Using zebrafish selectively bred to have either the

proactive or reactive stress-coping phenotypes, I will collect embryos and microinject CRISPR-Cas9 constructs to create gpx1b knockout lines. After rearing to adulthood, I will compare verified mutants to the controls for each line to investigate differences in behavioral stress response to an acute novelty stressor (novelty tank diving test). I will also quantify brain oxidative stress and antioxidant biomarkers to elucidate impact on redox homeostasis and stress response. Ultimately this research may lead to insights regarding mechanistic relationships of glutathione and stress-coping phenotypes and their role of oxidative stress in the brain.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427

EVALUATION OF SITE CHARACTERISTICS TO IDENTIFY CHANGES NEEDED TO INCREASE USEFULNESS OF EXISTING WATERFOWL HABITAT

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In south-central Nebraska waterfowl are common migrants, during spring and fall, and some species also breed here. Some landowners along the Platte River would like to modify existing habitat to better serve waterfowl needs. Specifically, this project focuses on a location along the Platte River where waterfowl have been observed. The objectives of this study are to identify current plant species and soil characteristics for this location. We conducted plant surveys and collected soil cores at 30 sites. Plant surveys showed there were 30 different plant species observed. We are currently in the process of analyzing soil cores for root biomass, soil type, soil moisture, pH, and nitrogen. Results from this study will be used to create a habitat management plan that will allow us to recruit more waterfowl to this location. Future goals for this location are to provide food resources and habitat for use by both migratory and breeding waterfowl.
Funding for this project provided by University of Nebraska at Kearney Undergraduate Research Fellows Program.

NEST SITE CHARACTERISTICS OF GREAT HORNED OWLS (BUBO VIRGINIANUS) IN NEBRASKA.

Author
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The Great Horned Owl (*Bubo virginianus*) is a large avian predator in much of North America, known for its diverse diet and adaptability to different environments. Despite its broad distribution across North America, nest site characteristics of tree nests remain unknown due to the species being nocturnal and use of nests from other species. They are known to occupy a wide variety of nesting sites including old nests of other species, cavities in

trees or on cliffs, barns, and man-made structures. This research project investigates nest site characteristics of Great Horned Owls in central and eastern Nebraska, examining tree species, nest height, and diameter breast height (dbh) measurements for the nesting tree compared to a nearby random, non-nest tree. We have not detected any significant differences in nest tree characteristics. One challenge is we do not know the species that made the original nest, and nests were found in many different environments. Thus, we need a larger sample size to describe nest site characteristics across varying habitat types. By continuing to document nest site characteristics, this research can contribute to better understanding habitat use by the population of Great Horned Owls in Nebraska.

Friday, April 25, 2025 7:45am - 10:55am

CHEMISTRY MORNING SESSION- 1

Chemistry **Chairperson(s): Dr. Matt Beio**

FRIDAY, APRIL 25 **Location: Arbor Suite B**

MORNING SESSION - 1

7:45 Presenters upload talks onto the room computer desktop.

8:00 STUDYING DIFFERENT INFANT FORMULAS AND BREASTMILK AND THEIR EFFECTS OF FLUOROSIS AND/OR DECAY ON TEETH. Jocelyn Schiaffo and Mary Keithly

8:15 CARDIOTOXIC EFFECTS OF VASOPRESSORS ON IN VITRO MYOCARDIAL TISSUE. Elijah Huntington and Mary Keithly

8:30 THE PYROLYSIS PARADIGM: TRANSFORMING PLASTIC WASTE INTO VALUABLE RESOURCES. Chance Cooper, Tim Keith, and Mary Keithly

8:45 ELECTROCULTURE OF TOMATO PLANTS. Thomas Walsh, Mary Keithly, Clint Evrard, and Tim Keith

9:00 EXAMINATION OF INSULIN DEGREDATION. Colton Holoubeck and Dr. Mary Keithly

9:15 THE USE OF NITROGEN-BASED FERTILIZERS ON TOMATO PLANTS. Ashley Jansen

9:30 **BREAK** - Presenters upload talks onto the room computer desktop.

9:40 ANALYZING THE EFFECTIVITY OF WILDLAND FIREFIGHTER MASKS. Kendall Petty, Tim Keith, and Mary Keithly

9:55 Presentation has been moved to the Chemistry Poster Session. A SURVEY OF COMPUTATIONAL METHODS FOR THE IDENTIFICATION OF PSYCHOACTIVE DRUGS BASED ON SPECTRA. Kenjiro Pieters and Brett A. Cagg

10:10 ENCAPSULATION-DRIVEN PHOTOCYCLOADDITION CHALCONES - STUDY OF SUPRAMOLECULAR AND PHOTOCHEMICAL PROCESSES. Pattabiraman M, and Chatterjee J, Regmi S.

STUDYING DIFFERENT INFANT FORMULAS AND BREASTMILK AND THEIR EFFECTS OF FLUOROSIS AND/OR DECAY ON TEETH

Author
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An overabundance of fluoride consumed by young children has contributed to cases of fluorosis which is a cosmetic condition that causes white spots or striations on the enamel of teeth. It is important to take care of enamel because once enamel is fully formed, the body is not able to heal it once damaged. Fluoride is used in common items such as toothpaste, mouthwash, and fluoridated water to prevent dental caries, but there has been debate if these common sources can be linked to fluorosis development. Previous research has studied infant formula and its potential risk of developing fluorosis because often, infant formula contains the optimal amount of fluoride, but when paired with fluoridated water, an exceeding amount of fluoride is consumed by the infant. A comparison of two different infant formulas (Similac Total Comfort and Enfamil) using fluoridated and non-fluoridated water with breastmilk was analyzed for effects of fluorosis and/or decay on bovine teeth. Bovine teeth were used because they are easier to obtain and have a similar makeup to human teeth. When done soaking, the teeth were placed in artificial saliva for the remainder of the day. Analysis is currently underway. Results will be analyzed using the PXRF for elemental analysis of the enamel, SEM to closely visualize enamel, and pictures were taken to compare coloration.

CARDIOTOXIC EFFECTS OF VASOPRESSORS ON IN VITRO MYOCARDIAL TISSUE

Author
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Co-Author
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Chadron State College

Pharmacological research of cardiac tissue has not covered certain aspects of biochemical interaction for many years. Current research focuses on myocardial stem cells which lack many characteristics of natively grow tissues. The absence of these characteristics may result in inaccurate interpretations of drug effects on cardiac tissues in other studies. The following paper will investigate the viability of thin-slice cardiac tissue collected from Wistar rats. The cardiac tissue culture model apparatus developed by J. Miller et al. serves as a basis for studying natively grown tissue drug interactions. The apparatus is capable of mechanical stimulation via electrodes and proper tissue perfusion via submerging samples in oxygenated Tyrode’s solution which has been recorded to maintain cardiac tissue viability for up to 12 days. Following the proposal by J. Miller et al., the Wistar rat samples will be properly prepared and loaded into a similar apparatus and introduced to the vasopressor medications epinephrine, norepinephrine, and dopamine over a 12 day trial period. These vasopressors are commonly used in critical care settings, however, epinephrine, norepinephrine, and dopamine pose certain individualized risks to cardiac tissue. The following research may reveal key points of data such as what dosage generates equivalent cardiac energy output between the medications and the levels of cellular damage induced by the medications. Investigating equivalent energy output and damage to cardiac tissue will inform physician opinion as to the best indicated medication given a patient’s presentation. By analyzing the effect of classical vasopressor medication on viable cardiac tissue, this research will also determine which vasopressor offers the greatest cardioprotective effects, as well as equivalent energy output.

THE PYROLYSIS PARADIGM: TRANSFORMING PLASTIC WASTE INTO VALUABLE RESOURCES

Author
Chance Cooper

Co-Author
Mary Keithly
Chadron State College

Although plastic use has become increasingly common throughout modern society, consumers often think of the convenience associated with plastic use rather than the potential long-term consequences. Astronomical amounts of plastic waste accumulate throughout the world on an annual basis, and the United States is not exempt from contributing to this waste production. Unfortunately, the same property that makes plastic desirable, namely its longevity, is a large source of the reason that plastic waste can be so detrimental to the environment. Since plastic pervades every aspect of the average person;s daily life, one of the main objectives of plastic pyrolysis would be to repurpose plastic waste. Additional objectives include isolation of useful materials from the pyrolysis process with the potential for creating collectible fuels and adding to the options for renewable energy source production. Plastic waste was obtained from recycling bins. A plastic shredder was used to break the bottles down into more manageable plastic pieces prior to the construction of a pyrolysis chamber utilizing glassware from the science department at Chadron State College. A pyrolysis reaction was achieved through the application of heat. Then a collection apparatus facilitated the final process of isolating resulting products, which were further examined with a fractionating column, gas chromatography mass spectrometry, and IR spectroscopy to analyze products obtained. Analysis is underway, but it is important to note that production of flammable fuel from plastic waste is expected through a pyrolysis process. Pyrolysis is a viable option to repurpose excessive plastic waste into valuable fuel, which will serve the dual purpose of reducing environmental waste and providing an energy source from recycled materials. Not only is this important from a waste reduction standpoint, but it is also economically feasible due to the low cost of implementation.

ELECTROCULTURE OF TOMATO PLANTS

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The 20th century heralded numerous groundbreaking discoveries in biology, including the double helix theory of DNA and the advent of antibiotics. Among these innovations was the concept of electro-culture, the use of low voltage electrical currents to stimulate plant growth, initially pioneered by Georges Lakhovsky in the 1920s. Despite its demonstrated effectiveness, the precise mechanisms behind electro-culture remain unclear, with hypotheses suggesting increased ion availability in soil or enhanced nutrient uptake via electroporation. To investigate the latter, we conducted an experiment with 12 tomato plants subjected to electrical currents of 3V, 6V, and 9V, alongside a control group. Each plant was grown in separate pots with standardized soil and copper wire to deliver the current. Plants were monitored weekly for growth rate, height, leaf size, and plant mass, with any signs of infection noted to assess the electroporation theory. Our findings aim to elucidate the underlying mechanisms of electro-culture, potentially optimizing its application for enhanced agricultural productivity.
This study utilized 12 tomato seeds (Everwild Farms – 100 Homestead Heirloom Tomato Seeds) to ensure repeatability and consistency in results. Each seed was planted in a separate pot to prevent cross-contamination of soil. Electro-culture stakes with copper wire were used to introduce electrical currents into the soil. Standard potting soil was used to maintain uniform ion concentration. A laboratory battery provided currents of 3V, 6V, and 9V, at 10-minute intervals per day based on Makundraj B. Patil's study on R. *sativus*. The control group received no electrical current. Plants were watered daily with 10 milliliters and exposed to equal amounts of light via growth light.

Measurements of plant height, leaf size, and mass were taken weekly over nine weeks to assess growth patterns and potential infections.

EXAMINATION OF INSULIN DEGREDATION

Author
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Co-Author
Mary Keithly
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To improve the structural integrity of insulin during storage and transportation, the degradation of insulin under various conditions and with specific additives was analyzed. Prior studies have reported combining specific cyclodextrins with insulin improves insulin's structural integrity while also preventing the formation of insulin amyloid fibrils. We report that a combination of Forthyoside A and bovine insulin prolonged the preservation of insulin and minimization of insulin amyloid fibrils under less-than-ideal conditions. Bovine insulin was incorporated into a phosphate buffer (pH 7.2) with the presence and absence of Forthyoside A, respectively. Each sample consisted of 25 mm phosphate buffer (pH 7.2), 0.5 mg/mL insulin. To test the viability of the insulin when combined in the solution, UV spectroscopy at 280 nm was determined from the stock insulin and the diluted insulin in the sample to ensure the insulin remained soluble. Samples were then either heated to 80°C for 24 hours, shaken on a Gyratory shaker for 2.5 days, or heated above 80°C with shaken for 24 hours, respectively. After these adverse conditions were applied to the solutions, amyloid formation was quantified by visible observation of turbidity and observation through a spectrophotometer at a range of 200 to 800 nm with substantial peaks at 280 nm. The change in concentration of soluble insulin was determined using the absorbance at 280 nm. Once amyloid fibril formation was confirmed after heating, shaking, or heating with shaking, respectively, new samples were made at the same proportions and combined with 300 mmol Forthyoside A. The same conditions of heating, shaking, or heating with shaking were applied to these samples. Initial results with Forthyoside A indicate that insulin is more stable and soluble upon the addition of Forthyoside A compared to without. The addition of specific cyclodextrins or Forthyoside A to insulin provides a promising avenue of research that can provide a safer and more efficient additive to synthetic insulin used by patients for diabetes mellitus worldwide.

THE USE OF NITROGEN-BASED FERTILIZERS ON TOMATO PLANTS

Author
Ashley Jansen

THE USE OF NITROGEN-BASED FERTILIZERS ON TOMATO PLANTS

Ashley Jansen
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Fertilizers have been used for many years to help add nutrients back into the ground for plant growth. Many nutrients are essential to the development of large plants. With our growing population and a higher demand for food, finding the best types of fertilizers is critical. Before, when the lands weren't civilized, the soil had plenty of nutrients to sustain growing crops for a smaller population. Native Americans were the first to use fish as a type of fertilizer. From there, settlers started to use guano, bones, fish, slaughterhouse waste, wood ash, sodium nitrate, ammonium sulfate, cottonseed meal, and poudrette (Sellars, 2021). However, many nutrients are needed for efficient plant growth. One of the most essential nutrients required is nitrogen, which is readily available and produces large crops. The three types of nitrogen fertilizers that will be used in this experiment are made in different concentrations. Urea has the highest concentration of nitrogen at 45%, Ammonium Nitrate has a concentration of 33%, and the lowest concentration is Chillen Nitrate at 16% (Simms, 2023).

Testing the different concentration ratios of nitrogen in fertilizers can help us determine whether a higher or a lower amount is required for growth. Many plants use nitrogen as a source of nutrients, but some need it more than others. The tomato plant will be used, as tomato plants often need larger amounts of nitrogen in the soil. In this experiment, twelve total tomato plants will be grown, 3 with no fertilizers, three with urea, three with ammonium nitrate, and three with Chilean nitrate. In the Urea pot, there will be around .003 cups per gallon of soil. In the ammonium nitrate pot, there will be .008 cups per gallon of soil; in the Chilean nitrate pot, there will be .016 cups per gallon of soil. Every week, measurements will be taken to determine which fertilizer helps to produce larger plants and fruits. When growing, more fertilizer will be added in smaller amounts every three weeks to sustain nitrogen. Upon the use of different concentrations of fertilizers, various outcomes can occur. Expected would be that Urea will produce the largest plants and fruit as it has the highest nitrogen percentage, which is released slowly. As tomato plants like a high amount of nitrogen in the soil,

having a higher concentration fertilizer will ultimately produce a larger plant than a fertilizer with lower concentrations.

Citation
Sellars, S. Synthetic Nitrogen Fertilizer in the U.S. • farmdoc daily. farmdoc daily. https://farmdocdaily.illinois.edu/2021/02/synthetic-nitrogen-fertilizer-in-the-us.html (accessed 2024-04-04).
Simms, D. Fertilizers. https://research-ebsco-com.chadronstate.idm.oclc.org/c/mfmvvt/viewer/html/2gc6qybhvr (accessed 2024-03-28).

ANALYZING THE EFFECTIVITY OF WILDLAND FIREFIGHTER MASKS

Author
Kendall Petty
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Three different commonly used types of wildland firefighter masks compare the effectiveness of heat resistance as well as chemical absorbance to one another. The three different mask types used in this study were HS-4 Mask with SR-100 Respirator, HS-2 Face Protector with Particle Mask, and UB-V2 Wildland Firefighter Ultimate Bandana. The three types of masks are commonly used by wildland firefighters for their heat resistance and chemical absorbance to better protect them from harmful inhalants during firefighting. The three masks all vary in composition and in price to test if the more expensive masks are more effective than the less expensive versions. Each mask's heat resistance was tested using a MAPP Oxygen Torch calibrated to a target temperature of 1500°F. The heat resistance phase of testing analyzed the masks for degradation over a period time by analyzing air flow and determine when the structural degradation is compromised. The results could lead to improved selection of masks for wildland firefighters. After the conclusion of the experiment other areas of further research will be underlined based on the findings of this study. This study’s apparatus has been set, and testing is currently being done.

ENCAPSULATION-DRIVEN PHOTOCYCLOADDITION CHALCONES - STUDY OF SUPRAMOLECULAR AND PHOTOCHEMICAL PROCESSES

Author
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Encapsulation of photoreactive alkenes within cavitands as a reliable method for controlling photocycloaddition (PCA) reactions is an ongoing endevor in our research group. Dubbed the cavitand-mediatd photocycloaddition (CMP) approach, this methodology provides a supramolecular means of directing the bimolecular PCA of a wide range of aryl acrylic acids (Ar-CH=CH-COOH) towards specific regio- and stereoisomers, yielding several truxillic and truxinic acid dimers selectively and in high yields. The presence of truxillic and truxinic acid cores in several natural compounds and bioactive molecules adds significance to this endeavor. This presentation features our exploration of CMP applied to the PCA of chalcones (Ph-CO-CH=CH-Ph), wherein key differences in product chemoselectivity and the spectroscopic features of the host-guest complexes, in comparison to acrylic acids, were observed. This new study, which investigates the photochemical and supramolecular factors governing the differences in reactivity and selectivity between acrylic acids and chalcones, provides additional insights into the factors that influence the effectiveness of CMP. It is hypothesized that differences in intermolecular hydrogen bonding pi-pi stacking, and cavity-induced conformational restrictions contribute to the observed selectivity in the PCA of chalcones versus acrylic acids. These findings are expected to expand the scope of CMP and pave the way for its potential application in the selective synthesis of bioactive and pharmaceutically relevant molecular architectures.

Friday, April 25, 2025 8:00am - 9:15am

EARTH SCIENCES MORNING SESSION- 1

Chairperson: Irina Filina

Earth Sciences: Geophysical studies in the Northern Atlantic **Chairperson: Dr. Irina Filina**

FRIDAY, APRIL 25 **Location: Legacy A**

MORNING SESSION - 1

8:00 Presenters upload Session talks onto room computer desktop.

8:15 GEOPHYSICAL ANALYSIS OF CONJUGATE GREENLAND AND VORING MARGIN. Anika N. Mayeesha, Kaitlin Steinauer and Irina Filina

8:30 CONTINENTAL OR OCEANIC? MODELING THE CRUST BENEATH THE GREENLAND-ICELAND-FAROE RIDGE. Zachary Clowdus and Irina Filina

8:45 EXPLORING THE TECTONIC EVOLUTION OF THE KOLBEINSEY RIDGE VIA INTEGRATED GEOPHYSICAL ANALYSIS OF A PROPAGATOR WAKE SERIES. Ethan Stowell and Irina Filina

9:00 REFINING SEDIMENTARY AND CRUSTAL THICKNESS MAPS OF THE NORTHERN ATLANTIC OCEAN FROM LEGACY SEISMIC REFLECTION AND REFRACTION DATA. Hermione Lofton, Md AbdullahSalman, Tochukwu Onyebum and Irina Filina

9:15 **BREAK**

GEOPHYSICAL ANALYSIS OF CONJUGATE GREENLAND AND VORING MARGIN

Author
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University of Nebraska-Lincoln

Co-Author
Kaitlin Steinauer
University of Nebraska-Lincoln

Co-Author
Irina Filina
University of Nebraska-Lincoln

The Vøring Plateau and Vøring Spur, prominent features of the northeast Atlantic Ocean, are critical for understanding the tectonic and magmatic processes associated with continental breakup along volcanic rifted margins. However, the subsurface structure, crustal affinity, and precise location of the ocean-continent boundary (OCB) remains unclear. Traditionally, these regions have been classified as “thick oceanic crust” based solely on magnetic signatures, while their conjugate margin in Greenland is well accepted as stretched and magmatically modified continental crust. This study aims to delineate the OCB and reassess the crustal classification of the Vøring Plateau and Vøring Spur by integrating various geophysical datasets, including bathymetry, free-air gravity, total magnetic intensity (TMI), seismic refraction and reflection data, and IODP 396 borehole information and comparing their geophysical signatures with those of the Greenland margin. We developed two refined subsurface models for both Vøring and Greenland margin along seismic profile 11-03 and profile AWI-20030500 respectively to test two possible scenarios: (1) an oceanic crustal nature, (2) a continental crust modified by magmatic intrusions. By applying integrated geophysical modeling, we analyze free air gravity anomalies, magnetic signatures, and seismic profiles while maintaining consistent physical properties across both margins. Constraints from known seaward-dipping reflector (SDR) complexes, well data, and crustal velocity structures are incorporated to refine subsurface interpretations. The findings will provide new insights into the tectonic evolution of the North Atlantic, contributing to improved regional tectonic models and a deeper understanding of passive margin development.

CONTINENTAL OR OCEANIC? MODELING THE CRUST BENEATH THE GREENLAND-ICELAND-FAROE RIDGE

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Co-Author
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The Greenland-Iceland-Faroe Ridge (GIFR) is a high-standing, aseismic ridge flanked by passive continental margins, with Greenland to the west and the North Sea to the east. The GIFR has intermediate crustal thickness values, ranging from 20 to 40 km, which do not readily classify as having either oceanic or continental affinity. The crust, sometimes termed “Icelandic-type” crust, is believed to have been formed by interactions between the highly productive hotspot located under Iceland and the North Atlantic spreading center. Most researchers believe the GIFR is composed of anomalously thick oceanic crust, however, other research has suggested the possibility of a continental component within the crust. A recent study has proposed that the GIFR is composed of 3-10 km of mafic magma flows and dykes underlain by up to 30 km of magma-inflated continental crust. This idea requires a re-evaluation of the formation of Iceland and the entire GIFR within this framework. Here we test these two endmember scenarios by developing simplified models of oceanic and stretched continental crust across the GIFR. The models use an integrative geophysical approach that takes advantage of publicly available bathymetric, seismic, gravity anomaly, and magnetic anomaly data. Velocity models derived from seismic refraction experiments define the principal geometrical constraints and provide critical information on the crust-mantle boundary and continent-ocean transition. Geologically reasonable physical parameters are applied to the models, and the gravity and magnetic anomaly signals are compared to the observed data. The forward models reveal that these scenarios may not be readily resolvable even with this integrated geophysical approach. The models suggest that a lower crust consisting of magma-inflated continental crust is feasible given these datasets. The results of this study indicate that further integration is necessary to distinguish between the two modeled scenarios. Additionally, a better understanding of the mechanisms and large-scale geometry of a magma-inflated lower continental crust would be beneficial for modeling.

EXPLORING THE TECTONIC EVOLUTION OF THE KOLBEINSEY RIDGE VIA INTEGRATED GEOPHYSICAL ANALYSIS OF A PROPAGATOR WAKE SERIES

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Co-Author
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The Kolbeinsey Ridge is an actively spreading mid-ocean center located to the North of Iceland in the North Atlantic Ocean. The Kolbeinsey Ridge comprises five segments striking N/NE to S/SW, joined by four junctions. Three of these connections have been identified in gravity data as complex geologic structures rather than orthogonal transform faults found at typical junctions, such as the fourth intersection. The center structure is distinctly visible as a W-shaped negative gravity anomaly and is described in literature as a propagator wake. Propagator wakes are W and V-shaped systems of faults and pseudofaults resulting from ridge segments competing for magmatic sources. Junctions to the North and South of the most pronounced propagator wake also exhibit characteristics of propagator wakes but have less well-defined geometries in geophysical data. This study aims to correlate the characteristics of these atypical junctions using an integrated geophysical methodology. We will use gravity, bathymetric, and seismic data (where available) to constrain the geometries of W and V-shaped features. We then will correlate the ages of

critical events, such as initiation, reversal, and propagation rate using aeromagnetic data to compose a tectonic timeline of the ridge evolution. Comparing these data will allow us to gain insight into the complex magma interactions (continuous vs localized propagation) of these enigmatic structures, providing crucial information for future reconstructions of the tectonic evolution of the North Atlantic Ocean.

REFINING SEDIMENTARY AND CRUSTAL THICKNESS MAPS OF THE NORTHERN ATLANTIC OCEAN FROM SEISMIC REFLECTIONS AND REFRACTIONS

Author
Hermione Lofton
University of Nebraska-Lincoln

This project aims to better understand the tectonic structures of the Northern Atlantic Ocean, such as the actively spreading Kolbiensey Ridge, the extinct Aegir Ridge and the Jan Mayen Fracture Zone and Jan Mayen Microcontinent, the extent of which remains disputed in the scientific community. To better delineate the tectonic structures in the Northern Atlantic, we have developed thickness maps of sedimentary and crustal layers from analog seismic reflection and published refraction data. Seismic reflection data from GeoMapAPP were used to measure thickness of sediments in two-way travel time, which was then converted to meters by using an average velocity derived from ocean drilling results in the area. The crustal thickness map was developed from measurements along eighteen seismic refraction profiles. We have compared our crustal and sedimentary thickness maps with several published datasets. In particular, we evaluated our sediments against the GlobalSed and the Crust1.0 global compilations. Preliminary results reveal discrepancies over the Norwegian margin and the Jan Mayen Microcontinent, which we attribute to differences in the geologic interpretation of the basement in seismic reflection data. We also interpreted the boundaries of major tectonic elements and compared them to published maps revealing reasonable agreement. The developed thickness maps will guide a future tectonic reconstruction of this complex geologic region.

REMARKABLE MXENES: TRANSFORMING TEXTILE-BASED SUPERCAPACITORS

Author
Abaigeal Aydt
University of Nebraska - Lincoln

The widespread use of portable electronics encourages interest in the research of wearable supercapacitors. Current methods to create textile-based supercapacitors (TSCs) involve the synthesis of conductive materials to coat fibers such as cotton or wool. Among various materials, MXenes, a family of two-dimensional transition metal carbides or nitrides, have gained significant attention. Different coating methods and yarn types are of interest for further optimizing the manufacturing of conductive yarns. Yarn coating was previously done by dipping the yarn into the MXene colloidal solution and drying it under a continuous vacuum. To optimize the method, an auto-coater was developed for simultaneously coating and drying yarn. The current auto-coater employs a fan and motor system. The motor with a shaft spins the newly coated and dried yarn onto a spindle. Once coated, a series of tests are run. In comparing two yarns, wool and cotton, the wool yarn has greater pseudocapacitive behavior when analyzing the cyclic voltammetry (CV) scans, while cotton yarn had more resistive behavior. TSCs are knitted by hand. This process is improved using a digital knitting machine (Kniterate). Kniterate can be programmed to knit TSCs used in this research. To utilize the machine, fundamentals of operation and coding knowledge are needed. This machine offers several advantages; TSCs can be knitted with more consistent sizing, mass production is more efficient, and the knitting environment is more controlled. Using wool fibers, the auto-coater, and the Kniterate, the research of developing wearable MXene TSCs is expanding to include studying the effect of yarn substrate and processing on performance.

Friday, April 25, 2025 8:00am - 9:45am

SCIENCE EDUCATION MORNING SESSION- 1

Chairperson: Christine Gustafson

Science Education **Chairperson: Christine Gustafson**

FRIDAY, APRIL 25 **Location: Prairie Suite C**

MORNING SESSION - 1

7:40 Presenters upload talks onto room computer desktop.

7:45 ZOOM Session opens for participants to join https://unl.zoom.us/j/98500223804

8:00 TURMERIC THREADS – DYING TO CHANGE COLOR. Conner Schwend, Mary Keithly, Tim Keith

8:15 CONTRIBUTIONS OF A GEOGRAPHIC PERSPECTIVE. Kyle Tredinnick

8:30 FOOD INSECURITY AMONG COLLEGE STUDENTS IN FOUR YEAR HIGHER EDUCATION INSTITUTIONS IN NEBRASKA. Michael Atuahene Djan

8:45 INQUIRY-GUIDED LEARNING TO DEVELOP NEAR-SPACE EXPERIMENTS. Derrick A. Nero

9:00 USING POKEMON TO TEACH TAXONOMIC CLASSIFICATION AND ANIMAL DIVERSITY. Nicholas Wohlgemuth

9:15 Conclude Science Education Session

9:30 **BREAK**

CONTRIBUTIONS OF A GEOGRAPHIC PERSPECTIVE

Author
Kyle Tredinnick
University of Nebraska at Omaha

Relegation of geography as the mere memorization of place names and locations has led to the devaluing of the perspectives it offers in better understand our planet's physical and human systems. This is due, in part, to the ineffectiveness of academic geographers in being able to communicate the particular habits of mind and behaviors of geographic practice which define our field. This presentation reviews the scholarship surrounding the field of geographic practices, and discusses the placement of geography within the sciences. Emphasis will be place on opportunities for interdisciplinary collaborations to enrich inquiries in other fields through the inclusion of geographic perspectives. Insights from ongoing research into the nature of geographic practices in understanding, answering, and solving geographic problems will be discussed with particular emphasis on how a practice-based approach can be helpful in broadening investigations into authentic issues. CONTRIBUTIONS OF A GEOGRAPHIC PERSPECTIVE is connected to the work being conducted by University of Nebraska - Lincoln Doctoral Candidate Kyle Tredinnick, who also works as an adjunct instructor in the Department of Geography/Geology at the University of Nebraska at Omaha and as a Social Studies teacher for Omaha Public Schools.

FOOD INSECURITY AMONG COLLEGE STUDENTS IN FOUR YEAR HIGHER EDUCATION INSTITUTIONS IN NEBRASKA

Author
Michael Atuahene Djan
University of Nebraska - Lincoln

This study seeks to understand and address the challenges of food insecurity among college students in higher education institutions in Nebraska. Food insecurity, a lack of consistent access to enough nutritious food is a growing issue that affects students' ability to focus, perform academically, and thrive in their personal lives. Despite its widespread impact, there's limited research on how this issue plays out among many higher education institutions in Nebraska, and I am driven to fill that gap. Through this study, I hope to shed light on the realities students face and offer meaningful solutions to support their success.

The heart of this research lies in the stories and experiences of students. Using a convergent mixed-methods approach, I will combine quantitative surveys with qualitative interviews to capture the lived experiences of students. Quantitative data will be gathered through an online survey using Qualtrics, incorporating validated instruments such as the USDA Food Security Survey Module to assess food security status, academic performance, and demographic characteristics. Simultaneously, qualitative data will be collected through semi-structured interviews with a purposive sample of students reporting food insecurity, providing deeper insights into their lived experiences, challenges, and coping mechanisms. The integration of these data sources will allow for a comprehensive understanding of the issue and inform evidence-based interventions.
This study is guided by Abraham Maslow's Hierarchy of Needs, which reminds us that basic needs like food must be met before individuals can reach their full potential. By listening to students and analyzing their experiences, I aim to answer three key questions: How does food insecurity affect students' academic performance and well-being? What strategies do students use to cope with food insecurity? What recommendations emerged in addressing food insecurity among college students in Nebraska after integrating the quantitative results with the qualitative findings. This research is about more than numbers, it's about understanding the real human impact of food insecurity and finding ways to make college a better, more supportive experience for everyone. I hope the findings will inspire actionable changes, from expanding campus food pantries to creating more affordable meal plans, so that no student has to choose between eating and learning. This work is my contribution to building a more equitable and nourishing future for students in Nebraska and beyond.

INQUIRY-GUIDED LEARNING TO DEVELOP NEAR-SPACE EXPERIMENTS

Author
Derrick Nero
NASA NE Space Grant

A longitudinal study of the science self-efficacy and engineering self-efficacy of 144 undergraduate students over six academic semesters at a metropolitan university in the United States Midwest. The study was conducted through a 17-week general education Science course that utilizes high-altitude ballooning to conduct near-space experiments. The course uses Inquiry-Guided Learning Theory as a framework for first- and second-year college students to conceive, develop, build, and conduct near-space experiments. Students' science self-efficacy and engineering self-efficacy were determined by the Engineering Skills Self-Efficacy Scale. The Engineering Skills Self-Efficacy Scale collects qualitative, ordinal data of self-efficacy perceptions in performing specific engineering skills in three domains: experimental, tinkering, and design. Two of the three domains' scales were administered (Experimental Self-Efficacy Scale and Design Self-Efficacy Scale) at the start and end of the course beginning Spring 2022. The Experimental Self-Efficacy Scale was used to identify students' science perceptions, and the Design Self-Efficacy Scale was used to identify students' engineering perceptions. Students demonstrated significant gains in their engineering self-efficacy.

TICKBORNE DISEASE EDUCATION FOR INDIGENOUS BISON WORKERS

Author
Alexandrea Welch
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Co-Author
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Co-Author
Mystera Samuelson
University of Nebraska Medical Center

Co-Author
Shaun Cross
University of Nebraska Medical Center

Ticks are vectors for various pathogens, posing significant public health risks and increasing tickborne disease risk. Outdoor workers are at a heightened risk of exposure to ticks and tickborne diseases. Additionally, tickborne diseases can impact livestock, including bison, vital to indigenous communities. The InterTribal Buffalo Council, in collaboration with the Central States Center for Agricultural Safety and Health, holds a yearly Bison Worker Safety & Herd Health Roundtable. Participants, including herd managers and indigenous leaders, were presented with educational material regarding tickborne diseases in conjunction with Tick Tag Go hosted at the University of Nebraska-Lincoln. Core areas that we aimed to address included tick identification, prevention, and tickborne diseases. We also aimed to gauge the participants' knowledge base and perceptions regarding tickborne diseases by asking questions throughout the presentation. Immediately following the presentation, a questionnaire was administered to 1) gauge the perceived impact of the educational material, 2) understand how behaviors regarding tickborne diseases may change following the presentation, and 3) identify areas of improvement for future educational outreach events. Overall, the presentation was well received by participants. Following the presentation, participants agreed that the presentation provided new knowledge of ticks and tickborne diseases (96.3%). A majority of respondents stated they were more likely to implement tick-preventative practices (70.4%) and felt confident in where to identify ticks on their bodies (81.5%). A majority of participants stated that the materials were relevant to their needs (74.1%). A large portion of participants (44.4%) also stated that additional educational materials in their respective communities would be of use. This study is unique as, to our knowledge, previous working groups have yet to report prior knowledge or education of tickborne diseases amongst Indigenous communities. This is despite an increasing trend of tickborne diseases in this community. Our findings support a continuing need to educate and empower Indigenous communities, especially fieldworkers, regarding tickborne diseases.

TURMERIC THREADS- DYING TO CHANGE COLOR

Author
Conner Schwend

Co-Author
Tim Keith
Professor

Co-Author
Mary Keithly
Professor

Curcuma Longa or Turmeric is a large broad leaf plant that produces a beautiful purple flower that belongs to the ginger family Zingberaceae. It is a perennial that is native to most of south-eastern Asia due to the fact that it needs relatively high temperatures and high rainfall to thrive. The plant also produces a large rhizome that has a yellowish-orange color and a pungent smell associated with it. Turmeric is commonly used as a spice in many southern Asian dishes. The turmeric root also has many other properties besides being a good spice for food and also has many medicinal uses as well. Research shows that it is a natural anti-inflammatory for joints and bowel inflammation, can improve liver health, has some effect on menstrual imbalances and pain, can improve memory, aids in heart conditions, and can help with colon cancer. But, most importantly in this case it can change the color of your shirt. Based upon an observation that a shirt stained with turmeric and washed with a basic solution caused the color to change from yellow to a pinkish red, the use of turmeric to develop color-changing shirts was investigated. The research first started with bits of old white lab coat cut into strips and dyed with turmeric. The dyeing method used was to create a vat of turmeric dissolved in water and let the clothes “marinate” in the solution. Once dipped, the cloths consequently turned yellow. Soon after drying, the clothes were splashed with OxyClean and they indicated a

pinkish-red color. The strips were splashed with lemon juice to turn back yellow. The pH of the turmeric is approximately 6.0, and once on the shirts, it begins to change color to pink at 7.4 ultimately showing that even distilled water at a pH of 7 will change the turmeric clothes back to yellow. This project was then used for a student outreach program at the local elementary school that was partnered with Dr. Keithly and was a great success the student engagement was significant with a participation of over 350 students. Further implications for the use of these color changes are being investigated for science outreach events at CSC in the future and results will be forthcoming.

USING POKEMON TO TEACH TAXONOMIC CLASSIFICATION AND ANIMAL DIVERSITY

Author
Nicholas Wohlgemuth
Nebraska Wesleyan University

Despite many biology students' innate interest in animal diversity, teaching taxonomy and classification can be challenging to deliver in an engaging format. To capture the excitement of natural historians discovering and classifying unknown organisms, I developed an activity that utilizes Pokémon—a popular fictional universe with diverse regional fauna—to introduce key taxonomic and animal classification concepts and procedures. In this activity, groups of three to four students were given sealed packs of Pokémon trading cards. Each card depicted an animal-like Pokémon that students could "discover" and classify using biological taxonomy. Students completed a structured worksheet requiring them to determine the Pokémon’s symmetry, expected germ layers, and body cavity organization. Based on these characteristics and the Pokémon’s superficial traits, students classified the Pokémon to at least the genus level. If no known species aligned with their Pokémon, students were allowed to assign it a species name. To justify their classification, students compared the Pokémons’ features to real-world animals. The learning objectives for this lesson were to: Identify and describe different types of animal body symmetry, differentiate between diploblastic and triploblastic organisms, classify organisms based on body cavity type, and apply hierarchical taxonomic classification systems to cryptogenic species. This instructional technique can provide an accessible and interactive framework for introducing students to taxonomy, animal classification, comparative anatomy, and evolutionary relationships.

Friday, April 25, 2025 8:00am - 10:45am

ANTHROPOLOGY: HUMANS PAST AND PRESENT MORNING SESSION- 1

Co-Chair: Maggie Klemm Co-Chair: Dakota Taylor

Anthropology: Human Past and Present **Chairpersons: Dakota Taylor & Maggie Klemm**

FRIDAY, APRIL 25 **Location: Prairie Suite B**

MORNING SESSION - 1

8:00 Presenters make sure presentations are sent to Dakota & Maggie to store on OneDrive

8:15 DIGITAL IMAGE CORRELATION IN THE ANALYSIS OF DENTAL RECORDS: A LITERATURE REVIEW. Alexander E. Curry

8:30 GREAT PLAINS LINGUISTICS. Amy Sue Peterson

8:45 NOSTALGIA OR NOVELTY? INVESTIGATING THE MODERN PASSION FOR COLLECTING ITEMS. Sophia Huss

9:00 UNSETTLING THE WEST: MINORITY NARRATIVES OF THE OREGON TRAIL AND HOMESTEADING. Sidney Wickham

9:15 FROM SHELF TO CART: DECODING GROCERY SHOPPING DECISIONS. Jordyn Rogge

9:30 **BREAK**- Presenters hang up posters on provided boards

MORNING SESSION - A2 (POSTERS: 9:45-10:45 am)

PORCINE SCAPULAE AS A PROXY FOR HUMAN CRANIA IN MECHANICAL TESTING. Alexander E. Curry

STRUCTURAL VIOLENCE AND MORTALITY AT THE US-MEXICO BORDER: A REVIEW OF THE PREVENTION THROUGH DETERRENCE POLICY. Abigail Vaughn

TAPHONOMIC ANALYSIS OF ODOCOILEUS VIRGINIANUS DECOMPOSITION IN THE GREAT PLAINS: A PILOT STUDY. Victoria Pate, Savannah McAdow, Audrey Holbeck, and Mack Cristino

STEWARDS OF THE DEAD: ETHICAL PRACTICES AND CHALLENGES IN THE CURATION OF HUMAN SKELETAL COLLECTIONS. Lillie Turpin

UNDERSTANDING LINCOLN'S PAST: UNL CAMPUS ARCHEOLOGY PROJECT. Mary Watson

FROM SHELF TO CART: DECODING GROCERY SHOPPING DECISIONS

Author
Jordyn Rogge

This ethnographic study explores the factors influencing consumer purchasing decisions in Lincoln, Nebraska, with a focus on the adoption of organic and environmentally sustainable products. Utilizing qualitative methods, the research employs extensive participant observation and semi-structured interviews with store employees and shoppers. Observations will primarily focus on consumer behavior in the produce and dairy sections, while semi-structured interviews will examine motivations behind choices such as preferences for organic or plant-based products.

In addition to exploring product preferences, the study will pay close attention to how demographic factors—such as race, gender, age, and socioeconomic status—may influence purchasing decisions. By observing these characteristics, the research seeks to understand how various social identities shape consumer behavior in the context of sustainable and organic consumption. Conducted in a middle-class suburban environment, this study aims to contribute to a deeper understanding of the evolving dynamics of food retailing and emerging trends in healthy food consumption. Ultimately, the research will offer insights into how consumers navigate food choices in response to health, environmental, and social influences.

GREAT PLAINS LINGUISTICS

Author
Amy Peterson
University of Nebraska-Lincoln

Native American languages are a varied collection spread across North, Central and South America. Please note that these are not dialects or versions, but distinct languages. According to Mithun (2011), from the first contacts with Europeans, there were about 300 languages spoken in North America, 350 languages in Central America, and almost 1,500 in South America. The focus of this project is narrowed to the Great Plains area of North America, which includes Nebraska, Kansas, and Iowa. There are seven Tribes and Nations that will be discussed:
• The Iowa Tribe of Kansas and Nebraska, or the Ioway;
• The Sac and Fox Tribe of the Mississippi in Iowa, or the Meskwaki;

• The Omaha Tribe of Nebraska;
• The Ponca Tribe of Nebraska;
• The Santee Sioux Tribe of Nebraska;
• The Winnebago/Ho-Chunk Tribe of Nebraska;
• The Sac and Fox Nation of the Missouri in Kansas and Nebraska
In this work, I will compare the different linguistic families as far as sentence structures and phonetic alphabets. I will also discuss work being completed in regards to my dissertation, including working with the seven communities to bring together their languages and cultures into a portal that will be useful to students from K-12 and the college level, and independent scholars.

NOSTALGIA OR NOVELTY? INVESTIGATING THE MODERN PASSION FOR COLLECTING ITEMS

Author
Sophia Huss

It is agreed upon by many that the act of collecting is a behavior in humans that is far from modern. It is an action that has been documented numerous times throughout history, both on small, individualistic and large, corporational scales. Common knowledge around collecting is primarily focused on the ideas of museums and personal accumulations. As maintained by the European Museums Network, the oldest known museum was built in 530 B.C,—nearly 2,555 years ago—and was devoted to Mesopotamian antiques ("The Worlds Oldest Museums", n.d.). This isn't to say that the interest in collecting started then, as many claim that the urge to collect stems from evolutionary impulses and it is theorized by these groups that collecting has been a habit since early humanity (Dillon, 2019). Others who have researched this topic hold the belief that collecting originates from intrinsic motivations such as simple, aesthetic purposes or psychological reasons, examples including adolescent deprivation or insecurity (Tanselle, 1998). Another theory behind collecting motivations explores possible social connections, as it has been studied and found that the majority of people begin their collections based on familial influences (Jorgensen et al., 2023). This literature review will investigate the relationships between collecting and anthropology and will use secondary research in an attempt to identify and answer the motivating factors behind why people collect, and the sub-question of how their collections began.

PORCINE SCAPULAE AS A PROXY FOR HUMAN CRANIA IN MECHANICAL TESTING

Author
Alexander Curry
University of Nebraska Lincoln/ Graduate Student

This study's objective is to largely serve as a literature review of current information regarding porcine scapulae and human crania morphometrics and behavior under mechanical testing. Surprisingly, little information is published about the morphometrics of pig scapulae, but luckily two little-known articles from Øyvind Nordbø in 2020 and Nordbø et al. In 2018 provide most of the information forensic anthropologists would likely want to know regarding porcine scapulae morphology. Identifying areas of maximum and minimum thickness as well as noting the typical placement of contours that would affect behavior under mechanical testing [1]. This, in conjunction with the work of Rickman & Shackel in 2018 assessing the formation of crack propagation on porcine scapulae, not only provides the relevant morphometrics but also relevant mechanical testing data to back it up [2]. However, more pressing to this research subject is the compositional similarities of human and porcine flat bone. Human flat bone composition is documented extensively with articles like Lynnerup et al. 2005 going as far as documenting the ratio of diploic space in human crania and its variation with age, sex, and general morphology [3]. Porcine flat bone composition however is scant reported on, with Nordbø 2020 being the closest we get in terms of finding any detail on overall composition. Exposing a critical gap in the field, as many articles and experiments operate under the assumption that porcine flat bone and human flat bone are structurally similar without having any actual citation or experiment to reinforce that point. This presentation

serves not only to show the scientific community the currently available information regarding porcine scapulae as a proxy for human bone in mechanical testing, but also to expose the fact that little is published about the ratio and function of diploic space in these porcine bones as they compare with humans, and while overall structure and appearance remain similar, it is still worth researching and, more importantly, documenting how this porcine diploe behaves when serving as a proxy.

1. Nordbø, Ø. (2020). Modelling the shape of the pig scapula. Genetics Selection Evolution, 52(1). https://doi.org/10.1186/s12711-020-00555-5
2. Rickman, J. M., & Shackel, J. (2018). A novel hypothesis for the formation of conoidal projectile wounds in Sandwich Bones. International Journal of Legal Medicine, 133(2), 501–519. https://doi.org/10.1007/s00414-018-1946-x
3. Lynnerup, N., Astrup, J. G., & Sejrsen, B. (2005). Thickness of the human cranial diploe in relation to age, sex and general body build. Head & Face Medicine, 1(1). https://doi.org/10.1186/1746-160x-1-13

RECIDIVISM VS. REHABILITATION: CAN GLOBAL PRISON SYSTEMS BECOME A REVOLVING DOOR?

Author
Mallorie Thompson
University of Nebraska-Lincoln

This paper will investigate the differences between global prison systems, why we see certain rates of recidivism and the long term effects of rehabilitation on incarcerated individuals. Recidivism is a term that refers to a “tendency toward chronic criminal behavior leading to numerous arrests and re-imprisonment” (The Editors of Encyclopedia Britannica, 2025). When trying to avoid high recidivism rates, rehabilitation is implemented. Rehabilitation is the “idea that the purpose of punishment is to apply treatment and training to the offender so that he is made capable of returning to society and functioning as a law-abiding member of the community” (The Editors of Encyclopedia Britannica, 2025). The United States, El Salvador, and Norway all display drastically different approaches within their systems and I will be arguing why some methods lead to increased recidivism and individuals can remain in “mental prisons” after release. A phenomenon that relates to the United States in particular is the “Prison Industrial Complex", which “refers to the intricate relationship between government entities and private industries that encourages the growth of incarceration rates and the prison system” (Mercadal, 2024). Comparatively, Norway is renowned for having one of the most effective prison systems in the world with one of the lowest recidivism rates. Including El Salvador in the picture opens a new perspective and brings into question what peacekeeping can look like, sometimes blurring the line of what the western perspective views as humane and inhumane.

STEWARDS OF THE DEAD: ETHICAL PRACTICES AND CHALLENGES IN THE CURATION OF HUMAN SKELETAL COLLECTIONS

Author
Lillie Turpin
University of Nebraska-Lincoln

This ethnographic study examines the experiences, roles, responsibilities, and ethical considerations of professionals tasked with the stewardship of human skeletal collections. Through participant observation and semi-structured interviews with archaeologists, anatomists, anthropologists, osteologists, and other professionals, this research will explore how they navigate preservation, access, and repatriation issues. While many professionals emphasize the educational and research value of skeletal collections, they also face increasing demands for decolonization and repatriation under laws such as NAGPRA. Stewards also face ethical concerns regarding non-donated skeletal collections, for which clear legal and institutional guidelines remain lacking. This study will also include a comprehensive literature review to contextualize these challenges within broader ethical, legal, and historical discussions. By examining both professional perspectives and existing scholarship, the study aims to reveal how personal and professional ethics shape decisions regarding skeletal remains, particularly in cases where provenance is uncertain. This study will contribute to ongoing discussions about the future of human remains in research and public institutions and ethical best practices in osteological education.

STRUCTURAL VIOLENCE AND MORTALITY AT THE US-MEXICO BORDER: A REVIEW OF THE PREVENTION THROUGH DETERRENCE POLICY

Author
Abigail Vaughn
University of Nebraska-Lincoln

Over the last 30 years the mortality rate of undocumented migrants at the US-Mexico border has risen, creating a critical need for research on the human rights implications of US border policy1. In response, forensic anthropologists have advocated for the inclusion of osteological variables indicative of early-life stress in the biocultural profile, both to aid in the identification process and to emphasize the impact of structural inequality on individuals from marginalized communities2. For my master's thesis, I hope to examine the effects of the 1994 Prevention through Deterrence policy on the unidentified migrant population in the Tucson Sector. The study will use evidence of antemortem trauma and oral health issues, such as caries, abscesses, and edentulism, documented by Pima County Office of the Medical Examiner (PCOME) autopsy reports. Using a stratified sampling method by one-year period, I plan to compare data on individuals from the period immediately prior to the funding of Operation Safeguard (1995-1999) to those from the time immediately following its onset (2000-2005)3, to determine the likelihood of differences between the two populations arising by chance. This presentation will be a literature review of the current knowledge on structural violence and mortality rates at the US-Mexico border in the period surrounding the enactment of the Prevention through Deterrence policy. I hope to create a foundational understanding of the demographic changes within undocumented migrant populations and significant United States policy changes which occurred at the beginning of the 21st century, so that my research may expand on the effects of Operation Safeguard on this marginalized community.

1. Palamenghi A, Cattaneo C. The response of the forensic anthropology scientific community to migrant deaths: Where are we at and where do we stand?. Forensic Science International. 2024 Sep 25:112235.

2. Beatrice JS, Soler A, Reineke RC, Martínez DE. Skeletal evidence of structural violence among undocumented migrants from Mexico and Central America. American journal of physical anthropology. 2021 Dec;176(4):584-605.

3. Martínez DE, Reineke RC, Rubio-Goldsmith R, Parks BO. Structural violence and migrant deaths in Southern Arizona: Data from the Pima County Office of the Medical Examiner, 1990–2013. Journal on Migration and Human Security. 2014 Dec;2(4):257-86.

TAPHONOMIC ANALYSIS OF ODOCOILEUS VIRGINIANUS DECOMPOSITION IN THE GREAT PLAINS: A PILOT STUDY

Author
Victoria Pate
University of Nebraska-Lincoln

Co-Author
Savannah McAdow
University of Nebraska-Lincoln

Co-Author
Audrey Holbeck
University of Nebraska-Lincoln

Co-Author
Mack Cristino

This study seeks to address the gap in decompositional and taphonomic studies in temperate North America by introducing preliminary studies in the Great Plains through observational data of a white-tailed deer (*Odocoileus virginianus*) carcass at the Reller Prairie Field Station, Martell, Nebraska. This will contribute to the forensic science community by providing preliminary data regarding taphonomic processes in the Great Plains, which is currently lacking due to absence of body donation facilities in this area, and will assess the applicability of white-tailed deer as a human proxy for future taphonomic research. Future research will explore other controlled experimental scenarios to confirm the use of white-tailed deer as proxies for human decompositional analysis.

The *Odocoileus virginianus* carcass was discovered on University of Nebraska-Lincoln (UNL) property on May 31, 2024, by participants of a forensic archaeology field school. The property (Reller Prairie Field Station) is in Martell, Lancaster County, Nebraska, USA, located approximately 30 km southwest of UNL's City Campus. The Köppen climate classification for this area (Nebraska) is type Dfa, warm continental. The property contains short to mid-grass prairie, meadows, and riparian forests along the Olive Branch of the Salt Creek. The white-tailed deer carcass was located postmortem, suspended from the left hind leg along the fence running North/South on the western perimeter of the Reller Prairie property (SW 29th St.). The specimen was removed from the fence, allowing it to rest on its left side. To document taphonomic processes, observational data of the positionality and state of decomposition of the remains were recorded for six weeks following deposition with a terminal date of July 13, 2024. To supplement observations, weather and temperature data were recorded. A trail camera (Tasco 12MPTrail Camera, 720p) was installed north of the specimen to capture potential scavenging. After six weeks of daily data collection, observational data documentation was reduced to once a week due to near-complete skeletonization. The specimen was collected and cataloged at the Environmental Archaeology/Faunal Laboratory in Manter Hall on UNL's City Campus, where further morphological data were gathered. The taphonomic processes studied included rates of decomposition in accordance with meteorological data, scavenger/insect activity, and general qualitative morphological changes. These processes followed the generalized decomposition sequence with expected deviation for a Great Plains climate.

Accumulated degree day (ADD) calculations were completed using average daily temperatures (in Celsius) from the Martell Weather Channel over the six-week (42-day) period to analyze region specific temperatures within the Great Plains. The average ADD score was calculated to be 1065. This score was then correlated to the total body score (TBS), calculated according to Megyesi et al. (2005), which ranged from 3 to 33. Based on the comparison of ADD and TBS calculations, it was determined that the decomposition of the specimen followed an expected decomposition

sequence, but continued analysis may elucidate specific Great Plains climatic indicators.

UNDERSTANDING LINCOLN'S PAST: UNL CAMPUS ARCHAEOLOGY PROJECT

Author
Mary Watson
University of Nebraska Lincoln

This paper focuses on the research of material culture recovered from archaeological excavations on the University of Nebraska-Lincoln campus, with an emphasis on ceramics discarded at the turn of the 19th century. By analyzing household goods such as white ware and ironstone ceramics alongside historical records, this research investigates how consumer tastes, societal norms, and cultural trends are captured in the collection of materials. The expansion of Lincoln from a small town into a rapidly growing state capital was fueled by railroad access, bringing manufactured goods and new consumer opportunities to the region. The discarded household ceramics found in historic wells and cisterns offer valuable insight into these evolving consumer habits. Through documentation, analysis, and the creation of a public digital exhibit using Omeka S, this project highlights how material culture reflects broader economic and social changes. Special attention is given to the neighborhood predating the Ross Film Theater, where archaeological evidence from residential and commercial spaces illustrates the relationship between the expanding university, urbanization, and consumerism. This project not only fosters skill development in digital curation and historical research but also deepens public understanding of Lincoln's material history and the broader impact of consumer culture in shaping everyday life.

UNSETTLING THE WEST: MINORITY NARRATIVES OF THE OREGON TRAIL AND HOMESTEADING

Author
Sidney Wickham

Western Expansion attracted a diverse array of people, yet much of the literature on the Oregon Trail tends to focus primarily on European settlers and their encroachment on Native American lands (Historic Oregon City, 2019). This project aims to provide a more inclusive perspective by examining the often-overlooked experiences of marginalized groups. Using qualitative methods, the research gathers migration narratives across Nebraska—primarily through primary source diaries—to explore the broader patterns of westward migration. The central research question asks: What do these narratives reveal about migration through Nebraska, and how did different ethnic groups interact with one another? This inquiry is part of a larger mixed-methods research project in anthropology and history, which examines the relationships between Indigenous peoples, minority groups, and settlers along the Oregon Trail, particularly within the context of the Homestead Act (United States Congress, 1862). It considers both the positive and negative aspects of these encounters, specifically focusing on how African Americans, Chinese immigrants, and other marginalized communities engaged with settlers and each other (Lang, n.d.). By analyzing these dynamics, the project seeks to offer a more nuanced understanding of the cultural, social, economic, and political impacts of westward expansion on diverse communities during this pivotal period in American history.

VIABILITY OF DIGITAL IMAGE CORRELATION IN THE ANALYSIS OF DENTAL RECORDS FOR INDIVIDUALIZATION IN FORENSIC ANTHROPOLOGY:

Author
Alexander Curry
University of Nebraska Lincoln/ Graduate Student

Title: Viability of Digital Image Correlation in the Analysis of Dental Records for Individualization in Forensic Anthropology: A Literature Review

Alex E. Curry1, acurry13@unl.edu

1 - Department of Anthropology, University of Nebraska-Lincoln, Lincoln, NE.

This study's objective is to serve as an introductory piece to digital image correlation (DIC) for those who are not familiar with it and offer some propositions on how DIC can be used within the field of forensic anthropology. More specifically, in trauma analysis through comparative medical radiography, measuring bone deformation between multiple images, and comparison of dental imagery between suspected decedents and postmortem images.

Digital image correlation has its foundation in civil engineering, where it is commonly used to test the deformation of materials under stress testing, generating relevant 'heat' maps that indicate areas of increased deformation, and in some programs even drawing directional indicators that display the direction of the deformation along with its severity. DIC accomplishes this task by tracking blocks of pixels and monitoring how the coloring and positioning change from picture to picture, usually requiring materials that exhibit a varied observable surface (like concrete or bone material). Sometimes this material is manually created by inflicting a paint speckle pattern upon the surface, but in sufficiently complex surfaces this process is not needed.

Recent advances in digital image correlation software have allowed select researchers to apply these tools to biomechanical studies, most notably in the analysis of compression in porcine flat bone material. Creating vibrant and easy-to-understand graphics that detail the deformation of bone material between images, which entertains a possibility of use within a forensic anthropological context. Not only being able to identify sites of trauma but also having such programs be able to analyze such sites and offer input on the direction of deformation may prove invaluable where antemortem imaging of a decedent is available for comparison. This could be especially useful in the comparison of dental records due to the generally uniform position from which these radiographic images are taken and the ability to replicate such images.

There are several noteworthy articles and programs in the world of digital image correlation that have since crossed into the realm of biomechanics. Bringing the subject matter ever closer to forensic anthropology, with more recent studies opening lines of inquiry into possible use cases for such programs in comparative medical radiography for the purposes of identification and the analysis of trauma.

Friday, April 25, 2025 8:30am - 10:55am

APPLIED SCIENCE AND TECHNOLOGY MORNING SESSION - 1

Chairperson: Mary Ettel

Applied Sciences and Technology **Chairperson: Dr. Mary Ettel**

FRIDAY, APRIL 25 **Location: Prairie Suite A**

MORNING SESSION- 1

8:30 ZOOM Link: https://wsc.zoom.us/j/95609434397?pwd=Vsx0DAIMo5xUvPp41zkzW7jVUqogjh.1

8:45 Presenters upload session talks onto room computer desktop.

9:00 BREAK

9:15 SEQUENCING THE GENOME OF A *BORRELIA BURGDORFERI* STRAIN FOUND IN THURSTON COUNTY, NEBRASKA. Natalie Hamaker, Ann Buchmann, and Travis J. Bourret

9:30 THE BEHAVIOR OF TEXTILE SUPERCAPACITORS FABRICATED WITH MXENE-COATED CASEIN MILK PROTEIN YARN. Alyssa Grube, Sarang Ismail, Mahmoud Shaban, Abaigeal Aydt, Siamak Nejati, and Mona Bavarian

9:45 NEURAL CONNECTIVITY CHANGES AFTER TARGETED MUSCLE REINNERVATION. Toka Mootaz AboElnour, Kaitlin Fraser, Kai Yang, and Jorge Zuniga

10:00 **BREAK**- Presenters upload session talks onto room computer desktop.

10:10 THE EFFECTS PRONATION AND SUPINATION OF THE FEET HAVE ON LATERAL HEAD TILT. Morgan Ekwall, and Rachelle Rider D.C

10:25 MICROBIAL HARMONIES: INVESTIGATING THE INFLUENCE OF MUSIC GENRES ON *E. COLI* GROWTH. Christopher Jennings, and Dr. Jeffrey Kiiskila

10:40 NAVIGATING DIFFICULT CONVERSATIONS IN HEALTHCARE: THE USE OF AI CHATBOTS IN TRAINING UNDERGRADUATE AND GRADUATE NURSING. Lindsay Iverson, Tamara Oliver, Rachel Malander, Kaylee Van Handel, Samantha Phillips, and Steven Fernandes

SEQUENCING THE GENOME OF A BORRELIA BURGDORFERI STRAIN FOUND IN THURSTON COUNTY, NEBRASKA

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SEQUENCING THE GENOME OF A BORRELIA BURGDORFERI STRAIN FOUND IN THURSTON COUNTY, NEBRASKA

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This study attempts to phylogenetically classify and genetically analyze a strain of Borrelia burgdorferi, the causative agent of Lyme disease, that was extracted from a tick found in Thurston County, Nebraska. Whole genome sequencing of this strain provides insight into potential differences in the metabolism and infection cycle of the specific strain that may infect people or animals living in Nebraska. It is important to determine the phylogenetic relationships of individual strains of B. burgdorferi so that it can be better understood how different strains are moving across North America and which strains are prevalent in different parts of the world. The whole genome sequencing for this study was done by the University of Nebraska Medical Center genomics core, which ran long paired reads, performing 2 x 250 paired ends, on the MiSeq instrument using a MiSeq Reagent Nano Kit v2 (500 cycles). The results of the whole genome sequencing were then analyzed by running a variation analysis against Borrelia burgdorferi strain B31 on the Bacterial and Viral Bioinformatics Resource Center (BV-BRC) website. Single nucleotide polymorphisms (SNPs) have been found in many genes and specifically the gene that encodes for outer-surface protein C (OspC). OspC is an indicator of the Thurston County B. burgdorferi strain’s relationship to other strains from North America and Europe. Using the sequence of the ospC gene, the Thurston County strain has been compared to other strains within the BV-BRC database to create a phylogenetic tree that demonstrates the relationship of the new strain of B. burgdorferi that is threatening Nebraska.

THE BEHAVIOR OF TEXTILE SUPERCAPACITORS FABRICATED WITH MXENE-COATED CASEIN MILK PROTEIN YARN

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Biomedical research has been exploring incorporating flexible electronics into implantable devices to collect and store energy as well as make these electronics more compact. One strategy to achieve both goals is via textile supercapacitors (TSCs) which are typically made by applying conductive material, such as MXenes, to a yarn substrate and then knitting it up into electronic components. MXenes are a two-dimensional material has a base chemical formula of $M_{(n+1)}X_nT_x$, where M is a transition metal, X is carbon and/or nitrogen, and T is the surface termination determined by the synthesis method. $Ti_3C_2T_x$ MXenes are the most popular because they have high conductivity, it has a long charge/discharge cycle lifespan, and it is nontoxic; however, it is not naturally flexible, at odds with the need for flexible yarns and fabrics for wearability, and it is susceptible to oxidation. TSCs were fabricated by coating MXenes onto casein yarn and knitting up TSCs with a digital knitting machine. Casein yarns were observed to be more readily coated by MXene flakes in an autocoater and have a more even coating along the length of yarn. In addition, parallel yarn tests were conducted to characterize intrinsic conductive behavior. The fiber surface of uncoated and MXene-coated casein yarn was analyzed using X-Ray Photoelectron Spectroscopy (XPS) and Scanning Electron Microscopy (SEM). The Cyclic Voltammetry (CV), Electrochemical Impedance Spectroscopy (EIS), and Galvanostatic Charge/Discharge (GCD) were conducted to fully characterize the TSCs performance.

NEURAL CONNECTIVITY CHANGES AFTER TARGETED MUSCLE REINNERVATION

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Upper limb amputations have a significant impact on daily function, with more than 30,000 new cases annually in the United States. Phantom limb pain (PLP) is a prevalent debilitating post-amputation complication, linked to cortical reorganization. Neuroimaging studies suggest that increased limb use can mitigate maladaptive plasticity and reduce pain. Targeted muscle reinnervation (TMR) is a surgical intervention where residual limb nerves are rerouted to alternative muscle sites to improve myoelectric prosthesis control, subsequently increasing limb use. TMR correlated to long-term reversal of maladaptive neural changes and improving PLP. Typically, the sensorimotor cortex controls the contralateral limb, but amputation often disrupts this leading to ipsilateral dominance. Long-term studies indicate a shift towards contralateral dominance and increased connectivity after TMR, suggesting that neuromuscular loop restoration and pain reduction contribute to these changes. Similarly, studies on hand transplantation indicate initial activation in motor planning areas before primary sensorimotor engagement. However, the short-term cortical effects and underlying neural mechanisms remain underexplored. This study aims to evaluate short-term cortical reorganization following TMR in an adult upper limb amputee due to trauma 4 years prior, by analyzing hemispheric dominance and functional connectivity. We hypothesized that before TMR, hemispheric dominance will favor the ipsilateral side with weak interhemispheric connectivity, and short-term post-TMR changes will show increased interhemispheric connectivity in premotor regions and reduced activation in primary motor and sensory areas. The

TMR procedure involved excising neuromas in the median and ulnar nerves and transferring the nerves to muscle motor branches at the elbow level. Functional near-infrared spectroscopy was used to assess neural activity before and after the procedure during a motor imagery task rather than at rest, providing a more functional perspective on TMR-induced changes. Pre-TMR, hemispheric dominance was bilateral, with weak interhemispheric connectivity. Post-TMR, laterality unexpectedly shifted toward the ipsilateral hemisphere, whereas interhemispheric connectivity in the premotor regions increased, while sensory cortex connectivity both inter and intrahemispheric decreased. These findings provide valuable insights into the early cortical responses to TMR. Increased interhemispheric connectivity in premotor regions may represent an early-stage indicator of cortical adaptation following TMR. A novel finding was the further shift from contralateral dominance post-TMR before full motor function is restored. The study highlights the potential of functional neuroimaging in tracking cortical changes post-TMR, underscoring its relevance for optimizing rehabilitation strategies.

THE EFFECTS PRONATION AND SUPINATION OF THE FEET HAVE ON LATERAL HEAD TILT

Author
Morgan Ekwall

The foundation of the human body is the feet. Foot position is known to affect the lower body alignment either positively or negatively. A strong foundation is vital to the stability of the structure as a whole. For instance, if the foundation of a building is damaged or misaligned the rest of the building will shift resulting in instability. This concept is also relatable to the human body. Previous research shows when the foot is pronated the tibia will rotate internally, the knee will follow moving medially causing an internal rotation of the femur resulting in an anterior pelvic tilt of the os coxa bone that is on the same side. The anterior tilt of the os coxa bone will raise the iliac crest and cause the sacrum to angle away from the os coxa. The movement of the sacrum will affect the inferior spine resulting in the superior spine and shoulders to counter the movement by angling in the opposite direction of the sacrum. Changing of the foot position should result in a lateral head tilt. Based on the movements throughout the body, when the foot is pronated the lateral head should tilt to the same side as the pronated foot. Supination of the foot results in the tibia and femur rotating eternally and knee moving laterally causing a posterior pelvic tilt in the same side os coxa bone. The posterior rotation in the os coxa will cause the iliac crest to drop and the sacrum will angle towards that side. The same side shoulder will rise, and the opposite side will drop due to the superior spine countering the movements of the inferior spine. Supination should cause the head to tilt to the opposite side of the supinated foot. To collect data a 15 millimeter, heal lift was used to induce supination and pronation of the right foot. Stickers were placed next to the people’s lateral canthi. The subject stood in their normal stance with no adjustment and a picture was taken and used as a control. The position of the right foot was adjusted to both pronation and supination. A picture was taken at each adjustment so data can be collected, and movements can be monitored separately. A protractor was used to determine the change in the angle showing the movement of the head. Data analysis is currently underway. Preliminary results support hypothesis.

MICROBIAL HARMONIES: INVESTIGATING THE INFLUENCE OF MUSIC GENRES ON E. COLI GROWTH

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The relationship between microorganisms and sound waves remains underexplored, with limited research on how music impacts bacterial growth. This study examines the effects of different music genres on *Escherichia coli* growth, aiming to assess sound exposure as a potential non-thermal food preservation method. Cultured *E. coli* was grown on Trypticase soy agar plates and exposed to music from rock, pop, and classical genres, along with white noise as a

control. A sound chamber equipped with a Bluetooth speaker ensured consistent exposure, with sessions lasting 1–3 hours over 24 hours. Colony growth was measured to determine the bioeffects of musical characteristics such as tempo, rhythm, and pitch range. It is hypothesized that pop music, with its higher frequencies and amplitudes, will exert the greatest mechanical stress on bacterial membranes, resulting in the most significant growth inhibition. Rock and classical music, offering broader frequency ranges and varied tempos, are expected to have lesser effects. This research aims to contribute to the field of bio-musicology while exploring innovative food preservation methods. If successful, sound exposure could provide a safer, cost-effective, and consumer-friendly approach to enhancing food safety standards and reducing foodborne illness risks.

NAVIGATING DIFFICULT CONVERSATIONS IN HEALTHCARE: THE USE OF AI CHATBOTS IN TRAINING UNDERGRADUATE AND GRADUATE NURSING

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Nursing students at the undergraduate and graduate levels benefit from opportunities to practice having difficult conversations with patients and families. Artificial Intelligence (AI) applications provide a unique opportunity for learners to gain experience and hone this skill prior to human interaction. The purpose of this project is to develop a tiered experiential approach to preparing nursing students for difficult conversations prior to interacting with real-life standardized patients. Our team aims to adapt, pilot, and evaluate an AI-based communication tool for student engagement in practicing difficult conversations. Approximately 80 undergraduate and graduate nursing students will first practice difficult conversations via an AI chatbot before engaging with a standardized patient (appropriately leveled for students). Rubrics will be utilized for course outcomes evaluation and learners will complete a post-activity survey to determine student perceptions regarding the usability and efficacy of the AI-based communication tool.

Friday, April 25, 2025 9:30am - 10:45am

EARTH SCIENCES MORNING SESSION- 2A

Chairperson: Jason Coenen

Earth Sciences : Geological studies worldwide **Session Chair: Jason Coenen**

FRIDAY, APRIL 25 **Location: Legacy A**

MORNING SESSION - 2A

9:30 INTEGRATED GEOPHYSICAL ANALYSIS OF SEAMOUNTS, PROPAGATOR WAKES AND PSEUDOFAULTS IN SOUTHERN CASCADIA. Md Abdullah Salman, Morgan Madsen and Irina Filina

9:45 EXPLORING THE TECTONIC EVOLUTION OF THE KOLBEINSEY RIDGE VIA INTEGRATED GEOPHYSICAL ANALYSIS OF A PROPAGATOR WAKE SERIES. Tochukwu Onyebum, Irina Filina and Filomena Loreto

10:00 A TALE OF TWO BASINS: A MARINE DIATOM HISTORY OF THE SOUTHERN CAPE BASIN AND TRANSKEI BASIN SOUTH OF AFRICA. Jason J. Coenen, IODP Exp. 361 Science team and IODP Exp. 392 Science team

10:15 DIATOMACEOUS SOFT SEDIMENT CLASTS UNDER THE ROSS ICE SHELF: DISCRETE RECORDS IN TIME. Megan Heins, Jason Coenen, Amy Leventer and David Harwood

10:30 ENHANCING PYUSERCALC: OPTIMIZING AN OPEN-SOURCE JUPYTER NOTEBOOK FOR URANIUM-SERIES DISEQUILIBRIUM MODELING. Smitha Haridasan and Lynne Elkins

INTEGRATED GEOPHYSICAL ANALYSIS OF SEAMOUNTS, PROPAGATOR WAKES AND PSEUDOFAULTS IN SOUTHERN CASCADIA

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This study integrates gravity, magnetic, seismic, and earthquake data to enhance the understanding of tectonic structures and subsurface properties within the Southern Cascadia Subduction Zone (SCSZ). The first objective is to refine the catalog of known seamounts by revisiting prior analyses with newly available CASIE21 seismic reflection data, allowing for improved identification and interpretation of seamount locations. This study documented morphological characteristics of newly identified seamounts from CASIE21. The second objective is to map and model propagator wakes (PWs), pseudofaults (PSFs) and seamounts in the SCSZ. Spatial analysis of gravity and magnetic data allow us to map PWs, PSFs and seamounts, which refine our understanding of faulting, deformation and magmatism at smaller scales within the SCSZ. Additionally, the study develops geophysical models along three seismic profiles from CASIE21 to analyze variations in the physical properties of seamount complexes, PWs, and PSFs. The models highlight changes in density, showing a gradual increase from the Juan de Fuca (JdF) ridge

toward the subduction zone. In addition, several lower-density regions are required in the crust to explain observed gravity anomalies, which we explain as evidence of crustal weakness and enhanced faulting within PWs and PSFs. These structures correlate with observed earthquakes and crustal deformation, offering a comprehensive framework for understanding the tectonic processes governing the SCSZ. This study underscores the importance of integrated geophysical approaches in assessing subduction zone dynamics and their implications for seismic hazards.

A TALE OF TWO BASINS: A MARINE DIATOM HISTORY OF THE SOUTHERN CAPE BASIN AND TRANSKEI BASIN SOUTH OF AFRICA

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In the Spring of 2016 (IODP Expedition 361) and 2021 (IODP Expedition 392), records from the Cape Basin (Site U1479) and the Transkei Basin (Site U1581) were collected in the Indian-Atlantic Ocean Gateway (I-AOG) to better understand long-term changes in ocean circulation tied with the Agulhas Current and Benguela Current systems. Site U1479 was collected in a transition zone between the Influence of the Benguela Current Upwelling and Agulhas Leakage, both important oceanographic features for understanding Earth's climate system. The Transkei Basin Site U1581 was collected in the southern portion of the Indian Ocean south of Africa in 4591 m water depth. For both records, a high-resolution study of diatom biostratigraphic markers, assemblage data, and absolute diatom abundance records were collected to help develop an age model, better understand the conditions recorded by diatom assemblages, and infer upwelling and nutrient pool dynamics with the study of the accumulation of diatoms in these marine sediments. Additionally, an X-ray fluorescence (XRF) record provides a higher resolution paleoproductivity proxy to calibrate diatom observations. These records span the Mid-Pleistocene Climate Transition (1.2 million years to present) to better understand surface and bottom water conditions during this significant step in Earth's climate system from 41 kyr obliquity-paced cycles to higher amplitude 100 kyr glacial-interglacial cycles.
Cape Basin Site U1479 shows three major steps in biogenic silica and marine diatom accumulation over the MPT. The diatom assemblage is dominated by *Chaetoceras* resting spores (CRS), a feature of the Bengula Upwelling system that suggests upwelling in the Southern Cape Basin over glacial-interglacial cycles. Around 900 ka, marine diatom accumulation increases and remains high throughout the interval from 900 ka to 740 ka, and then by around 619, diatom deposition ceases at the site, suggesting a loss of nutrients and upwelling conditions. Transkei Basin has a similar three-stepped transition. However, the assemblage is dominated by Southern Ocean diatoms before and after the 900 ka to 740 ka interval. The I-AOG is a dynamic region for surface and bottom water circulation, and diatoms are a valuable proxy for assessing the signals recorded in these sites. Future work will expand the intervals in intervals barren in marine diatoms to broaden these relationships through the late Miocene (the last ~7 million years).

INTEGRATED GEOPHYSICAL ANALYSIS AND 2D MODELING OF TECTONIC AND CRUSTAL STRUCTURES ACROSS THE TYRRHENIAN SEA

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The Tyrrhenian Sea, a Neogene back-arc basin in the central Mediterranean, remains a subject of scientific contention regarding its crustal nature and composition. Oceanic basalts, gabbroic rocks, and exhumed mantle peridotites have been recovered across the basin. Crustal heterogeneity in the region reflects the complex interplay of back-arc extension processes, driven by the eastward retreat of the Calabrian-Apennine subduction system. These processes include localized mantle exhumation, crustal thinning, and magmatic intrusions. Moreover, recent IODP Expedition 402 revealed granitoids and serpentinized peridotites in closely spaced drill sites within the Vavilov Basin. This apparent heterogeneity calls for further investigation using an integrated geophysical approach. This study examines the region's crustal affinity through an integrated analysis of published seismic reflection and refraction data from the MEDOC 4 and 6 profiles, topography data, and potential field (free air gravity and magnetic) data. Drilling results from DSDP 373, ODP Leg 107, and IODP Expedition 402 provide geological constraints for geophysical interpretations. This study develops a geophysical framework that highlights the region's geologic complexity. The two 2D subsurface models along the MEDOC-4 and MEDOC-6 profiles, which we present in this study, illustrate the geometry of the region's crustal and mantle structures and account for variations in gravity and magnetic anomalies based on differences in physical properties. The density and magnetic susceptibility contrasts across key geologic features, including the Baronie, Magnaghi, Vavilov, and Flavio Gioia Seamounts, are evident in these models. Additionally, we provide a map delineating the spatial distribution of rock types in the central Tyrrhenian Sea, distinguishing continental, oceanic, and exhumed mantle domains through integrated data analysis. The models make provisions for future studies to refine the zones of distinct crustal affinity, specifically by serving as inputs for 3D modeling of the region.

DIATOMACEOUS SOFT SEDIMENT CLASTS UNDER THE ROSS ICE SHELF: DISCRETE RECORDS IN TIME

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The reconstruction of the history of the West Antarctic Ice Sheet (WAIS) is an important steppingstone to our understanding of how the ice sheet will respond to a warming world as we move into the future. WAIS plays an important role in global climate dynamics and will lead to sea level rise as its ice volume is returned to the sea. If we want to better understand the WAIS response to our changing climate, we must first understand the environmental factors and timings of past ice sheet fluctuations. We can parse out intervals of ice sheet retreat using siliceous marine microfossils – specifically of the remains of photosynthetic diatom algae. These fossils grew in West Antarctic seas and were deposited in interior basins during extended times of decreased ice sheet cover. This study uses the presence of age-diagnostic diatom species to identify discrete events and reconstruct a composite history of marine sedimentation across West Antarctica during past warm and deglacial conditions. We are specifically looking at diatomaceous soft sediment clasts that have been isolated from the rest of the sediment matrix. These clasts have been eroded and transported by ice. This study examined sediment cores collected by the *RVIB Nathanial B. Palmer* in 1994 from the Eastern Ross Sea ice margin and from the Ross Ice Shelf Project (RISP) coring project in 1977-78 from beneath the Ross Ice Shelf. Glaciomarine sediment samples were sieved and picked to concentrate diatom-

bearing sediment clasts, which were then individually prepared for diatom analysis. Preliminary research from both sample sets reveal that some clasts are completely barren of diatoms, whereas others contain a rich assemblage of siliceous microfossils. We have determined ages ranging from the early Oligocene to late Miocene. Techniques employed in this study will be further implemented during the SWAIS 2C (Sensitivity of the West Antarctic Ice Sheet to 2 degrees Celsius of warming) drilling project, which aims to recover drill cores of ~200 meters length from near the grounding zone of the West Antarctic Ice Sheet. Examination of these discrete, microfossil-bearing sediment clasts will help determine the ages of subglacial marine sediment strata. These diatomaceous clasts will allow us to sample pieces of primary sediment material – sourced from strata originally deposited further inland, this project will provide a clear record of discrete diatom assemblages, including some of the southernmost diatom occurrences, from under the Ross Ice Shelf and the West Antarctic Ice Sheet.

ENHANCING PYUSERCALC: OPTIMIZING AN OPEN-SOURCE JUPYTER NOTEBOOK FOR URANIUM-SERIES DISEQUILIBRIUM MODELING

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Keywords: Uranium-Series Disequilibrium, Mantle Melting Models, Computational Optimization

Abstract: The accurate modeling of uranium-series (U-series) isotopic disequilibria in basaltic lavas is essential for understanding mantle melting processes. The pyUserCalc Jupyter Notebook, developed by Elkins and Spiegelman (2021), provides an accessible and cloud-hosted tool for modeling these disequilibria under equilibrium and disequilibrium porous flow conditions. However, to enhance its functionality, usability, and computational efficiency, we are systematically refining the code. This work leverages advanced programming and software engineering principles, including data input optimization, profiling existing models, refactoring, modularization, optimized numerical solvers, testing and improved data visualization, to increase the tool's flexibility and scalability. Our improvements aim to facilitate broader adoption by the geoscience community through open-source distribution on GitLab. Key enhancements include restructuring the code into reusable classes and functions, optimizing performance for large-scale simulations, and incorporating better parameter selection interfaces. These refinements ensure that pyUserCalc remains a robust, reproducible, and extensible platform for investigating U-series disequilibrium during mantle melting and melt transport processes.

References:

Elkins, L.J. and Spiegelman, M., 2021. pyUserCalc: A revised Jupyter Notebook calculator for uranium?series disequilibria in basalts. Earth and Space Science, 8(12), p.e2020EA001619. Available: https://gitlab.com/ENKI-

Friday, April 25, 2025 9:30am - 10:45am

EARTH SCIENCES MORNING SESSION- 2B

Earth Sciences: Meteorological studies in Nebraska and beyond **Session Chair: Ross Dixon**

FRIDAY, APRIL 25 **Location: Legacy B**

MORNING SESSION - 2B

9:30 IMPACT OF IRRIGATION IN THE CENTRAL GREAT PLAINS USING A HIGH-RESOLUTION CLIMATE MODEL. Ifeanyi Chukwudi Achugbu, Liang Chen and Qi Hu

9:45 LAND-ATMOSPHERE COUPLING EXPLAINS UNCERTAINTY IN SOUTHERN GREAT PLAINS SUMMER PRECIPITATION PROJECTIONS. Emmanuel O. Audu and Ross D. Dixon

10:00 IS PRECIPITATION EFFICIENCY GREATER OVER LAND OR OCEAN? Ross Dixon

10:15 NUMERICAL REPRESENTATION OF SURFACE ENERGY FLUXES DURING A RAIN-ON-SNOW FLOODING EVENT. Erik Janzon, Ross Dixon, Tirthankar Roy, Zachary Suriano and Samuel Davidson

10:30 DEVELOPING A PREDICTIVE DEPARTMENT OF TRANSPORTATION WINTER SEVERITY INDEX. Thomas Kauzlarich, Curtis L. Walker, Mark Anderson and Liang Chen

DEVELOPING A PREDICTIVE DEPARTMENT OF TRANSPORTATION WINTER SEVERITY INDEX

Author
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Co-Author
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Winter severity indices (WSIs) have been used by transportation agencies as a retrospective tool to help gauge the severity of a winter season and as an evaluation metric for winter maintenance operations. The literature documenting existing WSIs depicts a myriad of approaches that have been developed for specific state Departments of Transportation (DOTs). The WSI used by the Nebraska DOT, known as the Nebraska Winter Severity Index (NEWINS), provides an independent framework to determine the severity of a winter season through the categorization of individual winter storms. However, a limitation of NEWINS along with most WSIs is that they are not predictive for individual winter storms. A recent development among WSIs to overcome this shortcoming is the development of an impact-based predictive WSI by the Weather Prediction Center known as the Winter Storm Severity Index (WSSI). The WSSI outputs impact-based forecasts at a 24-h temporal resolution for different winter weather hazards and is designed for a broad range of National Weather Service partners and stakeholders (e.g., emergency management, school officials, transportation personnel, farmers and ranchers, general public, and energy industry).

This study leverages the NEWINS framework (Walker et al. 2019b) to now predict individual winter storm severity for hazard planning applications. Forecast data are used to create a predictive WSI as a hazard planning tool, hereafter referred to as NEWINS-Predictive (NEWINS-P). The overall NEWINS-P framework includes five components: snow severity (NEWINS-S), precipitation type, icing, blowing snow, and drifting snow. The components aim to forecast different in-storm and post-storm winter weather hazards over a 72-h duration at a 6-h resolution, a finer resolution than the WSSI. The NEWINS-P framework is assessed through spatial forecasts across Nebraska and temporal forecasts at select locations on select Colorado Low and Alberta Clipper Systems from the 2018–19, 2020–21, and 2022–23 winter seasons. Additionally, forecast trends in the NEWINS-S component are examined in the form of a time series to demonstrate local forecast changes. An evaluation metric is developed to assess the most severe forecast period for each case study. Along with forecast data, observational data are obtained from surface weather stations and gridded observed snowfall to verify forecasts and storm severity.

The results show that the forecasts of the five components composing the NEWINS-P framework properly resolve the different winter weather hazards at the state and local level. At the state level, the Colorado Low Systems displayed greater forecasted impacts than the Alberta Clipper Systems. Moreover, the Colorado Low Systems produced a higher intensity and spatial coverage of NEWINS-S categories, more types of precipitation, and more blowing and drifting snow concerns than Alberta Clipper Systems. Assessing the NEWINS-S time series for the case studies demonstrated the local forecast changes in the categories between NDFD runs. The NEWINS-P is shown to be a tool that can support transportation agencies in their winter maintenance operations for personnel and resource planning in advance of winter storms.

IMPACT OF IRRIGATION IN THE CENTRAL GREAT PLAINS USING A HIGH-RESOLUTION CLIMATE MODEL

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Irrigation practices can be optimized to increase agricultural yields, but their influence on local and regional rainfall patterns is still not fully understood. In this study, the Weather Research and Forecasting (WRF) Model at the convection-permitting scale was used to simulate the impacts of irrigation on the hydroclimate in the central Great Plains (CGP) during the growing season of five wet years and five dry years. Irrigation tends to reduce near-surface and lower-atmosphere temperatures, and the cooling effect is stronger in the dry years than in the wet years. Irrigation leads to an overall increase in precipitation over CGP, and there is more increase in rainfall during the dry years than in the wet years. The enhanced increase in rainfall in the dry years could be attributed to more decrease in the lifting condensation level (LCL) and planetary boundary layer height (PBLH), but with a stronger increase in convective available potential energy (CAPE), which are favorable for isolated convections. We also explored the impacts of different irrigation intensities on precipitation events. Over the CGP, irrigation activities mainly enhance the intensity of precipitation events but do not necessarily trigger more precipitation events. With more intense irrigation, heavy precipitation may get significantly stronger. This study explores the large-scale and local effects of irrigation on precipitation under both normal and extreme irrigation conditions in order to better understand the role of irrigation in hydroclimate extremes through land-atmosphere interactions over the US Great Plains.

IS PRECIPITATION EFFICIENCY GREATER OVER LAND OR OCEAN?

Author
Ross Dixon
University of Nebraska Lincoln

Precipitation efficiency (PE), the ratio of total precipitation to some estimate of vertically integrated condensate, is a useful variable for understanding the integrated hydrological cycle. A recent paper (Li et al. 2022) generated a simple climatology for PE using monthly values of TRMM precipitation and MODIS condensed water path to explore constraints on climate change. As a proxy for small-scale processes, instantaneous PE using AMSR-E and CloudSat has also been recently used to investigate the iris effect (Ito and Masunaga 2022). As global Earth system models are run with higher resolutions, their ability to produce reasonable values of PE in both space and time may be a useful metric for evaluating these models. Output from several high resolution climate simulations and reanalyses show different signals in PE across the tropics, where some produce greater PE over the ocean and some produce greater PE over the land. This raises the fundamental question of whether precipitation efficiency should be greater over land or ocean. Here I will explore this idea and propose a new observational dataset that will be useful for exploring this discrepancy.

LAND-ATMOSPHERE COUPLING EXPLAINS UNCERTAINTY IN SOUTHERN GREAT PLAINS SUMMER PRECIPITATION PROJECTIONS

Author
Emmanuel Audu
University of Nebraska-Lincoln

Co-Author
Ross Dixon
University of Nebraska-Lincoln

There is considerable uncertainty in summer precipitation projections across the Great Plains of the United States. While models generally agree on the sign of summer precipitation change in the Northern Great Plains, most global climate models do not agree on the significance of changes in the summer precipitation in the Southern Great Plains. In this study, we analyzed an ensemble of 28 global climate models from the Coupled Model Intercomparison Project Phase 6 (CMIP6), using pre-industrial control (piControl) and high-emission future scenario (SSP585) outputs. First, we identified substantial variability in atmospheric and terrestrial coupling strength across the United States in unforced simulations, with different models representing these couplings in distinct regions of the CONUS. We then demonstrated that coupling strength in unforced simulations explains a significant portion of the variance in summer precipitation change across the Southern Great Plains. However, in the Northern Great Plains, our findings indicate that large-scale atmospheric features primarily drive precipitation changes, rather than local coupling processes. This study highlights the contrasting drivers of precipitation change in the central U.S., with local coupling governing variability in the Southern Great Plains and large-scale processes dominating in the Northern Great Plains.

NUMERICAL REPRESENTATION OF SURFCE ENERGY FLUXES DURING A RAIN-ON-SNOW FLOODING EVENT

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Co-Author
Samuel Davidson
Western Kentucky University

The March 13-14, 2019 floods that impacted parts of the Great Plains United States were triggered by a severe Rain-on-Snow (ROS) event. ROS events are hydrometeorological phenomena characterized by liquid precipitation that falls upon an existing snowpack, leading to rapid snow ablation. Predictions of ROS flooding events remain highly challenging and depend upon the accurate representation of surface energy fluxes that contribute to the snowmelt. Here, the Weather Research and Forecasting (WRF) numerical weather prediction (NWP) model is coupled with the Noah-MP land surface model (LSM) to simulate the March 2019 ROS event. We will examine the results of the WRF model prediction of the event from a surface energy flux perspective, with particular focus on the latent heat flux, which is underestimated in the model compared to observations. It is shown that a potential source of error lies in the LSM representation of the latent heat flux, which itself is sensitive to the surface resistance to evaporation. We will examine the sensitivity of model snowmelt when adjusting this parameter, presenting a potential solution to the error in latent heat flux during ROS events.

Funded by NOAA Grant NA23OAR4310275.

Friday, April 25, 2025 9:30am - 10:55am

PHYSICS AND ENGINEERING MORNING SESSION- 2

PHYSICS AND ENGINEERING **Chairperson: Dr. Adam Davies**

FRIDAY, APRIL 25 **Location: Prairie Suite C**

MORNING SESSION- 2

9:30 Presenters please upload Session talks onto room desktop computers.

9:40 SINGLE-LASER SYSTEM FOR SIMULTANEOUS LOCKING TO COOLING AND REPUMP TRANSITION IN RB-87. Millyzient McClure, Brad Dinardo

9:55 MACHINE LEARNING APPROACHES TO STUDYING BROAD ABSORPTION LINE QUASAR OUTFLOWS. Jonathan Pierce

10:10 MACHINE LEARNING FOR ANOMALOUS PARTICLE DETECTION IN ULTRAPERIPHERAL RELATIVISTIC COLLISIONS OF HEAVY IONS. Brianna Kinkaid

10:25 AI-ASSISTED CELLULAR AND ORGANOID ANALYSIS FOR LENALIDOMIDE-BASED RADIOIMMUNOTHERAPY AGAINST GLIOBLASTOMA. Isaac Amoah, Kaylee Brilz, Pralhad Itani, Charlotte Block, Sara Strom, Jayce Hughes, Natasha Ratnapradipa, Dylan Bui, Jacob Woolf, Jackie Austin, and Dr. Andrew Ekpenyong

10:40 UNSUPERVISED MACHINE LEARNING FOR ANALYSIS OF 3D IN-VITRO ASSAYS AGAINST RADIORESISTANT AND CHEMORESISTANT CANCERS. Pralhad Itani, Isaac Amoah, Lan Peyton, Jayce Hughes, Natasha Ratnapradipa, Charlotte Block, and Dr Andrew Ekpenyong

SINGLE-LASER SYSTEM FOR SIMULTANEOUS LOCKING TO COOLING AND REPUMP TRANSITION IN RB-87

Author
Millyzient McClure
Hastings College

The objective of our project is to develop a single-laser system capable of simultaneously locking to both the cooling and repump transitions of the D2 Rubidium-87 line. Our approach of using a single laser and a saturated absorption spectroscopy setup aims to enhance the efficiency of laser cooling techniques. The first step in achieving this goal includes the development of a repump transition beam to keep the cooling transition going. This will be accomplished using an Electro-Optic Modulator (EOM) with attached fiber optic couplers in combination with a radio-frequency driver (RF) to create the necessary frequency modulation. Locking the laser to the cooling transition we will be able to siphon off some of the cooling light and send that into the EOM to blue shift the light to be on resonance with the repump transition. This work contributes to the next phase of laser cooling technology, which is essential for advancing precision measurements, quantum simulations, and ultra-cold atom experiments. The completion of our project will provide a significant step toward the end goal of laser cooling.

MACHINE LEARNING APPROACHES TO STUDYING BROAD ABSORPTION LINE QUASAR OUTFLOWS

Author
Jonathan Pierce
Creighton University

We present a novel application of machine learning techniques to investigate the driving mechanisms behind quasar outflows. Broad Absorption Lines (BALs), detected in the ultraviolet spectra of about 20% of quasars, exhibit Doppler blueshifts—providing clear evidence of energetic mass outflows from these active galactic nuclei. Despite their critical role in quasar evolution and feedback processes, the physical mechanisms governing these outflows remain poorly constrained. In this study, we develop specialized machine learning tools to analyze BAL features in quasar spectra from the Sloan Digital Sky Survey (SDSS). Our approach trains algorithms to identify and characterize spectral signatures associated with different theoretical models of quasar outflows, enabling a systematic comparison of competing dynamical mechanisms. By efficiently processing large spectral datasets, our method has the potential to uncover patterns that traditional analysis techniques might overlook, offering new insights into quasar feedback and evolution.

MACHINE LEARNING FOR ANOMALOUS PARTICLE DETECTION IN ULTRAPERIPHERAL RELATIVISTIC COLLISIONS OF HEAVY IONS

Author
Brianna Kinkaid
Creighton University

The goal of this project is to use machine learning through an autoencoder for detection of rare particle decay processes in ultraperipheral collisions. Ultraperipheral collisions are collisions of relativistic nuclei that just miss each other. This leads to the production of only a few particle tracks rather than the thousands which can be found in central collisions. A standard search for rare particles in ultraperipheral collisions would require developing selection criteria specific to the sought after particle. Through the use of an autoencoder, we are able to search for rare particle decay events without having to specify selection criteria. We have generated a sample of events similar to those observed in ultraperipheral collisions in the ALICE detector at the Large Hadron Collider. This sample was used to train our machine learning algorithm. A test set was created from an independent sample of typical events and injected with rare events, and the autoencoder flags the rare events as anomalous. We present a prediction of the number of pentaquarks that could be observed using this procedure in the ALICE detector in CERN runs 3 and 4, given previous cross-section and branching ratio measurements.

This project is supported in part by the Department of Energy through the grant DE-FG02-96ER40991.

AI-ASSISTED CELLULAR AND ORGANOID ANALYSIS FOR LENALIDOMIDE-BASED RADIOIMMUNOTHERAPY AGAINST GLIOBLASTOMA

Author
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Creighton University

Co-Author
Charlotte Block
Creighton University

Co-Author
Pralhad Itani
Creighton University

Glioblastoma (GBM) is the most common and aggressive primary brain tumor in adults, with a median survival of about 15 months despite the current standard of care, which includes surgery, radiotherapy, and chemotherapy. This study investigates the use of the immunotherapeutic drug Lenalidomide in combination with radiotherapy to improve therapeutic outcomes. MATLAB-based AI codes (machine learning) are used to cluster and analyze cellular and organoid imaging data, providing a deeper understanding of treatment effects at the cellular level.

Two GBM cell lines are treated with Lenalidomide and subjected to clinically relevant radiation doses using a cell irradiator. Cell migration is monitored in real time, and survival analysis is conducted using cloud-based clonogenic assays. Images of treated cells and organoids are analyzed using machine learning algorithms implemented in MATLAB to cluster morphological changes. Our results demonstrate that Lenalidomide, in combination with radiotherapy, significantly enhances the antitumor effects on GBM. Machine learning analysis of imaging data reveals distinct clustering patterns corresponding to treatment-induced morphological changes.

UNSUPERVISED MACHINE LEARNING FOR ANALYSIS OF 3D IN-VITRO ASSAYS AGAINST RADIORESISTANT AND CHEMORESISTANT CANCERS

Author
Pralhad Itani

Co-Author
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Co-Author
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Co-Author
Jayce Hughes
Creighton University

About 25% of cancer patients receive chemotherapy and about 50% to 60% receive radiotherapy. Yet, several cancers are both chemo- and radioresistant, such as glioblastoma (GBM). This study aims to enhance treatment outcomes for cancers exhibiting high resistance to radiation and chemotherapy by utilizing MATLAB-based unsupervised machine learning to cluster and analyze cellular and organoid imaging data. We used Electric Cell-Substrate Impedance Sensing (ECIS) to monitor cellular activities, such as adhesion, proliferation, and migration, following chemotherapy and radiotherapy. Additionally, a cloud-based platform, Axion Omni provides millions of images over time. Unsupervised machine learning in MATLAB was employed to cluster morphological changes from imaging data, identifying patterns correlating with possible treatment efficacy. 3D data acquisition is on-going and machine learning results will be presented.

Friday, April 25, 2025 10:20am - 12:35pm

AERONAUTICS AND SPACE SCIENCE MORNING SESSION- 1B

Aeronautics and Space Science

Chairperson: Scott Tarry
Moderator: Derrick Nero

FRIDAY, APRIL 25

Location: Zoom/Virtual
https://unomaha.zoom.us/j/98581065199

MORNING SESSION - 1B

10:20 DIRECT INK WRITE 3D PRINTING OF FULLY DENSE AND FUNCTIONALLY GRADED LIQUID METAL ELASTOMER FOAMS. Spencer Pak and Eric Markvicka

10:35 EMBEDDED ELECTROOSMOTIC PUMPS FOR UNTETHERED SOFT ROBOTS. Patrick McManigal and Eric Markvicka

10:50 TESTING PROTECTIVE MATERIALS UNDER NEAR-SPACE CONDITIONS. Alexsandr Fadeev, Derrick Nero, Marat Sadykov, and Yury Salkovskiy

EVALUATING PROTECTIVE MATERIALS IN NEAR-SPACE ENVIRONMENTS USING BACTERIA AND SPORES. Yury Salkovskiy, Derrick Nero, and Marat Sadykov

11:05 PORTABLE CAMERA-AIDED SURGICAL SIMULATOR FOR LAPARCOPIC CHOLECYSTECTOMY WITH COGNITIVE TRAINING. Victoria Nelson, Yucheng Li, and Carl Nelson

11:20 HIGHLY EFFICIENT REGOLITH BIDIRECTIONAL INTEGRATED EXTRACTION DEVICE. Jennifer Zuspan, Hector Cong Jimenez, Kwuin Ping Felix Cong Jimenez, Tanner Sasse, Aleea Stanford, and Dr. Carl Nelson

11:35 A CALIBRATION TECHNIQUE FOR ANCHOR POINT ESTIMATION IN CABLE-DRIVEN PARALLEL ROBOTS. Emmanuel Akinola, Yucheng Li, and Carl Nelson

11:50 ENHANCING COMPUTER SCIENCE CURRICULUM USING OFF-THE-SHELF TECHNOLOGY PROJECTS TO ENHANCE WHOLE BRAIN AND BALANCED LEARNING. William Loring

12:05 THE IMPACT OF GRAZING SPECIES ON PRAIRIE ECOSYSTEMS: A COMPARATIVE STUDY OF BISON AND CATTLE. Maeghan Murie, Casey Grippando, and Kendra Johnson

PRAIRIE SYSTEMS REBUILD MICROBIAL SYSTEMS. Shelley McCain and Maeghan Murie

REVITALIZING HERITAGE: A NUTRITIONAL COMPARISON OF TRADITIONAL EAGLE CORN AND INDUSTRIAL CORN VARIETIES. Jiah Marks Sr. and Maeghan Murie

A CALIBRATION TECHNIQUE FOR ANCHOR POINT ESTIMATION IN CABLE-DRIVEN PARALLEL ROBOTS

Author
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Department of Mechanical and Materials Engineering

Co-Author
Yucheng Li
University of Nebraska-Lincoln

Co-Author
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university of nebraska-lincoln

Cable-driven parallel robots (CDPRs) are a class of parallel manipulators that use cables rather than rigid links to control an end effector or mobile platform. The actuated cables can be readily fixed to an anchor point adjacent to a defined workspace, offering several advantages, including lightweight construction, design simplicity, a large operational range, high payload capacity, low inertia, and reconfigurability. In dynamic and unstructured environments like the lunar landscape, accurate estimation of anchor points is crucial for the control and stability of CDPRs. Calibration, which refines the kinematic model by identifying geometric parameters and assembly errors, often relies on external measuring systems. However, these systems can be expensive and complex, highlighting the need for efficient, self-sufficient calibration methods to enhance accuracy and reliability. This work presents a calibration method for estimating anchor positions using the hyperbola equation centered at the origin reducing the reliance on external or internal measuring systems. This method leverages the relationship between the end-effector position and the cable length variations, to generate hyperbolic loci which are then used to estimate the position of the anchor point. In the planar case, the model determines anchor locations using three known end-effector positions along a straight path. To maintain cable tension, a novel spiral variable stiffness mechanism is prototyped, enabling precise position control, adaptive disturbance resistance, and reduced measurement error.

DIRECT INK WRITE 3D PRINTING OF FULLY DENSE AND FUNCTIONALLY GRADED LIQUID METAL ELASTOMER FOAMS

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Co-Author
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University of Nebraska-Lincoln

Liquid metal (LM) elastomer composites offer promising potential in soft robotics, wearable electronics, and human-machine interfaces. Direct ink write (DIW) 3D printing offers a versatile manufacturing technique capable of precise control over LM microstructures, yet challenges such as interfilament void formation in multilayer structures impact material performance. Here, a DIW strategy is introduced to control both LM microstructure and material architecture. Investigating three key process parameters–nozzle height, extrusion rate, and nondimensionalized nozzle velocity–it is found that nozzle height and velocity predominantly influence filament geometry. The nozzle height primarily dictates the aspect ratio of

the filament and the formation of voids. A threshold print height based on filament geometry is identified; below the height, significant surface roughness occurs, and above the ink fractures, which facilitates the creation of porous structures with tunable stiffness and programmable LM microstructure. These porous architectures exhibit reduced density and enhance thermal conductivity compared to cast samples. When used as a dielectric in a soft capacitive sensor, they display high sensitivity (gauge factor = 9.0), as permittivity increases with compressive strain. These results demonstrate the capability to simultaneously manipulate LM microstructure and geometric architecture in LM elastomer composites through precise control of print parameters, while maintaining geometric fidelity in the printed design.

EMBEDDED ELECTROOSMOTIC PUMPS FOR UNTETHERED SOFT ROBOTS

Author
Patrick McManigal
UNL Mechanical & Materials Engineering

Recent advances in soft robotics have enabled robots that can adapt to diverse environments, safely co-inhabit space with humans, and be worn on the body to assist with mobility. While this subfield of robotics has seen major advancements over the last decade, soft robots are severely hindered by their use of electrical and pneumatic tethers. These tethers are required to interface between soft actuators and rigid control hardware/pumps. In this work, we propose the creation of an untethered soft robotic actuator which utilizes embedded electroosmotic pumps (EEOPs). The actuator has a small form factor, enabling untethered actuation without sacrificing performance.

ENHANCING COMPUTER SCIENCE CURRICULUM USING OFF-THE-SHELF TECHNOLOGY PROJECTS TO ENHANCE WHOLE BRAIN AND BALANCED LEARN

Author
William Loring
Western Nebraska Community College

Computer Science curriculums have traditionally used creating desktop applications as the focus of their learning activities. Off the shelf robotics kits and other technology projects provide a hands-on approach and allows the students to see and experience their code in a more tangible form. The WNCC Computer Science curriculum starts in the first year with Intro to Robotics. This class uses an off the shelf Arduino based robot. This robot can be programmed by a mobile device, Scratch based block environment, and Arduino C. Arduino C is very similar to Java, which makes this a good programming scaffold to Java and C++. The WNCC Computer Science curriculum is in the second year of redesign in collaboration with the University of Nebraska at Lincoln and Southeast Community College through the STEM-CONNECT grant. One of the major focuses is using multiple languages as a scaffolded curriculum. Learning SQL, Python, Java, C++, Docker, and Rust better prepare students for the diversified software engineering workplace. Using multiple languages brings the students to a higher conceptual level, rather than memorizing the syntax of a specific language. This year we are working on an open-source MARS rover project named by the students, Tyr. This project has crossdisciplinarity support with Computer Science and Engineering students working together. One team is 3D printing the various parts. Another team is working on designing and creating the electronics. Another team is working on the programming. Our goal is to have the project complete by the end of the semester. This hands-on approach of seeing the results of their code in the physical world enables a faster feedback learning cycle and better transfer and retention of knowledge, skills, and conceptual frameworks. Students enjoy working with the robots, VR, and other technical projects in the physical world, having fun enables better learning.

EVALUATING PROTECTIVE MATERIALS IN NEAR-SPACE ENVIRONMENTS USING BACTERIA AND SPORES

Author
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UNMC

Co-Author
Yury Salkovskiy
UNO

Co-Author
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UNO

One of the major challenges of spaceflight is protecting humans from electromagnetic radiation, high-energy particles, and extreme environmental conditions. Ionizing radiation from solar events, including gamma rays and x-rays, causes DNA damage, mutations, and oxidative stress through generation of reactive oxygen species (ROS), disrupting cellular metabolism and gene expression. These risks highlight the need for innovative protective materials for long-duration space exploration. However, replicating space radiation and environmental extremes on Earth is challenging. To address this, we developed a high-altitude balloon-based testing platform to evaluate protective materials under near-space conditions. These modules expose bacterial cultures and spores to stratospheric environments characterized by intense UV radiation, high-energy particle flux, low pressure, and frigid temperatures (~-55°C). We hypothesize that these extreme conditions effectively simulate space environments for material performance assessment. Using Bacillus subtilis as a model, we will examine bacterial survivability, mutation rates, and spore germination after exposure to 254 nm UV light. CFU reduction, mutation frequency (Rif^R, Spc^R), and germination efficiency will be analyzed. A high-altitude balloon experiment will refine exposure protocols under stratospheric conditions. To assess cold resistance, bacterial samples will be subjected to -80°C, with success criteria including <50% survival in uncovered samples after 5 minutes. These results will inform balloon-based testing to further analyze bacterial resilience in space-like conditions. By integrating laboratory and high-altitude tests, we aim to validate protective materials against radiation and temperature extremes, contributing to astronaut safety in long-duration missions.

HIGHLY EFFICIENT REGOLITH BIDIRECTIONAL INTEGRATED EXTRACTION DEVICE

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The University of Nebraska-Lincoln R.E.D. Teams' Micro-g NExT design team has proposed the Highly Efficient Regolith Bidirectional Integrated Extraction (HERBIE) for NASA's Micro-g NExT design challenge. This device will aid astronauts in sample collection on the surface of the moon by providing a simply operated ergonomic device that can collect and store small samples of lunar regolith. HERBIE is operated by pulling upward on the side handle to actuate the mechanism housed inside the device frame. The device will allow astronauts to maintain a mostly upright position while collecting regolith from the moon's surface. HERBIE consists of three main sections: device frame, sample container, and actuator. The device frame consists of a three-tiered telescoping rod, housing mount and top handle. The top handle connected to the three-tiered rod provides stability to the astronaut while operating the device while the rod allows for full extension away from the astronaut and any disturbed regolith. The sample container consists of a 3" by 3" area to store collected regolith of a depth of 4 mm. The regolith is collected via two sliding doors that seal together. This container can then be removed and replaced. The actuator system consists of two arms connected to an internal cable system, that when pulled to the upright position, closes the sample housing door. This internal cable system is driven by a handle located at the top side of the telescoping rod. The device is dust tolerant and resistant to corrosion from chlorinated water for testing at NASA's Neutral Buoyancy Laboratory. It only requires manual

power and can be operated with an astronaut’s gloved hands. Each mechanism has been developed using rapid prototyping tools such as laser cutting and 3D printing. The final version of the device will primarily be made of a mix of custom and off-the-shelf stainless steel and aluminum components as well as 3D-printed components. This project is financially supported by the NASA Nebraska Space Grant and the University of Nebraska-Lincoln’s Engineering Student Advisory Board.

PORTABLE CAMERA-AIDED SURGICAL SIMULATOR FOR LAPAROSCOPIC CHOLECYSTECTOMY WITH COGNITIVE TRAINING

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This project aims to develop a portable, cost-effective, and highly realistic surgical training simulator for laparoscopic cholecystectomy that integrates virtual reality (VR) technology. Laparoscopic cholecystectomy is the standard procedure for gallbladder removal. This procedure can lead to biliary duct injury due to the misidentification of anatomical features. Existing training systems are expensive and difficult to transport because they focus on the development of physical skills and environments. This training simulator is designed to be compact, durable, and inexpensive, making it suitable for use in diverse environments, including space exploration missions. To align with NASA's technological needs, this project addresses the critical challenge of limited access to traditional training facilities in space. This simulator features a modular design, allowing for easy assembly and disassembly, and is capable of tracking surgical instruments using a color-based segmentation algorithm and stereoscopic perception. The simulation environment is initially focused on laparoscopic gallbladder surgery but can be extended to other procedures. Key outcomes include improved surgical confidence, reduced errors, and enhanced cognitive skills acquisition. Ultimately, this innovative training simulator will contribute to advancing surgical education and preparedness, improving patient outcomes, and ensuring the health and safety of astronauts during space missions.

PRAIRIE SYSTEMS REBUILD MICROBIAL SYSTEMS

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Globally soil microbial diversity has endured great losses due to mismanagement practices of these vital ecosystems necessary to sustain life. A total of 33% of our planet’s soil is degraded. Given the right conditions through proper management practices, soil microbial communities have the ability to regenerate into a healthier, more sustainable working network. In 2017, 8 grass and 23 forb species were seeded into 12 acres of previously tilled land located at the Nebraska Indian Community College in Santee Nebraska. This has allowed for restoration back into native species. Four divided

research plots were created from the12 acres of land. Leaving the plots idle, burning, bush hogging, and haying are the four rotational methods of management that have been utilized. Timelapse photography was installed in 2022 to show landscape changes over time. Furthermore, plant counts, soil testing, and weather data have also been collected. Our findings show that amid climate challenges and previous undesirable management practices, overall health and return of the microbial communities within these research plots have prevailed. Soil restoration is a useful mechanism in restoring balance to the natural diverse system improving healthier outcomes.

This project is supported by Federal Award Number 80NSSC20M0112.

REVITALIZING HERITAGE: A NUTRITIONAL COMPARISON OF TRADITIONAL EAGLE CORN AND INDUSTRIAL CORN VARIETIES

Author
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Co-Author
Jiah Marks
Nebraska Indian Community College

Eagle Corn, a sacred maize variety, has been cherished by the Pawnee Nation for generations, a unique land trace that stands as a symbol of health, resilience, and cultural identity. This paper will explore the nutritional distinctions between Eagle Corn and modern industrial corn, uncovering the potential lifesaving nutrition in this ancient grain. Available evidence suggests that Eagle Corn boasts elevated levels of essential vitamins, minerals, and antioxidant nutrients which are known to be vital for optimal human health. Notably, the heightened presence of antioxidants like anthocyanins in Eagle Corn may contribute to improved eye health and reduced oxidative stress. Eagle Corns' robust genetic diversity imparts natural resistance to pests and diseases, diminishing the reliance on chemical fertilizers and pesticides and fostering environmentally friendly farming practices. In contrast, industrial corn varieties, engineered primarily for high yield and uniformity, often exhibit diminished nutritional density. The shift towards these commercial strains has not only narrowed our dietary diversity, but also distanced us from the rich heritage embedded in traditional crops like Eagle Corn. By reinstating Eagle Corn into contemporary agriculture, we can enhance nutritional well-being, promote biodiversity, and honor the cultural legacy of Indigenous communities. Eagle Corn represents a reconnection with ancestral wisdom and a stride toward a more sustainable future. Embracing this ancient medicine invites a reevaluation of our food systems, prioritizing nutritional richness over industrial efficiency, and celebrating the profound intersection of culture, health, and the environment. Exploring the untapped potential of traditional crops could unlock new avenues for improving public health and environmental sustainability. It's time we look beyond supermarket shelves and rediscover our agricultural heritage.

This project is supported by Federal Award Number 80NSSC20M0112.

TESTING PROTECTIVE MATERIALS UNDER NEAR-SPACE CONDITIONS

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Co-Author
Marat Sadykov
University of Nebraska Medical Center

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As humanity progresses toward deep space exploration and the potential settlement of other planets in the Solar System, developing reliable personal protection against space hazards becomes increasingly crucial. Protective clothing materials are essential for shielding both humans and sensitive

equipment from harmful radiation and extreme cold during space missions. However, creating realistic testing conditions to assess the protective capabilities of these materials remains challenging due to the wide spectrum of solar radiation, compounded by low temperatures and pressure. There is a significant gap in methods for evaluating the performance of protective materials under conditions that closely simulate those of high-altitude and space flights. To address this gap, we propose using a high-altitude balloon to send a module above Earth's ozone layer, carrying bacterial cultures shielded by test materials. Once there, the cultures will be exposed to hard ultraviolet light, ionizing radiation, and low temperatures. After the module lands, we will evaluate how well the test materials protected the bacteria from radiation and freezing. We have developed a module prototype featuring a lightweight, thermo-insulating container made of polystyrene foam, equipped with a manipulator designed to deploy radiation-transparent containers holding cultures of bacteria or their spores covered by test materials. At a predetermined altitude, the manipulator will extend the holder for exposure and then retract it back into the container. We hypothesize that our module can deliver live bacterial cultures, shielded by the test materials, and expose them to the conditions of a near-space flight. We will test this hypothesis by (1) testing the module prototype for exposing materials at a specified altitude and (2) evaluating the feasibility of an internal heating system to maintain above-freezing temperatures inside the module. The methodologies developed through this project will be crucial in creating a device that effectively evaluates the performance of personal protective gear and apparel against electromagnetic and ionizing radiation, as well as thermal fluctuations, in the extreme conditions of near space. Our approach provides a reliable and cost-effective alternative to material testing in orbital flights. This method could establish a new industry standard for assessing the efficacy of personal protection in high-altitude flights, space travel, and interplanetary exploration.

THE IMPACT OF GRAZING SPECIES ON PRAIRIE ECOSYSTEMS: A COMPARATIVE STUDY OF BISON AND CATTLE

Author
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Co-Author
Kendra Johnson
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Grassland ecosystems are among the most threatened biomes worldwide, with significant biodiversity loss and soil degradation due to human activity, including intensive agriculture and livestock grazing. Historically, bison (Bison bison) were a keystone species in North American prairies, shaping plant communities, soil structure, and microbial diversity through their grazing behaviors, movement patterns, and nutrient cycling. However, their near-extinction due to overhunting and habitat destruction led to their replacement by cattle (Bos taurus) in most grassland ecosystems. While cattle grazing systems dominate modern ranching practices, the ecological consequences of replacing bison with cattle are not yet fully understood. This study aims to investigate and compare the ecological roles of bison and cattle in prairie ecosystems, with a particular focus on their impact on soil health, microbial communities, plant diversity, and overall ecosystem resilience.

This project is supported by Federal Award Number 80NSSC20M0112.

Friday, April 25, 2025 10:20am - 12:35pm

AERONAUTICS AND SPACE SCIENCE MORNING SESSION-2B

Aeronautics and Space Science **Chairperson: Michaela Lucas**
Moderators: Kendra & Michael Sibbernsen

FRIDAY, APRIL 25 **Location: Zoom/Virtual**
https://unomaha.zoom.us/j/95965040865

MORNING SESSION – 2B

10:20 DEVELOPMENT OF A DEPLOYABLE SOFT ROBOTICS DEVICE INSPIRED BY INSECT WING EXPANSION. Lucas Rowden, Cole Emeigh, and Sangjin Ryu

10:35 INVESTIGATING SEI LAYER FORMATION AND STABILITY IN SODIUM-ION BATTERIES FOR LONG-TERM CYCLE LIFE AND SPACE APPLICATIONS. Jayden Palik

10:50 MEDIOLATERAL EXOSUIT FOR BALANCE CONTROL. Alexia Rains, Christopher Engsberg, Nathaniel Hunt, Philippe Malcolm, and Mukul Mukherjee

11:05 SYMMETRY BIOFEEDBACK OF TEMPORAL GAIT METRICS THROUGH PLANAR TACTICLE STIMULATION. Christopher Engsberg, Nathaniel H. Hunt, Philippe Malcolm, and Mukul Mukherjee

11:20 MODULATING GAIT VARIABILITY TO ENHANCE RESILIENCY TO PERTURBATIONS. Kolby J. Brink and Aaron D. Likens

11:35 CAROTID ARTERY BLOOD FLOW AND COMPLIANCE ARE PRESERVED DURING ACUTE CEREBRAL VENOUS CONGESTION. Cody P. Anderson, Michael Allen, and Song-Young Park

11:50 DEVELOPING A CUSTOM ORTHOSIS TO ALLEVIATE MUSCLE ATROPHY AND DECONDITIONING IN ASTRONAUTS DURING PROLONGED SPACE FLIGHT. Michael Allen and Song-Young Park

12:05 IMPACTS OF GROUP III/IV MUSCLE AFFERENT STIMULATION DURING PROLONGED SITTING IN MILD HYPERCAPNIC CONDITIONS ON CARDIOVASCULAR AND AUTONOMIC FUNCTION IN OLDER ADULTS. Andres Benitez-Albiter, Matthew Jones, Michael F. Allen, Cody PAnderson, Muhammet Enes Erol, Gwenael Layec, and Song-Young Park

12:20 THE EFFECTS OF NITROUS OXIDE ON POLYMER SEALS AND LUBRICANTS FOR PROPULSION SYSTEMS. Grant Meyer and Ryan Storm

12:35 ASTRONOMY RESEARCH IN OMAHA WITH AN EVSCOPE WITH A FOCUS ON PLANETARY DEFENSE. Autumn Peters

ASTRONOMY RESEARCH IN OMAHA WITH AN EVSCOPE WITH A FOCUS ON PLANETARY DEFENSE

Author
Autumn Peters
Department of Math and Sciences, Metropolitan Community Coll

For my undergraduate research project this year at Metropolitan Community College, I studied astronomy topics in general. I used an electronic smart scope called an eVscope from Unistellar to make scientific measurements and take photos of astronomical objects. Through a collaboration with SETI. (the Search for Extraterrestrial Intelligence), I participated in citizen science campaigns with a research focus on planetary defense. In this talk, I will be showing different pictures of astronomical events and telescopic images of galaxies, nebulas, planets, and star clusters. I will also share what I have learned about planetary defense and the images about data analysis of different asteroids over the last 7 months.

CAROTID ARTERY BLOOD FLOW AND COMPLIANCE ARE PRESERVED DURING ACUTE CEREBRAL VENOUS CONGESTION

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Introduction: Space travel is associated with carotid artery stiffening despite no changes in tunica intima thickness, thereby implicating physiological signaling as a potential mechanism. Purpose: Therefore, the purpose of this study was to determine the role of carotid artery hemodynamics on carotid artery compliance in a simulated zero-gravity environment. Hypothesis: The overall hypothesis was that a simulated zero-gravity environment would lead to cerebral vascular venous congestion, thereby impairing carotid artery shear rate and endothelial-mediated vasodilation, leading to an acute reduction in carotid artery compliance. Methods: 10 healthy-young subjects (26±5 yrs) participated in this study. Subjects were head-up tilted (HUT) to 70° for 20 min to represent the gravitational environment on Earth. Subjects were then head-down tilted (HDT) -6° for 30 min to simulate a zero-gravity environment. Outcome measures were assessed during the last 5 min of HUT and HDT, respectively. Blood pressure was assessed continuously with a Finometer. Carotid artery diameter, blood flow, and wall shear rate were assessed with ultrasound. Carotid artery compliance was assessed as the change in carotid artery diameter for a change in blood pressure. Jugular vein diameter was assessed with ultrasound. Cerebral oxygenation was assessed with near-infrared spectroscopy. Results: Jugular vein diameter was elevated in HDT compared to HUT (?6.72±2.06 mm, $p<0.01$). Cerebral oxygenation was unchanged in HDT compared to HUT (?-0.39±18.97%, $p=0.77$). Peak antegrade carotid artery blood flow was unchanged in HDT compared to HUT (?0.13±0.54 L/min, $p=0.22$). The peak antegrade shear rate was unchanged in HDT compared to HUT (?-30.45±171.86 s^{-1}, $p=0.14$). Finally, carotid artery compliance was unchanged in HDT compared to HUT (?-0.27±7.96 dB, $p=0.88$). Conclusions: Despite substantial venous congestion in HDT compared to HUT, carotid artery hemodynamics and compliance were preserved. It is likely that carotid artery hemodynamics were preserved to maintain cerebral oxygenation. Therefore, acute cerebral venous congestion may not contribute to acute carotid artery stiffening during short-term exposure to zero-gravity.

This research was supported by the NASA Nebraska Space Grant.

DEVELOPING A CUSTOM ORTHOSIS TO ALLEVIATE MUSCLE ATROPHY AND DECONDITIONING IN ASTRONAUTS DURING PROLONGED SPACE FLIGHT

Author
Michael Allen

Introduction: Space flight poses numerous challenges for human physiology leading to various physical impairments, much of which stem from the effects of prolonged exposure to microgravity. Chronic exposure to microgravity is known to impair endothelial dysfunction, contributing to muscle atrophy, loss of bone density, orthostatic intolerances, and cardiac deconditioning typical in astronauts following space flight. On earth, these conditions are commonly associated with physical inactivity and are therefore counteracted by increasing physical activity. This is often done through various exercise regimens designed to initiate stress on the musculoskeletal system that induce positive adaptations. Unfortunately, mitigating these effects during space flight is often met with significant challenges. Aboard the international space station (ISS), astronauts are required to spend two hours performing physical exercise using equipment modified to simulate the effects of gravitational strain. While such exercise regimens may be effective to alleviate some of the physiological abnormalities associated with space flight, it is likely that the small exercise period may not be sufficient enough to attenuate the profound effects imposed on the body by chronic microgravity. This presents a critical need to develop alternative approaches designed to elicit consistent skeletal muscle stimulation outside of the required during space flight. Purpose: Therefore, the purpose of this project was to develop a custom knee orthosis device that is capable of generating consistent low-intensity resistances to flexion and extension of the leg. Methods and Results: A prototype of the knee orthosis was developed using readily available CAD software and 3D printed on a Bambu Labs Carbon X1 printer. The hinge joint serves as the focal point of the knee orthosis, using a combination of adjustable compression and rotational frictional forces designed to provide steady resistance through motion. Conclusion: The deleterious effects of microgravity on physiological function during prolong space flight pose as a significant limitation to space exploration. Traditional approaches to mitigate these effects involve various exercise regimens and protocols to be performed while in space. However, this is still not enough to overcome the chronic loss of gravitational forces exerted on the body. This custom knee orthosis stands to serve as a steppingstone to preserving the health and wellbeing of astronauts while in space by imposing mild resistances to non-exercise movements that stimulate low levels of skeletal muscle activity which may increase endothelial function, delay muscle atrophy, preserve bone density, and protect against cardiac deconditioning. This work was funded by the NASA Nebraska Space Grant Fellowship.

DEVELOPMENT OF A DEPLOYABLE SOFT ROBOTICS DEVICE INSPIRED BY INSECT WING EXPANSION

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Wings are a crucial element to the survival of many insects, as insects can fly with wings to find food and mates in nature. When insects mature and emerge from their chrysalises, their wings unfold as the blood which runs through the veins of the wings. This project aims to harness this concept of a

folded structure which is expandable through the injection of a fluid. In this study, a device has been created through thermal bonding fabrication process using customized metal pieces to achieve desired channel geometries. The device material is a thin plastic sheet with thermal bonding capability on one side. Two sheets of plastic are bonded together, and a channel network is left between the two through a thermal pressing method. When the sheets are bonded together with a thermal press, metal pieces are placed atop the material to outline the network geometry to prevent contact with the thermal press so the portions of the sheets which are outlined do not become bonded. This method allows the sheets to form a strong bond while encasing the hollow channels. The device is lightweight, foldable, and allows for the injection of fluid through the channel network. With the fabrication method, devices can be easily reproduced and allow researchers to create many devices with different networks. Devices have been developed to standardize the fabrication process, allowing for the diversification of channel networks instilled in each device. Recently, simple I-shaped channel devices have undergone injection testing with a 3D-printed device port attachment, bonded with multiple adhesives. These tests observed the port bonding capabilities under the different adhesives to identify viable options, and to study the effect of different volumetric flow rates during injection. These tests identified epoxy as the most viable option for device port attachment. Using this bonding method, increasingly complex networks will be fabricated and undergo injection testing to study combinations of network complexity and input and output variants. Fluids of differing viscosity will be injected to analyze effects on devices of the same geometry. After the testing of complex networks and injection fluids, networks more closely resembling insect wings will be created to undergo similar testing with the addition of high-speed imaging to study fluid behaviors and profiles.

IMPACTS OF GROUP III/IV MUSCLE AFFERENT STIMULATION DURING PROLONGED SITTING IN MILD HYPERCAPNIC CONDITIONS ON CARDIOVAS

Author
Andres Benitez-Albiter

Introduction: Aging brings about several physiological changes, including a decline in vascular endothelial function, increased arterial stiffness, and disruptions in autonomic regulation, all of which contribute to a higher risk of cardiovascular disease (CVD). These changes may make older adults especially vulnerable to factors that further impair vascular health. Prolonged sitting (PS), defined as remaining seated for 2+ hours, is an independent risk factor for CVD. It often occurs in environments with elevated carbon dioxide (CO?) levels (mild hypercapnia), which may further deteriorate vascular function. However, little is known about how PS in such conditions affects older adults. Purpose: This study aimed to explore the cardiovascular effects of PS in a mild hypercapnic environment in older adults. Additionally, it examined whether active leg movement could help mitigate vascular dysfunction in this setting. Methods: 7 healthy older adults (6 males, average age 72 ± 3.68 years) took part in two experimental visits, each involving 2.5 hours of PS in a mild hypercapnic environment (CO? = 1500 ppm). The sessions included a control condition with no movement (CON) and an active leg movement condition (ACT). Endothelial function in the popliteal and brachial arteries was assessed through flow-mediated dilation (FMD), while autonomic function was assessed using heart rate variability. Reoxygenation and metabolic rate, indexes of microvascular function, were evaluated using near-infrared spectroscopy. All assessments were conducted before and after the sitting. Results: Brachial FMD was reduced in the CON condition compared with ACT (D -1.89 ± 0.52%, P<0.0001 vs D 1.05 ± 1.09%, P=0.0047, respectively). Popliteal FMD was attenuated in the CON condition compared to ACT (D -1.73 ± 0.53%, P<0.0001 vs D 1.01 ± 1.07%, P=0.005, respectively). Muscle metabolic rate was only decreased in CON condition (D-0.03 ± 0.03 %/s, P=0.0318). No significant changes in reoxygenation rate or autonomic function were observed. Conclusion: This preliminary data shows that uninterrupted prolonged sitting with mild hypercapnia further impaired the already compromised macro- and microvascular function of older adults. However, intermittent bouts of movement were sufficient to preserve leg vascular function during bouts of PS.

INVESTIGATING SEI LAYER FORMATION AND STABILITY IN SODIUM-ION BATTERIES FOR LONG-TERM CYCLE LIFE AND SPACE APPLICATIONS

Author
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The solid electrolyte interphase (SEI) layer is one of the most critical components in next-generation rechargeable batteries, such as sodium-ion batteries. The SEI is a thin layer, in the nanometer range, that forms during initial cycling on the surface of the electrode due to the reduction of the organic liquid electrolyte. The thickness and composition of the SEI layer have a large impact on the long-term cycling stability of the battery, and this can vary depending on the formation protocol used during the initial cycles, such as low vs high current density. High-performance batteries are needed in many space applications, such as powering spacecraft and instruments, but capacity loss and low coulombic efficiency during extended cycling are still problems. This research aims to investigate how the SEI formation protocols impact the long-term cycling stability of sodium-ion batteries. Electrochemical techniques are used, along with spectroscopic ellipsometry, to better understand how the thickness and refractive index of the SEI influence the capacity decay and coulombic efficiency. Preliminary results show how controlling the formation protocols significantly impacts SEI thickness and uniformity, which influences the battery's long-term cycle life. This work provides valuable insight into the relationship between SEI characteristics and battery performance, helping to develop the next generation of batteries for extended space missions. Future work will look to explore low-temperature environments to simulate the extreme conditions in space and toward in situ ellipsometry measurements for monitoring the SEI in real-time.

MEDIOLATERAL EXOSUIT FOR BALANCE CONTROL

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Background: Balance control is often quantified by measuring the distance of the center of mass from the base of support. However, dynamic balance control during gait also demands the consideration of the velocity of the center of mass. Instead, we can quantify the distance between the velocity-adjusted center of mass and the base of support, or the Margin of Stability (MoS). Astronauts often experience balance deficits upon returning from space due to vestibular disturbances. Exoskeletons or exosuits are a promising solution that has been shown effectively in research. However, such devices are often difficult to implement into regular rehabilitation due to cost and logistical feasibility. Our lab proposed a soft, passive exosuit that helps modulate mediolateral balance control via tensioned cables about the hip joint. However, in order to create a perceptible change in frontal plane control, a moment arm extension device needs to be utilized. However, the optimal specifications of this device are unknown. Thus, the purpose of this study is to determine the optimal length of a moment arm extension device for the exosuit. We hypothesize that greater offset from the body would result in greater improvements in balance control. Methods: Ten subjects completed 25 minutes of walking on the treadmill at 1.0 m/s. Subjects completed a familiarization, baseline, and four blocks of experimental and washout trials. Each block will consist of one of four moment arm length conditions (0mm, 30mm, 55mm, or 80mm) and a washout where the exosuit is disengaged. All experimental conditions were conducted while perturbing the subjects by forcing circumduction, which has been shown to disturb mediolateral control. Moment arm conditions were randomized to avoid order effects. Electromyographic and kinematic data were collected and analyzed. Results: The 55mm distance appears to be the optimal moment arm length, as it shows decreases in abductor muscle activation and MoS toward baseline values compared to circumduction conditions. This suggests that exosuit use helped manage balance control by reducing the demand on the abductor muscles, thereby improving efficiency in movement. By offloading some of the mechanical work typically performed by the abductors, the exosuit may contribute to greater stability and reduced fatigue. This finding highlights the potential for passive exosuits in enhancing balance performance across various applications, including astronaut rehabilitation and individuals with balance impairments. (COI declaration: P.M. is an inventor of WO2023192982A2)

MODULATING GAIT VARIABILITY TO ENHANCE RESILIENCY TO PERTURBATIONS

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Decades of biomechanical research have established that healthy movement patterns exhibit an optimal structure of variability, which deteriorates with aging and pathology. Recent studies demonstrate that synchronizing movements to a metronome with optimal variability can restore healthy gait patterns, reduce energy expenditure, and increase resilience to trips. Our research investigates whether manipulating gait variability through haptic metronome cueing improves stability and resilience to unforeseen disturbances in both young and older adults. The study will recruit 80 subjects,

evenly divided between young (19-35 years) and older adults (65+ years). Participants will first perform a 5-minute baseline walk at self-selected pace on a split-belt treadmill while secured with a harness (zero bodyweight support) to establish individual mean and variance of inter-stride intervals. These values will be used to normalize cueing signals to each participant's natural gait pattern. Subjects will then be randomly assigned to one of four experimental conditions: haptic metronome with white noise variability (unhealthy pattern), pink noise variability (healthy pattern), invariant timing (constant), or a control group walking without metronome guidance. During the 15-minute experimental trial, participants will synchronize their right heel strikes to the wrist-worn haptic metronome according to their assigned variability condition. Between 7-10 minutes into the trial, the treadmill belt under the non-dominant leg will be unexpectedly arrested for 500ms, creating a perturbation that simulates a real-world trip. Recovery time—measured from perturbation onset to re-establishment of normal gait patterns—will serve as the primary dependent variable. Motion capture technology will record full-body kinematics to analyze recovery strategies in detail. This research has direct applications to aerospace environments, as maintaining stability in variable conditions mirrors challenges astronauts face in microgravity. By demonstrating that specific types of gait variability can enhance stability across age groups, we can develop targeted training protocols for NASA personnel to improve performance on the NASA Task Load Index, particularly in temporal demand and performance domains. These protocols could be implemented during pre-flight training, in-flight conditioning, and post-flight rehabilitation, ultimately contributing to mission success and astronaut safety.

SYMMETRY BIOFEEDBACK OF TEMPORAL GAIT METRICS THROUGH PLANTAR TACTILE STIMULATION

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Astronauts tend to experience gait and balance deficits after extended exposure to microgravity resulting in the requirement of gait rehabilitation. We hope to improve these rehabilitation strategies by implementing adaptive feedback about the subject’s real-time movements. This feedback would provide a goal for movement changes to improve their walking pattern. Biofeedback is a common method for accomplishing this goal. Our goal is to provide biofeedback about the subject’s stepping pattern using a novel method – through vibrations applied to the feet. In the current study, we aim to validate that biofeedback applied to the feet is an effective method for altering gait parameters like stepping patterns and stance time asymmetries, in healthy young adults. This would support the feasibility for using this device in future rehabilitative studies. We will conduct experiments with this feedback system that instructs participants to either lengthen or shorten their stance times through vibrating insoles in the participants’ shoes. Subjects will be instructed to push off the ground when their foot vibrates, and if no vibration is felt, that means their push off should occur later during the next steps. Preliminary results demonstrate subjects adjusting their stance times according to the target symmetry provided through the vibrations. Subjects were best at achieving low levels of asymmetry, but not high degrees of asymmetry. When providing feedback to have the dominant limb be in stance for 40% longer than the non-dominant limb, the subject reached an asymmetry of 28%. However, when instructing the subject to have the reverse, they only reached 15% asymmetry. This demonstrates that leg dominance may impact the degree of asymmetry that can be reached between the two limbs. If this project supports the use of plantar tactile biofeedback for instructions in altering a subject’s stepping pattern, then this feedback may be especially valuable for quickly teaching someone how to effectively use assistive technologies, such as exoskeletons, in special environments like altered gravity.

THE EFFECTS OF NITROUS OXIDE ON POLYMER SEALS AND LUBRICANTS FOR PROPULSION SYSTEMS

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Ensuring the safety of polymer sealants in propulsion systems is critical for space applications, where materials must exhibit both thermal stability and resilience under extreme conditions. This study investigates the effects of nitrous oxide (N_2O), a common oxidizer in rocket propulsion, on key propulsion sealants and lubricants. Exposure testing was conducted using in-house pressure chambers with liquid and gaseous N_2O for short term (~100 Hr) to long term (~2000 Hr) durations. Liquid N_2O was used on solid samples of fluorinated ethylene propylene (FEP), polyether-ether-ketone (PEEK), and polytetrafluoroethylene (PTFE), while gaseous N_2O was applied to PTFE greases containing ether. Post-exposure analysis was performed to assess changes from time scale-dependent and physical properties. Fourier transform infrared spectroscopy (FTIR), nanoindentation, laser scanning microscopy (LSM), and thermogravimetric analysis (TGA) were employed to evaluate chemical and physical interactions with N_2O. FTIR was used to detect functional group modifications, nanoindentation detected changes in mechanical static and dynamic behavior, LSM enabled visualization and surface roughness analysis, and TGA identified thermal shifts through variations in onset temperatures across different exposure conditions. Preliminary results show N_2O exposure alters the performance of FEP and PTFE, while PEEK remains relatively stable. These findings provide critical insight into the chemical and mechanical degradation of polymer sealants in N_2O-rich environments, informing material selection and design strategies for propulsion systems in space applications.

Friday, April 25, 2025 11:00am - 12:00pm

MAIBEN LECTURE: DR. MARY ANN VINTON

FRIDAY, APRIL 25 **Location: Great Plains Room**

Friday, April 25, 2025 12:00pm - 12:30pm

STATE OF THE ACADEMY AND FRIENDS OF SCIENCE AWARDS

FRIDAY, APRIL 25 **Location: Great Plains Room**

Friday, April 25, 2025 12:00pm - 1:00pm

INBRE STEERING COMMITTEE

Arbor Suite A

FRIDAY, APRIL 25 Location: Arbor Suite A

Friday, April 25, 2025 12:00pm - 1:15pm

LUNCH BREAK

FRIDAY, APRIL 25 **Location: UNL East Campus Union Cafeteria**

Friday, April 25, 2025 12:30pm - 1:15pm

GRADUATE SCHOOL PREPAREDNESS PANEL

Bring your Lunch and Come Learn about Tips for Applying to Graduate School! **Location: Great Plains Room A**
Learn about specific local Graduate Programs and hear from local Graduate Students!

Panelists:
Lynne Dieckman- Department of Chemistry and Biochemistry, Associate Professor, and Associate Chair, Creighton University, Omaha, NE
Garrett Soukup- Graduate Program Director, Professor and Interim Chair in the Biochemical Sciences Department, Creighton University, Omaha, NE
Kimbery Rothgeb-IGPBS Education Program Coordinator, University of Nebraska Medical Center, Omaha, NE
Brian Peterson- Online Coordinator and Academic Coach II, University of Nebraska - Kearney, Kearney, NE
Erin Haacker-Department of Earth and Atmospheric Sciences, Associate Professor, University of Nebraska- Lincoln, Lincoln, NE
Adedotun Adefolalu, Graduate Research Assistant, Becker Lab, Department of Biochemistry/Redox Biology Centre, University of Nebraska- Lincoln, Lincoln, NE
Sabyasachi Mohanty, PhD student in Complex Biosystems program, Department of Chemical and Biomolecular Engineering, University of Nebraska- Lincoln, Lincoln, NE

Friday, April 25, 2025 1:15pm - 2:45pm

FORENSIC SCIENCES AFTERNOON SESSION- 1

Forensic Science **Chairperson: Dr. Charles Murrieta**

FRIDAY, APRIL 25 **Location: Legacy A**

AFTERNON SESSION– 1

1:15 Presenters upload session talks onto room computer desktop.

1:30 Zoom session is open for remote presenters.

1:45 DIPTERA COLOR PREFERENCE AT DECOMPOSITION SCENES. Haley Fleetwood, Erin Bauer, Charles Murrieta, Larry Barksdale

2:00 MICROBIOME DYSBIOSIS PROMOTES TUMOR PROGRESSION AND IMMUNE SUPPRESSION IN A PDAC MOUSE MODEL. Mohammed Hassan, Iman Ahmed, Christover D' Angelo, Kathryn Cooper, and Maher Abdalla

2:15 ANALYSIS OF ARTIFICIAL BLOOD, GUNSHOT RESIDUE, AND FIBER TRANSFER IN A SIMULATED MASS SHOOTING SCENARIO. Cassandra Voigt and Charles Murrieta, Ph.D

2:30 **BREAK**

ANALYSIS OF ARTIFICIAL BLOOD, GUNSHOT RESIDUE, AND FIBER TRANSFER IN A SIMULATED MASS SHOOTING SCENARIO

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Tragically, mass shootings have become more common in today's society. In 2014, 275 mass shootings were investigated. This number jumped by 30% in 2020. Due to the variability in the number of victims and location (outdoor or indoor), investigations of such crimes can be challenging. Retrieving evidence from these scenes, with subsequent reconstruction must be done in a timely manner. This project sought to simulate an outdoor mass shooting scenario and analyze retrieved evidence. Victim and bystanders were simulated with contrasting-colored shirts on wood supports and the victim shot at close range. The shirts were then individually placed in paper evidence bags for transport to the laboratory. Photography and microscopy were used to analyze the shirts for trace evidence, with emphasis on artificial blood spatter, gunshot residue, and fiber. This project demonstrated the importance of simulated scenarios, such as mass-shootings, to explore variables and hopefully investigate crime scenes more efficiently.

DIPTERA COLOR PREFERENCE AT DECOMPOSITION SCENES

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Flies (Diptera spp.) are commonplace and often considered a nuisance. During the warmer days of the year, flies can increase in number and are typically attracted to detritus as a source of energy. This is especially apparent in crime scenes involving decomposing bodies or blood spatter. Flies regurgitate or defecate blood they have ingested from a death scene, leaving artifacts behind. As crime scene reconstruction involves blood spatter analysis, fly artifacts can modify a crime scene and therefore confuse investigators. Flies and fly larvae are commonly used to determine post-mortem interval. However, little is known if flies are attracted to specific colors. Such information may allow investigators to properly evaluate blood spatter and distinguish from fly artifact, allowing for a more accurate investigation. This project was designed to observe if flies in an outdoor environment have observable preferences to color. Using a pig carcass (Sus scrofa), colored paper was oriented around the decomposing carcass and fly populations observed over a 2-week period. At the end of the project, it was observed that flies tend to gravitate toward yellow, white, and blue over red, black, or green. Although this was an initial survey, it does offer the possibility that insects may be attracted to one color, or series of colors. With additional research, this may ultimately offer crime scene investigators tools to process scenes more accurately.

MICROBIOME DYSBIOSIS PROMOTES TUMOR PROGRESSION AND IMMUNE SUPPRESSION IN A PDAC MOUSE MODEL

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Pancreatic ductal adenocarcinoma (PDAC) is the third most common cause of cancer deaths in the United States and has an overall 5-year survival rate of about 10%. A delayed diagnosis, the rapid spread of metastases, and resistance to treatments are key contributors to the poor outcomes observed in PDAC patients. Intratumoral microbiome signature has been implicated as a predictive factor of long-term survivorship in PDAC patients. However, we still lack a complete map of microbiota-host-drug interactions in PDAC, especially the effect of chemotherapy on the microbiome. Antibiotics (Abx) exposure has been demonstrated to improve the efficacy of standard Nab-paclitaxel and gemcitabine (NPG) chemotherapy. We studied microbiome depletion using broad-spectrum Abx in an orthotopic mouse model of PDAC, followed by NPG treatment. Tumor volume and weight were recorded and collected for trypsin digestion. Infiltrated immune cells were studied by flow cytometry and confocal microscopy. Gut and tumor samples (16S rRNA) were sequenced for microbiome diversity and correlated with PDAC response to NPG. On the other hand, we investigated the role of antibiotics on KPC 7107 cell line proliferation using MTT assay, western blot, confocal microscopy, and clonogenic assay. Our results show that using wide-spectrum Abx promotes tumor growth in PDAC mice. Abx disrupts the immune microenvironment, shifts tumor-associated macrophage (TAM) polarization to anti-inflammatory (M2) macrophages, reduces infiltrated CD8+ T cells, and increases exhausted CD8+ T cells. Interestingly, combining Abx with chemotherapy resulted in an enhanced chemotherapy effect, as measured by tumor size and volume. Our sequencing results show increased alpha diversity (measured using Shannon entropy) for mice receiving Abx only and for the combination treatment. However, mice receiving NPG only had lower alpha diversity than the control. Beta diversity demonstrated a significant difference in microbial composition when comparing all groups except Abx to the combination. There was a significant difference in beta diversity using the Bray-Curtis measure when comparing Abx to control and Abx to gemcitabine. LefSE analysis of differentially enriched taxa suggests enrichment of inflammatory taxa, such as Proteobacteria, at the phylum level in the antibiotics-only samples. Our in vitro study shows that antibiotics increase the proliferation of PDAC mice in Abx treatment compared to the untreated group.

Friday, April 25, 2025 1:15pm - 4:00pm

BIOLOGY AFTERNOON SESSION- 1

BIOLOGY **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Arbor Suite A**

AFTERNOON SESSION – 1 **Subsection Co-Chairs: Adedotun Adefolalu and Sabyasachi Mohanty**

1:15 Presenters upload Session talks onto room computer desktop.

1:30 PHYSIOLOGICAL AND BEHAVIORAL EFFECTS OF OVER-THE-COUNTER HALLUCINOGENS ON *GROMPHADORHINA PORTENTOSA*. Crimsen Blankenship, Ashley Jansen, and Jeffrey Kiiskila

1:45 RANDOM MUTAGENESIS TO IDENTIFY UNIQUE MUTATIONS AFFECTING TETX8 TETRACYCLINE DESTRUCTASE ACTIVITY. Marisa Dendinger, Sam Aden, Lemei Zhang, and Karin van Dijk

2:00 GENE EXPRESSION AS AN EARLY INDICATOR OF HONEY BEE COLONY HEALTH. Autumn Woolpert, Alexa Kozlak, and Carol Fassbinder-Orth

2:15 ANALYSIS OF THE HOOF STRUCTURE WITH JOJOBA OIL AND ALOE VERA. Autumn Skow and Rachelle Rider

2:30 BREAK- Presenters upload Session talks onto room computer desktop.

2:45 INVESTIGATING *ARABIDOPSIS* HDA5 ROLE IN PSEUDOMONAS SYNRINGAE T3E-MEDIATED SUPPRESSION OF PLANT IMMUNE RESPONSES. Ryan W. Heser, Jake T. Schmid, and Karin van Dijk

3:00 INVESTIGATING NEW GENES REQUIRED TO PRODUCE HEAT-STABLE ANTIFUNGAL FACTOR (HSAF) IN LYSOBACTER ENZYMOGENES. Nike Idowu, Youfu Zhao, and Liangcheng Du

3:15 Scheduled talk moved to Poster Session. INVESTIGATION OF *PTEROPUS ALECTO* IFITM3 GENES AS A VIRAL RESTRICTION FACTOR WITH HSV-1 INFECTIONS. Abbie Willett and Dane Bowder

3:30 URANIUM ABSORPTION IN PRODUCE. Aiyana Fujiyamat and Kinsley Mason

3:45 THE ROLE OF N-ACETYLCYSTEINE AMIDE ON ANXIOLYTIC RESPONSES AND GLUTAMATE NEUROTRANSMISSION IN *DANIO RERIO*. Brooklynn K. Schmidt and Ryan Y. Wong

PHYSIOLOGICAL AND BEHAVIORAL EFFECTS OF OVER-THE-COUNTER HALLUCINOGENS ON GROMPHADORHINA PORTENTOSA

Author
Crimsen Blankenship

Co-Author
Ashley Jansen
Chadron State College

Co-Author
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Chadron State College

The study of pharmaceuticals and their effects is a constantly evolving area. One of the emerging ways to test these effects is using insects known to have blood-brain barriers and peripheral nervous systems similar to humans. Previous studies were carried out on Drosophila melanogaster; however, *Gromphadorhina portentosa* (Madagascan hissing cockroach) have been used in a few studies due to having a similar blood-brain barrier to humans and as a larger model for study. In this study, *G. portentosa* are being monitored for the impact of well-studied over-the-counter medications, Diphenhydramine and Dextromethorphan to determine if they are viable for pharmaceutical testing. *G. portentosa* is being evaluated for behavioral changes, memory changes, and dependency on these medications. Subjects had initial observation periods of three weeks in which behavior patterns were observed, and daily trials were conducted with a mouse maze to evaluate memory. Following the observation period, doses of Diphenhydramine at 20 mg mL-1, 10 mg mL-1, and 5 mg mL-1 of sugar water were given in separate test cages and were observed for a week after an

initial dosing day. Methods were repeated for Dextromethorphan. Results are currently being collected and evaluated; however, it is hypothesized that the drugs will increase aggression in *G. portentosa* and increase the time it takes for them to finish the maze.

RANDOM MUTAGENESIS TO IDENTIFY UNIQUE MUTATIONS AFFECTING TETX8 TETRACYCLINE DESTRUCTASE ACTIVITY

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When first discovered, antibiotics revolutionized the treatment of bacterial infections. However, their efficacy has diminished over time due to the emergence and spread of antibiotic-resistant bacterial strains. One such antibiotic is tetracycline, which inhibits bacterial protein translation by targeting ribosomal functions. Some bacteria have evolved to resist tetracycline through the *tetX8* gene, which encodes a tetracycline destructase that deactivates tetracycline via covalent modification. TetX proteins use oxygen, NADPH, and FAD to perform flavin-mediated hydroxylation rendering tetracycline inactive. While key amino acid residues involved in tetracycline degradation have been identified, the precise mechanisms remain elusive. In a study that started in a course-based undergraduate experience (CURE) lab and continued beyond the CURE lab, we used random mutagenesis to generate a mutant library of *tetX8*. Screening on media with varying tetracycline concentrations identified mutants with altered tetracycline resistance. These mutants were further characterized using Kirby Bauer disk diffusion and Minimum Inhibitory Concentration (MIC) assays. Sequence analysis revealed unique mutations in some mutants. Ongoing studies aim to elucidate the effects of these mutations on enzyme structure and activity.

EXPLORATION OF HORMONAL MARKER EXPRESSION AS AN EARLY INDICATOR OF HONEY BEE COLONY HEALTH

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Honey bees and other pollinators have been experiencing record declines in recent years. For honey bees these declines include annual colony losses of 50% or more. These losses threaten global ecosystems and agricultural productivity. Numerous factors such as pesticide exposure, intensive agriculture, transportation, pathogen infection, and immunosuppression are thought to contribute to these high colony losses. However, the exact causes are unknown, so there are no methods for reliably predicting colony loss. This longitudinal study monitored *Apis mellifera*

(European honey bee) colonies in a commercial honey bee operation in Iowa for one year to determine whether correlations between colony-level health and molecular-level data could be observed and used to predict colony loss. Multiple metrics across fifty colonies were measured, including levels of four physiological markers: vitellogenin, phenoloxidase, odorant-binding protein, and octopamine receptor. These markers are involved in colony division of labor and immune function. Colonies were sampled monthly, and relative expression levels were quantified using a digital droplet polymerase chain reaction (ddPCR). Results are expected to be useful for developing tools that can identify failing colonies early to prevent pathogen transmission and minimize colony losses.

ANALYSIS OF THE HOOF STRUCTURE WITH JOJOBA OIL AND ALOE VERA

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Hoof health is essential for horses' mobility, conformation, and performance. The keratinous structure of the hoof wall, composed of microfibrils and an amorphous protein matrix, is highly susceptible to dehydration, particularly in high-drought environments. The unique structure of the hoof wall allows for nutrient absorption through diffusion, making hydration management critical. Dry hooves can lead to cracks, lameness, and reduced horse utility. This study investigates the effects of a jojoba oil and aloe vera conditioner on horse hooves to improve hydration, promote growth, and maintain structural integrity in arid conditions. The research involved treating the front hooves of three horses with a 2:1 mixture of jojoba oil and aloe vera while using the hind hooves as controls. The mixture was applied every four to six days for three months, with measurements of hoof growth and crack formation documented biweekly. Scanning electron microscopy (SEM) was employed to analyze the structural impact of the conditioner and assess how the hoof structure changed. Preliminary findings suggest improved moisture retention, reduced cracking, and enhanced hoof hardness, as observed through visual and farrier evaluations. Preliminary findings suggest that the jojoba oil and aloe vera conditioner may improve hoof hydration and resilience, indicated by reduced cracking and better hoof texture over the treatment period. This demonstrates that jojoba oil and aloe vera, known for their hydrating, antibacterial, and antifungal properties, could provide a cost-effective and natural solution for mitigating hoof damage caused by arid conditions. Further analysis of SEM results will provide deeper insights into the structural integrity of treated versus untreated hooves. The results contribute to the development of practical equine care strategies, supporting the health, longevity, and economic value of horses.

INVESTIGATING ARABIDOPSIS HDA5 ROLE IN PSEUDOMONAS SYNRINGAE T3E-MEDIATED SUPPRESSION OF PLANT IMMUNE RESPONSES

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Pseudomonas syringae is a Gram-negative bacterial plant pathogen that infects economically relevant crops like tomato and soybean in addition to the model host plant *Arabidopsis thaliana*. Similar to various human pathogens, *P. syringae* relies on a type III secretion system (T3SS) to proliferate and cause diseases. The T3SS is essentially a molecular syringe that the bacterium uses to inject an arsenal of proteins called type III effectors (T3Es) directly into host cells. Although we understand that T3Es collectively contribute to disease primarily by suppressing plant innate immunity, the exact molecular mechanisms by which most of these proteins do so to allow disease progression remain elusive. This project is focused on *A. thaliana* histone deacetylase 5 (HDA5), a protein we have previously shown to be involved in deacetylating chromatin along a subset of innate immune genes when *Arabidopsis* is infected

with wildtype *P. syringae* DC3000. This deacetylation does not occur with a hrcC mutant incapable of translocating T3Es into the plant cell. Our hypothesis is that injection of T3Es into plant cells during a *P. syringae* infection results in HDA5 translocation into the nucleus of *Arabidopsis*. To determine if this localization occurs, we decided to isolate intact nuclei from *Arabidopsis* leave tissue and analyze HDA5 localization and abundance pre- and post- *P. syringae* infections. We have adapted existing nuclei isolation protocols incorporating membrane lysing buffers followed by a series of centrifugation steps and a Percoll density gradient to fractionate plant cell organelles. Once samples were obtained, isolation and purity of nuclei was determined using fluorescence microscopy with the DNA binding dye, DAPI. In addition, we used immunoblotting with anti-histone H3 antibodies and anti-UDP Glucose Pyrophosphorylase to detect nuclear and cytoplasmic fractions respectively in order to determine the purity level of the nuclei. Preliminary data shows clean intact nuclei with minimal cellular debris contamination. This is a promising step toward our goal. We are now investigating the localization of HDA5 upon *P. syringae* infection using transgenic *Arabidopsis* plants expressing HA-tagged HDA5.

INVESTIGATING NEW GENES REQUIRED TO PRODUCE HEAT-STABLE ANTIFUNGAL FACTOR (HSAF) IN LYSOBACTER ENZYMOGENES

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Lysobacter enzymogenes strain C3 (LeC3) is a biocontrol agent that produces natural antibiotic compounds to combat microbial pathogens. However, the development of a broad-spectrum antifungal compound like HSAF for agricultural and pharmaceutical applications is hindered by their low yield and complex laboratory synthesis. To increase productivity, it is essential to comprehend how the production of HSAF is regulated in *Lysobacter*. We have previously identified mutants lacking in HSAF production and antifungal activity by transposon mutagenesis. The mechanism behind these mutants' loss of antifungal products is still unknown. The HPLC analysis of metabolite extracts verified that the mutants did not produce HSAF. Antifungal assays confirmed that the mutants did not inhibit *Fusarium graminearum*. The phenol hydroxylase gene (ph), which encodes a protein that is a member of the ferredoxin $NADP^+$ reductase family, is one of the genes that is being studied. VirB10 of the Type IV secretion system family was also studied. We investigated the ph gene's possible physiological role in maintaining redox balance. When exposed to oxidative stress from hydrogen peroxide, methyl viologen, and UV light, the wild-type LeC3 (wtC3) grew faster than the ?ph. With the introduction of an antioxidant such as glutathione (GSH), ?ph whose metabolism and growth were initially slowed down by oxidative stress, started to have a fast growth. HPLC analysis showed that ?ph produced a higher yield of a siderophore called lysochelin. Both wtC3 and ?ph development were accelerated by glucose and maltose but slowed by glycerol. TEM and SEM analysis showed pili were barely present in the VirB10 mutant, while wtC3 had a significant number of pili. Our findings suggest that the ph gene may influence redox processes necessary for the cyclization of polycyclic rings of HSAF by participating in electron transfer via reduced NADPH. VirB10 likely participates in constructing the pili that create surface contacts for extracellular signals, to which the *Lysobacter* cells would respond by producing HSAF. We are currently using tools in biochemistry, genetics, and chemical biology to obtain more evidence for the function of these new genes in HSAF production.

URANIUM ABSORPTION IN PRODUCE

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Uranium, a naturally occurring radioactive element, is found in the topsoil of Earth's crust, including in Chadron, Nebraska where it is present in soil and water. The occurrence of the element poses potential health risks associated with uranium exposure. Exposure to radioactive elements may result in acute radiation syndrome, while long-term exposure can lead to cancers or cardiovascular diseases. To determine whether plants grown in uranium-contaminated soil, gathered from the town's ponds, absorb uranium and cause genetic changes, analysis of plant growth in various levels of uranium were analyzed. Plants such as green beans, strawberries, sweet potato slips, and green peas were grown to assess uranium's impact on plant growth and genetic integrity.

Plants were grown in a controlled environment with miracle grow then transferred into soil gathered from contaminated local ponds. To track uranium levels in the soil and monitor uptake, portable x-ray fluorescence (pXRF) was used. Uranium levels were high in both ponds ranging from 8 to 13 parts per million (ppm). Analysis is currently underway and the presence of uranium in plant tissues will be visualized, and DNA and protein sequencing tests will identify any genetic mutations caused by the exposure. Mutations will be reviewed to determine their severity and potential parallels to human genetic responses to radiation. A better understanding of uranium's biological effects and its potential implications for local ecosystems and human health is critical for the Chadron, Nebraska area. These findings may provide insight into environmental contamination and inform remediation strategies in areas that are affected by uranium.

THE ROLE OF N-ACETYLCYSTEINE AMIDE ON ANXIOLYTIC RESPONSES AND GLUTAMATE NEUROTRANSMISSION IN DANIO RERIO

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Animals experience a variety of stressors and anxiety-inducing scenarios throughout their lives. Proactive and reactive stress coping styles are two ways animals respond to stress and anxiety. Proactive individuals tend to show lower stress and anxiety behaviors while reactive individuals tend to show the opposite. Studies have linked stress to increased glutamate levels, and dysregulation of glutamate has been associated with various stress- and anxiety-related disorders. It is crucial to maintain glutamatergic modulation to appropriately respond to stress and anxiety. N-Acetylcysteine amide (NACA) is an emerging compound to regulate glutamate in the brain. While studies have utilized NACA to study stress and anxiety in zebrafish, the role of glutamate in facilitating the display of alternative stress coping styles is not well understood. We tested the hypothesis that acute treatments of NACA will reduce stress-related behaviors. After NACA administration in zebrafish with the proactive or reactive stress coping style, we quantified anxiety-related behaviors (light/dark test) and active vesicular glutamate transporters (VGLUT) via immunohistochemistry to quantify neuronal glutamate activity. After treating fish for 24 hours with 1 mg/L of NACA, we saw a significant decrease in anxiety-like behavior compared to the control group. However, the magnitude of the anxiolytic effect by NACA did not differ between the proactive and reactive coping styles. By providing a better understanding of glutamate neurotransmission between the different stress coping styles and NACA's effect on glutamate modulation in stress, we may gain insights into new ways to treat stress and anxiety-related disorders.

BIOLOGICAL AND MEDICAL SCIENCES AFTERNOON SESSION- 1A

Biological and Biomedical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains Room A**

AFTERNOON SESSION – 1A **Subsection Chairperson: Dr. Lynne Dieckman**

1:15 Presenters upload Session talks onto room computer desktop.

1:30 MODULATION OF NEURONAL ANTIVIRAL RESPONSES BY LNCRNA NOSTRILL. Cassandra Leuty, Aaron Marta, Ethan Lorenson, Kristen Drescher, and Annemarie Shibata

1:45 MOISTURE-WICKING PROSTHETIC LINER WITH ANTIMICROBIAL PROPERTIES. Eleanor Britson and Dr. Jorge Zuniga

2:00 NADH PHASOR FLIM AS A METHOD FOR CANCER DETECTION USING IN VITRO AND IN VIVO STUDIES. Alexander A. Chen , Greer L. Porter, Jackson M. Laurent, Jinann A. Shoshara, Reese A. Kolar, Zachary J. Smith, and Michael G. Nichols

2:15 NADH PHASOR FLIM DETECTS METABOLIC CHANGES ASSOCIATED WITH HER2 EXPRESSION IN BREAST CANCER *IN VITRO*. Greer L. Porter, Laura A. Hansen, and Michael G. Nichols

2:30 OPTIMIZED SPECKLE TRACKING ALGORITHM FOR ESTIMATING FASCIAL LAYER MOVEMENT IN ULTRASOUND. Charleigh Schonlau , Stanislav Macha? , and Greg Bashford

2:45 SOLVING THE STRUCTURE OF A MUTANT PCNA PROTEIN. Eva Doescher, Robyn Scott, Lynne Dieckman.

3:00 PREDICTING COMPLEX INTERACTIONS BETWEEN PCNA AND CAF-1 USING ALPHAFOLD3. Ryan Ward, Ian Hall, Lynne Dieckman

3:15 **BREAK -** Presenters upload Session talks onto room computer desktop.

3:30 PURIFICATION OF DTPT USING SMALPS AS AN ALTERNATIVE TO DETERGENTS. Andrew J. Sheppard

3:45 REPRODUCIBILITY OF COMPUTATIONAL ANALYSES TO UNDERSTAND MICROBIOME COMPOSITION AND FUNCTIONAL PROFILE. Sudha Pandey

4:00 ROLE OF APLP2 IN KINASE SIGNALING IN PANCREATIC CANCER. Kaitlin J. Smith, Kenadie R. Doty, Gabrielle L. Brumfield, Joyce C. Solheim

4:15 INVESTIGATING REGULATION OF DAF-12 BETWEEN THE SEXES OF *BRUGIA MALAYI* NEMATODES. Shannon Kennicutt, Sudhanva Kashyap, and Douglas Christensen

MODULATION OF NEURONAL ANTIVIRAL RESPONSES BY LNCRNA NOSTRILL

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Viral infection contributes to neurodegeneration and is associated with multiple diseases, including, Multiple Sclerosis (MS). Neurons and microglia initiate antiviral responses to clear virus; however, failure of these responses can lead to neurodegeneration. Previous work have shown that *in vitro* infection of microglia with Theiler's Murine Encephalomyelitis Virus (TMEV) upregulates Nostrill. Nostrill is an NF?B-dependent long noncoding RNA that regulates Interferon Regulatory Factor 7 (IRF7) and Type I Interferon (IFN?/?) gene transcription. In the TMEV mouse model of viral-induced demyelination, neurons are the initial targets of infection, followed by microglia. It is not known if neurons express or upregulate Nostrill. We hypothesize that Nostrill regulates early neuronal antiviral innate immune responses by associating with transcriptional regulators such as NF-?B to increase IRF7 and promote interferon synthesis. We utilized mouse Neuro2a cells to perform RT-qPCR, Fluorescent *In Situ* Hybridization (FISH), and co-immunoprecipitation (Co-IP) assays. RT-qPCR analysis of steady-state mRNA showed that TMEV-infected Neuro2a cells significantly upregulated Nostrill 2-fold ($p<0.01$, n=3), IRF7 87-fold ($p<0.01$, n=3), IFN? 12-fold ($p<0.001$, n=3), and IFN? 266-fold ($p<0.0001$, n=3) compared to uninfected cells. To determine if upregulation of the antiviral genes of interest corresponds with Nostrill expression, we used a silencing RNA construct specific for Nostrill to knockdown Nostrill expression. RT-qPCR showed that silencing of Nostrill significantly reduced Nostrill 3.3-fold ($p<0.0001$, n=3), IRF7 48-fold (p?0.05, n=3), IFN? 16-fold ($p<0.0001$, n=3), and IFN? 241-fold ($p<0.001$, n=3) compared to a silenced control with TMEV. These data suggest that Nostrill plays a role in regulating antiviral gene expression. To determine if Nostrill influences protein production, we co-immunoprecipitated phosphorylated-IRF7 (pIRF7) from uninfected and TMEV-infected Neuro2a cells. Co-IP revealed that TMEV infection significantly increased pIRF7 ~6.7 fold compared to uninfected cells. FISH probed for Nostrill showed differential localization in uninfected and infected cells. In uninfected cells, 88% ($p<0.0001$, n=4) of Nostrill localized in the nucleus, but in TMEV-infected cells, Nostrill localization in the nucleus significantly reduced by 60% ($p<0.0001$, n=4), whereas 40% localized in the cytoplasm. These data demonstrate that in TMEV-infected Neuro2a cells, Nostrill expression has a positive role in modulating the IRF7 signaling pathway at the mRNA and protein level in the nucleus and the cytoplasm. Future studies will investigate the specific mechanisms of Nostrill using RNA immunoprecipitation (RIP) and Chromatin Immunoprecipitation (ChIP) assays to determine which proteins and genes Nostrill interacts with.

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MOISTURE-WICKING PROSTHETIC LINER WITH ANTIMICROBIAL PROPERTIES

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Excessive sweating and bacterial growth on the residual limb are significant challenges faced by prosthetic users. To address these concerns, we developed a prototype for a prosthetic liner designed to combat both excessive perspiration and bacterial proliferation. The key innovation of this liner is the material used—Styrene-ethylene-butylene-styrene (SEBS), a polymer embedded with a copper-based composite that provides antimicrobial properties. The material not only promotes comfort but also helps to maintain hygiene by reducing bacterial growth.

The prosthetic liner is engineered to handle up to 500 mL of sweat in just 38 minutes, significantly reducing moisture buildup on the residual limb. In addition, SEBS demonstrates a remarkable ability to reduce bacterial concentration by more than 99.99%, with no viable bacteria detected after 24 hours. The material achieves a 5-log reduction in bacterial count, further ensuring the prevention of infections commonly associated with prosthetic use.

By combining these advanced features—effective moisture management and superior antimicrobial properties—our prototype aims to improve both the comfort and health of prosthetic users. This innovative approach has the potential to significantly enhance the user experience, making prosthetics more hygienic and comfortable for daily use. The findings from this development could lead to the creation of more efficient and health-conscious prosthetic solutions.

NADH PHASOR FLIM AS A METHOD FOR CANCER DETECTION USING IN VITRO AND IN VIVO STUDIES

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Squamous cell carcinoma (SCC) is the second most common form of skin cancer in the United States, with about one million people diagnosed per year (American Cancer Society). SCC is caused by UV damage to the layers of the epidermis which results in faulty DNA repair mechanisms and harmful mutations. Often, SCC is diagnosed via invasive methods such as punch, shave, or incision biopsies. According to the Warburg effect, cancerous cells typically rely on anaerobic glycolysis instead of oxidative phosphorylation to maintain the energy needed for proliferation. NADH is a vital coenzyme produced through glycolysis, critical to the TCA cycle, and observable via phasor FLIM. Our lab seeks to establish a non-invasive method for detecting skin cancer using fluorescence lifetime imaging microscopy (FLIM) to monitor levels of free and protein bound NADH in target cells. We have performed several *in vitro* and *in vivo* experiments to validate NADH phasor FLIM as a diagnostic imaging technique. Our *in vitro* study is aimed at detecting the influence of human epidermal growth factor receptor 2 (HER2) using SCC 74A (low HER2) and 74B (high HER2) cell lines cultured in 21% and 2% O_2. We performed a three-way ANOVA (HER2 inhibition, treatment, oxygen availability) to see the effect of differential oxygenation on the fraction of protein bound NADH and the increased reliance on the electron transport chain under hypoxic conditions. In our *in vivo* study, we exposed SKH1 mice to UV radiation in a 25-week experiment, observing the NADH bound fraction in developing skin lesions. The combination of *in vitro* and *in vivo* studies allows us to better understand observed changes in the NADH bound fraction and gives us confidence that NADH phasor FLIM can be used to diagnose cancerous tissues. The

project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

NADH PHASOR FLIM DETECTS METABOLIC CHANGES ASSOCIATED WITH HER2 EXPRESSION IN BREAST CANCER IN VITRO

Author
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Current cancer diagnosis methods are invasive and often fail to identify significant alterations to cellular metabolism before structural changes take place. These metabolic changes can result from a combination of different factors like oxygenation, energy supply, and gene expression which ultimately lead to function or dysfunction of the electron transport chain (ETC). Of notable interest is human epidermal growth factor receptor 2 (HER2). HER2 is one of several receptor tyrosine kinases that activates the PI3K/AKT pathway responsible for cell cycle progression and survival in the tumor environment, making HER2 overexpression a key marker for cancerous tissues. If the metabolic effect on the ETC due to HER2 overexpression and other factors could be detected before physical changes take place, then perhaps cancer prognoses could be significantly improved. We investigated NADH-phasor fluorescence lifetime imaging microscopy (FLIM) as a non-invasive, completely optical method for assessing ETC activity associated with breast cancer. Metabolic changes were assessed by calculating the free:protein-bound ratio (bound fraction) of NADH from its time-resolved fluorescent decay. SKBR3, MCF-7, and MDA-MB-231 cell lines cultured in 2% and 21% O_2 were imaged via NADH-phasor FLIM under varying conditions of glucose supplementation, ETC uncoupling or inhibition, and HER2 inhibition. Glucose deprivation in all cell lines resulted in an increase in the NADH bound fraction. ETC uncoupling resulted in an increase while ETC inhibition resulted in a decrease in the NADH bound fraction. HER2 inhibition yielded a decrease in the NADH bound fraction in all cell lines except for MDA-MB-231. Our data gives us confidence that NADH phasor FLIM is sensitive to cancerous metabolism and protein expression. The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

OPTIMIZED SPECKLE TRACKING ALGORITHM FOR ESTIMATING FASCIAL LAYER MOVEMENT IN ULTRASOUND

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Fascia is a complex, interconnected tissue that encapsulates organs, muscles, and tendons. Until recently, fascial dynamics could not be studied in vivo, but advancements in ultrasound imaging now allow the noninvasive study of fascia. Understanding the movement of fascial layers relative to each other and fascia relative to muscle tissue could provide critical insights into biomechanics and musculoskeletal health. This research represents the first measurement of fascia translation in vivo. Ultrasound videos were collected using identical scan depth (1.5 cm), transducer frequency, and scan location on 10 subjects. The fascia on the quadricep muscle was scanned, due to a large surface area and the ability to collect high-resolution ultrasound images. Data collection was conducted at the Department of Rehabilitation and Sports Medicine at Charles University in Prague. An algorithm was designed to track fascial movement from frame to frame in an ultrasound cine loop. The algorithm was coded in a custom program made in MATLAB that measures the similarity between portions of frames in the loop. Similarity measurements were

made by looking at the speckle pattern corresponding to the fascia in the ultrasound image. These measurements were done by calculating the correlation in speckle pattern from frame to frame, using the Sum of Absolute Differences metric. As the program tracked a specified spot, or kernel, throughout the scan, its coordinates were recorded. A graph was then produced showing the position of the kernels on each fascial layer over time. Movement was tracked only in the horizontal direction due to the negligibility of vertical displacement. The maximum inter-layer displacement within a single video frame was then reported within the program. Ten scans were analyzed, each reporting values for the maximum displacement between layers of deep fascia, and between deep and superficial fascia layers. The average maximum displacement between layers of deep fascia was 0.67 mm, with a standard deviation of 0.31. The average maximum displacement between superficial and deep layers of fascia was 1.77 mm, with a standard deviation of 0.79. The average ratio of the superficial-deep layer displacement to the deep-layer displacement was 3.47. The MATLAB algorithm showed success in accurate tracking of the different fascia layers, measuring their displacement over time in scans. This algorithm offers us more insight into the role that fascia plays in the body. The ability to study the dynamic abilities of fascia in vivo paves the way for future biomechanical research.

SOLVING THE STRUCTURE OF A MUTANT PCNA PROTEIN

Author
Eva Doescher

To package eukaryotic DNA inside the nucleus, DNA wraps around histone proteins to form nucleosomes. Two major proteins involved in nucleosome assembly are proliferating cell nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1). PCNA is a sliding clamp protein that surrounds DNA and recruits proteins to the replication fork, including CAF-1. CAF-1 is a histone chaperone protein that deposits histones on DNA, specifically on silenced regions of the genome. The direct interaction between PCNA and CAF-1 is crucial for proper gene expression, but the mechanism of how these two proteins interact is not known. We identified a mutant form of PCNA (R44A) binds CAF-1 with a higher affinity than wildtype PCNA, indicating a possible autoinhibitory function of R44 in PCNA. The goal of my project is to determine the structure of the R44A mutant PCNA protein through X-ray crystallography. I purified the R44A mutant PCNA protein and tested hundreds of crystallization conditions. Thus far, I identified conditions that promote formation of hexagonal crystals, which diffract to ~3.5 angstroms. I am currently optimizing crystallization conditions to obtain a resolution at or below 3.0 angstroms for structural determination. Solving the structure of the mutant R44A PCNA protein will provide valuable information about the mechanism of the interaction between PCNA and CAF-1 and will help our understanding of how these two proteins work together during nucleosome assembly to maintain gene silencing.

PREDICTING COMPLEX INTERACTIONS BETWEEN PCNA AND CAF-1 USING ALPHAFOLD3

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Genetic material is stored in the form of chromatin, which is composed of units called nucleosomes. Nucleosomes consist of DNA base pairs wrapped around proteins called histones, which are deposited on to DNA immediately after replication. During replication, proliferating cell nuclear antigen (PCNA), a ring-shaped homotrimer that encircles and slides along double-stranded DNA, recruits other proteins involved in DNA metabolism to the replication fork. Immediately after replication, PCNA recruits chromatin assembly factor 1 (CAF-1) to the replication fork. CAF-1

deposits modified histones on newly synthesized DNA in silenced regions of the genome. The direct interaction between PCNA and CAF-1 is essential for proper gene silencing and improper gene silencing in cells is linked to several serious genetic diseases. Our goal is to understand the structural mechanism of the PCNA-CAF-1 interaction. However, determining the 3D structure of CAF-1 bound to PCNA has been difficult for scientists due to CAF-1 being an intrinsically disordered protein. Experimentally, we have shown multiple PCNA-binding regions exist in CAF-1. Here, we've used AlphaFold3 to visualize full PCNA-CAF-1 interactions to better understand the complete mechanism of interaction. These predictions confirm there are multiple PCNA-binding regions on CAF-1 can bind to individual PCNA monomers. In addition, these regions can bind PCNA simultaneously, suggesting multiple binding events and conformational changes within these proteins are required for a robust interaction. Overall, these predictions paired with experimental results will help in our understanding of how PCNA and CAF-1 function together to regulate gene silencing.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

PURIFICATION OF DTPT USING SMALPS AS AN ALTERNATIVE TO DETERGENTS

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Staphylococcus aureus is one of the most widespread bacterial pathogens and antibiotic resistance is common in most infections. The decreasing efficacy of antibiotics has put pressure on medical professionals and researchers to focus efforts on developing alternative treatments for *S. aureus* infections. The Gee lab studies the peptide transporters of *S. aureus* as potential therapeutic targets. Di- and tri-peptide transporter (DtpT) is a membrane protein present in all genomes of *S. aureus*. DtpT is responsible for importing peptides of 2-3 amino acids in length and plays a key role in the nutrient uptake of *S. aureus.* The purpose of this study is to develop an effective procedure to express and purify SaDtpT, so it can be characterized in future experiments. Working with membrane proteins presents unique difficulties, including potential toxicity when overexpressing in E. coli, low solubility, and loss of native protein conformation when extracting with detergents. Our goal is to isolate DtpT without compromising the structure of the protein and with minimal modifications to its sequence. To overcome these challenges, we will be using styrene maleic acid lipid particles (SMALPs) as an alternative to detergents when isolating DtpT. SMALPs are a form of lipid nanodisc that are used to extract membrane proteins while mimicking the structure of the native membrane. By using SMALPs as our solubilizing agent, DtpT will go through minimal environmental stresses, allowing for its structure to be conserved when isolating it from its native membrane. The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIH.

ROLE OF APLP2 IN KINASE SIGNALING IN PANCREATIC CANCER

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Pancreatic cancer is well-known for its aggressive nature and ability to metastasize, often leading to late-stage diagnosis. This study focuses on the amyloid precursor-like protein 2 (APLP2), a member of the amyloid precursor protein (APP) family that is upregulated in various cancers, including pancreatic cancer, where it promotes cell migration, invasion, and metastasis. Previous studies have indicated that reduction of APLP2 leads to decreased activation of the c-Jun N-terminal kinase (JNK) signaling pathway, but its broader effects on kinase signaling pathways in human pancreatic cancer remain unclear. This research investigates how APLP2 expression influences JNK and other kinase signaling pathways in pancreatic cancer cells. We hypothesize

that reducing APLP2 levels in S2-013 human pancreatic cancer cells alters JNK activation and other key signaling pathways.

To test this hypothesis, we performed siRNA-mediated APLP2 knockdown in S2-013 cells, confirming knockdown efficiency via Western blot. Western blot analysis also assessed total JNK expression, which remained unchanged following APLP2 knockdown. Additionally, a Human Phospho-Kinase Array was used to determine the relative phosphorylation levels of 37 kinase sites in APLP2 knockdown and scramble control samples. The array identified key alterations in kinase signaling, including a pronounced increase in phosphorylation of the proline-rich Akt substrate of 40 kDa (PRAS40) and decreases in phosphorylation of CREB, ERK1/2, and JNK 1/2/3, suggesting APLP2 influences multiple signaling pathways in pancreatic cancer cells. Qiagen Ingenuity Pathway Analysis (IPA) identified three major signaling pathways most affected by APLP2 knockdown: (1) MAPK targets/nuclear events mediated by MAP kinases, (2) G-protein coupled receptor (GPCR) signaling, and (3) FAK signaling.

Together, these findings suggest that APLP2 regulates key signaling pathways driving pancreatic cancer progression and provides insights into the molecular mechanisms by which APLP2 contributes to pancreatic cancer's aggressive nature. Future studies will assess whether JNK inhibition modulates the effects of APLP2 knockdown on cell migration in S2-013 cells.

"The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427."

REPRODUCIBILITY OF COMPUTATIONAL ANALYSES TO UNDERSTAND MICROBIOME COMPOSITION AND FUNCTIONAL PROFILE

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Reproducibility remains a critical challenge in computational bioinformatics, particularly in the analysis of 16S rRNA sequencing data. This study systematically analyzes the reproducibility of an existing bioinformatics pipeline for 16S rRNA sequencing by applying established reproducibility metrics from available literature and identifying key trends in computational consistency and output variability. A structured and well-documented code framework is developed to systematically assess the pipeline's reproducibility, ensuring transparency and facilitating future evaluations. The analysis identifies key challenges and best practices for improving computational reproducibility in microbiome research.
This work contributes to the ongoing effort to establish reproducibility as a standard practice in bioinformatics.

INVESTIGATING REGULATION OF DAF-12 BETWEEN THE SEXES OF BRUGIA MALAYI NEMATODES

Author
Shannon Kennicutt
Wayne State College

Lymphatic filariasis also known as Elephantiasis, is a severely debilitating parasitic infection caused by mosquito transmitted nematodes and affecting nearly 50 million people living in tropical and subtropical regions. Over 650 million people in 39 countries are vulnerable to several filariasis species, with the nematode Brugia malayi endemic in South and Southeast Asia causing almost 10% of all Lymphatic filariasis cases globally. There have been many programs aimed at eliminating Lymphatic filariasis by use of preventive chemotherapy agents, which have successfully eliminated Lymphatic filariasis within 9 countries since the year 2000. However, Brugia malayi present a unique challenge compared to other nematode species as current drug interventions only control the disease by killing the microfilaria, or immature larvae of the species. This leaves the adult worm unharmed and capable of producing more larvae, which can prolong treatment requirements and increase risk for drug resistance. Levamisole has shown promise in controlling Brugia infections by activating nAChR channels within the worm's muscle cells, causing an influx of cations that cause worm paralysis. However, only the male worms are permanently paralyzed. To investigate this difference, we identified the gene daf-12 as a gene of interest that is upregulated within male Brugia. Analysis using qPCR has identified differences between male and female regulation as well as regulation among

females that have been treated with varying amounts of levamisole. The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

Friday, April 25, 2025 1:15pm - 4:30pm

BIOLOGICAL AND MEDICAL SCIENCES AFTERNOON SESSION- 1B

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains Room B**

AFTERNOON SESSION - 1B **Subsection Chairperson: Dr. Gwen King**

1:15 Presenters upload Session talks onto room computer desktop.

1:30 EXAMINING HOW VAPING IMPACTS B AND T CELL RESPONSES TO PEANUT. Joseph Roeder, Marissa Hoover, Zane Carlson, and Joseph J. Dolence

1:45 KLOTHO EFFECTS ON COCHLEAR STRUCTURE AND FUNCTION. Fauzan Siddiqui, Ayden Chavez, Gwendalyn King

2:00 LEVERAGING BRAIN ORGANOIDS FOR STUDYING POTENTIAL TREATMENTS FOR INFECTION. Brittany Rabe, Paul H. Davis2, Sowmya Yelamanchili3

2:15 NOSTRILL MEDIATED MICROGLIAL POLARIZATION FOLLOWING ACUTE AND CHRONIC INDUCED DEMYELINATING DISEASE PATHOLOGIES *IN VIVO*. Hannah Pflum, Jodi Hallgren, Aaron Marta, Paige Harty, Kristen Drescher, and Annemarie Shibata

2:30 OPTIMIZATION OF NK CELL SIMULTANEOUS ADCC & DIRECT KILLING ASSAY TO INCREASE DATA OUTPUT FOR EACH HUMAN DONOR. Isabelle S. Weber and Paul W. Denton

2:45 **BREAK** - Presenters upload Session talks onto room computer desktop.

3:00 POTENTIAL OF MILK EXTRACELLULAR VESICLES/EXOSOMES AS DRUG DELIVERY VEHICLES. Javaria Munir and Janos Zempleni

3:15 STRUCTURAL ANALYSIS OF *CRASSOSTREA GIGAS* OAZ-PK RNA. Hannah Ladwig, Rhiannon McCracken, and Juliane Soukup

3:30 THE SPX REDOX SWITCH CONTROLS CYSTINE UPTAKE AND TOXICITY IN *STAPHYLOCOCCUS AUREUS* UNDER DISULFIDE STRESS. Abigail G. Hall, Abdulelah A. Alqarzaee, Sasmita Panda, Sujata S. Chaudhari, Dorte Frees, and Vinai C. Thomas

3:45 USING IMAGE ANALYSIS TO MEASURE THE ATTRACTION OF BENEFICIAL MICROBES TO ROOT EXUDATES. Morgan R. Mahoney and Tessa L. Durham Brooks

4:00 METFORMIN VS OVARIAN WEDGE RESECTION IN POLYCYSTIC OVARIAN SYNDROME. Mae L. Grahek

4:15 EXPLORING *CHLAMYDIA TRACHOMATIS* MOMP EXPRESSION IN A EUKARYITIC HOST CELL FOR POSSIBLE VACCINE DEVELOPMENT. Parker Tinsley, Shawn Pearcy, Gaëlle Spagnol, and Douglas Christensen

EXAMINING HOW VAPING IMPACTS B AND T CELL RESPONSES TO PEANUT

Author
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The impact of vaping on immune responses that originate in the lung remain unclear. We have compelling data that exposure to either vape juice or electronic conditioned media (ECM) (made by bubbling vapor into media) during exposure to peanut (PN) inhibits the generation of PN-specific antibody responses and leads to milder anaphylactic challenges upon PN challenge. In this study, we examined whether ECM influences the ability of B and T cells to respond to PN. We exposed mice to PBS, PN, ECM, or PN in ECM using the 14-day inhalation model that showed ECM stifled PN-specific IgE and IgG1 responses. On day 14, lung draining lymph nodes were harvested and processed for flow cytometric analysis of B and T cells. Tfh cells, but not Th2 cells, displayed reduced reactivity to PN due to exposure to ECM. B cells appeared similar between mice exposed to either PN or PN in ECM. Overall, our data suggests vaping suppresses PN-specific immune responses by inhibiting the response of Tfh cells. This knowledge is important because failure to mount response against PN suggests that vaping may inhibit immune responses against common respiratory infections. More studies are needed to understand how vaping influences immune responses against PN.

KLOTHO EFFECTS ON COCHLEAR STRUCTURE AND FUNCTION

Author
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Co-Author
Ayden Chavez

Co-Author
Gwendalyn King

The Klotho protein is an important regulator of aging, neurocognitive health, and auditory function. Decreased expression in Klotho is linked to cognitive decline and hearing impairment across species. Our lab has focused on neuronal effects of Klotho because mouse Klotho-deficiency results in very early memory impairment. While Klotho clearly affects neuronal structure and function, Klotho is implicated in wider brain function than neurons alone can explain. Recently we have engaged in studies to characterize the role of Klotho in the choroid plexus. Choroid plexus generates most of the brain's cerebrospinal fluid while also having roles in blood: brain barrier function. Our studies are revealing profound effects on protein transporter expression with Klotho-deficiency that suggest cerebrospinal fluid cannot be normal. This said, mouse brains only contain a total of ~35µl of cerebrospinal fluid making direct evaluation difficult.

Beyond the brain itself, we know that Klotho deficient mice are deaf, and we know that their principal cells, the hair cells are not at fault for this abnormality. In the cochlea, Klotho expression only occurs in the stria vascularis. Stria produces endolymph fluid required for the transduction of mechanical hearing signals into electrical activity for

communication to the brain. To determine whether we have two secretory tissues that express Klotho with similar effects on function, we are working to characterize the Klotho-deficient cochlea. This project aims to investigate age-dependent differences in transporter proteins, extracellular matrix and vasculature of the cochlea's stria vascularis of 3-week (pre-memory impairment) and 7-week-old (post-cognitive impairment, pre-death) mice with and without Klotho. By examining these two time points, we aim to identify the time course of change with KL-deficiency during the shortened Klotho-deficient lifespan.?

This research will employ techniques including immunohistochemistry, microscopy, and quantitative analyses to compare control to Klotho-deficient brains. If the stria is similar to the choroid plexus, we are expecting to see decreased transporter protein expression, a thickened basal lamina, and calcification of blood vessels.

This research aims to understand how age-related molecular changes in the stria vascularis of the cochlea contribute to functional decline. By exploring these pathways, we hope to identify therapeutic targets to preserve auditory and cognitive function during aging.

LEVERAGING BRAIN ORGANOIDS FOR STUDYING POTENTIAL TREATMENTS FOR INFECTION

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Studying brain infections poses many challenges, most related to the lack of sufficient models. Mice, and other animal models that are usually used to replace human subjects in research, are not entirely representative of the human brain and consequently are not fully reliable when used to study anti-infective drug-like investigational compounds in treating brain infections. For this reason, researchers are developing brain organoids that can be used to evaluate novel compounds and to better understand human brain development when related to neurological disorders and infections. Brain organoids have the ability to make researching the brain more feasible and we plan to leverage them to study various potential treatment modalities experienced by the warfighter and civilian populations.

NOSTRILL MEDIATED MICROGLIAL POLARIZATION FOLLOWING ACUTE AND CHRONIC INDUCED DEMYELINATING DISEASE PATHOLOGIES IN VIVO

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Neurodegenerative pathologies can develop from systemic inflammation caused by viral infection. Microglia play an essential role in the innate immune response of the central nervous system; dysregulation of microglial antiviral activity is often associated with neurodegenerative disease development. Long non-coding RNAs (lncRNAs) regulate processes by interacting with RNA-binding proteins, such as transcription factors. Differential lncRNA regulation has been observed in neurodegenerative disease states such as within the blood serum and lesions of multiple sclerosis (MS) patients. The novel lncRNA iNOS Transcriptional Regulatory Intergenic lncRNA Locus (Nostrill) has been shown *in vitro* to regulate antiviral immune responses through IRF7 gene expression. I hypothesize that *in vivo* Nostrill plays a role in regulating microglial antiviral immunity and microglial polarization into a proinflammatory state during TMEV infection in mice. Theiler's murine encephalomyelitis virus (TMEV) is a single stranded RNA cardiovirus that induces infectious demyelinating disease (IDD) in susceptible mice (FVB/nJ) that recapitulates MS in humans. FVB/nJ (FVB) mice are unable to effectively clear TMEV infection which results in chronic demyelinating disease. Meanwhile, C57BL/6J (C57) can effectively clear TMEV infection and do not develop demyelinating disease. The mice were intracranially injected with either 10 ?l of TMEV and HBSS or 10?l of HBSS. Behavioral testing began at 11-day, 39-day, and 94-day postinjection. After behavioral studies, the mice were euthanized and brain, spleen, and spinal cord tissues were collected for RT-qPCR and in situ hybridization analyses. RT-qPCR analyses of 11-day mouse cortical tissue show that Nostrill is significantly upregulated in FVB/nJ (n ? 4, increased 2.5-fold, p=0.003) compared to C57 mice. Proinflammatory microglial markers such as ITGAM are upregulated in infected FVB male mice at 39-day (n=6, increased 0.93-fold, p=0.038) compared to control FVB males. Proinflammatory marker Iba1 is downregulated in infected FVB females at 39-day (n=6, reduced 0.46-fold, p=0.0013) compared to control FVB females. These data suggest a correlation between Nostrill upregulation and polarization of microglia in chronic neurodegenerative disease states. Further research involving isolation of primary microglia and RT-qPCR for proinflammatory microglial cytokines is needed to understand the underlying molecular mechanisms of virally induced neuronal damage seen in TMEV-IDD mouse model system and neurodegenerative disease.
This publication was made possible by grants from the National Institute for AIDS and Infectious Disease (NIAID) (1 R15 AI156879) and the National Institute for General Medical Science (NIGMS) (5P20GM103427), components of the National Institutes of Health (NIH), and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIAID, NIGMS or NIH.

OPTIMIZATION OF NK CELL SIMULTANEOUS ADCC & DIRECT KILLING ASSAY TO INCREASE DATA OUTPUT FOR EACH HUMAN DONOR

Author
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University of Nebraska at Omaha

Traditionally, when looking at natural killer (NK) cell killing efficacy, direct killing or antibody-dependent cell-mediated cytotoxicity (ADCC) have been studied independently of one another. Our lab is focused on examining the impacts of immunotherapies on human NK cell functions. We quickly realized that we needed a way to control for human-to-human differences within our experiments. Thus, we developed an assay to look at both types of killing within the same human sample and called it the NK cell – simultaneous ADCC and direct killing assay (NK-SADKA). In our new study our goal is to optimize the NK-SADKA by minimizing the number of tubes required to perform the immunotherapy impact assessment. Success in this effort will allow us to investigate more conditions with the limited quantity of human NK cells that can be obtained from a single buffy coat blood product. To accomplish our goal, we are assessing direct killing and ADCC in the same tube, rather than separate tubes. In order to put both target cell lines in one tube, we are looking at staining each cell line with a unique stain so they can be differentiated in the flow cytometer such that both forms of killing efficacy can be determined. Then we will perform a comparison between NK-SADKA 1.0 and 2.0 to assess any changes in killing efficacy. Data to date will be presented. The project described was supported in part by an Institutional Development Award (IDeA) from the NIGMS of the National Institutes of Health under Grant # 5P20GM103427.

POTENTIAL OF MILK EXTRACELLULAR VESICLES/EXOSOMES AS DRUG DELIVERY VEHICLES

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Extracellular Vesicles (EVs), previously known as exosomes, were discovered in 1981 as small membrane-bound vesicles secreted from platelets. They were initially considered as ‘trash bags’ until their functional importance as ‘immunogen’ was studied in 1996. Later, it was found that EVs secreted by platelets can revascularize heart tissues.Currently, EVs are known to be secreted by almost all mammalian cells and are used for cell-cell communication, including inter-species communication through EVs in dietary materials. These EVs are small in size (50-150 nm), bound by a phospholipid bilayer and carry cargo (e.g., microRNAs, long non-coding RNAs, mRNAs, proteins, metabolites and lipids). Moreover, mammalian fluids such as saliva, urine, blood, tears, lymph and milk contain circulating EVs. The question of whether the EVs’ cargo remains functional and imparts a physiological effect on the recipient cell is being investigated actively. This feature has enabled the researchers to pursue investigation into their potential role as drug-delivery vehicles to specific tissues.This talk highlights the discovery of extracellular vesicles (EVs) in bovine milk and how they have the potential to carry therapeutic cargo in targeted tissues, including hard-to-reach tissues such as the brain. Although these small vesicles (50-150 nm) are found in human milk, caprine milk, pig’s milk, but the peculiar feasibility and features of bovine milk have made them an excellent candidate for drug delivery applications. These include scalability (i.e. one cow can produce 10^{21} exosomes per annum), the ability to be loaded can be loaded with therapeutic cargo (e.g. microRNAs), the capacity to cross blood brain barrier (BBB), stability in stomach and intestines, and immuno-compatibility. Studies have shown that when bovine milk EVs are administered orally to C57/BL6J mice, they are distributed to different organs such as liver, lungs, heart, spleen etc. The ability of bovine milk EVs to cross BBB can be harnessed for treating brain related disorders such as Alzheimer’s, Parkinson’s etc. At present, 98% of drugs designed by pharmaceutical industry fail to cross BBB and bovine milk EVs can fill this gap. The trial of bovine milk EVs in mice demonstrated that only ~ 50 % of these EVs are distributed in organs whereas the remainder is excreted out. To maximize the dose to a specific targeted organ (e.g. the brain), the organ-homing peptide (organ-targeting peptide) attached to the surface of milk EVs should be utilized.

STRUCTURAL ANALYSIS OF CRASSOSTREA GIGAS OAZ-PK RNA

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Co-Author
Rhiannon McCracken
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Co-Author
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Riboswitches are a type of non-coding RNA that regulate downstream gene expression upon metabolite binding. When a riboswitch interacts with its ligand, it undergoes a conformational change resulting in a change in gene expression. This change in gene expression operates as a feedback mechanism, affecting the same metabolic pathway in which the ligand functions. The Soukup Lab researches potential eukaryotic riboswitches within the Ornithine Decarboxylase Antizyme pseudoknot (OAZ-PK) RNA. One such potential riboswitch is found in the OAZ-PK RNA of a species of oyster, *Crassostrea gigas*, which is believed to interact with various natural and non-natural polyamines. In-Line Probing (ILP) experiments can be used to analyze the structural changes of this RNA segment upon binding to differing concentrations of these polyamines. Preliminary data from ILP experiments with *Crassostrea gigas* OAZ-PK RNA indicate that the binding of spermine results in a structural change to the RNA segment, but not other polyamines. Current experiments aim to examine the presence of a structural change upon binding of closely related polyamines, spermidine and pentamine. Riboswitches have demonstrated significant impacts on the regulation of metabolic pathways in bacteria, and thus are being used as a target of possible antibiotic treatments. Identification of similar riboswitches in eukaryotic species will provide an opportunity for the development of novel antibiological agents.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

THE SPX REDOX SWITCH CONTROLS CYSTINE UPTAKE AND TOXICITY IN STAPHYLOCOCCUS AUREUS UNDER DISULFIDE STRESS

Author
Abigail Hall
University of Nebraska Medical Center

Spx is an essential redox-sensitive transcriptional regulator that responds to disulfide stress and maintains thiol homeostasis in the gram-positive pathogen *Staphylococcus aureus*. The formation of an oxidized disulfide in the Spx redox switch enables it to bind the alpha subunit of the RNA polymerase and facilitate expression of various genes involved in thiol homeostasis. Remarkably, we engineered a *spx*^{C10A} mutation that encoded an oxidation-insensitive Spx^{C10A} variant suggesting that functions associated with redox signaling in Spx are not essential for growth. However, the *spx*^{C10A} mutant exhibited increased sensitivity to diamide-mediated disulfide stress compared to the wild-type strain. Here, we demonstrate that the impaired growth of the *spx*^{C10A} mutant following diamide stress does not arise from its inability to maintain intracellular thiol homeostasis. Rather, the *spx*^{C10A} mutant can efficiently adapt and counter thiol oxidation through increased CymR-dependent cystine uptake. Paradoxically, our findings reveal that cystine uptake during disulfide stress is toxic to the growth of the *spx*^{C10A} mutant. The inactivation of the major cystine transporters in *S. aureus* under disulfide stress prevented the *spx*^{C10A} mutant from adapting to the oxidized intracellular thiol environment, but unexpectedly restored its growth. These findings indicate that *S. aureus* may utilize redox signaling through Spx to limit toxicity from cystine uptake during disulfide stress.

USING IMAGE ANALYSIS TO MEASURE THE ATTRACTION OF BENEFICIAL MICROBES TO ROOT EXUDATES

Author
Morgan Mahoney

Co-Author
Tessa Durham Brooks
Doane University

Plants release exudates from their roots, which are a combination of amino acids, sugars, and organic acids. These exudates attract beneficial bacteria that help stabilize the environment, especially under stressful conditions for the plant. The bacteria combat numerous stressors for the plant, and in turn, receive nutrients from the root exudates. Although we understand the general relationship, we do not understand the many specific interactions bacteria have with roots and how those change under stress conditions. My goal is to develop a high-throughput image analysis method to measure chemotaxis. The parameters of this project include installing scanners to capture images of bacterial movement automatically over time to ground truth against the capillary assay, which is a well-established method. To do so, I will identify molecules that can act as a positive control and molecules that can act as a negative control. I will create standard curves for comparing the two methods and for quantification of experimental results.

METFORMIN VS OVARIAN WEDGE RESECTION IN POLYCYSTIC OVARIAN SYNDROME

Author
Mae Grahek

Polycystic ovarian syndrome (PCOS) is a common diagnosis among women of childbearing age. It is a metabolic condition that is characterized by androgen excess and its associated symptoms which includes but is not limited to hyperandrogenism, menstrual irregularities, polycystic ovaries, acne, hirsutism, infertility, anovulation. The Rotterdam Criteria is used to make a diagnosis and needs two of the following: hyperandrogenism, menstrual irregularities, polycystic ovaries. Because of its complexity, treatment should address the different aspects of the disease process. First line treatment in those not desiring fertility is generally oral contraceptive pills (OCPs). For those desiring fertility, treatment begins with weigh management and clomiphene citrate (CC), then exogenous gonadotropins or laparoscopic ovarian surgery (LOS), lastly in vitro fertilization (IVF). Avoiding IVF may be important as it risks ovarian hyperstimulation. Despite the varying treatments available, an ideal treatment has not emerged. Metformin can be helpful in glucose intolerance but is not recommended for the induction of ovulation despite increased ovulation rates compared to a placebo. In those who underwent an ovarian wedge resection, 90% achieved regular cycles post-surgery and 88% experienced major weight loss. Pregnancy rates for those on metformin and ovarian wedge resection were 35.7% and 90%, respectively. While there is no one size fits all approach to the treatment of PCOS, the utilization of ovarian wedge resection when first line therapies fail, proves advantageous not only for symptomatic relief but for achieving fertility.

EXPLORING CHLAMYDIA TRACHOMATIS MOMP EXPRESSION IN A EUKARYITIC HOST CELL FOR POSSIBLE VACCINE DEVELOPMENT

Author
Parker Tinsley
Wayne State College

According to the World Health Organization, there are over 128 million *Chlamydia trachomatis* infections each year. Untreated women frequently spread *C. trachomatis* to newborn's eyes causing trachoma, an irreversible blindness. In the interest of vaccine development, Major Outer Membrane Protein (MOMP), a *C. trachomatis* trimeric porin protein, appears to be a good candidate due to its abundant surface expression. Our lab has over expressed MOMP in a prokaryotic host and purified the protein in monomeric form to approximately 95% purity. However, protein folding in reduced

atmospheres of host strains may affect its use in vaccines. To address this issue, we explore the application of direct expression of MOMP in a eukaryotic host through use of a shuttle vector (pcDNA3.1) with a confirmed in-frame N-terminal signal sequence designed to traffic over-expressed MOMP to cell surface membranes. This publication was made possible by grants from the National Center for Research Resources (5P20RR016469) and the National Institute for General Medical Science (NIGMS) (8P20GM103427), a component of the National Institutes of Health (NIH) and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIGMS or NIH.

Friday, April 25, 2025 1:15pm - 4:30pm

BIOLOGICAL AND MEDICAL SCIENCES AFTERNOON SESSION- 1C

Biological and Medical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Great Plains Room C**

AFTERNOON SESSION – 1C **Section Subchairperson: Dr. Jason Carbaugh**

1:15 Presenters upload Session talks onto room computer desktop.

1:30 SCREENING NOVEL COMPOUNDS FOR ANTIMICROBIAL EFFICACY AGAINST A DIVERSE PATHOGEN PANEL. Kayleen J. Mijangos and Paul H. Davis.

1:45 NFKB-DEPENDENT LNCRNA NOSTRILL IS UPREGULATED IN RESPONSE TO VIRAL INFECTION *IN VIVO*. Ethan Lorenson, Aaron Marta, Alexa Pulliam, Hannah Martin1, Kristen Drescher, and Annemarie Shibata

2:00 SINGLE MOLECULE STUDIES OF NUCLEOSOME ASSEMBLY PROTEINS. Emma Foley and Lynne Dieckman

2:15 *STAPHYLOCOCCUS EPIDERMIDIS* HIGH PERSISTER ISOLATES EXHIBIT INCREASED TOLERANCE TO COMPONENTS OF THE INNATE IMMUNE SYSTEM. Chayton CM. Kumpost, Austin Nuxoll, Kimberly Carlson, Alexis Hobbs

2:30 SYNTHESIS OF INTERMEDIATE SCAFFOLDS FOR POTENTIAL TREM-1 INHIBITORS TO TREAT NEUROINFLAMMATION. Vanessa Duncan and Gopal Jadhav

2:45 **BREAK**- Presenters upload Session talks onto room computer desktop.

3:00 TARGETING THE LIPOAMIDE BINDING SITE OF PYRUVATE DEHYDROGENASE KINASE (PDK) TO TREAT METABOLIC DISEASE. Noah Shackelford, Brandon Hollister, Allen A. Thomas, Michael A. Moxley

3:15 TRANSCRIPTOMIC AND LIPIDOMIC INSIGHTS INTO ALBUMIN-MEDIATED FARNESOL REGULATION IN *CANDIDA ALBICANS*. Brigid M. Toomey, Daniel J. Gutzmann, Shyanne D. Urbin, and Audrey L. Atkin

3:30 UL5 AND HCMV PATHOGENESIS: INVESTIGATING UL5'S ROLE IN LYTIC REPLICATION AND LATENCY. Kai Waddell, Kamryn Pfenning, Lindsey B. Crawford

3:45 USING ADAM17 INHIBITION TO BOOST HUMAN NATURAL KILLER CELL- MEDIATED ANTIBODY-DEPENDENT CELL-MEDIATED CYTOTOXICTY. Angela Truong, Charlie Berryman, Victor Rivero, Paul W Denton

4:00 USING BACTERIOPHAGES TO TREAT *P. SYRINGAE* INFECTIONS IN TOMATO PLANTS. Sierra Laschanzky, Katelyn Jindra, and Erin Doyle

4:15 STRUCTURAL ANALYSIS OF OAZ RNA FROM HOMO SAPIENS. Shawn A. Ramachandran and Juliane Soukup

SCREENING NOVEL COMPOUNDS FOR ANTIMICROBIAL EFFICACY AGAINST A DIVERSE PATHOGEN PANEL

Author
Kayleen Mijangos

The increasing rise of antimicrobial resistance, driven by the overuse and misuse of antibiotics, has emphasized the urgent need for novel compounds. As resistance continues, infections that were once treatable have become increasingly harder to treat, resulting in increased mortality rates throughout the world. To address this, this study evaluates promising compounds against a diverse panel of bacteria, which includes *Listeria innocua, Neisseria mucosa, Staphylococcus epidermidis, Proteus mirabilis,* and *Mycobacterium smegmatis.* These bacteria were selected to represent diverse bacterial pathogens based on their different bacterial structures and resistance mechanisms. To conduct screenings, the antimicrobial efficacy of the experimental compounds was assessed by determining the half-maximal inhibitory concentration (IC_{50}) across a concentration gradient of 0.5 uM to 50 uM. Bacterial screenings were conducted using a protocol implemented with an OpenTrons robotic system, enhancing efficiency and minimizing potential errors. This study identified compounds with IC_{50} values below 10uM for several bacterial species in the panel. The IC_{50} values identified indicate promising antimicrobial activity and merit further investigation. This study is ongoing, with compounds continuously being evaluated. Thus, the discovery of additional promising candidates remains possible.

INVESTIGATING FACTORS INFLUENCING PERSISTER FORMATION IN STAPHYLOCOCCUS EPIDERMIDIS CLINICAL ISOLATE

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Staphylococcus epidermidis is a common skin bacterium that can cause opportunistic infections, particularly in immunocompromised individuals and those with indwelling medical devices. These infections are often persistant due to biofilm formation and the presence of persister cells, a subpopulation of dormant bacteria. We investigated the role of the tricarboxylic acid (TCA) cycle in persister cell formation in *S. epidermidis*. By measuring extracellular acetate

levels, a byproduct of the TCA cycle, we found a correlation between reduced TCA cycle activity and increased persister formation in certain *S. epidermidis* isolates. Additionally, we assessed the susceptibility of these isolates to the antimicrobial peptide LL-37. (Insert LL-37 results here). Our findings provide insights into the mechanisms underlying persistent *S. epidermidis* infections and may inform the development of novel therapeutic strategies targeting persister cells.

NFKB-DEPENDENT LNCRNA NOSTRILL IS UPREGULATED IN RESPONSE TO VIRAL INFECTION IN VIVO

Author
Ethan Lorenson
Creighton University

Viral infection results in inflammation throughout the body and the brain. Increases in neuroinflammation following viral infection can result in neuronal death and increased risk for neurodegenerative disease. Theiler's Murine Encephalomyelitis Virus-Induced Demyelinating Disease (TMEV-IDD) is a commonly used mouse model for neurodegenerative disease that recapitulates the chronic neuroinflammation seen in primary progressive multiple sclerosis in humans. Proinflammatory responses in TMEV-IDD mice involve neuronal and glial cell signaling and regulation of gene transcription, many of which have been recently associated with long noncoding RNA and their ability to regulate gene transcription. Previous in vitro work in our lab demonstrated that TMEV-infected microglia upregulate transcription of NFkB-dependent lncRNA Nostrill. Current work is investigating the role of Nostrill in neurons during the antiviral response. Neurons are known to be infected before microglia in TMEV-IDD, and Nostrill appears to be upregulated in virally infected neurons in vitro. The role of Nostrill in neuronal antiviral responses in vivo is not understood. Our lab uses two strains of mice to investigate the role of lncRNAs in the neuronal antiviral immune response. One strain, FVB/NJ, is susceptible to TMEV-IDD while the other strain, C57BL/6, is resistant to TMEV-IDD. We hypothesize that Nostrill is differentially expressed in neurons of TMEV-IDD susceptible and TMEV-IDD resistant mice. The TMEV-IDD mice are developed in the lab and prior to sacrifice, mice undergo behavioral tests to evaluate grip strength (pull bar), mobility and learning (balance beam), mobility and jumping (cylinder), sensorimotor and general locomotion (open field), and mobility and locomotion (grid walk). After sacrifice, mice hippocampi samples undergo fluorescent in situ hybridization (FISH) to determine whether Nostrill production was influenced by TMEV infection and to determine where Nostrill is expressed in neurons. Behavioral and FISH analyses show a positive correlation between the development of TMEV-IDD and increased expression of Nostrill in vivo. Nostrill localization in the nucleus or cytoplasm will be determined through FISH analyses. These data will provide novel information about the role of the lncRNA Nostrill in neuronal antiviral immune responses in animals that develop neurodegenerative disease.

This publication was made possible by grants from the National Institute for AIDS and Infectious Disease (NIAID) (1 R15 AI156879) and the National Institute for General Medical Science (NIGMS) (5P20GM103427), components of the National Institutes of Health (NIH), and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIAID, NIGMS or NIH.

SINGLE MOLECULE STUDIES OF NUCLEOSOME ASSEMBLY PROTEINS

Author
Emma Foley
Creighton University

When a cell divides, its genome must be replicated and passed on to the next generation of cells. During replication, newly synthesized DNA is organized into nucleosomes, the fundamental units of chromatin. This packaging process, called replication coupled nucleosome assembly, is crucial for protecting DNA and maintaining genomic stability. The level of compaction between these nucleosomes determines which genes are silenced or expressed, where loosely packed nucleosomes are typically expressed, and tightly packed nucleosomes are typically silenced. Proliferating

cellular nuclear antigen (PCNA) and chromatin assembly factor 1 (CAF-1) are two proteins required for this process. The interaction between PCNA and CAF-1 is essential for nucleosome assembly to occur. However, the mechanism of this interaction is not well understood. To determine the binding kinetics and affinity of the PCNA-CAF-1 interaction, I am using single molecule total internal reflection fluorescence (TIRF) microscopy. We have established a robust TIRF assay, confirming protein immobilization and optimizing binding assays to capture individual binding events between single molecules of CAF-1 and PCNA or DNA. By varying wild-type protein concentrations used in these assays, we are determining the binding kinetics of the interaction. Future experiments with mutant proteins will map interaction sites between CAF-1 and PCNA, providing crucial insights into nucleosome assembly and the contribution of this protein interaction to genomic integrity.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427.

SYNTHESIS OF INTERMEDIATE SCAFFOLDS FOR POTENTIAL TREM-1 INHIBITORS TO TREAT NEUROINFLAMMATION

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Triggering Receptor Expressed Myeloid cells 1 (TREM-1) is an immunoglobulin superfamily surface receptor found on neutrophils, monocytes, and microglia. TREM1 overexpression has been associated to the development of neuro-inflammatory diseases, while TREM1 inhibition gives protection. Based on past research, such as chemical docking into the TREM-1 crystal structure, we identified GJ compound as a possible TREM-1 inhibitor. We confirmed GJ-TREM-1 interaction using surface plasmon resonance and neuroprotective effects in biological assays. Based on this, a structure-activity relationship (SAR) was developed to assist the medicinal chemistry synthesis of non-toxic, bioavailable, and powerful TREM1 inhibitor analogs of the GJ molecule. We optimized a series of chemical reactions involving numerous steps in chemical synthesis and effectively created various intermediate and final molecules. All compounds were purified using flash chromatography, and their structures were verified with 1H and 13C NMR. These compounds are undergoing high-throughput screening to determine their TREM-1 inhibitory profile. TREM-1 inhibitory drugs will be evaluated for potency, effectiveness, safety, bioavailability, and pharmacokinetics. If successful, these chemicals will serve as the foundation for the creation of pharmaceutical drugs to treat inflammatory and neuro-inflammatory illnesses. The study is still underway, and patent applications for these GJ compounds are being filed.

TARGETING THE LIPOAMIDE BINDING SITE OF PYRUVATE DEHYDROGENASE KINASE (PDK) TO TREAT METABOLIC DISEASE

Author
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The pyruvate dehydrogenase complex (PDC) is a complex of three enzymatic units that links two pathways of central metabolism, glycolysis and the tricarboxylic acid cycle. PDC activity is regulated in part by its inhibitor, pyruvate dehydrogenase kinase (PDK), with overexpression of PDK being associated with numerous metabolic disorders including various forms of cancer, type 2 diabetes mellitus, and heart disease. An extensive virtual screen was performed, in which chemical structures from the Enamine database were docked with the lipoamide binding site of the isozymes PDK 1-4. Chemical structures with high docking scores by screening were then purchased commercially

or synthesized in house and tested for their activity against PDK via a PDC-coupled assay. Compounds that demonstrated significant inhibition of PDK underwent further concentration-dependent testing to determine half-maximal inhibitory concentrations (IC_{50}) as an estimate of potency. Hit compounds identified by the enzymatic assay would be studied with more complex parameter computer simulations in order to identify important noncovalent interactions within the lipoamide binding pocket. These efforts led to the purchase and synthesis of additional chemical analogs of hit compounds to better elucidate the structure-activity relationship (SAR) of PDK lipoamide site inhibitors. Further research into these compounds and related structures is ongoing, with the goal of yielding compounds useful in the treatment of metabolic disease.

The project described was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427 as well as NIH NIGMS Grant # 1R15GM152925-01.

TRANSCRIPTOMIC AND LIPIDOMIC INSIGHTS INTO ALBUMIN-MEDIATED FARNESOL REGULATION IN CANDIDA ALBICANS

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Candida albicans is an opportunistic fungal pathogen capable of morphological transitions between yeast and filamentous forms, a key feature of its virulence. Farnesol, a quorum-sensing molecule produced by *C. albicans*, inhibits filamentation, while the blood serum is known to stimulate it. Our previous work demonstrated that the serum protein albumin sequesters farnesol, reducing its bioactivity and promoting filamentation. To further elucidate albumin's role in farnesol regulation, we conducted RNA sequencing (RNA-seq) of *C. albicans* grown in albumin-containing media. Differential expression analysis revealed global activation of glycolytic genes in the presence of albumin, suggesting metabolic shifts beyond farnesol sequestration. Broad KEGG and GO analyses highlighted potential regulatory pathways influenced by albumin exposure.
Additionally, we compared this transcriptomic dataset to those of *HAP5* and *CAS5* mutants, which are known to oversecrete farnesol, in an effort to identify genes involved in farnesol secretion. While we observed overlapping transcriptional signatures, we were unable to pinpoint a definitive secretion mutant. However, by this workflow, we previously identified *CWH8* as a key gene responsible for farnesol production, and we used a *cwh8?* null mutant as a farnesol-deficient control in our experiments. To further investigate albumin's influence on sterol metabolism, we employed LC-MS-based lipidomics to analyze farnesyl-phosphate and farnesyl-pyrophosphate localization in both wild-type and *cwh8?* mutants grown in standard and albumin-containing media. Our findings provide insight into albumin's broader role on farnesol-associated regulatory mechanisms and host-microbial interacts during infection by *C. albicans*. This work was supported by the NIH INBRE scholarship to B.M.T. from the National Institute Of General Medical Sciences of the National Institutes of Health under Award Number 5P20GM103427.

UL5 AND HCMV PATHOGENESIS: INVESTIGATING UL5'S ROLE IN LYTIC REPLICATION AND LATENCY

Author
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Human Cytomegalovirus (HCMV) is a common ?-Herpesvirus with a seroprevalence of about 60-90% among the general population. It remains a significant pathogen due to its latent, lifelong infection and significant complications in those pregnant or immunocompromised. To understand how this virus causes disease and persists, we are studying the function of a viral gene, UL5, with unknown function. To begin, we are determining the role of HCMV UL5 during lytic replication, a specific viral lifecycle stage where the virus is active and directly producing new virus particles. A prior proteomics study indicated that UL5 may directly interact with cellular proteins ANKRD13A and ST3Gal1. Both cellular proteins are important for protein regulation and immune function which are key pathways dysregulated by HCMV. We determined that HCMV infection upregulates ANRKD13A and ST3GAL1. Subsequently we transfected cells with plasmid constructs containing UL5 to study its expression and cellular interactions individually. We found ANKRD13A and ST3Gal1 were downregulated in UL5-transfected cells. We are continuing to explore the direct interaction of UL5 with ANKRD13A and ST3GAL1 at the protein level. Finally, we have preliminary data that suggests UL5 is expressed during latency, another critical part of HCMV's lifecycle. Our future studies will continue to characterize the role of HCMV UL5 in lytic and latent infection of HCMV to advance our understanding of HCMV infection and latency and open avenues for targeted therapeutic interventions.This project was supported by an Institutional Development Award (IDeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant # 5P20GM103427. This project was also supported by funding from NIH P20GM113126 and UNL startup funds to LBC.

USING ADAM17 INHIBITION TO BOOST HUMAN NATURAL KILLER CELL- MEDIATED ANTIBODY-DEPENDENT CELL-MEDIATED CYTOTOXICTY

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Human natural killer (NK) cells are known to kill diseased cells through two different methods: direct killing and antibody-dependent cell-mediated cytotoxicity (ADCC). NK cells can be stimulated through a cascade triggered by toll-like receptor 9 (TLR9) agonism, which begins in neighboring (non-NK) white blood cells. This neighboring cell-based activation process allows for physiologically relevant levels of NK cell stimulation. Importantly, we found that stimulation in this manner only increases direct killing by human NK cells; ADCC did not change as a result of this stimulation approach. Our working hypothesis for the lack of change in ADCC relates to the fact that NK cells rely on CD16, a surface receptor, to carry out ADCC. Notably, activated NK cells cleave CD16 from their surface using ADAM17 sheddase as a mechanism to autoregulate their activity. In our experiments, we are combining a TLR9 agonist with an ADAM17 sheddase inhibitor. We expect this approach to allow for boosting both direct killing and ADCC, in contrast to what we found with TLR9 agonist treatment alone. Because the ADAM17 sheddase inhibitor is

dissolved in a different solvent (DMSO) than the TLR9 agonist (H2O), our first set of experiments are to determine how much of the DMSO solvent can be tolerated by human NK cells before either killing efficacy is impaired. Once this value is determined, we will know the maximum concentration of ADAM17 inhibitor that we can possibly use so that we can begin to develop our dose-response curves for this drug. Finally, we will combine the drugs together in our lab's recently described killing assay to assess the functional outcomes of the combined intervention. Our data to date for this aspect of the project will be presented. The project described was supported in part by an Institutional Development Award (IDeA) from the NIGMS of the National Institutes of Health under Grant # 5P20GM103427.

USING BACTERIOPHAGES TO TREAT P. SYRINGAE INFECTIONS IN TOMATO PLANTS

Author
Sierra Laschanzky
Doane University

Bacteriophages are viruses that infect bacteria. Bacteriophages have the potential to be used in a process called phage therapy, where a bacterial infection is treated with these viruses instead of/alongside antibiotics or other treatment methods. Phage therapy in plants has been tested before, and has shown promising results. However, more research is needed before this treatment option becomes a truly viable method. We isolated and characterized 14 bacteriophages from soil samples collected across Nebraska using the host bacteria Pseudomonas syringae pv. tomato DC3000. This bacteria strain is specific to tomato plants. My research goal is to make a cocktail of phages and test their viability in treating Pst infections in planta in both pre- and post-infection studies. For pre-infection groups, we will pre-treat 4 week old tomato plants with our phage cocktail 24 hours prior to dip inoculation with Pst bacteria. For our post-infection groups, we will dip inoculate tomato plants with Pst 24 hours prior to introducing our phage cocktail. We will measure plant wilt and leaf discoloration to compare the two treatment methods in order to determine if a phage cocktail is a viable treatment option for Pseudomonas syringae.

STRUCTURAL ANALYSIS OF OAZ RNA FROM HOMO SAPIENS

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Riboswitches are segments of non-coding RNA found in the 5' untranslated region of messenger RNA that influence the expression of a downstream gene when bound to cellular metabolites. Binding of a metabolite induces conformational changes and directly regulates gene expression via alterations in downstream transcription, translation, or RNA processing machinery. While most riboswitch regulatory elements have been identified in bacteria, eukaryotic riboswitch behavior implicated in the biosynthesis of polyamines remains largely uninvestigated. Polyamines are organic compounds that are pervasive in living cells and are vital for many cellular processes, such as growth, survival, and differentiation. Furthermore, they can act as ligands in their interactions with DNA, RNA, and proteins to influence cell maturation. Thus, further research investigating the role of riboswitches as regulatory elements and their specificity for ligands is imperative as it will enhance the ability to utilize riboswitches for applications in medical therapeutics for various diseases, such as cancer. One such potential eukaryotic riboswitch that is highly conserved and preserved in multiple organisms is the Ornithine Decarboxylase Antizyme RNA (OAZ RNA). Recent studies from Dr. Soukup's lab suggest strong evidence for a potential riboswitch in human OAZ RNA through analysis of riboswitch-ligand interactions and conformational changes. The focus of my project is to further investigate the interactions between OAZ RNA from *Homo sapiens* and varying concentrations of polyamines, specifically with regards to conformational changes and eventual gene expression. In-line probing (ILP) is the central

assay used to analyze these structural interactions. Specifically, this assay can elucidate whether the OAZ RNA exhibits one of the three key characteristics of riboswitches—conformational changes induced by ligand binding—by utilizing varying concentrations and types of polyamines. Thus, this research project aims to explore the importance and relevance of interactions between riboswitches and polyamines in humans, thereby contributing to both the scientific and medical communities.

Friday, April 25, 2025 1:15pm - 4:30pm

BIOLOGICAL AND MEDICAL SCIENCES AFTERNOON SESSION- 1D

Biological and Biomedical Sciences **Chairperson: Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: Garden Room**

AFTERNOON SESSION – 1D **Subsection Chairperson: Dr. Nick Hobbs**

1:15 Presenters upload Session talks onto room computer desktop.

1:30 EXAMINATION OF CANDIDA ALBICANS LIPID PHOSPHATASE MUTANT CWH8?/? FOR FARNESOL PRODUCTION, TRANSPORT, AND RESPONSE. Shyanne D. Urbin, Daniel J. Gutzmann, Brigid M. Toomey, Kenneth Nickerson, and Audrey L. Atkin

1:45 KINETIC CHARACTERIZATION OF PROTEINS CRITICAL TO GENE SILENCING. Ivy Williams and Lynne Dieckman

2:00 THE ROLE OF NOSTRILL IN CHRONIC TMEV INFECTION OF FVB/NJ MICE. Paige Harty, Aaron Marta, Jodi Hallgren, Kristen Drescher, and Annemarie Shibata

2:15 LINCRNA NOSTRILL INFLUENCES *IN VIVO* ANTIVIRAL RESPONSES IN A TMEV-IDD MODEL SYSTEM. Aaron Marta, Kristen Drescher, and Annemarie Shibata

2:30 NANOPARTICLE-BASED BIOSENSING ASSAY FOR MULTIPLEXED DETECTION OF CIRCULATING TRANSCRIPTS FOR EARLY DETECTION OF PDAC. David Johnson, Prakash Kshirsagar, Maneesh Jain, Surinder Batra

2:45 **BREAK**- Presenters upload Session talks onto room computer desktop.

3:00 NSF IRES PROGRAM FOR DEVELOPING POINT-OF-CARE TESTING DEVICES FOR PATHOGEN DETECTION. Sangjin Ryu

3:15 THE EFFECTS OF MENTAL AND PHYSICAL ACTIVITY ON SPEECH LANGUAGE DELAYS. Maddison Frohling and Mary Keithly

3:30 THE POTENTIAL IMPACTS OF AN FDA-APPROVED ANTIDEPRESSANT TRAZODONE ON DYSLIPIDEMIA. Naara Ramirez and Yipeng Sui

3:45 USING 3D-PRINTED DEVICES TO ELUTE AND CONCENTRATE *S. CEREVISIAE* DNA. Jade Salgado Antunez and Kristy Kounovsky-Shafer

4:00 VIRTUAL AND EXPERIMENTAL *MYCOBACTERIUM TUBERCULOSIS* E3 LIPOAMIDE INHIBITOR SCREENING AND MD SIMULATIONS. Nathan Lilla and Michael A. Moxley

EXAMINATION OF CANDIDA ALBICANS LIPID PHOSPHATASE MUTANT CWH8?/? FOR FARNESOL PRODUCTION, TRANSPORT, AND RESPONSE

Author
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Candida albicans is an opportunistic fungus that colonizes the gastrointestinal tract and mucosal membrane of a large proportion of humans. The virulence of *Candida albicans* is strongly linked with its ability to exhibit polymorphism. *Candida albicans* can switch between yeast and hyphal morphologies, a process that is mediated by a sterol synthesis byproduct called farnesol. Farnesol is a known inhibitor of germ tube formation, or the switch from yeast to hyphal morphologies which is a key part of biofilm formation. *Candida albicans* is able to detect farnesol in its environment, but it is unclear how farnesol is moved from production, to secretion, and ultimately to detection. In this project, the production, response, and secretion of farnesol is examined through the lens of CWH8, the gene coorelated to farnesol production in *Candida albicans*. First, *cwh8?/?*, the deletion mutant of CWH8, was confirmed to not produce farnesol compared to wild-type *Candida albicans*. Additionally, the effects of CWH8 deletion on germ tube formation and exogenous farnesol response was evaluated, concluding that *cwh8?/?* has limited germ tube development while still responding to farnesol. The *cwh8?/?* mutant also was identified as being susceptible to cell wall stress. Finally, *cwh8?/?* opened an avenue to investigate the transport of exogenous farnesol into the cell, leading to the identification of potentially important genes involved in farnesol transport. The project described was supported by an Institution Development Award (IdeA) from the National Institute of General Medical Sciences of the National Institutes of Health under Grant #5P20GM103427.

KINETIC CHARACTERIZATION OF PROTEINS CRITICAL TO GENE SILENCING

Author
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Creighton University

DNA in eukaryotes must be organized and tightly packaged to fit inside the cell nucleus. To accomplish this, DNA is coiled around histone proteins to form nucleosomes, which are further condensed to form chromatin. Depending how tightly the nucleosomes are packaged dictates whether a gene will be expressed or silenced. The regulation of nucleosome assembly and gene silencing requires the coordinated action of two proteins: proliferating cell nuclear antigen (PCNA) and chromatin assembly factor-1 (CAF-1). PCNA is a sliding clamp protein that recruits and coordinates proteins during DNA-templated processes. CAF-1 is recruited by PCNA to deposit histone proteins on nascent DNA. If PCNA and CAF-1 are unable to interact, gene silencing is disrupted, resulting in genome instability and disease. However, the mechanism of interaction between these two proteins is not clear. In addition, it is not known how PCNA is able to differentiate between its many binding partners at the replication fork. My goal is to understand the unique mechanism and kinetics of binding between CAF-1 and PCNA using surface plasmon resonance. I determined the canonical PCNA-CAF-1 interaction occurs with an affinity of 4mM and utilizes a 2-step binding mechanism. I am currently working to quantitate the kinetics of binding between PCNA and two novel binding motifs we have identified in CAF-1. Coupling my kinetic data with structural and thermodynamics studies of the PCNA-CAF-1 interaction will provide a better understanding of how CAF-1 and PCNA interact to regulate nucleosome assembly and maintain gene silencing. This work will also provide insight into how PCNA differentiates between CAF-1 and other PCNA-binding proteins at the replication fork.

THE ROLE OF NOSTRILL IN CHRONIC TMEV INFECTION OF FVB/NJ MICE

Author
Paige Harty

Viral infections in the central nervous system (CNS) initiate a neuroinflammatory CNS environment. Depending on the genetic background of an individual, viral infection and antiviral immune responses can result in neural toxicity, marked by neurodegeneration and demyelination, and have been linked to

neurodegenerative diseases such as multiple sclerosis (MS). Neurodegenerative diseases such as MS are associated with proinflammatory gene expression. Proinflammatory gene expression can be regulated by long non-coding RNAs (lncRNAs), and lncRNAs are differentially expressed in humans with MS. Our lab has identified a lncRNA that is upregulated by TMEV viral infection in vitro called Nostrill. Nostrill, or iNos Transcriptional Regulatory Intergenetic LncRNA Locus, is a long noncoding RNA that is upregulated in microglia during inflammatory responses (Mathy et al, 2021). To stimulate an inflammatory response, Theiler's Murine Encephalomyelitis Viral-Induced Demyelinating Disease (TMEV-IDD) is a useful mouse model system for studying antiviral immune responses that lead to neurodegeneration and demyelination similar to MS. This study explores the role of Nostrill in CNS antiviral defense in genetically susceptible IDD mice (FVB/NJ). In FVB/NJ mice, TMEV-IDD pathogenesis has two phases: acute and chronic. The acute phase arises in cerebral neurons, and after 7 days, the virus spreads to cells in the spinal cord. Chronic leukomyelitis begins after 28 days post infection as neuroinflammatory processes are initiated in the infected spinal cord. The study hypothesizes that there will be an upregulation of Nostrill and proinflammatory genes in FVB/NJ mice during chronic leukomyelitis. FVB/NJ male and female mice were intracerebrally infected with TMEV, and tissue was collected for RNA isolation and RT-qPCR analyses 35 and 90 days post-infection. Preliminary results show Nostrill is upregulated at 35 days post infection. Future work will provide information about whether Nostrill plays a significant role in chronic TMEV viral persistence at 90 days. These results will determine whether Nostrill is a potential lncRNA target for regulating neuroinflammatory processes that contribute to demyelinating disease.

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LINCRNA NOSTRILL INFLUENCES IN VIVO ANTIVIRAL RESPONSES IN A TMEV-IDD MODEL SYSTEM

Author
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Viral infection can cause a neuroinflammatory response leading to neuronal damage and an increased risk of neurodegenerative disease in humans. During viral infection of the central nervous system (CNS), neurons and microglial cells work together to drive the initial antiviral response to effectively or ineffectively clear viral infection resulting in acute or chronic infections, respectively. Previous work in our lab shows that viral infection of microglia with Theiler Murine's Encephalomyelitis Virus (TMEV) upregulates an NFkB-dependent long noncoding RNA Nostrill. Nostrill regulates Interferon response factor 7 (*Irf7*) and Type 1 interferon (*Ifn?/?*) gene transcription in microglia *in vitro*. In the TMEV-IDD (TMEV-Induced Demyelinating Disease) mouse model, neurons are infected before microglia. Whether neurons upregulate Nostrill to mount an antiviral response is not known. The TMEV-IDD model system allows me to determine whether Nostrill is important for antiviral responses in neurons of TMEV susceptible (FVB/nJ) and resistant (C57Bl6) mice and if so, whether it is differentially expressed. During the height of neuronal TMEV infection, 11-day mice were sacrificed and used in downstream experiments. To determine steady state mRNA levels and localization of Nostrill, Reverse Transcription- Quantitative Polymerase Chain Reaction (RT-qPCR) and Fluorescent In Situ Hybridization (FISH) experiments were completed on whole brain and hippocampal tissue. RT-qPCR of whole brain tissue showed that TMEV infected female and male FVB/nJ mice significantly upregulate Nostrill ~2.5-fold (p=0.003, N?4) and ~2-fold (p=0.007, N?4), respectively. RT-qPCR of the hippocampus showed that all TMEV infected mice significantly upregulated Nostrill when compared to uninfected mice. In whole brain and hippocampal tissue, RT-qPCR of TMEV infected FVB/nJ mice showed an upregulation of antiviral and inflammatory genes of interest-- Ifn?, Ifn?, Irf7, iNos, Ccl2, and Tnf?-- compared to uninfected FVB/nJ mice and

TMEV infected C57Bl6 mice. FISH analysis of neurons in the cortex and hippocampus showed that TMEV infected compared to uninfected mice expressed significantly more Nostrill, ~13.6-fold in FVB/nJ ($p<0.0001$, N=4) and ~6-fold in C57Bl6 ($p=0.0488$, N=4). TMEV infected FVB/nJ mice had a ~9-fold increase in Nostrill expression compared to TMEV infected C57Bl6 mice. These data suggest that the lincRNA Nostrill is differentially expressed in the brain and specifically in the neurons of mice that develop virally induced neurodegenerative disease (FVB/nJ). Future studies are to use Fluorescence-Activated Cell Sorting (FACS) to isolate primary neurons and microglia of infected C57Bl6 and FVB/nJ mice to investigate differential *in vivo* expression of Nostrill.

This publication was made possible by grants from the National Institute for AIDS and Infectious Disease (NIAID) (1 R15 AI156879) and the National Institute for General Medical Science (NIGMS) (5P20GM103427), components of the National Institutes of Health (NIH), and its contents are the sole responsibility of the authors and do not necessarily represent the official views of NIAID, NIGMS or NIH.

NANOPARTICLE-BASED BIOSENSING ASSAY FOR MULTIPLEXED DETECTION OF CIRCULATING TRANSCRIPTS FOR EARLY DETECTION OF PDAC

Author
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UNMC

Due to the inability of existing serum CA-19.9 biomarker tests to diagnose pancreatic cancer (PC) at an early and curable stage, 85-90% of PC tumors extend beyond the pancreas or are metastasized at the time of diagnosis. Thus, effective and affordable serum-based screening modalities are needed to allow for early detection. Several differentially upregulated circulating transcripts, such as miRNAs and mucin splice variants have been identified as promising biomarkers. However, their very low concentration in sera dictates a need for new detection technology that is rapid, ultrasensitive, direct, and multiplexed. Here is described the development of an innovative DNA-linked Nanoprobe (DNA-AuNPr)-based miRNA assay for direct (PCR-free), in-situ (RNA isolation-free), ultrasensitive, and multiplexed quantification of circulating transcripts (MUC4?6 and miRNAs) from small-volume serum samples. Unique DNA-AuNPr targeted to MUC4?6 and miRNAs were synthesized by conjugating four different fluorophore-tagged DNA probes to PEG-coated gold nanoparticles, and the resulting DNA-AuNPr were fully characterized with UV, DLS, Zeta potential, and TEM. A kinetic evolution assay of multicolor fluorescence signal was performed for ultrasensitive quantification of synthetic miRNAs in uniplex and multiplexed settings. The utility of the assay was tested for detecting MUC4?6 alone and four miRNAs together, directly in denatured sera of patients with PDAC, chronic pancreatitis (CP), and healthy control (HC) in a blinded validation set compared with the performance of CA-19.9. Optimization of uniplex assay of MUC4?6 and multiplexed assay of a panel of differentially overexpressed miRNAs yielded promising results. All assays exhibited a high linear dynamic range (10 pM-500 pM), and the limit of detection ranged from 3-10 pM. The MUC4?6 revealed differential overexpression in PC samples compared to CP and HC controls. Previous bioinformatic analyses and literature study revealed significant upregulation of miR-21, miR-210, miR-141, and miR-203b in PC compared to HC. Confirming this, standard curves from the uniplex and multiplex miRNA assays demonstrated differential overexpression in PC versus CP and HC controls. The direct, RNA-isolation free miRNA quantification method performed equally well or better than quantification of an equivalent amount of isolated RNA from serum. Preliminary ROC analysis from the training and blinded validation set revealed clear discrimination between patients with PC and with CP, with AUC values of >0.95, greater than CA-19.9 alone.

NSF IRES PROGRAM FOR DEVELOPING POINT-OF-CARE TESTING DEVICES FOR PATHOGEN DETECTION

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The International Research Experiences for Students (IRES) program of National Science Foundation (NSF) offers international research opportunities to undergraduate and graduate students in STEM to develop globally engaged STEM workforce through international research experiences. My IRES program (NSF Grant No. 2246339) brings a cohort of undergraduate and graduate students Toyohashi University of Technology (TUT) in Japan for 8-week-long

summer research experience.

The previous global COVID-19 pandemic showed the need for a reliable yet quick diagnostic method for detecting viral pathogens. Point-of-care testing (POCT) devices can meet the need because they provide cost effective, easy-to-use solutions with a high detection success rate. Microfluidics is an ideal technology for developing POCT devices because it allows for the miniaturization of larger-scale applications. Thus, utilizing microfluidics is beneficial for POCT because of reduced time, cost, and resources. The filter-free wavelength (FFW) complementary metal oxide semiconductor (CMOS) sensor can sense multiple wavelengths in the incident light without using any optical filters. Because of this unique functionality, the FFW CMOS sensor is also ideal for POCT devices as it cuts down on both the size and cost of the sensor.

My IRES program aims to integrate microfluidics and the FFW CMOS sensor in a portable platform and to develop a POCT device for efficient detection of infectious pathogens. The Year 1 cohort for summer 2024 consisted of three undergraduate students and one graduate student with various STEM backgrounds. Guided by faculty mentors, the Year 1 cohort gained a unique experience of undergoing the research process in a short time. After literature review and brainstorming, the cohort found that developing an engineering solution for well-controlled alignment between the microchannel device and the CMOS sensor was critical. Therefore, they focused on integrating the microfluidic channel device, the CMOS sensor, and the 3D printed case. The cohort successfully designed, fabricated, and tested a prototype of the integrated system. Experience and self-reflection from the first year will be used as the basis for improving the second year of the program.

THE EFFECTS OF MENTAL AND PHYSICAL ACTIVITY ON SPEECH LANGUAGE DELAYS

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The Mayo Clinic estimates that 5-10% of all U.S. citizens have a speech and language delay, diagnosed or not. This research looked to examine speech and language delays under intense mental activity and physical activity. Research participants began the research experiment by answering four questions regarding their personal and family history of speech-language delays. Participants were split into three groups, control, puzzle, and treadmill, each on a different day and each participating in each group. Participants began on day one with the control group. The control group were read a pre-written prompt and were then asked to answer four random questions. The next day, participants were asked to complete a 60-piece puzzle while simultaneously hearing a pre-written prompt and four different questions from the control group. The next day, participants were asked to jog on a treadmill while also hearing the same prompt and separate questions from the prior two groups. At the end of each experiment, participants were asked to recall as many words as possible from the prompt read to them during each trial. Data collection is in progress, and results will be cross-examined with the initial questionnaire filled out by each research participant to look for possible correlations with prior diagnosis and research results. Data results of the physical activity group will also be cross-examined with the mental activity group, examining possible differences between the two. This research aims to determine whether mental activity or physical activity affects speech-language delays more. Research is still in progress, and a complete analysis will be presented upon completion.

THE POTENTIAL IMPACTS OF AN FDA-APPROVED ANTIDEPRESSANT TRAZODONE ON DYSLIPIDEMIA

Author
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Cardiovascular disease is the leading cause of death. Many cardiovascular health issues, such as atherosclerosis, are caused by dyslipidemia, a blood lipid imbalance. Pregnane X Receptor (PXR), a xenobiotic nuclear receptor, plays a role in atherosclerosis and dyslipidemia. PXR is activated by various environmental chemicals, including endocrine-disrupting chemicals (EDCs), found in common household items such as plastics, medications, and food. Trazodone is a clinically used medication to treat depression by increasing levels of serotonin in the brain. This drug's possible impacts on PXR and cardiovascular risk factors such as dyslipidemia are currently unknown. Our preliminary data suggested that Trazodone activated human PXR in both human intestinal (LS180) and hepatic (HepG2) cells. We hypothesized that Trazodone alters cholesterol uptake and negatively impacts human dyslipidemia through PXR pathway. In this study we use cell-based transfection assay to evaluate the underlying mechanisms by which Trazodone activates PXR. We found that Trazodone was a more potent agonist of human PXR than mouse PXR. Trazodone could activate PXR more intensely in human hepatic cells compared with human intestinal cells. Our data indicated that Trazodone was a selective PXR agonist and promoted the dissociation between PXR and its nuclear corepressors. Furthermore, we identified potential key amino acid residues within the PXR ligand binding pocket that interacts with Trazodone using computational docking study and site-mutagenesis assay. Next, we plan to use fluorescence labeled cholesterol to investigate if Trazodone alters cholesterol uptake within human intestinal cells. This study provides potential evidence on future cardiovascular disease risk assessment for Trazodone as well as other antidepressant drugs.

USING 3D-PRINTED DEVICES TO ELUTE AND CONCENTRATE S. CEREVISIAE DNA

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Difficulty arises in working with large genomic DNA and keeping the DNA strands full length. However, the ability to use large DNA molecules that span genomic variations aids in assembling the variations. Handling large molecules is challenging due to the fragility of the DNA, so a method is needed to prevent the breakage of *S. cerevisiae* DNA during cell lysis and to concentrate the DNA. This was achieved using a 3D-printed device with an agarose insert, a bis-acrylamide roadblock, and an agarose roadblock. *S. cerevisiae* was embedded in an agarose insert to protect the DNA during cell lysis. To get the DNA out of the insert, the agarose insert with *S. cerevisiae* DNA was loaded into the 3D-printed device, and an electric field was applied to elute DNA from the insert and into the solution electrokinetically. A dynamic range of time intervals and voltages were tested. Afterward, the DNA inserts were run on PFGE to determine the amount of DNA that remained in the insert after running it in the 3D-printed device.

VIRTUAL AND EXPERIMENTAL MYCOBACTERIUM TUBERCULOSIS E3 LIPOAMIDE INHIBITOR SCREENING AND MD SIMULATIONS

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Tuberculosis (TB), caused by *Mycobacterium tuberculosis* (Mtb), remains a major global health challenge, with millions of new infections annually. Lipoamide dehydrogenase (E3) is a key enzyme in Mtb metabolism, but it is also a part of an enzyme complex (PNR/P) responsible for reactive nitrogen species neutralization required for evading the host immune system. Therefore, targeting E3 with small-molecule inhibitors is a promising therapeutic approach to kill Mtb. In this study, we performed a virtual screening of 15 million drug-like compounds from the ZINC database using molecular docking to identify potential inhibitors of Mtb E3 that are selective for the Mtb enzyme over the human version. From the initial screen, 62 commercially available compounds were purchased and tested in *in vitro* kinetic assays. While the first round of screening did not show inhibition at the tested concentrations, molecular dynamics (MD) simulations of known Mtb E3 lipoamide site inhibitors were able to test a hypothesis regarding inhibitor/E3 interactions. These simulations showed that subsequent generations of lipoamide site inhibitors interacted more often with Arg-93 than earlier generations, confirming the importance of Arg-93 for more effective inhibition. MD simulations of lipoamide site inhibitor/Arg-93 interactions provide further support for future lipoamide site inhibitor design targeting this interaction.

Friday, April 25, 2025 1:15pm - 4:45pm

CHEMISTRY AFTERNOON SESSION- 1

Chemistry **Chairperson(s): Dr. Matt Beio**

FRIDAY, APRIL 25 **Location: Arbor Suite B**

AFTERNOON SESSION - 1

1:15 Presenters upload talks onto room computer desktop.

1:30 CHARACTERIZATION OF PHARMACEUTICALS BINDING TO POLYSTYRENE NANOPLASTICS USING HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY. Sadia Sharmeen, Md Masudur Rahman, Daniel D. Snow, and David S. Hage

1:45 AFFINITY-BASED CHROMATOGRAPHIC METHOD FOR ANALYZING THE INTERACTIONS OF PHARMACEUTICALS WITH NANOPLASTIC PARTICLES. Md. Masudur Rahman, Sadia Sharmeen, Harshana Olupathage, Daniel D. Snow and David S. Hage

2:00 USE OF ENTRAPMENT-BASED MICROCOLUMNS FOR ANALYSIS OF DRUG-PROTEIN INTERACTIONS BY ULTRAFAST AFFINITY EXTRACTION. Isaac Kyei, Kyungah Suh, Moira Gonzales, Saumen Poddar, David S. Hage

2:15 IDENTIFICATION OF PYRROLE-2-CARBOXYLIC ACID FROM LYSOBACTER INVOLVED IN INTERACTIONS WITH FUSARIAL FUNGI. Vishakha Jayasekera, Yong Han, and Liangcheng Du

2:30 PROGRESS TOWARDS EVALUATING THE FUNCTIONAL SELECTIVITY OF ENDOGENOUS D-AMINO ACID-CONTAINING NEUROPEPTIDES. Alisha Doda, Baba M. Yussif, and James W. Checco

2:45 NOVEL METHODOLOGY FOR THE CHARACTERIZATION OF RIBOSOME HETEROGENEITY BY NATIVE MASS SPECTROMETRY AND TOP-DOWN PROTEOMICS. Sachin Tennakoon and Jared B. Shaw

3:00 AU-PLATED ELECTRODE BIOSENSORS FOR PATHOGEN DETECTION AND GENETIC DIAGNOSTICS. Andrew J. Wegner and Erin M. Gross

3:15 **BREAK-** Presenters upload talks onto the room computer desktop.

3:30 INFLUENCE OF ARENE SIZE AND GEOMETRY IN ANTISEPTIC 1,2,3-TRIAZOLIUM SALTS. Emily M. Hanneken, Kaylen D. Lathrum, and James T. Fletcher

3:45 This presentation can be found in BMS Afternoon Session 1C. STRUCTURAL ANALYSIS OF OAZ RNA FROM *HOMO SAPIENS*. Shawn A. Ramachandran and Juliane Soukup

4:00 SYNTHESIS AND CATALYTIC ACTIVITY OF SCORPIONATE LIGAND METAL COMPLEXES IN ATRA REACTIONS. Isaiah D. Tabbert and Kayode D. Oshin

4:15 CHARACTERIZATION OF IONIC LIQUID METAL-ORGANIC FRAMEWORK COMPOSITE MATERIALS. Emma J. Fredstrom and Angela M. Devlin

4:30 ANTISEPTIC SALTS FROM ISOQUINOLINE- SUBSTITUTED 1,2,3-TRIAZOLES. Kaylen D. Lathrum, Emily M. Hanneken, and James T. Fletcher

CHARACTERIZATION OF PHARMACEUTICALS BINDING TO POLYSTYRENE NANOPLASTICS USING HIGH-PERFORMANCE AFFINITY CHROMATOGRAPHY

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Nanoplastics that have been found in water and the environment include polystyrene, polyethylene, polypropylene, polyvinyl chloride, and polyethylene terephthalate. These particles are found in various shapes and sizes (e.g., 1-100 nm) and with surfaces that range from hydrophobic to polar in nature, depending on the underlying polymer. The emergence of pharmaceuticals such as antibiotics or other classes of drugs in the environment has important toxicological and ecological implications for the health of our communities and our ecosystems. Many antibiotics and other pharmaceuticals have already been shown to bind reversibly to the surfaces of nanoplastics, which may be an important factor in determining the bioavailability and effects of these micropollutants in the environment. In this study, high-performance affinity chromatography (HPAC) and microcolumns containing physically-entrapped polystyrene nanoplastic particles are used to examine the strength of the binding by several pharmaceuticals known to bind to such particles. Characterization of the nanoplastic-containing support is carried out by means of thermogravimetric analysis and Fourier transform infrared spectroscopy. This work illustrates how HPAC can be used as an analytical tool for screening and characterizing the interactions of drugs and human-made contaminants with polystyrene nanoplastics or related binding agents found in water and the environment.

This work was supported, in part, by the National Science Foundation under grants CHE 2404209, and CHE 2320239.

AFFINITY-BASED CHROMATOGRAPHIC METHOD FOR ANALYZING THE INTERACTIONS OF PHARMACEUTICALS WITH NANOPLASTIC PARTICLES

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The growing prevalence of pharmaceuticals as micropollutants in the environment and their possible reversible interactions with agents such as nanoplastics, biomolecules, and other bioactive contaminants have led to the development of new techniques for analyzing such binding. In this study, polystyrene nanoplastic particles with a diameter of 60 nm were physically entrapped into a porous silica support and packed into 2.0 cm long and 2.1 mm inner diameter microcolumns for use in binding studies by high-performance affinity chromatography. The drugs that were examined were propranolol and carbamazepine, which frequently occur as contaminants in water and are known to interact with polystyrene. Thermogravimetric analysis was used to determine the amount of entrapped polystyrene particles. The binding seen by the model drugs on the microcolumns containing entrapped polystyrene was evaluated, with propranolol showing the highest retention. This method made it possible to quickly determine the equilibrium constants for the model drugs in binding to the entrapped polystyrene. This approach can be applied to extended to additional binding agents, such as other forms of nanoplastics, and to other micropollutants to study the interactions of these chemicals and materials in the environment.

USE OF ENTRAPMENT-BASED MICROCOLUMNS FOR ANALYSIS OF DRUG-PROTEIN INTERACTIONS BY ULTRAFAST AFFINITY EXTRACTION

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Drug-protein interactions are important in determining the pharmacological and toxicological properties of many drugs because they often affect drug metabolism, absorption, distribution, and excretion. These factors, in turn, affect the biologically-active form of the drug in the circulation (i.e., the free fraction) and alter the effective dosage of the drug. Common methods for studying drug-protein interactions include various spectroscopic methods and separation-based techniques such as capillary electrophoresis, ultrafiltration, equilibrium dialysis, and liquid chromatography. A recent liquid chromatographic approach that has been developed to study drug-protein interactions is ultrafast affinity extraction (UAE). UAE uses biological agents immobilized on solid supports such as silica particles to extract and analyze an analyte in milliseconds. In UAE, the retention of an applied solute is based on the specific reversible interactions that occur in biological systems such as drug-protein binding, antibody-antigen binding, or enzyme-substrate binding. Although covalent coupling methods are commonly used to immobilize a binding agent onto a solid for UAE, this method is prone to improper orientation, blockage of binding sites, and multisite attachment of the immobilized agent. These factors, which lead to decrease in activity of the immobilized ligand, can be minimized or eliminated by using a non-covalent immobilization method known as entrapment. This work demonstrates the use of entrapment to immobilize affinity ligands for use with UAE to study drug-protein interactions. The binding constants and rate constants determined by this method were in good agreement with those determined by other methods.

IDENTIFICATION OF PYRROLE-2-CARBOXYLIC ACID FROM LYSOBACTER INVOLVED IN INTERACTIONS WITH FUSARIAL FUNGI

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The Gram-negative bacteria *Lysobacter* are prolific producers of antibiotic products, making them an emerging group of biocontrol agents, especially for agricultural pathogens. As a part of the soil microbiome, *Lysobacter* species co-exist with a variety of organisms in the ecosystem, such as fungi, nematodes, and other bacteria. *Lysobacter* are known for their predatory behavior, which is linked to their production of lytic and several other extracellular enzymes. Despite their potential, little is known about the molecular mechanisms underlying the interactions between *Lysobacter* and other organisms. Therefore, here we studied the interactions between *Lysobacter* sp. 3655 and two economically important fungal pathogens, *Fusarium graminearum* and *Fusarium verticillioides*. A co-culture technique employing a dialysis tubing membrane was implemented to physically separate the two organisms.
We discovered a *Lysobacter* metabolite that is dramatically suppressed when co-cultured with fungi, and the structure of this molecule was determined to be pyrrole-2-carboxylic acid (P2C). We found that chitin, the *N*-acetylglucosamine polymer that makes up the fungal cell walls, also significantly reduced P2C production in *Lysobacter*. Further evidence indicated that P2C was converted into proline, a well-known stress modulator that enables the producing organisms to tolerate stress (e.g., fungi and chitin as biotic and abiotic stress factors for *Lysobacter*) and activate self-regulatory mechanisms. When exogenously added to bacterial cultures, P2C inhibited bacterial growth only in a specific concentration range, implying that P2C could function as a signaling molecule. This was supported by P2C's effect on the production of another group of natural products, heat-stable antifungal factor (HSAF) and analogs in *Lysobacter enzymogenes* OH11, in which P2C clearly suppressed the antifungal compounds. This is an indication of

P2C acting as a negative regulatory molecule.
Together, the results unveil P2C as a new signal involved in the crosstalk between the environmental bacteria *Lysobacter* and the surrounding fungal species.

Funding: Nebraska Research Initiative (NRI) & Nebraska Center for Integrated Biomolecular Communication (NCIBC)

PROGRESS TOWARDS EVALUATING THE FUNCTIONAL SELECTIVITY OF ENDOGENOUS D-AMINO ACID-CONTAINING NEUROPEPTIDES

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One of the understudied post-translational modifications that neuropeptides undergo is the conversion of L-amino acid residue to its corresponding D-amino acid residue. D-amino acid-containing peptides (DAACPs) have been shown to play significant biological roles, though these functions remain underexplored due to the lack of identified receptors for DAACPs. Currently, only two receptor classes for DAACPs are known: the achatin receptor, found in both *Aplysia californica* and *Platynereis dumerilli*, and two allatotropin-related peptide (ATRP) receptors (*ap*ATRPR1 and *ap* ATRPR2) in *Aplysia californica*. Only the D-amino acid-containing analog of achatin activates the achatin receptor in both *Aplysia* and *Platynereis*, while both the all-L-analog of ATRP (all-L-ATRP) and its corresponding D-amino acid-containing analog (D2-ATRP) activate the *Aplysia* ATRP receptors. We hypothesize that one diastereomer may differentially activate intracellular signaling pathways relative to all L-ATRP. In IP1 and cAMP assays performed with transiently transfected CHO-K1 cells, all-L-ATRP is a more potent activator of *ap*ATRPR1, whereas D2-ATRP activates *ap*ATRPR2 more effectively. However, *ap*ATRPR2 is more sensitive to D2-ATRP when signaling through $G_{?s}$ pathway as compared to $G_{?q}$ pathway. Similarly, *ap*ATRPR1 is more sensitive for all-L-ATRP when signaling through $G_{?s}$ pathway as compared to $G_{?q}$ pathway. These results suggest that the isomerization of L-amino acid residue to D-amino acid residue leads to preferential activation of one signaling pathway over another. To further investigate this hypothesis, we are conducting IP1, cAMP, ?-arrestin, and pERK assays for both *ap*ATRPR1 and *ap* ATRPR2. Ligand bias will be assessed by calculating the bias factors using an operational model of agonism. This research will help us better understand the role of L- to D-residue isomerization in cellular signaling. Moreover, the presence of DAACPs across phyla suggests that cellular signaling involving DAACPs is not restricted to *Aplysia* or *Platynereis* and the knowledge of functional selectivity could be relevant to other systems.

NOVEL METHODOLOGY FOR THE CHARACTERIZATION OF RIBOSOME HETEROGENEITY BY NATIVE MASS SPECTROMETRY AND TOP-DOWN PROTEOMICS

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Abstract:
Ribosomes are heterogeneous molecular machines essential for protein synthesis and have been studied for decades. However, there is a significant gap in understanding how structural and compositional heterogeneity modulates ribosomal function under varying biological conditions. Native mass Spectrometry in combination with top-down is uniquely capable of addressing this question with high specificity. Here, we compare ribosomal protein proteoform IDs and relative abundances determined by complex-up with top-down analysis data of *E. coli* ribosomal proteins. Complex-up falling under the wings of native mass Spectrometry, was performed using a Q Exactive UHMR Orbitrap (Thermo Scientific) modified with a 30W CO_2 laser to enable Infra-red multi photon dissociation (IRMPD). The 10.6 ?m IR laser photons enable the characterization of ribosomal proteins via selective dissociation of rRNA in the ribosomes. This method provides invaluable intact mass information related to proteoforms, yet top-down gives a more in-depth analysis as to the pinpoint locations of post translational modifications (PTMs), isobars and truncations, which are otherwise harder to identify through intact mass data alone. The preliminary results obtained show us harmony between the two approaches, hinting at the agreement between the synergetic of proteomics with native mass Spectrometry. So far, all our studies have been performed using commercially available Ribosomes, thereby, the next step will be to grow *E. coli* in the lab, extract ribosomes to reproduce the above key findings, which can reassure the capacity of complex-up approach.

Key words:
Heterogeneity, Complex-up, Top-down, Native mass Spectrometry, IRMPD, PTMs

AU-PLATED ELECTRODE BIOSENSORS FOR PATHOGEN DETECTION AND GENETIC DIAGNOSTICS.

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AU-Plated Electrode Biosensors for Pathogen Detection and Genetic Diagnostics

Folding-based nucleic acid electrochemical biosensors offer an inexpensive and fast method for clinical measurements, pathogenic identification, and disease diagnostics. Previous research in our lab fabricated electrochemiluminescent (ECL) nucleic acid biosensors using commercial gold electrodes. This method allows for fast detection, but the gold surfaces require extensive cleaning before modification. To solve this, in situ chip based ECL biosensors can be fabricated with a fresh, easily modifiable gold layer deposited over carbon. The surface can be modified with an alkane thiol and a fluorescently tagged aptamer, allowing for biosensor specificity.

Gold deposition efficiency was characterized via surface roughness. Roughness values of 3.8-4.2 are considered ideal because gold deposition quality and quantity are fit for biosensing applications. Gold must cover the entire electrode surface, and nanostructures must preferentially form buds (spherical nanostructures) over dendrites (flora like nanostructures). Various chronoamperometry deposition potentials, step numbers, and pulse widths were tested to find optimal conditions for plating. The chronoamperometry method developed is shown in table 1. The surfaces of plated electrodes using this method were qualitatively assessed via SEM as shown in figure 1. Drop-casting techniques are currently being investigated to find optimal conditions for gold surface modification.

Table 1: Chronoamperometry Method for Gold Deposition

Parameter	Value
Initial Potential	-0.50 V
High Potential	0.00 V
Low Potential	-0.50 V
Initial Step Polarity	Positive
Number of Steps	6
Pulse Width	10 s
Sample Interval	1.0 s
Quiet Time	2.0 s
Sensitivity	1 e-003 A/V

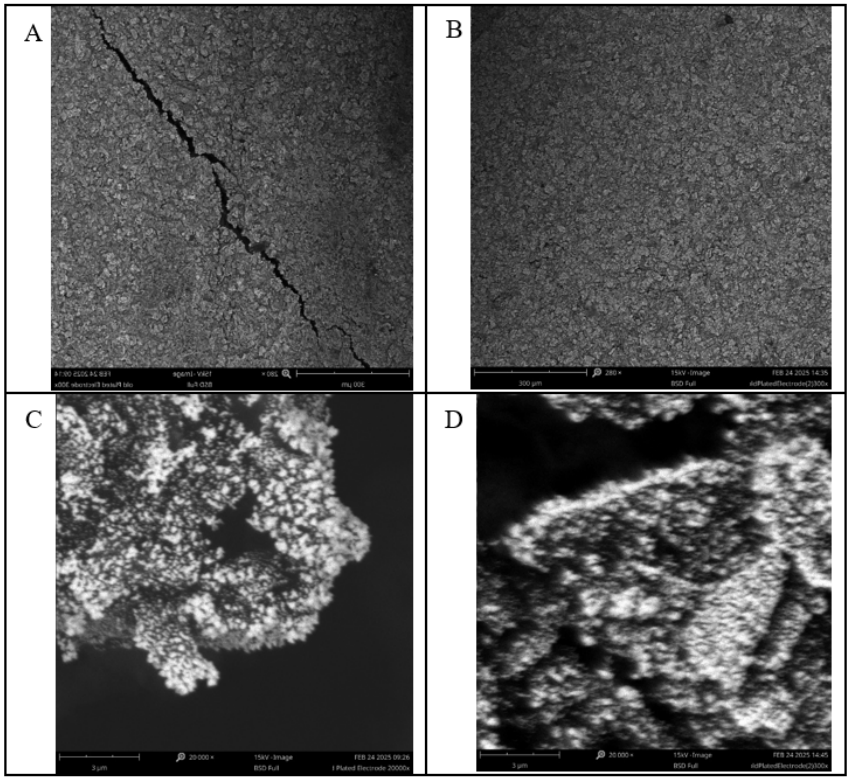

Figure 1: 280x & 20,000x Magnification Scanning Electron Microscope Images. Sub-figures (a) and (b) demonstrate uniform deposition of gold across electrode surface. Sub-figures (c) and (d) show buds as the dominant nanostructure formed.

INFLUENCE OF ARENE SIZE AND GEOMETRY IN ANTISEPTIC 1,2,3-TRIAZOLIUM SALTS

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Quaternary ammonium compounds (QACs) are a class of chemicals that can display antiseptic properties due to their combination of hydrophobicity and cationic nature. Found in many commercial disinfectants, QACs can destabilize cell membranes and lead to fatal cell leakage. Previous research has shown that trisubstituted-1,2,3,-triazolium salts display antiseptic properties that vary with their substituents. The goal of this study was to examine how varying the aryl substituent ring size and overall geometry of 1,5-diaryl-1,2,3-triazolium salts impacted antiseptic properties. Target triazolium salt compounds were synthesized using a base-catalyzed click chemistry approach between azides formed from Sandmeyer synthesis (azidobenzene, 4-*tert*-butylazidobenzene, 2-bromoazidobenzene and 2-bromo-4-*tert*-butylazidobenzene) and alkynes formed from Sonogashira coupling (ethynylbenzene, 1-ethynylnaphthalene and 9-ethynylphenanthrene) to make 1,5-diaryl-1,2,3-triazoles. To determine how an overall planar geometry might impact antiseptic behavior, fused ring analogs were made from triazole-bridged 1,5-diaryl precursors possessing 2-bromophenyl reactive groups using a Pd-catalyzed annulation reaction. Triazolium salts of both bridged and fused ring analogs with variable phenyl, naphthyl and phenanthryl subunits were prepared by alkylation at the N3-position, including both benzyl and photolabile groups. Following validation of each target molecule by HNMR and HRMS characterization, antiseptic testing was done using minimum inhibitory concentration (MIC) assays against Gram-positive bacteria (*S. epidermidis* and *B. subtilis*), Gram-negative bacteria (*E. coli* and *K. aerogenes*), and yeast (*C. albicans* and *S. cerevisiae*). Antiseptic properties were observed to vary with both arene size and geometry. Antiseptic salts with photolabile groups were successfully deactivated by exposure to UV light. This presentation will describe the synthesis of bridged and fused-ring 1,2,3-triazolium salts, as well as the structure-activity relationships of their antiseptic properties and photodeactivation.

SYNTHESIS AND CATALYTIC ACTIVITY OF SCORPIONATE LIGAND METAL COMPLEXES IN ATRA REACTIONS

Author
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Dr. Kayode Oshin

Atom Transfer Radical Addition (ATRA) reactions have emerged as a valuable synthetic methodology, instrumental in the formation of new carbon-carbon bonds and cardinal reagents. Tris-(2-pyridylmethyl) amine (TPMA) has represented one of the prominent ligands utilized in the formation of complexes for ATRA; however, its configuration poses structural hindrances that reduce its functionality. This research project endeavored to construct novel ligand motifs conducive to the production of improved complexes for ATRA reactions, while alleviating the structural impediments existing in TPMA. We hypothesized that eradicating one of the ligand arms in the tripodal TPMA structure could expose a greater portion of the active site of complexes formed with this ligand. To achieve this objective, we intend to open the coordination site of the ligand through the exchange of one of its aromatic rings with an aliphatic straight chain, expecting an increase in potency as a result. This experiment involved the synthesis of two ligands, ISOBPMEN-3C and L1OH-2C, followed by their subsequent complexation with FeBr3 and CuBr2 salts. Catalysis results revealed that complexes fabricated with our proposed ligands elicited higher ATRA yields for certain reactions compared to complexes made with TPMA. Our study has shown the potential for enhancing ATRA reactions with our ligand design, which could serve as a pivotal precursor in a wide range of future addition transformations.

CHARACTERIZATION OF IONIC LIQUID METAL-ORGANIC FRAMEWORK COMPOSITE MATERIALS

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Co-Author
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Metal-organic frameworks (MOFs) are porous materials that have the promise of forming composite materials that exhibit unique properties when loaded with a "guest" molecule. In this study, we prepare a composite material of an ionic liquid (IL), 1-butyl-3-methylimidizolium bromide ([bmim]Br), melt loaded into a Zr-MOF (UiO-66), with the aim of elucidating IL–MOF interactions. PXRD analysis confirmed that the ionic liquid was successfully melt loaded into UiO-66 without compromising its crystallinity. Composites of 24%, 35%, and 40% by mass of IL–MOF were prepared. Peak shifts were observed in Raman spectra for the composites compared to UiO-66; most notably, we observe that the magnitude of C–C peak shift dependent on the mass fraction of IL in the composite, indicating IL interactions with the UiO-66 linker.
Thermal analysis was employed to determine the maximum loading of [bmim]Br in UiO-66. Electrical conductivity of the three composites was measured to be 3.06×10^{-6} S/cm, 2.50×10^{-6} S/cm, and 3.19×10^{-5} S/cm for 24%, 35%, and 40% by mass of IL respectively, each of which demonstrated a conductivity enhancement from the MOF alone. These findings demonstrate that melt loading of IL into UiO-66 could be an effective strategy for conductivity enhancement of Zr-MOFs, which are otherwise insulating materials.

Funding: Creighton University College of Science Startup Funds and NASA Nebraska EPSCoR Research Infrastructure Development (RID) Federal Award #80NSSC22M0048)

ANTISEPTIC SALTS FROM ISOQUINOLINE- SUBSTITUTED 1,2,3-TRIAZOLES

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Trisubstituted-1,2,3-triazolium salts are a recently developed class of quaternary ammonium compound (QAC) antiseptics. The potency of such compounds can be altered by variation of subunit identity. This study prepared QACs from C5-isoquinoline substituted triazoles and determined the effect of heterocyclic N position on toxicity. This included a comparison of bridged and fused-ring analogs in order to evaluate DNA intercalation as a potential new antiseptic mode of action to complement the typical cell membrane disruption mechanism of activity. Base-catalyzed click reactions between a variety of alkynes and azides were used to prepare the “bridged” 1,5-diaryl-1,2,3-triazoles from azide and alkyne precursors, combining 4-, 5-, and 8-ethynylisoquinoline reactants prepared by Sonogashira coupling with azidobenzene and 2-bromoazidobenzene prepared by Sandmeyer reaction. Following click synthesis, brominated analogs allowed for the triazole compound to undergo a Pd-catalyzed annulation reaction, creating a “fused-ring” analog. N-benzylation occurred preferentially at the isoquinoline nitrogen, resulting in +1 salts. For some analogs it was possible to create +2 salts by additional N-benzylation at the N3-triazole position using excess benzyl bromide. Generally, the bridged analogs were more successful in the additional N-benzylation, as steric and electronic effects in the larger aromatic system of the fused-ring analogs disfavored the addition of more positive charge on the molecule. Target compounds were characterized by HNMR and HRMS. Minimum inhibitory concentration assays were performed to test antiseptic toxicity and microorganism specificity. In general, these triazolium salts were strongly active against Gram-positive bacteria, variably active against yeast, but not strongly active against Gram-negative bacteria. Details regarding the synthesis, characterization and antiseptic evaluation of these compounds will be presented.

Friday, April 25, 2025 1:30pm - 2:45pm

EARTH SCIENCES AFTERNOON SESSION- 1A

Chairperson: Harmon Maher Jr.

Earth Sciences: Geology and Paleontology in Nebraska

FRIDAY, APRIL 25 **Session Chair: Harmon Maher**

AFTERNOON SESSION – 1A **Location: Prairie Suite B**

1:15 Presenters upload afternoon sessions talks onto room computer desktop.

1:30 PXRF OF THE JADE COLLECTION. Brady McDaniel

1:45 STABLE ISOTOPE PALEOECOLOGY IN THE BRIDGERIAN (MIDDLE EOCENE) INVESTIGATION OF THE CANOPY EFFECT AND BRIDGERIAN CRASH. Aaron English and Ross Secord

2:00 STABLE CARBON AND STRONTIUM ISOTOPE PALEOECOLOGY OF WOOLLY AND COLUMBIAN MAMMOTHS IN THE CENTRAL GREAT PLAINS, U.S.A. Jacob McCloskey and Ross Secord

2:15 OSL DATING AND LOESS STRATIGRAPHY INDICATE NEBRASKA'S RAINWATER BASINS FORMED DURING THE LATE PLEISTOCENE. Paul R. Hanson and Matt R. Joeckel

2:30 A MICRO-FRACTURE FLUID FLOW NETWORK IN THE SIOUX QUARTZITE. Harmon Maher Jr.

2:45 **BREAK**

A MICRO-FRACTURE FLUID FLOW NETWORK IN THE SIOUX QUARTZITE

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University of Nebraska at Omaha

Post-depositional features seen in thin sections from Precambrian Sioux Quartzite exposures at Arrow Park, Dell Rapids, Devils Gulch and Blue Mounds include: pore cement, pressure-solved detrital grain contacts, secondary fluid inclusion planes (FIPs), quartz deformation lamellae, microveins, and a ubiquitous mesh of phyllosilicate seams (PS). Pyrophyllite, sericite and chlorite indicate very low-grade metamorphic conditions were attained. Well preserved detrital textures and a lack of post-depositional undulose extinction and/or recrystallization indicates that penetrative deformation by intracrystalline processes is absent, consistent with the stratal sub-horizontal orientation. Abundant pressure solution at detrital grain contacts is interpreted to have occurred during burial and lithification, with attendant quartz cementation in pores. The quartz pore cement is usually in optical continuity with the adjacent grains. Both pressure solution and cementation during diagenesis removed any open pore space, at which time intergrain permeability was minimal. Post-depositional FIPs have a rich array of morphologies that include: a) longer ones that transgress several grains, b) short ones within grains and pore cement, c) arrays that are attached to grain boundaries and which tip-out into pore cement and/or detrital grains, d) distinct clusters, e) and both T and X junctions. Two or more vertical and a bedding-parallel preferred orientations are typical in individual samples. FIPs and microveins are typically sub-parallel and FIPs occur within and clustered adjacent to the microveins. Microveins are composed of mixes of chalcedony, quartz, phyllosilicates and opaques. Outcrop scale veins are scarce and ~1 to several mms thick. The PS form a through-going and \irregular network that follows pressure-solved detrital grain

contacts, contacts between detrital grains and quartz pore cement, and contacts between quartz grains within the pore cement. They connect to a dense tangle of seams within larger pore cores. At ~5 microns thick the seams are easy to overlook. Some of the microveins cut through and postdate PS seams. An observed dense array of FIPs that linked two PS tips are suggestive of a fluid flow relay zone between the two. FIP clusters that truncate against PS are also consistent with a connection. A model is proposed where FIPs, microveins and PS all formed a pervasive self-healing fluid-flow network likely during late stage unloading from low-grade metamorphic depths. The amount and distance of fluid flow is uncertain but could have been considerable and associated with the Baraboo-Picarus orogen to the south.

OSL DATING AND LOESS STRATIGRAPHY INDICATE NEBRASKA'S RAINWATER BASINS FORMED DURING THE LATE PLEISTOCENE

Author
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University of Nebraska-Lincoln

Co-Author
Matt Joeckel
University of Nebraska-Lincoln

Rainwater Basins are shallow, commonly oval shaped playas that are preferentially oriented northeast-southwest in south-central Nebraska. Most of these depressions have a lunette along their southeastern edges that lies approximately 8 to 12 m above the adjacent playa floor. Stratigraphic relationships from boreholes indicate that the playas were eroded into Late Pleistocene alluvial deposits and that they are covered by varying thicknesses of late Quaternary loess. We collected 21 cores from six lunettes and dated them using optically-stimulated luminescence (OSL) dating. Sand dominated sediments within the lunettes yielded ages ranging from 21 to 51 ka with most dating between 25 and 38 ka. Our findings further support previous works that attribute Rainwater Basin formation to eolian deflation and indicate that the playas formed prior to Peoria Loess deposition in the late Pleistocene.

PXRF OF THE JADE COLLECTION

Author
Brady McDaniel
Chadron State College

Chadron State College has a wonderful geoscience program and an impressive collection of rocks, minerals, and fossils. Initially my plan was to run a pXRF analysis of the ore collection owned by CSC, but due to the move into the new Center Of Innovative Learning (COIL), those were much harder to access than a more recent jade collection. My project was then altered for me to collect pXRF data on the jade collection instead and analyze that. In this collection there are twelve different pieces of jade that are all unique in their own ways and exhibit a variety of different properties. At this current point in time all of the collection has had the pXRF run on them and the data has been collected and downloaded. Beginning next semester the data will be analyzed and the jades can be classified to be put on display in CSC’s Eleanor Barbour Cook Museum of Geology.

STABLE CARBON AND STRONTIUM ISOTOPE PALEOECOLOGY OF WOOLLY AND COLUMBIAN MAMMOTHS IN THE CENTRAL GREAT PLAINS, U.S.A.

Author
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Co-Author

Ross Secord
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The geographic distribution of mammoth species and knowledge of their habitats is important for understanding mammoth ecology in late Pleistocene ecosystems. Stable carbon isotopes ($?^{13}C$) preserved in herbivore tooth enamel reflect the animal's diet, dependent on the type and amount of C_3 (e.g. trees, shrubs, most grasses) and C_4 vegetation (e.g. warm-season grasses) consumed. Strontium isotope ratios ($^{87}Sr/^{86}Sr$) in tooth enamel reflects the geology of an animal's foraging area, providing insights into past migratory patterns. During the late Pleistocene, the central Great Plains was a transition zone between dry tundra-steppe environments adjacent to the Laurentide Ice Sheet (LIS) and wooded parkland habitats to the south. Fossil and DNA evidence indicate woolly (*Mammuthus primigenius*) and Columbian (*Mammuthus columbi*) mammoths coexisted in the region. To date, few isotopic studies have been conducted on mammoths in this area, and none make direct isotopic comparisons between coexisting woolly and Columbian mammoths.

Here, we measure enamel $?^{13}C$ and $^{87}Sr/^{86}Sr$ values in isolated mammoth molars from Nebraska and western Iowa/Missouri to test for differences in time-averaged diet and migration distances between locations and species. We hypothesize that mammoths in Iowa and Missouri preferred water-stressed C_3 vegetation near the Des Moines Lobe of the LIS, resulting in relatively higher $?^{13}C$ values within the strict C_3 diet range ($?^{13}C < -8‰$). We hypothesize that warm-adapted Columbian mammoths yield more variable $^{87}Sr/^{86}Sr$ values due to seasonal southward migrations outside of Nebraska. We find similar $?^{13}C$ values in the C_3 range across locations and species, suggesting no distinct dietary preferences during cold stadial periods. Most individuals with $?^{13}C$ values indicating a mixed C_3/C_4 diet ($?^{13}C > -8‰$) were Columbian mammoths, suggesting the species was more prevalent during warm interstadials or preferred C_4 grasses when available. All individuals had $^{87}Sr/^{86}Sr$ values consistent with local residency, except for one Nebraska woolly mammoth whose elevated ratios suggest periodic long-distance migrations (>500 km) beyond the region. Our study shows that woolly and Columbian mammoths displayed high ecological versatility in a transitional habitat.

Grant Information: Partial funding was provided by the grants (XX) to McCloskey (NGS/AAPG Yatkola Edwards), and Secord (NSF EAR 2124939)

STABLE ISOTOPE PALEOECOLOGY IN THE BRIDGERIAN (MIDDLE EOCENE) INVESTIGATION OF THE CANOPY EFFECT AND BRIDGERIAN CRASH

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Co-Author
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University of Nebraska - Lincoln, UNSM

The Bridgerian North American Land Mammal Age (50.3 to 46.4 Ma) has garnered much paleontological study; fossils from Wyoming's Bridger Basin have been collected for over a century and are now housed in most major natural history museum collections. Despite this wealth of specimens, however, many questions about Bridgerian paleoecology remain unanswered. The Bridgerian was a period of climatic transition, marking the shift from the hothouse conditions of the Early Eocene Climatic Optimum (EECO) to a cooler global climate. This climate shift coincided with a significant change in mammalian faunal assemblages. The diverse communities of the early Bridgerian gave way to ecosystems with reduced biodiversity. This transition was marked by an increase in species extinctions, while the rate of new species origination remained steady—an event known as the 'Bridgerian Crash.' Stable isotope analysis provides valuable insight into paleoecology, yet until this study has not been applied to fossils from the Bridger Basin. By measuring stable isotopes from mammalian enamel of the first three Bridgerian biochrons (Br1a, Br1b, Br2), we provide evidence of changing ecology. Forests covered the basin in the middle Eocene, but their structure has until now been unclear. The earliest depictions of the basin showed it as a dense, closed canopy

forest akin to the modern Amazon. There is a distinct stable carbon ($d^{13}C$) isotopic signature in modern closed canopy forests (and mammals that eat these plants): the understory has extremely negative values, with a positive trend rising in the canopy. This $d^{13}C$ signature is absent in open canopy forests. In sampling a collection of herbivorous fossil mammal taxa from the Bridgerian, we have tested whether a closed forest was present. Additionally, we have measured the stable oxygen ($d^{18}O$) isotopes that, combined with $d^{13}C$ measurements, provide novel data on mammalian niche partitioning in the Bridgerian. Developing a greater understanding of Earth's ecology during periods of extreme climate is paramount to addressing how future environments will function under anthropogenic climate change.

Friday, April 25, 2025 1:30pm - 3:15pm

ECOLOGY, SUSTAINABILITY, AND ENVIRONMENTAL SCIENCE AFTERNOON SESSION- 1

Chairperson: Mark Hammer

Ecology, Sustainability and Environmental Science **Chairperson: Mark Hammer**

FRIDAY, APRIL 25 **Location: Prairie Suite A**

AFTERNOON SESSION - 1

1:30 Presenters upload Session 3 & 4 talks from USB drives onto room computer desktop

1:40 ZOOM Session is open for participants to join https://wsc.zoom.us/j/93393162988

1:45 ENVIRONMENTAL MONITORING FOR TRIBAL NATIONS, Rosalind Grant and Martha Durr

2:00 HIGH-RESOLUTION CLIMATE SIMULATIONS OVER HIGH-MOUNTAIN ASIA: FOCUS ON THE CENTRAL HIMALYAYA AND KARAKORAM. Tika Gurung, Liang Chen, and Syed Hammad Ali

2:15 POLLEN AND POST-POLLINATION DEVELOPMENT IN *STUCKENIA PECTINATA* (SAGO PONDWEED). Mackenzie L. Taylor, Christie Dang, and Adam Wilson

2:30 THE EXTENT OF DEFOLIATION IN NATIVE AND NON-NATIVE GRASSES TO TRIGGER A RESPONSE MECHANISM. Jordan Carfield and Jayne Jonas

2:45 WILDFIRE BENEFITS NATIVE PLANTS IN GRAZED SEMI-ARID GRASSLANDS. Megan TenBensel, Bryan Drew, and Jayne Jonas

3:00 SMALL MAMMAL AND BIRD DIVERSITY IN A RECENTLY SEEDED VS. ESTABLISHED URBAN PRAIRIE. Anna DeGroot, Laura Bettenhausen, and Mark Hammer

3:15 **BREAK**

3:45-4:45pm POSTER SESSION

ESES-1 SMALL MAMMAL AND BIRD DIVERSITY IN A RECENTLY SEEDED VS. ESTABLISHED URBAN PRAIRIE. Anna DeGroot, Laura Bettenhausen, and Mark Hammer

ENVIRONMENTAL MONITORING FOR TRIBAL NATIONS

Author

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Nebraska Indian Community College

As temperatures rise, extreme weather phenomena happen more frequently due to climate change. Tribal Nations are most vulnerable to the dramatic effects. This is where environmental monitoring becomes crucial. The goal of my research project is to utilize the data from installed weather stations on Tribal Lands. The weather stations that have been implemented may observe air temperature, humidity, precipitation, wind, sunlight, soil temperature, and soil moisture. The data collected can support awareness and help Tribal Nations protect their people, lands, and cultural resources, as well as aiding in recovery and funding capacity. This project began with three interviews to build relationships and secure approval from previously elected Omaha Tribal officials, an Omaha elder, and current Omaha Tribal employees who work in the environmental department. Two meetings with non-tribal environmental programs (Platte Basin Timelapse and the National Weather Service) were arranged to gain insight on how to present the data to the public (Tribal communities). One last interview was set up with a neighboring Tribal Nation's program (the Ioway Tribe Pathways Project) to understand how their climate change adaptation plan was implemented and continued. While these conversations were just being started for the Omaha Tribe of Nebraska, the Isanti Tribe of Nebraska has already given their approval for environmental monitoring equipment to be installed on their Tribal Lands. For two years, the data collected from the weather station located on the Isanti Lands is being distributed through weather summaries that highlight current and emerging environmental impacts. This project is a part of a long-term effort to monitor the environment in a culturally appropriate way and provide outreach to the community about environmental hazards.

HIGH-RESOULTION CLIMATE SIMULATIONS OVER HIGH-MOUNTAIN ASIA: FOCUS ON THE CENTRAL HIMALAYA AND KARAKORAM

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High Mountain Asia (HMA) region, often referred as the Third Pole, plays a crucial role in the global water cycle as it contains the largest reserves of freshwater outside polar regions, providing water supplies to the millions of people downstream. Accurate modeling of hydroclimatic dynamics in HMA is crucial at higher elevations as it regulates these pristine water resources, where orographic gradients and peculiar climate system create substantial variations in precipitation and temperature. Data from lower elevations may not accurately reflect the unique climatic conditions above 3000 m elevation as there is limited observational data at these high altitudes, and the region's steep terrain requires finer spatial resolution to effectively represent hydroclimatic variables. This study presents the high-resolution simulations of high-altitude hydroclimatic conditions using the Weather Research and Forecasting (WRF) model forced with the ERA5 reanalysis data at a horizontal grid spacing of 12 km and 4 km, spanning two hydrological years from October 2016 to September 2018. The simulations are evaluated using data collected from observed stations above 3000 m elevation and available gridded products (CHIRPS, CMORPH, ERA5L). The analysis focuses on precipitation and temperature variations across annual to daily scales in the Central Himalaya and Karakoram regions, known for their contrasting glacial environments. The model reasonably captures temperature and precipitation's spatial and temporal variability, focusing on monsoon and winter periods for the Central Himalaya and Karakoram, respectively. In general, WRF outperforms ERA5L, providing more realistic spatial patterns. Inter-comparison of precipitation gridded products and WRF outputs show inconsistencies with over-and-underestimation depending on the reference dataset. Performance metrics (R^2 and RMSE) indicate station-specific variations in WRF

and ERA5L. Overall, probability density function and quantile comparison of daily precipitation and temperature demonstrate WRF outputs align better with in-situ data than ERA5L. Therefore, integrating multiple data sources using advanced statistics is critical to accurately assess the model's output for regional complexities.

POLLEN AND POSTPOLLINATION DEVELOPMENT IN STUCKENIA PECTINATA (SAGO PONDWEED)

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Hydrophily is a rare pollination mechanism in which pollen is transported via the water surface or underwater currents. Hydrophily is associated with certain pollen and flower traits that affect pollen dispersal, reception, and post-pollination processes. Despite the interconnectedness of pollination and post-pollination processes, reproductive traits have been comprehensively studied in only a few hydrophilous species. The goal of this study was to characterize reproductive development in the hydrophilous monocot, *Stuckenia pectinata* (Potamogetonaceae). *Stuckenia pectinata* inflorescences were collected in eastern Nebraska. The number and germination status of pollen grains on carpels was documented to determine the timing of pollen reception and onset of stigma receptivity, as well as pollen load size. Pollen to ovule ratio and fruit set were also documented and additional flower buds were prepared for analysis of pollen development using combined light, scanning electron, and transmission electron microscopy. Plants with immature inflorescences were collected and maintained in individual aquaria until stigmas were receptive. Flowers were hand pollinated and collected at various time points after pollination. The germination status of pollen grains on stigmas was determined and the length of the longest pollen tube per carpel was measured to document timing of post-pollination development. The pollen tube pathway was characterized. *Stuckenia* pollen grains share many developmental characters with closely related monocots and exhibit traits that likely facilitate hydrophily. Stigmas were receptive prior to anther dehiscence and pollen reception and germination were high. Stigmas remained receptive following anther dehiscence, allowing self-pollination. Pollen germinated rapidly and pollen tube growth rates were high. Results from this study will be compared with what is known from other hydrophilous species to better understand reproductive processes in these plants. The potential consequences of the transition to hydrophily for post-pollination processes will be discussed.

THE EXTENT OF DEFOLIATION IN NATIVE AND NON-NATIVE GRASSES TO TRIGGER A RESPONSE MECHANISM

Author
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Co-Author
Jayne Jonas

Defoliation can trigger significant responses in plants. We asked two questions in our research project: what extent of defoliation must happen for a significant grass response to occur? and does grass response differ between smooth brome (non-native invasive) and four native grass species used in grassland restoration? We used one cool season

non-native invasive: smooth brome, *Bromus inermis*. Two cool season grass natives were also used: Canada wildrye, *Elymus canadenisis* and western wheatgrass, *Pascopyrum smithii*. The warm season grass natives used include big bluestem, *Andropogon gerardii* and Indian grass, *Sorghastrum nutans*. We subjected 12 individuals of each of the five grass species to one of four levels of defoliation (0% defoliation, 25% defoliation, 50% defoliation, or 75% defoliation). There were also 12 plants of each species to serve as a baseline for determining the amount of leaf area to remove for each defoliation treatment. After allowing 3-4 weeks for plants to regrow, we will determine the leaf area and biomass of each grass individual. We will present our preliminary results and discuss whether our findings suggest a threshold level of herbivory at which grass growth switches from being able to compensate for loss of leaf area to being unable to recover from herbivory. We will also examine if the non-native grass has a higher threshold than the native species.

WILDFIRE BENEFITS NATIVE PLANTS IN GRAZED SEMI-ARID GRASSLANDS

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Grassland ecosystems are adapted to and maintained by periodic fire and grazing. However, management efforts in working lands often focus on cattle grazing despite the potential benefits of occasional prescribed burning for restoration of native plant species. In late April 2022, the Road 702 Wildfire burned an estimated 18,000 hectares of privately owned semi-arid grasslands in northwestern Kansas and southwestern Nebraska. Although characteristics of wildfire can differ from those of prescribed fire, this study was initiated in fall 2022 to monitor impacts of the Road 702 wildfire on plant recovery over time in a system subject to long-term fire suppression. Specifically, this study compares three sites: an overgrazed burned pasture, an ungrazed burned pasture, and a control pasture that was not burned and has not been grazed in at least 20 years. A grazed unburned pasture was not available for this study. Twenty permanent 1-m^2 sampling plots were randomly located on each site and plant species cover monitored annually through 2024. The site that was both burned and grazed tended to have higher species richness than ungrazed sites (both burned and unburned) by 2024. In addition, the proportion of native species in the burned-grazed site also tended to be higher than in the ungrazed sites. This study demonstrates the possible benefit of fire and grazing for increasing native plant diversity in a semi-arid rangeland where fire is not widely used as a management or restoration tool.

Friday, April 25, 2025 3:00pm - 4:15pm

EARTH SCIENCES AFTERNOON SESSION- A2

Chairperson: Irina Filina

Earth Sciences: Geological studies in Nebraska and beyond

FRIDAY, APRIL 25th **Session Chair: Irina Filina**

AFTERNOON SESSION – A2 **Location: Prairie Suite B**

3:00 A RECONNAISSANCE MAP OF ADAMS COUNTY, NEBRASKA. Robert Evander

3:15 EVIDENCE FOR SILICA AND REDUCED IRON TRANSPORT IN SANDSTONE AQUIFERS. Anne Lammes and Richard Kettler

3:30 MONITORING IRRIGATION AND RECHARGE IN NEBRASKA'S AQUIFERS WITH REPEATED GRAVITY SURVEYS. Kaitlin Steinauer and Irina Filina

3:45 EXPLORING INTRAPLATE SEISMICITY IN THE MIDWEST. Mindi L. Searls, Alexa Fernández, Caroline M. Burberry and Harmon D. Maher

4:00 BRIDGING ACADEMIA AND INDUSTRY: UNL GEOLOGY STUDENTS IN THE 2025 SEG EVOLVE PROGRAM. Md Abdullah Salman, Tochukwu Onyebum, Anika Nawar Mayeesha, Ethan Stowell and Irina Filina

A RECONNAISSANCE GEOLOGIC MAP OF ADAMS COUNTY, NEBRASKA

Author
Robert Evander
Columbia University

Co-Author
Robert Evander

The surface geology of Adams County Nebraska is dominated by a widespread mantle of Peoria Loess, which covers 90% of the county. The Platte River has removed the Peoria from a small sliver of the northwest corner of the county, then infilled this space with river terrace deposits. The southern half of the county is dissected by the headwaters of the Little Blue and Big Blue rivers. These rivers have both excavated narrow canyons. Both have deposited narrower terraces. This is an ongoing dissection. Neither river has reached the northern half of the county. The northern half of the county is flat, and characterized by disorganized drainages. Eleven small, shallow basins punctuate the northern half of the county. They range in size from 107 acres to 1135 acres. All eleven are elongate from the southwest to northeast. Nebraska Conservation and Survey geologists have named these structures rain basins. Ten of the eleven rain basins in Adams County have an elevated basin rim located immediately to their south. These basin rims rise higher than the surrounding country. These basin rims suggest that the rain basins are aeolian features, recapturing some of the sediments blown out of the rain basins as they were excavated by the winds. Beyond that, the rain basins of Adams County demonstrate considerable diversity. Eight of the Adams County rain basins have a marshy core. Three contain ponds. Three more have been captured by steams, and incorporated into stream courses. The rain basins may contain incipient springs. Some persist as wild areas. Others are completely developed by adjacent towns or farms. As the Little Blue and Big Blue rivers continue their headward erosion, these rain basins seem to represent advantageous directions for advance. The landscape of Adams County is demonstrably young. The Peoria Loess was deposited 10 to 12 thousand years ago, and it is the oldest of the exposed deposits in the county.

BRIDGING ACADEMIA AND INDUSTRY: UNL GEOLOGY STUDENTS IN THE 2025 SEG EVOLVE PROGRAM

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The **SEG EVOLVE** program, organized by the **Society of Exploration Geophysicists (SEG)**, provides a highly selective, mentor-guided virtual internship for students to develop critical skills relevant to the energy industry. In 2025, 11 teams from around the world are working on petroleum and geothermal energy exploration projects using both public and proprietary industry data. Four students from the University of Nebraska-Lincoln (UNL) were selected to participate in this six-month program, which focuses on geothermal prospect evaluation in Cooper Basin, Australia. The project is based on synthesis of geological, geophysical, and petrophysical data, as well as reservoir modeling, to evaluate potential exploration investments. This hands-on experience closely mirrors real-world industry workflows and culminates in a final presentation at the IMAGE Conference in Houston, Texas, in August 2025. The program emphasizes technical proficiency, data integration, and critical problem-solving, while weekly mentor interactions provide industry insights and professional development. Additionally, SEG EVOLVE fosters global collaboration, encouraging knowledge exchange among international student teams in a non-competitive learning environment. Participation in SEG EVOLVE has provided UNL students with a unique opportunity to bridge the gap between academia and industry, offering early-career geoscientists valuable exposure to real-world challenges and decision-making processes. We present our experience and insights, aiming to encourage future participants to participate in this remarkable program.

EVIDENCE FOR SILICA AND REDUCED IRON TRANSPORT IN SANDSTONE AQUIFERS

Author
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Co-Author
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Resistant sandstone outcrops occur where the sand has been lithified by intergranular cements. Iron oxide-cemented sandstones are not only resistant to weathering but may form outcrops and patterned rocks that are visually striking. Among the forms present in these sandstones are spherical, pipe-like, and boxwork concretions of iron oxide as well as patterns that bear a general resemblance to the Liesegang phenomenon. The spherical and box-work iron oxide-cemented rinds typically surround a friable sandstone core. Research at UNL (Loope et al., 2010 doi: 10.1130/G31213.1; Weber et al., 2012 doi:10.1130/G33062.1) has shown that such features formed in evolving aquifer systems. The sandstones were originally cemented by accumulations of ferrous carbonate deposited under reducing conditions. During the uplift and incision of the aquifer, more oxidizing waters invaded the system. The interface between iron carbonate-cemented sand and uncemented sand was then colonized by iron-oxidizing bacteria. Iron migrated from the concretion interior to the rind where it was oxidized by the microbes producing the forms observed today (rinded spheres, box-works, or pipe-like concretions). Although the iron-oxide-cemented sandstone is very resistant to weathering, some of the sandstone from which the iron was obtained is now extremely friable and less resistant to weathering than sandstone that never contained any ferrous carbonate cement. One interpretation of this observation is that silica cement was removed along with the iron carbonate cement and that

both iron and silica were transported to the site of iron oxide mineralization, perhaps as a ferrous silicate complex. Microbially-mediated oxidation of the iron and precipitation of iron oxides destabilized the complex species with resulting precipitation of silica as quartz. This project intends to test the hypothesis that silica (SiO_2) can be readily transported in aquifers in the presence of aqueous iron(II). The results of this research could provide support for an effort to quantify the effects of aqueous iron(II) on silica solubility. This interpretation and the hypothesis of this research can be falsified if there is no evidence that silica has also been transported from the concretion interior to the rind.
This research is funded by the Undergraduate Creative Activities and Research Experience (UCARE) program through UNL for the 2024-2025 academic year.

EXPLORING INTRAPLATE SEISMICITY IN THE MIDWEST

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Co-Author
Alexa Fernandez

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Co-Author
Harmon Maher
UNO

Intraplate seismicity is surprisingly common within the North American Craton. However, understanding the cause of this activity is challenging due to limited moment tensor data, restricting our understanding of earthquake mechanisms in this stable continental region. This research investigates the potential sources of stress that could lead to the reactivation of older faults and influence the observed seismic activity within the region, primarily considering glacial isostatic adjustment (GIA), far-field orogenic stresses, and gravitational body forces. Our research focuses on earthquakes in the Midwest and the New Madrid Seismic Zone, exploring the connections between these potential drivers and intraplate earthquakes. Through analysis of focal mechanisms, principal stress directions are identified and contoured tension (T)-axis plots are created revealing a NE to SW directed extension west of the Midcontinent Rift, consistent with GIA. In contrast, the observed NNW to SSE directed extension east of the Midcontinent Rift is more complex and requires a secondary driver in addition to GIA. These findings contribute to a deeper understanding of intraplate seismicity and highlight the need for more detailed, localized moment tensor data.

MONITORING IRRIGATION AND RECHARGE IN NEBRASKA'S AQUIFERS WITH REPEATED GRAVITY SURVEYS

Author
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Co-Author
Irina Filina

University of Nebraska-Lincoln

Utilizing gravity data to measure groundwater storage changes has been successful for NASA's Gravity Recovery and Climate Experiment. However, the data is satellite-based, so it lacks the resolution to determine variations at a local scale. This project adopts a similar approach but adjusts for small-scale groundwater level changes by utilizing a portable relative gravimeter. Throughout the 2024 irrigation and recharge season, regular gravity surveys were conducted at two study areas in eastern Nebraska. The change in gravity was then compared to data from observation wells at each site. The first study area is located west of Plymouth, NE, over an unconfined aquifer and exhibited 12.16 ft of groundwater level change in the observation well in 2024, which corresponds to a change of up to 41 micro-Gals in gravity readings. Preliminary results show a strong correlation between the Plymouth well data and gravity surveys. The second study area is near Oakland, NE, over multiple confined aquifers with four observation wells. The confined nature of these aquifers and associated effect of pressure head likely accounts for the dramatic groundwater level changes observed in the well data in the past. Oakland gravity surveys show trends between the four sites, but the 2024 well data are not released yet for a comprehensive comparison.

Friday, April 25, 2025 3:45pm - 4:45pm

AERONAUTICS AND SPACE SCIENCE POSTER SESSION

Chair: Kerri Schnase-Berge

Aeronautics and Space Science **Chairperson(s): Scott Tarry & Michaela Lucas**

FRIDAY, APRIL 25 **Location: UNL East Campus Student Union Third Floor Loft Gallery**

SESSION - POSTER

AERO-1 4D-PRINTED COMPLIANT MANIPULATORS FOR AUTONOMOUS ADDITIVE MANUFACTURING IN SPACE. Kasey Moomau

AERO-2 MARS ROVER SIMULATION: DEPLOYING RASPBERRY PI GOPOGO ROBOT WITH AUTONOMOUS NAVIGATION, LIDAR MAPPING, AND DATA COLLECTION. Jessica Soler

AERO-3 DECIPHERING MECHANISMS OF MITOXANTRONE ACTION IN HR-DEFICIENT CANCER. Savanna Wallin and Gloria Borgstahl

AERO-4 RISKY ROVERS: GAMIFYING THE DEVELOPMENT OF AUTONOMOUS MOBILE ROBOT BEHAVIOR. Ada-Rhodes Wish

AERO-5 DESIGN OF A COMPACT AND COMPLIANT VARIABLE STIFFNESS MECHANISM. Benjamin Zwiener and Carl Nelson

4D-PRINTED COMPLIANT MANIPULATORS FOR AUTONOMOUS ADDITIVE MANUFACTURING IN SPACE

Author
Kasey Moomau
Dr. Carl Nelson, Professor, Materials and Mechanical Enginee

Future space exploration missions require low-mass, high-tolerance in-situ additive manufacturing (AM) capabilities with minimal maintenance and reprocessable components. Current AM systems present challenges due to their reliance on extensive support equipment, human intervention, and careful handling, leading to increased costs and mission risks. This project introduces a novel solution: 4D-printed compliant manipulators designed to autonomously remove parts and reset build chambers during AM processes in microgravity environments. Unlike conventional mechanisms with bearings or hinges, these manipulators are monolithic, single-material structures that utilize folding and flexible geometries to guide motion. The

innovation leverages advanced 4D printing techniques to create mechanisms with embedded post-printing shape changes, allowing mechanisms to be printed in advantageous orientations and then folded into final geometries. This approach enables low-mass, robust designs with tunable strength, dexterity, and precision that can be manufactured by the same machines they will service. The research methodology includes iterative modeling and prototyping with conventional AM feedstocks before extending to cryogenically stable materials suitable for space applications. By providing modular, self-configuring robotic capabilities using a single feedstock, this technology addresses NASA's critical needs for reliable, low-maintenance solutions for in-situ manufacturing, logistics management, and micro-gravity assembly, potentially increasing the feasibility of future lunar/Martian outposts and orbital construction platforms.

DECIPHERING MECHANISMS OF MITOXANTRONE ACTION IN HR-DEFICIENT CANCER

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The DNA repair protein RAD52 has been highlighted as a promising drug target in homologous recombination (HR)-deficient cancers. HR-deficiency results in the inadequate repair of double-stranded breaks (DSBs) in DNA, which fuels genomic instability. DSBs are the most severe form of DNA damage and can be caused by ionizing radiation. Researchers have shown that HR-deficient cancer cells are reliant on RAD52-based HR, and RAD52 inhibition in these cells induces synthetic lethality. Thus, we hypothesize that targeting the RPA:RAD52 protein-protein interaction required for RAD52-based HR will induce synthetic lethality in HR-deficient cancer cells. We aim to fully characterize a recently identified inhibitor of this complex, Mitoxantrone (MX), and better define a novel mechanism of action for MX in HR-deficient cancers. To investigate this interaction, we examined the binding kinetics between MX and RAD52. Additionally, we further scrutinized the promiscuous nature of MX by elucidating its proteomic profile using a biotinylated MX-probe (MXP). We performed surface plasmon resonance (SPR) to quantify the strength of the interaction, and limited proteolysis to observe any shifts in stabilization induced by MX. Moreover, we confirmed that MXP interacts with RAD52 and also retains its affinity for other known binders of MX, such as topoisomerase II. Future studies using the probe may unveil other novel binding partners. Our research will aid in deciphering the interaction between MX and RAD52 and its potential application in HR-deficient cancer in order to reduce barriers of limited targeted therapies and to develop better therapeutics.

DESIGN OF A COMPACT AND COMPLIANT VARIALBE STIFFNESS MECHANISM

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Robotic systems are becoming increasingly ubiquitous due to their efficiency, precision, and longterm cost savings. While these systems show increases in performance, inefficiencies like increased energy consumption and tedious maintenance still depreciate their overhead. Variable Stiffness Mechanisms (VSMs) have been shown to reduce load and wear, but traditional designs are often complex, expensive, and primarily suited for rotational joints. This work introduces designs for a Compact and Compliant Variable Stiffness Mechanism (CCVSM) as a scalable and modular solution for improving energy efficiency and mechanical resilience in robotic systems. The CCVSM provides tunable compliance in the three Cartesian directions, enhancing adaptability and durability across various applications.

MARS ROVER SIMULATION: DEPLOYING RASPBERRY PI GOPIGO ROBOT WITH AUTONOMOUS NAVIGATION, LIDAR MAPPING, DATA COLLECTION

Author
Jessica Soler
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This project focuses on deploying a Raspberry Pi GoPiGo robot to simulate a Mars rover tasked with autonomous navigation, terrain mapping, environmental data collection, and live-streaming video. The goal is to develop an autonomous robot capable of navigating various obstacles, mapping

the environment, and collecting relevant data to simulate real-world challenges of exploring unknown environments. The robot is equipped with a LiDAR sensor for 2D terrain mapping and a BME680 sensor for environmental data collection, which includes measurements of temperature, humidity, and air pressure. Additionally, the robot streams live video, providing a real-time view of its surroundings. All data and video are transmitted back to a central command station (laptop) for analysis and monitoring. The Raspberry Pi GoPiGo serves as the primary vehicle for the project, integrating sensors for navigation, data collection, and video streaming. The laptop acts as the base station and serves as the control center for the entire operation. A custom graphical user interface (GUI) has been developed using Python and Tkinter to centralize the robot's operations, including live sensor data collection and display, terrain mapping visualization, video feed, and navigation controls. The robot's data and video feed are transmitted wirelessly via Bluetooth, ensuring seamless communication between the robot and the laptop. By integrating these technologies, the project will provide valuable insights into robot autonomy and contribute to the development of low-cost, effective solutions for environmental monitoring and mapping, applicable in various fields including space exploration.

RISKY ROVERS: GAMIFYING THE DEVELOPMENT OF AUTONOMOUS MOBILE ROBOT BEHAVIOR

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A major hurdle to the development of improved automation of space rovers is the difference between human risk attitudes and decision making and autonomous decision making. In previous work we have explored how computational cognition can be applied to better align autonomous decision making in space missions with human risk attitudes while rapidly respond to black swan events during simulated space missions. While this work moved the technology forward, it left open the question of how humans would have made decisions given the same scenarios. In order to bridge this gap a gamified Mars rover mission simulator was developed that allows us to perform one-to-one comparison of our autonomous behavior with humans performing the same tasks and facing the same scenarios. In this paper we discusss the development of the gamified simulation titled Risky Rovers, present the mathematical framework that it uses to model space mission risk, and demonstrate that it can be used to recreate previously observed experimental behavior as well as capture human decision making data given the same scenarios.

Friday, April 25, 2025 3:45pm - 4:45pm

BIOLOGY POSTER SESSION

Biology **Chairperson(s): Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: UNL East Campus Student Union Third Floor Loft Gallery**

SESSION - Poster

BIO-1 CHARACTERIZATION OF *CANDIDA ALBICANS* MICROTUBULE ORGANIZING CENTER. Megan Rysko

BIO-2 ISOPOD INTERACTION WITH PEA PLANT GROWTH. Anya Meyers

BIO-3 THE REALM OF NOVEL BACTERIOPHAGES PROUDLY INTRODUCES OUEDRAOGO 22, A BACTERIOPHAGE CHARACTERIZED BY A STABLE GENOME. Rolande Kanyala

BIO-4 INVESTIGATION OF PTEROPUS ALECTO IFITM3 GENES AS A VIRAL RESTRICTION FACTOR WITH HSV-1 INFECTIONS. Abbie Willett and Dane Bowder

BIO-5 INFLUENCE OF THE PREVALENCE OF APARAVIRUSES ON HONEYBEE MORTALITY. Alexa K. Kozlak, Woolpert J. Autumn, and Carol Fassbinder-Orth

CHARACTERIZATION OF CANDIDA ALBICANS MICROTUBULE ORGANIZING CENTER

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Co-Author
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Currently, there are limited treatment options for candidiasis, an infection caused by *Candida albicans* (*C. albicans*), which is becoming even more limited due to recent increase in drug resistance. Due to the many similarities between human cells and *C. albicans*, there has been little development of new drugs that are able to effectively treat infection, without having side effects to human cells. However, the microtubule organizing center (MTOC) of human cells differs greatly from the MTOC of *C. albicans*. Currently, there is limited knowledge of the composition and organization of MTOC of *C. albicans*. Through a variety of techniques, we aim to characterize the proteins that compose the MTOC of *C. albicans* to identify proteins that have the potential to serve as targets for novel candidiasis drugs.

ISOPOD INTERACTION WITH PEA PLANT GROWTH

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Below our feet, isopods roam. Isopods are an order of crustaceans that range from fully aquatic to purely terrestrial. The diet of an isopod consists of detritus, or dead organisms. This includes dead leaves, rotting bark, and even deceased animals. Isopods replenish the soil with microbes and nitrogen in their feces. Plants benefit from the enriched soil. Exactly how plants benefit from isopods is still heavily researched. The experiment focused on isopod presence and plant mass. The hypothesis was that the presence of isopods would increase the mass of the stem and root systems of Alaskan pea plants. The experiment group of pea plant seeds were populated with 12 isopods each. The roots and stems will be weighed separately to deduce whether or not isopods affect plant mass.

THE REALM OF NOVEL BACTERIOPHAGES PROUDLY INTRODUCES OUEDRAOGO 22, A BACTERIOPHAGE CHARACTERIZED BY A STABLE GENOME

Author
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POSTER DRAFT: OUEDRAOGO22

Department of Science, Metropolitan Community College, Omaha, NE
Bacteriophages are viruses that infect and destroy bacterial cells by hijacking their replication cycles. Starting in Fall 2023, Metropolitan Community College (MCC) has partnered with the Howard Hughes Medical Institute (HHMI) to launch the SEA-PHAGES (Science Education Alliance-Phage Hunters Advancing Genomics and Evolutionary Science) program for the first time.

As part of this program, students at MCC—Rolande Kanyala, Regine Ilboudo, Amy Ladue, and Josephine McLean—discovered a novel phage named Ouedraogo22, which infects the bacteria Gordonia rubripertincta. The discovery of Ouedraogo22 began with the collection of a soil sample on the warm morning of September 3, 2023, at noon. The sample was taken from a neighborhood park, 5-7 inches deep, in an area with wet grass in the middle of the field.
This soil sample underwent both direct and enriched isolation attempts. Plaque assays and spot tests using serial dilutions were conducted on both samples; however, only the enriched sample produced tiny plaques, which warranted further testing to discover a novel phage. The plaques were purified through two rounds of purification, allowing us to analyze the morphology of Ouedraogo22. The phage displays clear, tiny plaques with distinct boundaries, indicating that it can be classified as a lytic phage.
The amplification of the phage lysate yielded a titer of 5 x 109 PFU/ml using the webbed plate technique, and the phage DNA was extracted. The yield of phage DNA, measured using a Nanodrop spectrophotometer, was found to be 87.6 ng/?L. The quality of the DNA was further characterized using restriction enzyme digestion with HaeIII, MseI, and SacII, followed by less than 0.8% gel electrophoresis.
To visualize the phage morphology, we subjected the phage lysate to Electron Microscopy at the University of Nebraska Medical Center (UNMC). This analysis revealed that Ouedraogo22 has a capsid diameter of approximately 60 nm and a tail length of about 240 nm.

INVESTIGATION OF PTEROPUS ALECTO IFITM3 GENES AS A VIRAL RESTRICTION FACTOR WITH HSV-1 INFECTIONS

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Co-Author
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Herpes Simplex Virus type 1 (HSV-1) is one of the most common infections worldwide, affecting 3.7 billion people. Like many types of viruses, HSV-1 can be inhibited by viral restriction factors, proteins expressed in host cells in response to viral infection. Human interferon induced transmembrane protein 3 (IFITM3) has been found to inhibit a variety of human viruses including HSV-1 and Human Immunodeficiency virus (HIV). Research has shown that non-primate mammalian restriction factors have shown to be effective against human viruses, which begs the question, how extensive is this effect? The specific species we chose was the flying fox because of their active interferon system and ability to host many mammalian viruses with minimal negative outcomes. To investigate this we are going to overexpress the Pteropus alecto IFITM3 proteins in vero cells and subsequently infect the cells to measure the restrictive effects of flying fox IFITM3. To our knowledge there has been no research on this topic regarding Pteropus alecto IFITM3 and HSV-1. We anticipate that because of their similarities to human IFITM3 proteins they will maintain their restrictive abilities against HSV-1 due to their protein sequence similarity.

INFLUENCE OF THE PREVALENCE OF APARAVIRUSES ON HONEYBEE MORTALITY

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The Western honeybee, Apis mellifera, is a species that plays a crucial role in economics, agriculture, and the environment. Over the years, concerns about the health of honey bee populations have been mounting as they face a whole host of threats, including pollution, pests, and parasites. Since these causes have not been fully explored, this study investigated the dynamics of select hormones and pathogens that affect honey bee colonies in Iowa, New Zealand, and French Polynesia. From the study, the prevalence of pathogens and hormones, as well as their impact on honeybee survivability, was assessed. The most common pathogens were measured, including the Aparaviruses: Israeli acute paralysis virus (IAPV), acute bee paralysis virus (ABPV), and Kashmir bee virus (KBV). Aparaviruses have been previously identified as prevalent in colonies in the United States and New Zealand. Colonies were examined on a monthly basis, and their relative levels of key hormones and pathogens were measured using a digital droplet polymerase chain reaction (ddPCR). The results showed a significant, positive correlation between the virus and death of honey bees for ABPV, IAPV, and KBV. These results are expected to help address some of the factors influencing colony survival versus death, predict mortality early, and identify strategies to reduce colony death.

Friday, April 25, 2025 3:45pm - 4:45pm

BIOMEDICAL SCIENCES POSTER SESSION

Biological and Medical Sciences **Chairperson(s): Dr. Annemarie Shibata**

FRIDAY, APRIL 25 **Location: UNL East Campus Student Union Third Floor Loft Gallery**

SESSION - POSTER

BMS-1 MOSQUITOES IN NEBRASKA: WHAT ARE THEY CARRYING? Tori Thurber, Coleman, G., Rault-Bucklin, L.

BMS-2 LOSS OF DIGNITY AS A CAUSE FOR SUFFERING: OBJECTIFICATION OF THE HUMAN BODY AND THE INHIBITION OF HUMAN FLOURISHING. Cecilia Weidel, Mae L. Grahek, Christopher Krall SJ

BMS-3 EFFECTS OF LOWER EXTREMITY MUSCLE RESISTANCE TRAINING ON NAVICULAR DROP AND LEG ALIGNMENT IN PARTICIPANTS WITH FLATFOOT. Daylon Kellberg and Dimitrios Katsavelis

BMS-4 ENHANCING PHARMACY STUDENT SKILLS THROUGH AI-DRIVEN PATIENT COUNSELING SIMULATIONS. Sara Avila

BMS-5 WURST PROTEIN PLAYS A CRUCIAL ROLE IN THE MOLTING PROCESS OF INSECTS. Savannah Armendariz

BMS-6 ADULT NEUROGENESIS EFFECTS IN A PREMATURE AGING MODE. Allie Wong

BMS-7 OPTIMIZATION OF A HIGH-THROUGHPUT FRET ASSAY TO STUDY GLMS RIBOSWITCH SELF-CLEAVAGE IN STAPHYLOCOCCUS AUREUS. Steven Nguyen

BMS-8 OPTIMIZATION OF A HIGH-THROUGHPUT FRET ASSAY FOR IDENTIFICATION OF POTENTIAL ANTIBIOTIC COMPOUNDS. Daniel Cline

BMS-9 EVALUATING EXTRACTION TECHNIQUES FOR EXAMINATION OF SPICES AND MEDICINAL HERBS. Riley Bruno

BMS-10 ANTINOCICEPTIVE EFFECTS OF MORPHINE:KETAMINE MIXTURES IN FEMALE RATS. Carson Convery

BMS-11 CREATING A CUSTOM CHATBOT FOR MEDICAL SCHOOL PERSONAL STATEMENTS. Steven Fernandes, Faith Kurtyka, Cole Krudwig, and Sara Avila

BMS-12 ENHANCING PHARMACY STUDENT SKILLS THROUGH AI-DRIVEN PATIENT COUNSELING SIMULATIONS. Jessica Cumber, Kevin Fuji, Sara Avila, Halie Erwin, Cole Krudwig, Steven Fernandes

MOSQUITOES IN NEBRASKA: WHAT ARE THEY CARRYING?

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Mosquitoes are common vectors and have been found to carry West Nile Virus (WNV), Heartworm, and *Francisella tularensis*, with *Francisella tularensis* being more commonly carried by ticks in the United States. However, the species of mosquitoes that shows a positive result for what is being tested for should be known. The collected samples from this experiment are from a rural area of Nebraska, and the results can be compared to the mosquitoes collected in urban areas of Nebraska to determine if species known for being carriers are present in more densely populated areas. The research included testing if primers worked, extracting RNA/gDNA, and adjusting concentrations of RNA/gDNA from our samples to find the best concentration that would allow for detection through qPCR. Detection through qPCR was a vital part of this research as it can measure DNA amplification after each thermal cycle. Results showed positive samples for Heartworm, WNV, and *Francisella tularensis* from various species of Culex, Ochlerotatus, Aedes, and Psorophora. This research demonstrates the importance of awareness of which species are common carriers and what they can be carriers of.

LOSS OF DIGNITY AS A CAUSE FOR SUFFERING: OBJECTIFICATION OF THE HUMAN BODY AND THE INHIBITION OF HUMAN FLOURISHING

Author
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Human dignity is a foundational concept that underlines many practices of modern life, despite its focus being in critical scenarios rather than a foundational basis. In a world plagued by progress and utility, human flourishing is compromised at the cost of a person’s inherent dignity. Minor events that compromise dignity can have cumulative effects that inhibit an individual’s ability to flourish. Investigating the ways in which integrity of the human person is undermined, individuals can more adequately recognize and combat that which threatens the sanctity and dignity of the human person. A survey will assess Creighton student’s perceived dignity as it pertains to flourishing in the coming weeks. Current literature recognizes a correlation between various sources that undermine dignity and the

consequent suffering as a result. These sources include but are not limited to: depression, anxiety, shame, and quality of life. Dignity is the basis of human flourishing, and when undermined has physical implications inhibiting flourishing.

EFFECTS OF LOWER EXTREMITY MUSCLE RESISTANCE TRAINING ON NAVICULAR DROP AND LEG ALIGNMENT IN PARTICIPANTS WITH FLATFOOT

Author
Daylen Kallberg

Pes planus, also known as flatfoot, is characterized by overpronation of the foot and misalignment of the ankle, knee and hip joint that can increase the risk of lower extremity injuries. Current literature has focused primarily on intrinsic muscles, but the findings regarding their effectiveness remain inconclusive, while extrinsic muscles are often overlooked. PUPROSE: To examine the effect of a resistance training of two extrinsic foot muscles on navicular drop and leg alignment in participants with flatfoot. METHODS: Five college students with a Foot Posture Index (FPI) greater than 6 (FPI = 8.4±2; age = 21.2±1yr; BMI = 20.8±3) participated in the study. Participants performed an exercise protocol 3 times per week for 6 weeks, consisting of tibialis raises and ankle inversions, which targeted the two extrinsic muscles responsible for inverting the foot: anterior and posterior. Pre- and post-testing included evaluations of navicular drop and leg alignment during walking and jogging in three conditions: barefoot, shod, and with insoles. RESUTLS: Statistical analysis revealed a significant decrease (10%; p =.014) in navicular drop during jogging in the shod after the 6-week training program, while there was no significant changes in barefoot condition. Regarding leg alignment, there was 27% reduction in knee abduction that was significant (p=.04). CONCLUSION: The present findings suggest that specialized resistance training of the foot invertors can play an important role in leg alignment in individuals with flatfoot.

WURST PROTEIN PLAYS A CRUCIAL ROLE IN THE MOLTING PROCESS OF INSECTS

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Tracheal tube clearance is a crucial process during insect molting, ensuring the proper function of the respiratory system as the insect grows. The tracheal system, which is lined with a thin cuticular layer, must shed and renew this lining during each molt to accommodate the insect's expanding body and maintain efficient gas exchange. Although the protein *Wurst* has been implicated in tracheal tube clearance, its potential role in the broader molting process has not been explored. In this study, we show that the *TcWurst* protein is essential for tracheal development during molting in Tribolium castaneum and plays a critical role in the molting process itself. The knockdown of *TcWurst* resulted in tracheal collapse, severe molting defects, and lethality at all developmental stages. While the RNAi phenotype of *TcWurst* resembles the defects observed in chitin synthase (*TcChs-A*) knockdown in *T. castaneum,* our findings show that *Wurst* does not significantly affect chitin levels or structure in the cuticle. These results suggest a novel mechanism by which *TcWurst* regulates the molting process through proper tracheal development in insects.

ADULT NEUROGENESIS EFFECTS IN A PREMATURE AGING MODEL

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Body-wide genetic overexpression of the mouse Klotho protein extends lifespan, enhances memory, and prevents neurodegenerative disease development. Klotho deficient mice experience a dramatically shortened lifespan from the confluence of body-wide dysfunction including, related to the brain, rapid onset of memory impairment. Klotho is only expressed by the kidney and the brain and our lab is interested in better understanding of brain Klotho function. Klotho’s transmembrane protein form is expressed in the brain by neurons and choroid plexus cells. This protein can also be shed into the cerebrospinal fluid, presenting the possibility of non-cell autonomous effects.
Most investigation into Klotho function has focused on neuronal effects. However, choroid plexus cells express the highest amounts of Klotho within the brain. Choroid plexus cells are found in the ventricles and produce the brain’s cerebrospinal fluid (CSF), providing a homeostatic environment necessary for survival and function of all brain cells. To do so, choroid plexus cells express transporters on their surface to control water, small ions, and molecule flow out of the blood and into the CSF. Our initial investigations show that Klotho-deficient choroid plexus has decreased expression of most of the critical transporter proteins required for proper CSF production. Analysis of CSF is complicated as mice produce very low volumes of the fluid. To determine whether altered CSF may be produced by Klotho-deficient choroid plexus cells we are investigating the nearest stem cell niche.
The subventricular zone (SVZ) contains neurogenic precursors that extend their cilia into the CSF to sense and respond to stimuli. This informs their differentiation, dependent upon cues, into neurons or oligodendrocytes. Committed but immature neurons will move along a migratory path known as the rostral migratory stream to integrate into the olfactory bulb. We are working to determine whether the subventricular neurogenic niche, rostral migratory

stream, or olfactory bulb adult neurogenic populations are affected by Klotho-deficiency. To do so we are using immunohistochemistry to label different cell populations for quantification.

Work funded in part by NIH/NIA R15AG073947 (King, PI)

OPTIMIZATION OF A HIGH-THROUGHPUT FRET ASSAY TO STUDY GLMS RIBOSWITCH SELF-CLEAVAGE IN STAPHYLOCOCCUS AUREUS

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The continual threat of antibiotic resistance has required that new approaches and new targets be investigated in order to effectively fight a host of medically relevant bacterial infections. Riboswitches are RNA structural elements that bind cellular metabolites and control the expression of essential metabolic genes, providing a unique and distinct set of targets for the development of artificial agonists to fight bacterial infections. One riboswitch (the *glmS* riboswitch) binds to Glucosamine-6-Phosphate (GlcN6P), a building block of the cell wall in Gram-positive bacteria, and undergoes self-cleavage resulting in inactivation of the mRNA. This riboswitch is unique in that it is dependent on its metabolite/ligand GlcN6P for cleavage, as the ligand is a coenzyme for catalysis. The *glmS* RNA is the only known riboswitch that modulates gene expression through catalytic activity and thus is also a ribozyme. Identification of ligand analogs that activate the *glmS* riboswitch offers a novel approach to antibiotic development, which could potentially overcome the mechanisms of resistance that many types of bacteria have developed against traditional antibiotics. This study is focused on identifying GlcN6P analogs that can activate the *glmS* riboswitch in *Staphylococcus aureus*. A series of GlcN6P mimicking ligands have been evaluated for their ability to induce self-cleavage of the *glmS* riboswitch. The goal is to be able to rapidly evaluate compounds, including extensive libraries of small molecules, for their ability to support *glmS* RNA self-cleavage and therefore lead to further investigations of various ligands for potential antibiotic activity

OPTIMIZATION OF A HIGH-THROUGHPUT FRET ASSAY FOR IDENTIFICATION OF POTENTIAL ANTIBIOTIC COMPOUNDS

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Antibiotic resistance is an increasing threat that necessitates the creation of novel antibiotics with new molecular targets. Riboswitches are non-coding segments of messenger RNAs that bind cellular metabolites to induce conformational changes and alter gene expression. Riboswitches control essential metabolic pathways in many bacteria. The *glmS* riboswitch/ribozyme is present in many Gram-positive bacteria, including the food-borne pathogen *Bacillus cereus*. The *glmS* RNA is essential as it expresses the enzyme that makes glucosamine-6-phosphate (GlcN6P), a key component in cell wall synthesis. When GlcN6P, the natural ligand, is bound to the *glmS* RNA, it downregulates gene expression by inducing self-cleavage of the RNA. The *glmS*riboswitch is mechanistically unique as it is the only known riboswitch for which catalytic activity provides the basis of genetic regulation, and it is the only known ribozyme that depends upon a “coenzyme”, the metabolite GlcN6P, to actuate self-cleavage. This function of this riboswitch/ribozyme makes it a clear target for the development of novel antibiotics possibly utilizing artificial analogs of GlcN6P. In order to evaluate such analogs, I have focused on optimizing a high-throughput fluorescence resonance energy transfer (FRET) assay to test various ligands and libraries of compounds as possible antibiotics against Gram-positive bacteria by targeting the *glmS* riboswitch/ribozyme. The *glmS* riboswitch/ribozyme from *Bacillus cereus* has been studied with this method. The goal of this project is to develop the most efficient high-throughput assay in order to evaluate a library of GlcN6P analogs that could potentially be used as antibiotics against *B. cereus* and other bacteria expressing the *glmS* riboswitch/ribozyme.

EVALUATING EXTRACTION TECHNIQUES FOR EXAMINATION OF SPICES AND MEDICINAL HERBS

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Spices and spice-derived compounds have been used for medicinal purposes for thousands of years. While there is evidence of medicinal plants being used up to 5000 years ago, comprehensive documentation didn't surface until around the 16th century. In 1596 one of the first “herbal guides” was published, written by Li Shih Chen (published posthumously), ‘Pen Ts’ao’, outlining the medicinal uses and purposes of different plants and spices. Other more common drugs, still used to this day, also originated from plants; Some of these include cocaine, derived from the Coca Plant (*Erythroxylum coca*), or opium from the Opium poppy (*Papavar somniferum*), and even Marijuana from the Hemp Plant (*Cannabis sativa*). Understanding the chemistry and pharmacological impacts of these spices and plants will not only help us understand how these natural medications were used throughout history but also lead to a more comprehensive understanding on drug use, drug availability, and bioactive molecular analysis.

For our project, we tested commercially available herbs and plants: Curry, Turmeric, Ginger and Kratom. Different qualitative and quantitative extraction methods were employed to test extraction efficiency of bioactive molecules found in these spices and medicinal herbs. While we were able to identify a few bioactive molecules including Piperine in Curry, Sitosterol in Turmeric, and Gingerol in Ginger, we found the concentrations to be very small.

ANTINOCICEPTIVE EFFECTS OF MORPHINE:KETAMINE MIXTURES IN FEMALE RATS

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Pain management is a critical aspect of patient care, with opioids being the gold standard treatment for moderate to severe pain. However, opioids come with such adverse effects as abuse, dependence, and overdose. One strategy to mitigate these effects is to combine them with non-opioid analgesics. For example, our laboratory previously showed that the NMDA receptor antagonist ketamine selectively enhanced antinociceptive effects of the opioid morphine in adult male rats. The present study aimed to extend our previous findings in male rats to female rats (n=8, Sprague Dawley). Antinociception was assessed using a tail immersion test in water temperatures of 40°C (negative control), 50°C, and 55°C (positive control). For each session, all rats received six cycles of injections with morphine alone (1.7 – 17 mg/kg), ketamine alone (5.6 – 56 mg/kg), and morphine:ketamine mixtures in ratios of 3:1, 1:1, and 1:3. The first cycle consisted of a saline injection followed by a tail immersion test 13 minutes later. Then, another injection was administered after two minutes and then repeated for 6 cycles total. Results indicated that both morphine and ketamine, individually and in combination, significantly and dose-dependently increased tail withdrawal latencies in 50°C from approximately 5 sec to 15 sec, with morphine having greater potency as compared to ketamine. 3:1 and 1:1 morphine:ketamine mixtures demonstrated comparable potency in pain relief to the individual drugs; howeverhowever, ketamine in a 1:3 morphine:ketamine mixture enhanced the potency of morphine approximately 5-fold. These findings suggest that morphine:ketamine mixtures may be a viable alternative for pain management, however, its adverse side effects compared to either drug alone are still unknown.

CREATING A CUSTOM CHATBOT FOR MEDICAL SCHOOL PERSONAL STATEMENTS

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Co-Author
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Creighton University prides itself on pre-professional preparation, specifically advising, academic support, and co-curricular programming to help undergraduates achieve their dream of medical school. One of the most intimidating aspects of the medical school application, particularly for students who have focused on the hard sciences, is the personal statement: a brief, high-stakes explanation of why one wants to be a doctor.
This presentation explains the development of a custom chatbot for pre-med students that gives them real-time advice and feedback on the efficacy of the rhetorical elements of their personal statements, based on a rubric co-created by Creighton faculty and students. By reducing the intimidation of starting and revising a draft, the chatbot can encourage students to iteratively improve their statements, making the process more manageable. This feedback can enhance students' confidence and preparedness for medical school admission by making high-quality writing assistance accessible anytime.
This project also makes a timely intervention into the larger integration of AI into teaching and learning at Creighton University. This project will test the feasibility of using specially trained AI for student feedback, create a model for the training and development of such a system others can use, and evaluate the effectiveness of AI systems for similar use cases.

ENHANCING PHARMACY STUDENT SKILLS THROUGH AI-DRIVEN PATIENT COUNSELING SIMULATIONS

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Generative artificial intelligence (AI) models have risen in popularity and increased their capabilities since the introduction of ChatGPT by OpenAI in late 2022. AI chatbots can be trained on a variety of materials provided by the user for specific interactions in any number of settings. The goal of this project is to develop and assess an AI-based chatbot designed to support pharmacy students in building essential patient counseling skills within the three-year Dispensing and Patient Care (DPC) course series. The pilot text-based chatbot will initially be created for third year (P3) students in PHA 489 Dispensing and Patient Care III to simulate a realistic patient interaction and provide objective feedback based on the course patient counseling rubric to help students improve communication skills and patient counseling proficiency. Data collection will include chatbot session transcripts, rubric scores, and self-assessment surveys, and will be compared across all pharmacy pathways (Omaha, Distance, and Phoenix). Results will inform the potential expansion of chatbot-based practice opportunities across all levels of the DPC course series. Expected outcomes include increased student confidence in patient counseling, greater readiness for fourth year experiential rotations, and potentially a broader adoption of AI tools in the pharmacy program.

Friday, April 25, 2025 3:45pm - 4:45pm

CHEMISTRY POSTER SESSION

Chemistry **Chairperson: Dr. Matthew Beio**

FRIDAY, APRIL 25 **Location: UNL East Campus Student Union Third Floor Loft Gallery**

SESSION - POSTER

CHM-1 COPPER COMPLEXES WITH (2-AMINOETHYL)BIS(2-PYRIDYLMETHYL)AMINE AND N,N-BIS(2-PYRIDYLMETHYL)AMINOBUTANOL ATRA CATALYSTS. Isablle Kidd and Kayode Oshin

CHM-2 HOW FAR CAN COLLISION-INDUCED DISSOCIATION TAKE US IN TOP-DOWN CHARACTERIZATION OF MONOCLONAL ANTIBODIES? Lasini Amunugama and Jared B. Shaw

CHM-3 CAADH HYBRID CATALYSIS. Lauren Moon, Dr. Gaurav Kudalkar, Dr. Nivesh Kumar, Dr. David B. Berkowitz, and Dr. Mark Wilso

CHM-4 A SURVEY OF COMPUTATIONAL METHODS FOR THE IDENTIFICATION OF PSYCHOACTIVE DRUGS BASED ON SPECTRA. Kenjiro Pieters and Brett A. Cagg

CHM1 - COPPER COMPLEXES WITH (2-AMINOETHYL)BIS(2-PYRIDYLMETHYL)AMINE AND N,N-BIS(2-PYRIDYLMETHYL)AMINOBUTANOL ATRA CATALYSTS

Author
Isabel Kidd
Creighton University

Atom Transfer Radical Addition (ATRA) is an organic reaction that functionalizes olefins. Products from this reaction can be used to make important starting reagents. The goal of this project was to design new catalysts that efficiently facilitate ATRA. Currently, the most active catalyst used in ATRA incorporates a tripodal design. This configuration can lead to structural crowding of the active site during catalysis, reducing the efficiency of the reaction. We hypothesized that developing a catalyst that alleviates this structural issue, by increasing access to the active site, could result in increased efficiency, conversion, product yield, and turnover frequency. Two catalysts were synthesized that maintained the important tripodal motif while reducing crowding by modifying its ligand structure. The ligands (2-aminoethyl)bis(2-pyridylmethyl)amine and N,N-bis(2-pyridylmethyl) aminobutanol were synthesized and analyzed using various spectroscopy techniques to confirm their structure. The ligands were reacted with copper bromide to generate our desired catalysts. Catalyst structures were confirmed with spectroscopy techniques and single-crystal X-ray diffraction. ATRA reactions were performed using our catalyst and various olefins (alpha-olefins, aromatic-olefins, and branched olefins incorporating terminal C=C functional groups).Proton NMR spectroscopy was used to measure catalyst activity at various concentrations and results were compared to known catalysts. Results indicate that catalysts made with N,N-bis(2-pyridylmethyl) aminobutanol produced better yields when compared to catalysts made with (2-aminoethyl)bis(2-pyridylmethyl)amine. These results showed that mixed-donor catalysts perform more effectively when compared to same-donor catalysts. Compared to known catalysts, our catalysts made with N,N-bis(2-pyridylmethyl) aminobutanol were more efficient when using alpha olefins compared to aromatic or branched olefins.

USE OF CLOSTRIDIUM ACETOBUTYLICUM ALCOHOL DEHYDROGENASE (CAADH) IN STEREOCONTROLLED HYBRID SYNTHETIC SCHEMES

Author
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University of Nebraska Lincoln

Co-Author
Dr. Gaurav Kudalkar
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Co-Author
David Berkowitz
University of Nebraska-Lincoln

Our laboratory has heterologously expressed a *Clostridium acetobutylicum* alcohol dehydrogenase (CaADH) enzyme that, in our hands, displays remarkable substrate promiscuity and yet also quite impressive stereochemical fidelity. We have recently applied this to synthesizing aryl isoserine intermediates to prepare Taxol side chains, precursors to molecules in the Taxotere family of tubulin-binding chemotherapeutics, in high enantiomeric excess. The approach involves dynamic reductive kinetic resolution (DYRKR) upon the corresponding ?-chloro-?-keto esters. The enzyme preferentially deracemizes the substrate to the (S)-stereochemistry at the ?-C-Cl bond while displaying high facial selectivity in carbonyl reduction, yielding the D-stereochemistry at the ?-C-OH center. Active-site selectivity has been explored using heteroaryl and aryl substrates with electron-donating and electron-withdrawing groups, as well as fused bicyclic arenes with both sp^2 and sp^3-type fusions. A subset of enzymatic products has been successfully converted into final aryl isoserine side chains in three steps.
A promising extension of this project is the combining of this enzymatic reduction reaction with a coupling of the product with another aromatic compound and the optimization of such one-pot synthesis as proof and an example

that organometallic chemistry can take place in the same biology-amenable environment as an enzymatic reaction. Although this is not necessarily focused on demonstrating the application of CaADH, solidifying this hybrid catalysis would be novel and beneficial. The addition of a range of cross-coupling chemistries performed upon the p-bromophenyl isoserine side chain greatly enhances the structural diversity and functional group breadth that can be introduced into these taxoid side chains and highlights the value of such hybrid biocatalysis/cross-coupling approaches in medicinal chemistry/chemical biology.

HOW FAR CAN COLLISION-INDUCED DISSOCIATION TAKE US IN TOP-DOWN CHARACTERIZATION OF MONOCLONAL ANTIBODIES?

Author
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University of Nebraska-Lincoln

Co-Author
Jared Shaw
University of Nebraska-Lincoln

Abstract:
Monoclonal antibodies (mAbs) are essential biotherapeutics, requiring detailed structural characterization to understand their stability, functionality, and therapeutic performance. This study explores the potential of collision-induced dissociation (CID) for top-down mAb characterization, focusing on disulfide bond cleavage and sequence coverage under varying conditions. Infliximab and other IgG mAbs were analyzed in native, partially denatured, denatured, and supercharged states using Orbitrap mass spectrometers. Preliminary results show that CID effectively cleaves interchain disulfide bonds, generating abundant intact light chain ions and high sequence coverage, particularly in complementarity-determining regions (CDRs). Optimized conditions, including in-source unfolding and higher energy collisional dissociation (HCD), significantly enhance fragmentation efficiency. Surprisingly, CID produces fragmentation patterns comparable to electron- and photon-based methods, offering a more accessible approach for disulfide bond analysis in top-down proteomics. Key instrument parameters, such as collision energy and gas pressure, influence fragmentation efficiency and product-ion abundances. Ongoing studies will expand to additional solution conditions, refining parameters to maximize sequence coverage and enhance structural insights. This work establishes new benchmarks for combining native MS with CID to study solvent effects on infliximab's structure, charge distribution, fragmentation, and light/heavy chain separation.

Keywords:
CID, Disulfide bonds, Light chain, Heavy chain, Sequence coverage

A SURVEY OF COMPUTATIONAL METHODS FOR THE IDENTIFICATION OF PSYCHOACTIVE DRUGS BASED ON SPECTRA

Author
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Co-Author
Kenjiro Pieters
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This preliminary study focuses on the structural identification of psychoactive substances through the prediction of their Infrared (IR) spectra using a variety of electronic structure methods. We aim to compare optimized geometries,

and predicted spectra, with Density Functional Theory (DFT) and ab initio methods, to determine a reliable methodology for predicting structural and spectral properties of known psychoactive compounds. Currently, density functional theory is the electronic structure method of choice for these studies, but the best functional and basis set is debatable - and many suggestions have been made. In this study, the predicted structures and IR spectra of these compounds are compared to single crystal structures from the Cambridge Structural Database (CSD) and available experimental IR spectra. This research serves as a foundation for leveraging computational IR spectra prediction as a tool for structural elucidation, enabling more precise molecular identification and offering potential applications in the analysis of psychoactive substances in drug development and forensic science.

Friday, April 25, 2025 3:45pm - 4:45pm

ECOLOGY, SUSTAINABILITY, AND ENVIRONMENTAL SCIENCE POSTER SESSION

ECOLOGY, SUSTAINABILITY, AND ENVIRONMENTAL SCIENCE **Chairperson: Dr. Mark Hammer**

FRIDAY, APRIL 25 **Location: UNL East Campus Student Union Third Floor Loft Gallery**

SESSION- POSTER

ESES-1 SMALL MAMMAL AND BIRD DIVERSITY IN A RECENTLY SEEDED VS. ESTABLISHED URBAN PRAIRIE. Anna DeGroot, Laura Bettenhausen, and Mark Hammer

SMALL MAMMAL AND BIRD DIVERSITY IN A RECENTLY SEEDED VS. ESTABLISHED URBAN PRAIRIE

Author
Anna DeGroot
Wayne State College

Co-Author
Laura Bettenhausen
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Co-Author
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Wayne State College

Small mammal and bird communities were investigated in two urban prairie restorations within the Wayne, Nebraska city limits. One prairie (the Ley prairie) was seeded in February 2024 and the other (the WSC prairie) has been established for approximately 20 years. Diversity in birds and small mammals were compared to investigate potential differences during prairie succession. Data was collected from mid-September to late November of 2024. Sherman live traps were used to survey small mammals and visual/auditory transects were used to survey birds. Prior to the live trapping of small mammals, three different bait types (horse feed, sterilized bird seed, or a peanut butter/rolled oat mixture) were compared. Monitoring of the bait types using a camera trap revealed that bird seed was the most frequented by small mammals. Using bird seed as bait, live traps were set up along transects to compare mammals between each prairie. Voles and mice were the most abundant, with meadow voles dominating the majority of trapped species. Similar numbers of small mammals were trapped at both prairies. Generalist birds were mainly observed at both prairies, with nine bird species surveyed at the WSC prairie and fourteen surveyed at the Ley prairie. Some relationships between vegetation, dietary requirements of the animal species present, and structure of the

surrounding environments were observed, which provides insight into how communities develop throughout an ecological restoration process.

Friday, April 25, 2025 5:00pm - 8:00pm

INBRE SPONSORED RECEPTION AND SOCIAL EVENT

Social Event will take place at Morrill Hall on the UNL City Campus; 14th and U Streets

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2025 MAIBEN LECTURER

Dr. Mary Ann Vinton, Professor of Biology and Director of Environmental Science at Creighton Univerisity

Dr. Mary Ann Vinton grew up as a member of a five-generation family of cattle ranchers in the Nebraska Sandhills. She has received an undergraduate degree in Biology at the University of Wyoming, a MS at Kansas State University, and a PhD in Ecology at Colorado State University. She is now Professor of Biology and Director of Environmental Science at Creighton University in Omaha. Dr. Vinton teaches courses in biology, ecology, and environmental science. Her research program revolves around the ecosystem consequences of human impacts on plant communities, such as impacts wrought by invasive plants or the demise of once-common plants. Her research has been supported by the National Science Foundation, NASA-Nebraska Space Grant, and Nebraska Environmental Trust, and involves close mentoring of undergraduate research students. Recently, she has returned to the Sandhills to reconnect with her roots and study how landscapes are changing with management and climate.

Dr. Vinton inherited a section of land on the Dismal River from her mother and "Kinkaided" by her great, great aunt, Mary Crouch. The section is known as the "Aunt Mary" and is surrounded by family. She has used the Aunt Mary as a study site for biodiversity work and analyses of the landscape diversity inherent in the wet meadows and dry dunes in the Sandhills. In talking with friends and family, Dr. Vinton has become interested in the factors that affect land management and how decisions and attitudes are often not based on science or economic optimization, but often involve feelings of obligation and connection, stemming from long relationships between one another and land. In her presentation, she will blend ideas from natural and social science to explore the status and future of the Nebraska Sandhills as one of the most intact grasslands in the world.

2025 FRIENDS OF SCIENCE AWARDS

Since 1971, the Board of the Nebraska Academy of Sciences has taken great pride in recognizing those in the state who have made exceptional contributions to science. By shining a spotlight on these trailblazers, the Academy hopes to encourage continued innovation and discovery, ensuring that Nebraska remains at the forefront of scientific progress.

DR. DAVID CROUSE, PhD

David A. Crouse, Ph.D. is an Emeritus Professor in the Department of Genetics, Cell Biology and Anatomy at the University of Nebraska Medical Center in Omaha (courtesy appointments in Radiation Oncology and in Radiology). Dr. Crouse was born in Canton, Illinois and grew up as an “Army Brat” all over the world. He received his BS in Physics in 1966 and MS in Zoology (genetics emphasis) in 1968 from Western Illinois University. His graduate education was interrupted by two years (January 1969-Dec 1970) in the US Army including a year of service in Vietnam (June 1969-June 1970). In January 1971, he returned to graduate school, completing his PhD in Radiobiology at the University of Iowa in August 1974.

In 1977, after a three-year post-doc at the Argonne National Laboratory in Chicago, studying the late effects of radiation, Dr. Crouse moved to the University of Nebraska Medical Center as a very new Assistant Professor and progressed up the traditional academic ladder. His research interests, mostly funded by the NIH, were related to the re-development of the immune and hematopoietic systems following radiation exposure and bone marrow or peripheral blood stem cell transplantation.

Beyond his research, Dr. Crouse has had teaching experience and recognition in many areas of cell biology and radiation biology. His teaching emphasis for medical and graduate students was in hematology and immunology. He has also taken a lead role in promoting an understanding of the science and ethics that relate to stem cell biology. He developed programs and taught courses related to “Responsible Conduct in Research” and other important career issues for graduate students, post-docs and junior faculty (e.g., mentoring, authorship and publication ethics, promotion and tenure issues, guidelines for animal care and use, etc.). He also continues to lecture on topics related to late effects of radiation exposure.

He spent the entire 1994-1995 academic year working as American Council on Education Fellow with the Chancellor and Academic Vice Chancellor at the University of Nebraska - Lincoln. He returned to UNMC as the Associate Vice Chancellor for Academic Affairs and Executive Associate Dean for Graduate Studies tand spent seventeen years in those roles. During that time, he also served a total of nearly 5 years as the Interim Vice Chancellor for Academic Affairs and Interim Dean for Graduate Studies under both Chancellor Berndt and Chancellor Maurer. He retired in late 2012 but remains active with occasional lectures at UNMC or elsewhere as well as serving on several science or health science related boards.

His interests outside of the academic world include travel, photography, genealogy, woodworking and cooking. He also spent considerable time building and /or rebuilding homes for Habitat for Humanity as well as building cinder-block homes for very poor families in the rural communities just outside Quito, Ecuador (elevation, just over 10,000 ft).

DANIEL SITZMAN

Dan Sitzman, a life-long Omaha resident, currently is a Program Coordinator at Kiewit Luminarium, initiating the school field trip program at Nebraska's largest STEM discovery center. Dan's science educator career began with 32 years in the Omaha Public Schools, first as an eighth grade science teacher at J. Sterling Morton Junior High. While at Morton, Dan first presented at the Nebraska Association of Teachers of Science Fall Conference, as well as Nebraska Science and Math Initiative and Nebraska Operation Chemistry.
After eight years at Morton, Dan transferred to Omaha North High School, teaching biology and chemistry when he received the 2003 Presidential Award for Excellence in Science Teaching.

Dan then served as Curriculum Specialist at Omaha North for 12 years. He remained directly involved with students as co-sponsor for the school's Science Olympiad and Science Bowl teams and Science Fair students and director/teacher of Omaha North STEM Summer Camps. For seven years, Dan served as a districtwide Science Instructional Coach, supporting science teachers at 12 middle schools and seven high schools. He concluded his Omaha Public Schools career by teaching at the High School Alliance on the campus of University of Nebraska Medical Center. He continues to mentor student science researchers, including many who have represented Nebraska at the American Junior Academy of Sciences, International Science and Engineering Fair, and National Youth Science Camp.

His professional leadership at the local, state, and national level includes terms as President of the Nebraska Academy of Sciences, Nebraska Association of Teachers of Science, and the Metropolitan Science and Engineering Fair. Dan has presented at National Science Teaching Association's national and regional conferences, Magnet Schools of America, and many state conferences. He has been published in *Science Scope* and *The Learning Professional*. His service on boards and planning teams over the years includes Nebraska Science Festival, Nebraska Sci Comm, Nebraska Science Olympiad, Nebraska Building a Presence in Science, Nebraska Junior Academy of Sciences, National Science Teaching Association Regional Conference, and the National Association of Academies of Science. For two decades, he taught at University of Nebraska Omaha's Aim for the Stars Summer STEM Camps. As the Maiben Lecturer for the 2021 Annual Meeting, Dan presented part of his research on the history of the Nebraska Academy of Sciences, Nebraska Association of Teachers of Science, and Nebraska Junior Academy of Sciences.

Dan has received several other awards, including the Nebraska Association of Teachers of Science Catalyst Award, GW Brown Pinnacle Award, Peter Kiewit Foundation Nebraska Achievement in Teaching Award, and Phi Delta Kappa Showcase Teacher. Dan earned a B.S. in Natural Science from Saint John's University (Minnesota) and an M.S. in Curriculum and Instruction from University of Nebraska Omaha.

Thank you to the Sponsors of the 135th Annual Meeting of the Nebraska Academy of Sciences

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